some temperature above the λ-point, all other conditions remaining the same, and any film still present in the second case being removed by bringing a small electric lamp near the cryostat. The difference in the readings, which is a measure of the thickness of the helium II film, is throughout approximately 3°, the spread of the individual settings about the mean being ± 10 minutes of arc under good observational conditions. Fig. 2 gives the Nicol readings against height for a typical run at 1·45° K.

There appears to be but little variation of the thickness of the film at a given height with variation of temperature. Under the best conditions of shielding from heat influx the thickness increases from a shallow minimum near 1·6° K. to a maximum at about 2·18° K., and then decreases to zero at the λ-point. This would seem to indicate that the properties of the film cannot be explained in terms of van der Waals' forces only.

The variation of the Nicol rotation with height (h) at any given temperature can be expressed by the equation $\Delta N = k/h^{1/z}$, where z varies from 2·5 at 2·1° K. to about 3·5 at 1·1° K.

A provisional calculation has indicated that the relation between rotation of the Nicol and film thickness is almost linear over the range of thicknesses involved, and that a rotation of 200′ corresponds to a thickness of $2 \cdot 4 \times 10^{-6}$ cm. Thus the thickness at 1 cm. height and 1·5° K. is provisionally given as $1 \cdot 9 \times 10^{-6}$ cm.

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Photo-Fission of Uranium with Possible Emission of a Beryllium Nucleus

In the study of the slow-neutron ternary fission of uranium-235, there is evidence that short-range particles of greater mass than α-particles are emitted. Dewan and Allen[1] have reported ionization chamber experiments indicating the emission of particles of mass 13 ± 4 having ranges less than 1 cm. of air, and Titterton[2] has recorded events in photographic plates which suggest the emission of nuclei heavier than α-particles having ranges up to 3 cm. air equivalent. An example of such an event is given in Fig. 1, from which it will be seen that, owing to the short range of the third fragment, certain interpretation cannot be made.

The presence of energetic heavy fragments in the ternary photo-fission of uranium has now been suggested by the disintegration shown in Fig. 2, which was observed in a uranium-loaded Ilford

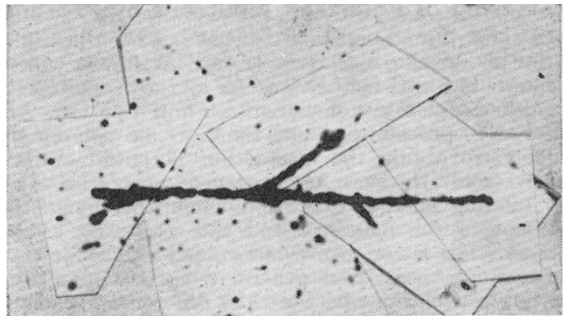

Fig. 1. Slow neutron ternary fission with possible emission of a short-range heavy fragment having M greater than 4. Observer: E. W. Titterton

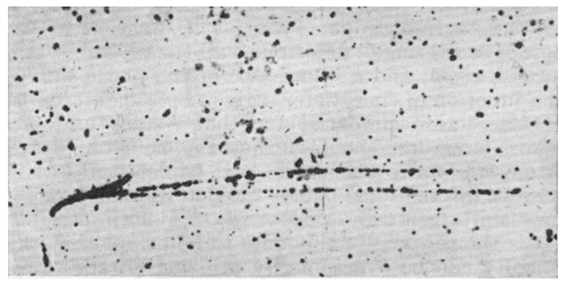

Fig. 2. Photo-fission with probable emission of a beryllium-8 nucleus. Observer: Mrs. A. M. Brown

emulsion type D_1 irradiated with 23 MeV. gamma-rays from the synchrotron of the Atomic Energy Research Establishment. Superficially, the disintegration appears to be a quaternary fission with the emission of two α-particles of energies 9·5 and 10·5 MeV. respectively, and inclined at 7° to each other. A second possibility is, however, that the event represents the emission of a beryllium-8 nucleus with an energy of 20·0 ± 0·5 MeV., which immediately disintegrates into two α-particles, the angle of emission of the beryllium-8 nucleus relative to the light fission fragment being 74°. This hypothesis can be tested by estimating the energy release, Q, required in the disintegration of beryllium-8 to give the observed energies, E_1 and E_2, and the angular separation, θ, of the α-particles. Q is given by the relation:

$$2Q = E_1 + E_2 - 2(E_1 E_2)^{1/2} \cos \theta,$$

which gives, using the observed values, $Q = 85 \pm 25$ keV. This value is in reasonable agreement with the figure 103 ± 10 keV. given by Hemmendinger[3] for the energy released in a transition from the ground-state of beryllium-8 to two α-particles.

Only one event of this kind has been observed in a study of some 10,000 photo-fissions, although many events involving the emission of single α-particles have been recorded[4].

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