Lightning Flashes.

IN your issue of January 14, 1886 (vol. xxxiii., p. 245), Mr. T. Mackenzie reported lightning from a bank of cloud to the clear sky, but, as it was quite dark, one cannot be certain that there were no indistinct outliers. In Hann's "Lehrbuch der Meteorologie" (ed. 1, p. 632) other cases of lightning from a cloud to the clear sky are referred to.

On the evening of March 26, at 6.30 p.m., before dusk had set in, there was a large thunder cumulo-nimbus cloud about eight miles north of Johannesburg. The summit of this cloud was very sharp against a clear dark blue sky. There was no false cirrus. Six flashes of lightning darted from near the summit of the cloud into the clear sky. The longest path was about ten degrees. One flash returned to the cloud, the others finished in the clear sky. Before dusk set in this phenomenon ceased to occur. All the flashes were directed to that part of the sky from which the cloud moved.

In a well-known book on meteorology we read "it is impossible to say whether a flash of lightning moves from a cloud to the earth or in an opposite direction," and further that the lightning is instantaneous. Hann does not confirm these statements, and it is time that they were modified in English text-books. Quite frequently I have observed lightning flashes leaving a cloud for the earth, but fading away before reaching it; the opposite phenomenon has not been observed. The paths of lightning shown by photographs taken in the Transvaal all indicate discharges from cloud to cloud, and from cloud to earth. The enclosed photograph, taken by Mr. T. N. Leslie at Vereeniging, is typical. Some flashes of lightning are instantaneous, the majority are not, but I do not think any exceeds a duration of a third of a second. The revolving wheel has been used, and shows that the duration is often certainly much longer than 1/40th of a second.

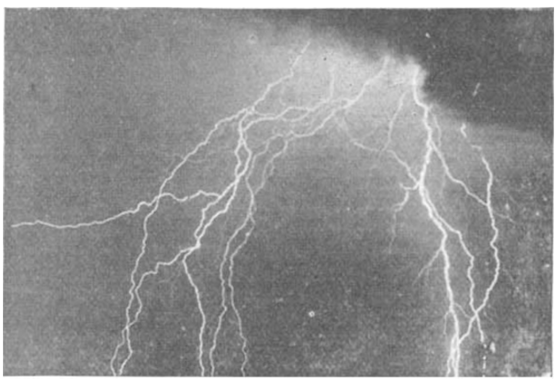

FIG. 1.—Lightning at Vereeniging, 1903.

Johannesburg, April 2. R. T. A. I.

Diurnal Variation of Ionisation in Closed Vessels.

UNTIL Messrs. Campbell and Wood give us some more definite information as to the magnitude of the daily variation which they have found in the natural ionisation of air in closed vessels (NATURE, April 19, vol. lxxiii., p. 583), it is somewhat premature to go into a detailed discussion as to how this discovery will affect theories of atmospheric electricity. Still, the letter in NATURE of April 26 (vol. lxxiii., p. 607) on this question from Dr. O. W. Richardson calls for some remarks.

The facts are shortly :—(1) Messrs. Campbell and Wood discover that the natural ionisation of air in a closed vessel has a double daily period, the maxima being between 8 a.m. and 10 a.m. and between 10 p.m. and 1 a.m., the corresponding minima being at 2 p.m. and 4 a.m.; (2) the potential gradient in the lower atmosphere has, at most places, also a double period, the maxima being at about 8 a.m. and 8 p.m., and the minima at about 4 a.m. and midday. Thus, allowing for a certain amount of uncertainty in the exact determination of the times of the maxima and minima, we may say that the daily variations of the natural ionisation and the potential gradient are similar.

In order to discuss a possible dependency of these two factors, Dr. Richardson assumes that "the distribution of the earth's field reduces itself to a case very similar to that between two plane electrodes immersed in a gas and maintained at a constant difference of potential." It is more than questionable as to whether this assumption is justifiable or not, for in atmospheric electricity we are dealing with constant quantities of electricity, and not with constant potentials. But, rather than follow up this objection, I would prefer to look at the problem from a different point of view, and show that the exact contrary conclusions can be deduced.

In discussing this problem, it is usual to accept that there is a negative charge on the earth's surface, and that the corresponding positive charge is a volume charge distributed in the atmosphere. Now all the measurements which we have of the daily variation of potential gradient have been made within a few metres of the surface. Within these few metres there can be, relative to the charge on the earth, very little volume charge, so what our measurements actually refer to is the charge on the surface, the relation being $dv/dh = -4\pi\sigma$. The point to notice in this is that, with a given charge on the surface and the corresponding charge in the atmosphere above, the vertical distribution of the charge and the conducting state of the upper atmosphere do not in the slightest affect the potential gradient within a few metres of the surface. If the potential gradient changes there it can only be by a change in the surface charge on the earth.

If there is a penetrating radiation which, besides ionising the air in closed vessels, also ionises the air in the atmosphere, we should expect from Messrs. Campbell and Wood's experiments the ionisation of the air in *all parts* of the atmosphere to have a daily variation. Thus the air quite near the surface would twice a day be exceptionally conducting; one would expect that at these times there would be a greater loss of the surface charge, and so the remaining charge to be diminished, and with it the potential gradient. The consequence would be a daily variation of the potential gradient corresponding to the variation of ionisation, but the maxima of one corresponding to the minima of the other.

That such a relation does exist between the ionisation of the lower atmosphere and potential gradient has been shown by many observers situated in most parts of the globe. Thus from Messrs. Campbell and Wood's results one would expect minima of the potential gradient to occur at about 8 a.m. and 10 p.m.; this is the exact reverse of what really occurs.

Thus it would appear as if Messrs. Campbell and Wood have added one more to the many puzzling factors connected with atmospheric electricity.

Manchester University. GEORGE C. SIMPSON.

August Rainfall.

ACCORDING to Greenwich experience, August has been a very dry month considerably oftener about sun-spot *maxima* than about *minima*. This fact may be of some practical interest.

Using Mr. Nash's table (from 1815), let us confine our attention to the three years about the eight maxima and the three about the eight minima, *i.e.* twenty-four years in each division.

The driest August in the *minima* division was in '55, with 1·40 inches. But in the *maxima* division there are ten cases of lower values, ranging from 1·25 inches down to 0·45 inch, viz. '38, '49, '59, '61, '69, '71, '82, '83, '84, '93. Since 1837 no three-year group of this division has been without at least one such very dry August, two have had two, and one three.

The total August rainfall in those twenty-four-year groups is, in the sun-spot *maxima* division, 50·25 inches, in the *minima* division 66·50 inches, the higher value thus showing an excess of 16·25 inches (nearly one-third of the lower).

The sun-spot maximum we are now near (1905?) has not been here considered, but I may remark that in 1904 we had one of those low August values (1·24 inches).

ALEX. B. MACDOWALL.