

mention now one simple way which I illustrated by experiment at the meeting referred to. It is fairly well recognized that sheet lightning is the reflection of a flash on a cloud, for example; but if there happens to be the presence of a cloud with a small opening in it somewhere between the actual flash and the distant surface of clouds, then, instead of "sheet" lightning appearing on the latter, there will be "projection" lightning—that is, the image of the flash, whose shape will depend upon the shape of the cloud on which it is cast.

In speaking of zigzag representations of lightning flashes, it is important to make some distinction between the artistic zigzag and a common pictorial type such as is seen on the covers of electrical books, in dissolving views, in scenic effects, and even in street advertisements. It is hardly fair to saddle the artists with the latter class. A good specimen of an artistic zigzag flash, and one which shows an observance of nature, can be seen in Wilson's famous picture of "Celadon and Amelia."

It certainly seems at first sight strange that the "projection" flash should not be included in the photographs of lightning flashes. Its non-appearance may be due (1) to the photographic plates not being sufficiently sensitive to register a flash of diminished brilliancy, for the projected image of any source of light has not the same intensity as the source itself. (2) The "projection" flash being of rarer occurrence, the number of photographs yet taken may not have included it. If the type is rarer, it may be objected that it is not likely that artists would generally depict a rare type in preference to the more common one; but the less dazzling nature of the "projection" would be sufficient to account for its adoption, rendering the form of the flash more distinct to the average eye. To take an illustration, if an electric arc light is suddenly flashed before our eyes, we fail to distinguish the form of the white-hot carbon points, but if its image were flashed upon a screen, their form would be distinctly visible.

It is worthy of note that some painters have chosen to represent other types than what I have termed the "projection" flash. See Turner's "Stonehenge," where "streaming" lightning is pictured. ERIC STUART BRUCE.

10 Observatory Avenue, Kensington, W., June 16.

The Bagshot Beds of Essex.

In the second part of the paper on the Westleton beds, by Prof. Prestwich, recently published in the *Quarterly Journal of the Geological Society* (vol. xlvi. p. 152), a section of the Brentwood railway cutting is given, which is, if possible, of more interest from the Eocene beds described than from its bearing on the questions dealt with in the paper.

Reading the new section together with what we already know, we get the following succession of beds at Brentwood:—

- (1) *Pebble beds*, capping the plateau up to 15 feet thick.
- (2) *Bagshot beds*, about 50 feet, consisting of—
 - (a) Yellow or white sands (bed 6 of Mr. Whitaker's section, "Geology of London," i. 274).
 - (b) The green sands and clays *with fossils* of the railway cutting.
 - (c) Yellow sand with seams of clay of the railway cutting.
- (3) *London clay*, about 435 feet, the upper part consisting of dark grey clay, with one or more beds of loam and yellow sand, the so-called "passage beds" exposed in the brick-fields near the station.

The fossils which Mr. Herries and I found near Frierning (Whitaker, "Geology of London," i. 276) came from white sand probably answering to bed 2a.

This section seems to show pretty clearly that the Bagshot beds of Brentwood are more nearly allied to the marine Bracklesham (Middle Bagshot) series than to the Lower Bagshots of the Bagshot Heath district, which are probably freshwater. If this be so, the masses of pebbles which overlie them may well be the remains of the pebble beds which so often mark the base of the Upper Bagshot (Barton) beds, and the parallel drawn by Mr. Herries and myself between the pebbles which cap the Warley and Brentwood plateau in Essex and those which cap Hook Heath and other hills in the Bagshot district becomes the more marked (*Proc. Geol. Assoc.*, vol. xi. pp. 13, 16, 20).

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HORACE W. MONCKTON.

Electro-Magnetic Repulsion.

THOSE who have not the means of showing the striking effects produced by Prof. Elihu Thomson may be glad to know a simple illustration of the same principles.

NO. 1078, VOL. 42]

A top consists of a soft iron disk with a brass axis put through it. A small magnet is held over the edge whilst spinning; each elementary sector as it moves up to and away from the poles of the magnet has currents induced which are repelled by the magnet; as the rotation dies out, the currents at a certain point become too feeble to overcome the attraction of the soft iron by the magnet. I bought the top two or three years back of M. Manet, 49 Rue Lourmel, Paris. W. B. CROFT.

Winchester College, June 21.

A Remarkable Appearance in the Sky.

THERE was an appearance in the sky last night, so remarkable that I am tempted to describe it, in case, our situation being high, it should have been better seen here than elsewhere. Along the horizon, from north to about north-east, a faint bank of cloud extended, above which was a space of light like that of the early dawn or of the rising moon. There was no quivering, or shooting upwards of rays, as in the ordinary northern lights; the light was steady, white tending to yellow, brighter at the lower part. Above it hung a purplish haze, through which the stars shone brightly, and occasional strips of dark cloud. It did not happen to be observed till 10.30 p.m., and it was hardly altered at 1.30 a.m., when it was still bright enough to mark the window-frame through a white blind, like moonlight. Besides the position, the fact of a solar eclipse occurring that day proved the moon to have nothing to do with it.

Sussex, June 18.

M. E.

PROBLEMS IN THE PHYSICS OF AN ELECTRIC LAMP.¹

I.

MORE than eighty years ago Sir Humphry Davy provided the terminal wires of his great battery of 2000 pairs of plates with rods of carbon, and, bringing their extremities in contact, obtained for the first time a brilliant display of the electric arc.² The years that have fled away since that time have seen all the marvellous developments of electro-magnetic engineering, have placed in our possession the electric glow-lamp, and brought the art of electrical illumination to a condition in which it progresses each year with giant strides. In addition to the importance attaching to their ever-increasing industrial use, there are many questions of purely scientific interest which present themselves to our minds when we proceed to examine the actions that take place when a carbon conductor is rendered incandescent in a high vacuum, or when an electric arc is formed between two carbon poles. It is to a very few of these physical problems that I desire to direct your attention to-night, but more especially to one which is particularly interesting from the bearing which it has on the general nature of electric discharge.

We know as a very familiar fact that if we attempt to raise the temperature of a carbon conductor inclosed in a vacuum beyond a certain limit, not far removed from the melting-point of platinum, the carbon begins to volatilize with great rapidity. If an electric glow-lamp has passed through its carbon more than a certain strength of current, the glass bulb speedily becomes darkened by a deposit of this volatilized carbon condensed upon it; and experience shows us that we cannot raise the temperature of that carbon beyond a definite point without causing this waste of the conductor to become very rapid. In the highly rarefied atmosphere within the bulb of a glow-lamp, the carbon, when at its normal incandescence, must be con-

¹ Friday Evening Discourse delivered at the Royal Institution by Prof. J. A. Fleming, M.A., D.Sc., on February 14, 1890.

² Sir Humphry Davy laid a request before the managers of the Royal Institution on July 11, 1803, that they would set on foot a subscription for the purchase of a large galvanic battery. The result of this suggestion was that a galvanic battery of 2000 pairs of copper and zinc plates was set up in the Royal Institution, and one of the earliest experiments performed with it was the production of the electric arc between carbon poles, on a large scale. It is probable, however, that Davy had produced the light on a small scale some six years before, and, according to Quetelet, Curiet observed the arc between carbon points in 1802. See Dr. Paris's "Life of Sir H. Davy."