LETTERS TO THE EDITOR

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Diurnal Variation of Ionisation in Closed Vessels.

THE connection between the periodicity in the ionisation in closed vessels and the variation in the intensity of the electric field near the earth's surface suggested by Messrs. Campbell and Wood in NATURE of April 19 (p. 583) may readily be explained on the theory of conduction through gases if we assume that the ionisation is caused by radiation from extra-terrestrial sources.

The view of the origin of the earth's field which appears to be in closest agreement with the facts is that it arises in rainy regions on account of the negatively charged rain conveying its charge to the earth, which thus becomes negatively charged. This leaves a high positive potential in the atmosphere immediately above the rainy region which very rapidly distributes itself over the earth's surface by means of discharges in the upper regions of the atmosphere where the pressure is low enough for ionisation by collisions to occur. Owing to the high conductivity of the upper regions of the atmosphere, therefore, the potential will differ only to a relatively slight extent over different regions of the earth's surface; most of the fall of potential between the positive charge over the rainy region and any point of the earth's surface will occur in the badly conducting layer of air at a high pressure, which is comparatively close to the earth's surface.

The above theory is due to Mr. C. T. R. Wilson, with whom I have recently discussed the matter. The explanation of the connection between the earth's field and the ionisation in closed vessels which follows might be made to fit other views of the nature of the earth's field, but I have selected Mr. Wilson's, as it appears to be the most probable.

The distribution of the earth's field, then, 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. Consider what happens if we increase the ionisation near one electrode to a greater extent than that near the other. The potential gradient will become smaller where the ionisation is greatest, and conversely. In the case of the earth the ionising rays presumably come from extra-terrestrial sources, and will be absorbed to some extent by the earth's atmosphere. They will therefore be more intense further away from the earth's surface, and when for some reason or another they increase in intensity they will increase the ionisation at a point some distance from the earth's surface to a greater extent than at a point near to it. From what has been said above, an increase in the ionising rays should therefore produce an increase in the electric intensity close to the surface, and *vice versâ*.

This corresponds exactly with what Messrs. Campbell and Wood have found to be the case; the maxima and minima in the earth's electric field are simultaneous respectively with the maxima and minima in the ionisation in a closed vessel.

It may be of interest to add that Borgmann (*Jurn. Russk. Fisik. Chimičesk. Obščestva* [physical part], xxxvii., No. 4, pp. 77–98, 1905) has also recorded a minimum at about 3 p.m. in the ionisation in a closed vessel. The fact that the time is nearly the same at Cambridge and St. Petersburg seems to indicate that the ionisation is caused by radiation coming from the sun. The fact that the daily variations in the earth's field are conditioned by the sun has already been remarked by meteorologists (*cf.* Arrhenius, "Kosmische Physik," ii., p. 890).

I wish to point out finally that the above explanation of the changes in the earth's field does not depend essentially on radiation coming from extra-terrestrial sources. Any cause which simultaneously increased the penetrating radiation near the earth and the ionisation further away from it would work in the same way.

O. W. RICHARDSON.

Trinity College, Cambridge, April 22.

The New Spot on Jupiter.

THE recent outbreak of dark material in the north equatorial belt and north tropical zone of Jupiter has further intensified, and forms a very prominent and striking feature in the region north-following the red spot. The slanting belt, alluded to in my letter published in last week's NATURE (p. 584), appears to be rapidly extending in a longitudinal direction, and the large dark oval spot on its following side has been several times re-observed here. Transits were obtained as under:—

	h. m.	Longitude
April 15	6 8	75·2
20	5 22	77 5
22	7 2	77·7

The rate of motion appears, therefore, to conform very nearly with that of the red spot and of system ii. of Crommelin's ephemerides (9h. 55m. 40·6s.). On April 20 the north tropical spot was very distinctly seen nearly two hours before sunset, and the transit obtained on that date was regarded as accurate.

The preceding side of the slant-belt is moving much faster than the north tropical spot, and it is highly probable that in a few weeks a new and conspicuous belt will have formed and entwined itself completely round the planet. In this phenomenon we have a repetition of that observed in the spring of 1860 (see Monthly Notices R.A.S., April, 1860, and December, 1898, vols. xx., p. 244, and lix., p. 76).

W. F. DENNING.

Bristol, April 23.

Utilisation of Nitrogen in Air by Plants.

YOUR reviewer (p. 531) of the above work has, like others, failed to furnish any proof against my theory of the fixation of free nitrogen by plants. He desiderates direct chemical proof of the increase of nitrogen in the plant, beyond the nitrogen that is provided by the seed and the soil. Those acquainted with agricultural chemistry know the difficulty of directly determining a slight increase in the quantity of nitrogen, in the circumstance of the comparatively large quantity of nitrogen in the soil necessary to produce a vigorous plant, and they will understand how difficult it is to produce such proof; with the greater information now available, however, it may now be forthcoming. But for this difficulty, the fixation of nitrogen would have been found out long ago.

The experiments at Rothamsted conducted by Lawes and Gilbert are identified with the subject of nitrogen. The idea of the inability of plants to fix free nitrogen is largely based on their experiments. As mentioned in a book written by the recently appointed director at Rothamsted—Mr. A. D. Hall—it occupied their minds "from the very beginning of their experiments until the end." It was their "dominant idea." I may therefore refer to experiments carried out there which show that Lawes and Gilbert themselves found (as many others have done) an increase in nitrogen in growing crops, the source of which could only be ascribed to the atmosphere; thus (see p. 10), "As a result of three years' cropping with barley and clover, and then with clover only, an average amount of 319·5 lb. of nitrogen was removed, yet the soil contained, on analysis at the end of the experiment, 2832 lb. of nitrogen per acre in the top 9 inches, or a gain of 175 lb per acre in the three years, making a total, with the crop removed, of nearly 500 lb. of nitrogen per acre to be accounted for." This was a troublesome fact. It was sought to be explained by the tubercles on legumes, but that an increase was got without legumes is shown by another set of experiments (see p. 8):—"the various crops were grown continuously with mineral manures, but without any supply of combined nitrogen; the following average amounts of nitrogen per acre were taken away:—

		lb.
"Wheat	24 years	22·1
Barley	24 ,,	22·4
Root Crops	30 ,,	16·4
Beans	24 ,, of which two fallow	45·5
Clover	22 ,, 6 crops only	39·8"

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