XX.—*Photographs of Electric Sparks in Hot and Cold Air.* By
Professor TAIT. (Plate XXXIV.)

At the meetings of the Society on February 1 and 15, 1875, I exhibited a number of photographs which had been executed for me in my laboratory by Mr A. MATHESON, one of my students who has acquired great skill in working with very sensitive films of collodion. My object in advising him to undertake this work was to discover, if possible, the cause of the peculiar zig-zag form which electric sparks, and specially those of a HOLTZ machine, always show in ordinary air. At the desire of the Council, a selection of a few of the more interesting of these photographs has been printed (by Mr DALLAS, F.R.S.E.) for the *Transactions* from the original glass negatives, by what is commonly called the carbon process.

Mr MATHESON used a quartz lens which I had procured for experiments on Fluorescence. It was usually placed so as to give an image about half the dimensions of the spark itself; sometimes a little larger. The sparks were furnished by a double HOLTZ machine made by RUHMKORFF. It was kept in perfect order by placing below it an inverted box of sheet iron, inside of which three small Bunsen lamps were kept burning.

The first eight sets in the plate were taken in ordinary air.

Figures 9–12 inclusive were taken in free air, a foot or two over the flame of a powerful 6-barrelled Bunsen burner.

13–16 inclusive were taken in a wide glass tube, through which air had been passed (under slight increase of pressure) from a long narrow spiral tube of iron, kept at a dull red heat. 13 represents the result just after the current of hot air began to pass; 14 after a few minutes; 15 and 16 after nearly half an hour.

The first thing to be observed is, that in the hot air the sparks form in general much smoother curves than in the cold. A specially excellent instance of this is furnished by the two sparks in 9, taken at a fraction of a second interval, of which the upper passed through the ascending column of very hot air, while the lower (as is easily seen by its being partially out of focus, as well as being much more luminous) passed *beside*, but not *through*, the hot column.

In various sparks of the first eight groups there are cases of sudden change of direction apparently through more than a right angle. To make absolutely

certain of this, however, it would be necessary to be sure of the position of the osculating plane at some one of these points. The simplest mode of doing this would have been to obtain simultaneous photographs of the spark from different points of view.

Another thing to be remarked is, that the zig-zag is sometimes directed nearly towards the observer, thus giving the appearance of a brighter spot at one point of the spark. Specially curious instances of this are to be seen in 2, 3, 6, 11, and 12. Those in 2 and 12, at least, distinctly indicate this particular origin. Some of the others may possibly have a different cause.

Bifurcation is very common. Thus, in a series of seventeen successive sparks (fig. 1)—the camera having been slowly (and, as is clear from the result, rather irregularly) moved (by hand) during their discharge—the first (on the left), the twelfth, and thirteenth are obviously each in part double. The lower spark in 5 presents a magnificent bifurcation. Two very fine instances (in successive sparks) are seen in 13. 6 shows a bifurcation, of which one branch is very feeble compared with the other. Other good examples occur in the upper spark in 7, and the middle one in 8.

The general result of an examination of these photographs is, that the zig-zag appearance depends upon something which heat is capable of removing from the air. This is therefore not aqueous vapour,—nor is it very minute drops of water, for even falling drops of water were found to produce no effect, beyond a mere *interruption* in the photographed spark (see fig. 12),—but is probably organic matter, which, as SCHROEDER and PASTEUR have shown, would be as effectually kept out of our apparatus (if once it were got rid of) by a plug of cotton wool as by actual combustion.