LETTERS TO THE EDITORS

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 788.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Intensity of Mesotrons in the Upper Atmosphere

IN view of the well-established decay of the mesotron and of the magnitude of the sea-level latitude effect, it is now certain that all mesotrons found have been produced in the atmosphere. It is therefore of great interest to measure their intensities at different heights, particularly at levels where they may be expected to have been produced.

Balloon flights have been made near Edinburgh during the past summer with this object. Triple coincidence counters, shielded with 10 cm. of lead disposed equally between them, have been used. The counters were coupled to a radio transmitter, which was a modified form of that used by Carmichael and Dymond¹. The thickness of lead was sufficient to absorb completely all electrons. In order to reduce the weight of absorber it was necessary to employ small counters, so that the ground rate of counting was only 0.4 per minute. Because of this small number, the statistical fluctuations in counting during the flights were high, and consequently a large number of flights would be required to obtain an accurate picture of the variation of intensity with height. As the work has now to be broken off, it seems desirable to record the results so far obtained.

Three flights have been made, which indicate that the intensity of vertically directed mesotrons rises to a maximum at a pressure of about 80 mm. mercury (16 km. height), the same point where the maximum for all particles (unshielded counters) occurs, and that its value at this height is approximately nine times the ground value. This should be compared with the increase of about forty times found by Pfitzer² and by Carmichael and Dymond¹ with unshielded counters. It is probable that the true increase is even less than this, as the counters, being only shielded in the vertical direction, can record showers coming in laterally. Soft showers of this nature are likely to be numerous at these altitudes, but at present there is no means of finding what correction must be made for them. At heights greater than that corresponding to a pressure of 80 mm. mercury, the intensity appears to decrease rapidly, but the rate of decrease is uncertain, due to the statistical errors mentioned.

These results are of particular interest when viewed in conjunction with Euler and Heisenberg's theory³ of the intensity variation of mesotrons in the atmosphere. Their assumption that the maximum production of mesotrons occurs at the maximum of the normal transition curve in the atmosphere is shown to be correct.

Also, from the observed ratio of intensities at the ground and at the maximum, some conclusions as to the energy distribution of the particles at their formation can be made. Euler and Heisenberg have assumed that the number of mesotrons with energies greater than E is given by $J(E_0/E)^\gamma$, where $\gamma = 1.87$. This is the same distribution as that of the primary

particles as shown by the latitude effect, and they show that it leads to the correct energy distribution at sea-level. If we exclude all particles of energy less than 1.2×10^8 ev., which will be unable to traverse the lead between the counters, their results lead to the total intensity at 80 mm. mercury pressure, being 390 times that at the ground, compared with the observed value of nine.

The discrepancy can be removed, however, if we assume that there is a minimum energy with which mesotrons are produced of about 8×10^8 ev. If the energy distribution is cut off at this value, Euler and Heisenberg's expression leads to the right value of the intensity ratio at the two heights.

The method of formation of the mesotrons is still unknown, although there is some evidence that they are produced by protons and not by shower particles. It should be noted, however, that the minimum energy of primary electrons in the latitude of Edinburgh is 2×10^9 ev., which is degraded by shower formation to from 5 to 7×10^8 ev. at 80 mm. pressure, the same order of magnitude as the minimum energy of the mesotrons.

In conclusion, I must thank many of my colleagues in the Department for their assistance with the balloon flights, and in particular Dr. C. B. Childs and Mr. A. Cowie.

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¹ Carmichael and Dymond, *Proc. Roy. Soc., A*, 171, 321 (1939).

² Pfitzer, *Z. Phys.*, 102, 23, 41 (1936).

³ Euler and Heisenberg, *Ergebn. exact. Naturwiss.*, 17 (1935).

Absolute Measurement of Electrical Resistance

IN recent years, at Birkbeck College, attention has been given to various methods of measuring electrical resistance absolutely. On the eve of war, this series of researches has been brought to a conclusion by the development of a method in which the potential difference across a resistor is balanced by the average E.M.F. of a commutating generator. Although Rosa¹, so far back as 1909, suggested such a method and proposed a form of apparatus, difficulties were encountered and no experimental data derived from any form of this method have been published. The method is attractive in requiring only the measurement of a frequency and a maximum mutual inductance.

By a new method, the rotor is made to have such an extremely flat maximum of mutual inductance with the field coils that, over a range of some 14° in the neighbourhood of commutation, no E.M.F. is generated. Further, over an adjustable portion of this range, covering the actual commutations, the rotor together with additional resistance is short-circuited, thus enabling the E.M.F. across the resistor to suffer no interruption but to supply instead the extra quantity of electricity absorbed by the rotor,