Letters to the Editor.

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The Aurora of May 13-15.

IN pursuance of the programme outlined in my letter to NATURE of March 31, p. 137, I have been photographing the spectrum of the night sky every night. On the night of May 13-14, and also of May 14-15, a strong auroral spectrum was obtained, showing the aurora line $\lambda 5578$, and also the negative bands of nitrogen, which were much stronger than the aurora line. Ten heads of these bands were shown on the photograph of May 14-15, though only six appear within the same spectral range in Vegard's investigation made on a special expedition to the Arctic.

That these nitrogen bands should be actually stronger than the aurora line is very remarkable. On ordinary nights it is generally possible to photograph the aurora line, while the nitrogen bands have never been photographed in the course of about 100 nights except on these two consecutive occasions.

It is of interest to note that the aurora apparently ceased before the magnetic storm was over, according to the data given by Dr. Chree in NATURE of May 19, p. 359. On the night of May 15-16 the aurora line was barely, if at all, visible on the plate, and below its average intensity on ordinary nights. Nothing could be seen of the nitrogen bands.

RAYLEIGH.

The Gravitational Field of an Electron.

IN the Proceedings of the Royal Society for February last (vol. xcix., A, p. 123) is an interesting paper by Dr. G. B. Jeffery, in which he applies an extension of Einstein's theory to ascertain something about the state of the æther close to an electron—though perhaps he might not express it in that way. He obtains independently, and then discusses, a result recently published by Nordström, namely, an extension of the now well-known γ of Schwarzschild's equation,

$$ds^2 = \gamma^{-1} dr^2 + \text{etc.} - \gamma c^2 dt^2,$$

by adding to it a mixed gravitational and electrical term, so that it becomes

$$\gamma = 1 - \frac{2Gm}{rc^2} + \frac{Ge^2}{K r^2 c^4};$$

wherein, while the old second term involves the gravitational potential, the new third term involves the square of the electrostatic potential.

I have introduced the dielectric constant of the æther into the denominator so as to keep dimensions right, and if we now choose to make use of the familiar "J. J. T." (1881) expression for the inertia of an electric charge, $m = 2\mu e^2/3a$ —which is reasonable, inasmuch as the gravitation constant is dominant over both the second and third terms—we may write the above value of γ thus:

$$\gamma = 1 - \frac{2Gm}{rc^2} \left(1 - \frac{3a}{4r} \right).$$

This expression attains a minimum value when $r = \frac{3}{2}a$; and it is unity both at infinity and at $r = \frac{3}{2}a$. This last probably means that the electric and mass terms just balance at the surface of an electron (for we may probably ignore the $\frac{3}{4}$ factor as unlikely

to be accurate so close to a charge), or else it means that the gravitational effect at an electron-boundary is reduced to one-quarter of its normal value. The formula does not apply in the interior of an electron, if an electron has any interior; though if it is a geometrical point, as Dr. Jeffery evidently thinks possible, then γ may rise to a very high value within what is commonly thought of as the boundary.

It is not to be thought that the new term is merely the natural consequence of electromagnetic mass, for it is opposed in sign; the electrical and the mass effects tend to neutralise each other; but nowhere do they succeed except at or near the boundary of an electron. For all distances large compared with the size of an electron γ has its customary Einstein value, so the third term has no astronomical significance whatever.

But a study of what happens to radiation when it impinges on, or penetrates between, the ultimate elements of matter—in fact, a study of the whole behaviour of a stream of radiation at its two ends, the source and the sink—is obviously of great importance. An immense amount of work has been done on the emission end of radiation, but less on the absorption end. By the two together we may ultimately hope to get some information as to the structure of an electron. It may be pardonable to mention some small papers of my own in this connection, in the *Philosophical Magazine* for April and probably for June and July this year, though the full working out is not attempted.

It must be emphasised that the e^2 , above, means the square of the unbalanced charge only—it is $(\Sigma e)^2$ not $\Sigma(e^2)$ —and that all neutralised charges are provided for by the second term. The conclusion that unbalanced electric potential and neutralised or mass potential oppose each other in their warping effect on the æther appears rather suggestive. I confess I should have expected a third term which did not involve the gravitation constant; and perhaps there may be a reconsideration on this point, for the present manner of obtaining the expression is far from easy—in fact, is abstruse.

OLIVER LODGE.

The Magnetic Storm of May 13-17.

THE magnetic storm which began soon after 1 p.m. on May 13 presented several unusual features beyond that of almost unprecedented magnitude. As recorded on the Eskdalemuir magnetographs, it showed a "sudden commencement" at 13h. 13m. G.M.T. on May 13. The phenomenon known by this name usually takes the form of a sharp change in value of the horizontal components of terrestrial force, frequently including as its first part a temporary drop in value lasting for about a minute, but always exhibiting a rise in value immediately thereafter. In the vertical component the change, when appreciable, is very much slower and is in the direction of the zenith. In the case of the storm now described the change in the north component was too quick for the photographic paper to receive a visible impression of the light spot. On the west component a drop in value is shown at first, amounting to 29γ (0.00029 C.G.S.) and extending over two minutes. There then followed a rise of 94γ, occupying 2½ minutes. On the vertical component the "sudden commencement" assumed an unusual form. There is quite clear evidence of a preliminary increase in value of the vertically downward directed force amounting to 8γ, followed immediately by a reverse change of 31γ, the latter being much more rapid than is generally the case. These preliminary phases having passed, the main features of the disturbance were quickly developed. This is quite in accord with the results of