AN UNUSUAL ELECTRON SHOWER*

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Figure 1 depicts an event observed in a 600 μ glass-backed Ilford G5 emulsion. The shower occurred at point 0 as indicated by a sudden increase in grain density of the incident track. For the first 150 μ from 0 the grain density of all secondary tracks (which are not separated) is 46 ± 4 grains per 50 μ, approximately 3·5 times the plateau value (13·0 grains/50 μ). 200 μ from 0 five tracks are resolved and the sum of their grain densities is 64 ± 2 grains/50 μ, approximately five times plateau. These values suggest that one track originated some 150–200 μ from 0, although the possibility that it originated at 0 is not entirely excluded.

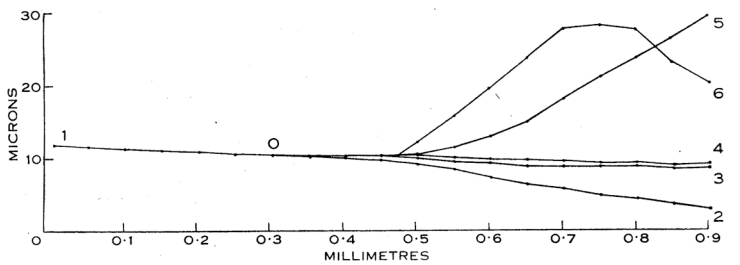

Fig. 1.—Enlarged drawing of the electron shower.

Results of scattering measurements are given in Table 1, where the errors are statistical probable errors only. Tracks 5 and 6 can be identified as electrons, track 2 is probably an electron, and tracks 1, 3, and 4 are certainly not due to particles heavier than mesons. The most likely explanation is that all tracks are electrons as they are initially contained in a cone of half angle $\sim 0 \cdot 5 \times 10^{-2}$ radians and this fact in itself suggests an electromagnetic interaction.

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Assuming that all particles are electrons it can be seen that there is roughly an energy balance between the primary and secondary particles.

The event is consistent with the direct creation of an electron pair by a fast electron in the Coulomb field of an electron. Track 6 is then interpreted as a knock-on electron produced by one of these four electrons proceeding from 0, although the chance of this knock-on occurring so close to the origin is low and estimated as 1/500. According to Heitler (1954) the expected ratio of pairs created in electron-electron collisions to pairs created in electron-nucleus collisions in a medium of atomic number Z is roughly $0{\cdot}8/Z$. For nuclear

TABLE 1

MEASUREMENTS ON ELECTRONS OF SHOWER

Track	Length (mm)	$\bar{\alpha}$ (100) (deg/100 μ)	Energy (electrons) (MeV)
1	2·9	0·041±0·011	650^{+230}_{-170}
2	2·2	0·20 ±0·04	132^{+34}_{-21}
3	2·3	0·093±0·023	285^{+94}_{-56}
4	2·3	0·13 ±0·03	204^{+62}_{-38}
5	1·2	0·46 ±0·11	57^{+19}_{-11}
6	1·4	2·0 ±0·3	13± 2

emulsions this ratio is 0·023. It is therefore curious that no event of this type has been previously reported, although a considerable number of tridents has been studied.

An analogous event interpreted as the direct creation of an electron pair in the field of an electron by a high energy incident photon has been reported (Hopper, Biswas, and Darby 1951), and again this is the only event of this type observed in the nuclear emulsions.

If we assume that all five tracks originated at 0 the result might be interpreted as double pair creation by a fast electron and the expected ratio of double pair creation to single pair creation is of the order of $1/137\ \pi$ (Heitler 1954). Two events of the creation of a double pair by a photon in one elementary act have been reported previously (Hooper and King 1950).

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References

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