

REPRINT OF PAPERS ON  
ELECTROSTATICS  
AND  
MAGNETISM

BY  
*Kelvin*  
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London  
MACMILLAN & CO.

1872.

300. The out of doors air potential, as tested by a portable electrometer in an open place, or even by a water dropping nozzle outside, two or three feet from the walls of the lecture room, was generally on these occasions positive, and the earth's surface itself, therefore, of course, negative;—the common fair weather condition, which I am forced to conclude is due to a paramount influence of positive electricity in higher regions of the air, notwithstanding the negative electricity of the air in the lower stratum near the earth's surface. On the two or three occasions when the in-door atmospheric electricity was found positive, and, therefore, the surface of the floor, walls, and ceiling negative, the potential outside was certainly positive, and the earth's surface out of doors negative, as usual in fair weather.

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ON SOME REMARKABLE EFFECTS OF LIGHTNING OBSERVED  
IN A FARM-HOUSE NEAR MONIEMAIL, CUPAR-FIFE.

(From *Proceedings of the Philosophical Society of Glasgow.*)

301. The following is an extract from a letter, addressed last autumn to me by Mr. Leitch, minister of Moniemail parish:—

“ MONIEMAIL MANSE, CUPAR-FIFE,  
26th August 1849.

“ . . . We were visited on the 11th inst. with a violent thunder-storm, which did considerable damage to a farm-house in my immediate neighbourhood. I called shortly afterwards and brought away the wires and the paper which I enclose. . . .

“ I have some difficulty in accounting for the appearance of the wires. You will observe that they have been partially fused, and when I got them first they adhered closely to one another. You will find that the flat sides exactly fit. They were both attached to one crank, and ran parallel to one another. The question is, how were they attracted so powerfully as to be compressed together? . . .

“ You will observe that the paper is discoloured. This has

been done, not by scorching, but by having some substance deposited on it. There was painted *wood* also discoloured, on which the stratum was much thicker. It could easily be rubbed off, when you saw the paint quite fresh beneath. . . .

“The farmer showed me a probang which hung on a nail. The handle only was left. The rest, consisting of a twisted cane, had entirely disappeared. By minute examination I found a small fragment, which was not burnt, but broken off.”

[The copper wires and the stained paper, enclosed with Mr. Leitch's letter, were laid before the Society.]

The remarkable effects of lightning, described by Mr. Leitch, are all extremely interesting. Those with reference to the copper wires are quite out of the common class of electrical phenomena; nothing of the kind having, so far as I am aware, been observed previously, either as resulting from natural discharges, or in experiments on electricity. It is not improbable that they are due to the electro-magnetic attraction which must have subsisted between the two wires during the discharge, it being a well-known fact that adjacent wires, with currents of electricity in similar directions along them, attract one another. It may certainly be doubted whether the inappreciably short time occupied by the electrical discharge could have been sufficient to allow the wires, after having been drawn into contact, to be pressed with sufficient force to make them adhere together, and to produce the remarkable impressions which they still retain. On the other hand, the electro-magnetic force must have been very considerable, since the currents in the wires were strong enough nearly to melt them, and since they appear to have been softened, if not partially fused; the flattening and remarkable impressions might readily have been produced by even a slight force subsisting after the wires came in contact.

The circumstances with reference to the probang, described by Mr. Leitch, afford a remarkable illustration of the well-known fact, that an electrical discharge, when effected through the substance of a non-conducting (that is to say, a *powerfully resisting*) solid, shatters it, without producing any considerable elevation of its temperature; not leaving marks of combustion, if it be of an ordinary combustible material such as wood.

Dr. Robert Thomson, at my request, kindly undertook to examine the paper removed from the wall of the farm-house, and enclosed with his letter to me by Mr. Leitch; so as, if possible, by the application of chemical tests, to discover the staining substance deposited on its surface. Mr. Leitch, in his letter, had suggested that it would be worth while to try whether this case is an example of the deposition of sulphur, which Fusinieri believed he had discovered in similar circumstances. Accordingly tests for sulphur were applied, but with entirely negative results. Stains presenting a similar appearance had been sometimes observed on paper in the neighbourhood of copper-wires through which powerful discharges in experiments with the hydro-electric machine had been passed; and from this it was suggested that the staining substance might have come from the bell wires. Tests for copper were accordingly applied, and the results were most satisfactory. The front of the paper was scraped in different places, so as to remove some of the pigment in powder; and the powders from the stained, and from the not stained parts, were repeatedly examined. The presence of copper in the former was readily made manifest by the ordinary tests: in the latter, no traces of copper could be discovered. The back of the paper presented a green tint, having been torn from a wall which has probably been painted with Scheele's green; and matter scraped away from any part of the back was found to contain copper. Since, however, the stains in front were manifestly superficial, the discolouration being entirely removed by scraping, and since there was no appearance whatever of staining at the back of the paper, nor of any effect of the electrical discharge, it was impossible to attribute the stains to copper produced from the Scheele's green on the wall below the paper. Dr. Thomson, therefore, considered the most probable explanation to be, that the stains of oxide of copper must have come from the bell-wire. To ascertain how far this explanation could be supported by the circumstances of the case, I wrote to Mr. Leitch asking him for further particulars, especially with reference to this point, and I received the following answer:—

“MONIEMAIL, CUPAR-FIFE,  
30th Nov. 1849.

“ . . . I received your letter to-day, and immediately called at Hall-hill, in the parish of Collessie, the farm-house which had been struck by the lightning. . . .

“ I find that Dr. Thomson’s suggestion is fully borne out by the facts. I at first thought that the bell-wire did not run along the line of discolouration, but I now find that such was the case. . . .

[From a drawing and explanation which Mr. Leitch gives, it appears that the wire runs vertically along a corner of the room, from the floor, to about a yard from the ceiling, where it branches into two, connected with two cranks near one another, and close to the ceiling.]

“ The efflorescence [the stains previously adverted to] was on each side of this perpendicular wire. In some places it extended more than a foot from the wire. The deposit seemed to vary in thickness according to the surface on which it was deposited. There was none on the plaster on the roof. It was thinnest upon the wall-paper, and thickest upon the wood facing of the door.\* This last exhibited various colours. On the thickest part it appeared quite black ; where there was only a slight film, it was green or yellow. . . .

“ I may mention that the thunder-storm was that of the 11th of August last. It passed over most of Scotland, and has rarely been surpassed for terrific grandeur at least beyond the tropics. It commenced about nine o’clock P.M., and in the course of an hour it seemed to die away altogether. The peals became very faint, and the intervals between the flashes and the reports very great, when all at once a terrific crashing peal was heard, which did the damage. The storm ceased with this peal.

“ The electricity must have been conducted along the lead on the ridge of the house, and have diverged into three streams ; one down through the roof, and the two others along the roof to the chimneys. One of these appears to have struck a large stone

\* These remarkable facts are probably connected with the conducting powers of the different surfaces. The plaster on the roof is not so good a conductor as the wall-paper, with its pigments ; and the painted wood is probably a better conductor than either.—W. T.

out from the chimney, and to have been conducted down the chimney to the kitchen, where it left traces upon the floor. It had been washed over before I saw it, but still the traces were visible on the Arbroath flags. The stains were of a lighter tint than the stone, and the general appearance was as if a pail of some light-coloured fluid had been dashed over the floor, so as to produce various distinct streams. All along the course of the discharge, and particularly in the neighbourhood of the bell-wires, there were small holes in the wall about an inch deep, like the marks that might be made by a finger in soft plaster.

“Most of the windows were shattered, and all the fragments of glass were on the outside. I suppose this must be accounted for by the expansion of the air within the house.

“The window-blind of the staircase, which was down at the time, was riddled, as if with small shot. The diameter of the space so riddled was about a foot. On minute examination I found that the holes were not such as could readily be made by a pointed instrument or a pellet. They were angular, the cloth being torn along both the warp and the woof.

“The house was shattered from top to bottom. Two of the serving-maids received a positive shock, but soon recovered. A strong smell of what was supposed to be sulphur was perceived throughout the house, but particularly in the bed-room in which the effects I described before took place.”

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## XVII. SOUND PRODUCED BY THE DISCHARGE OF A CONDENSER.

[LETTER TO PROFESSOR TAIT.]

KILMICHAEL, BRODICK,  
ISLE OF ARRAN, Oct. 10, 1863.

302. Yesterday evening, when engaged in measuring the electrostatic capacities of some specimens of insulated wire designed for submarine telegraph cables, I had occasion frequently to discharge, through a galvanometer coil, a condenser consisting of two parallel plates of metal, separated by a space of air about  $\cdot 007$  inch across, and charged to a difference of potentials equal to that of about 800 Daniell's elements. I remarked at an instant of discharge a sharp sound, with a