say that it is probable that the change of latitude effect with height lies between 0 and 11 percent, i.e., if the latitude effect at 1000 mb, is x percent then the latitude effect at 250 mb will be $(x+11)$ percent. If no change of latitude effect with height is assumed then the sea level latitude effect is found to be 41 percent for O.I. and 49 percent for A.B. These values do not agree at all well with those actually observed at sea level, the maximum value found being known to be of the order of 10 percent. It seems therefore that some change of latitude effects with height occurs. An unknown absolute difference exists between the data in O.I. due to a possible difference in sensitivity, but this should not occur for A.B. This difference, however, will not affect the slope of the lines obtained. It appears that further work, using equipment giving results with a statistical error of <1 for a recording period of 60 minutes would be necessary to clarify the situation.

These experiments have been carried out as part of the research program of the Dominion Physical Laboratory with the assistance of the R.N.Z.A.F. whose help is gratefully acknowledged.

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Evidence for the Photo-Fission of Uranium into Three Charged Fragments

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ILFORD type D_1 plates 100-μ thick have been impregnated with a saturated solution of uranium acetate and irradiated with 23-Mev γ-rays from the A.E.R.E. synchrotron. Exposures of up to 300R have been employed and photo-fissions are observed at approximately the rate to be expected from the cross section given by Baldwin and Klaiber.[1]

In the course of examining the plates 4 cases of photo-fission into three charged fragments have been found, a photomicrograph of one of which is given in Fig. 1. Details of the four events are given in Table I. We believe these events to be the first observed cases of this phenomenon in photo-fission. A tentative value for the rate of occurrence of this mode of fission can be given as 1 per 400 ± 200 binary photo-fissions.

In general form the events are similar to those observed in the ternary fission of U^{235} by slow neutrons[2-4] and, as in that case, the appearance of the tracks is compatible with the long range particles being α-particles.

The possibility that the observed fissions were induced by the neutron background and not by γ-rays has been considered. Calculations and measurements comparing the fission rates in and out of the γ-ray beam both show that the observed rate of binary fission is at least fifty times as great as could be accounted for by the slow and fast neutron backgrounds. In addition,

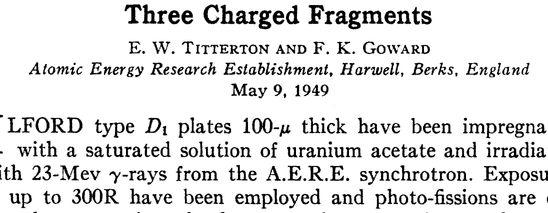

Fig. 1. Photomicrograph of event 2. Observer: Mrs. B. D. Mathieson. The long range light particle leaves the emulsion at the surface. The heavy fission fragments are wholly contained in the emulsion.

Table I. Details of four events indicating fission into three charged particles.

Event	Observer	Range of short fragment microns	Range of long fragment microns	Range of α-particle microns	Energy of α-particle Mev	Angle of emission of α-particle relative to long fragment (degrees)
1	Miss A. M. Graham	10.7	13.2	177	19.0	54
2	Mrs. B. D. Mathieson	8.9	12.8	143*	16.6*	105
3	Mrs. B. D. Mathieson	9.2	9.7	240	21.8	85
4	Mrs. B. D. Mathieson	12.5	13.8	100*	14.0*	76

* Track leaves emulsion.

(1) Experiments on the slow neutron ternary fission of U^{235} indicate a rate of occurrence of ternary events in which the α-particle has an energy exceeding 14 Mev as about 1 per 1000 binary fissions.[4]

(2) According to Tsien *et al.*,[2] the fission of U^{238} with fast neutrons does not give rise to tri-partition with a third fragment of range greater than 5-cm, air equivalent.

Combination of these results provides strong evidence that the 4 events are examples of the photo-fission of uranium in which a long range light particle is emitted in addition to the heavy fission fragments.

Thanks are due to Messrs. J. J. Wilkins and T. A. Brinkley for their help with the experiments and to the Director, A.E.R.E., Harwell, for permission to publish the results.

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On the Penetrating Component of Cosmic Ray Air Showers*

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RECENT experiments, carried out by Cocconi, Cocconi-Tongiorgi, and Greisen[1] have shown that the particles associated with extensive cosmic ray air showers which are capable of penetrating 17.5 cm Pb are thereafter absorbed very slowly with a mean range of approximately 3600 g/cm² Fe. This fact was cited as evidence that the penetrating particles are mainly μ-mesons. However, evidence has also been presented for the existence of penetrating nuclear particles in extensive showers.[2,3]

In the experiment to be described the detection of such heavy particles was attempted through the measurement of the counting efficiency of a tray of low pressure G-M counters under 18.5 cm Pb (200 g/cm²) for single penetrating shower particles. The presence of an appreciable fraction of nuclear particles more heavily ionizing than μ-mesons would be indicated by an increase of counting efficiency for penetrating shower particles over that for the total penetrating radiation at sea level. This latter radiation is known to consist predominantly of μ-mesons with very nearly minimum specific ionization.

The apparatus (Fig. 1) contained three trays (E, 1, 3) of argon-ether counters filled at a sufficiently high pressure (90 mm Hg) to yield an efficiency of very nearly 100 percent. In tray 2 were placed alternately a set of thirteen similar argon-ether counters and a set of helium-amyl acetate counters of identical geometry

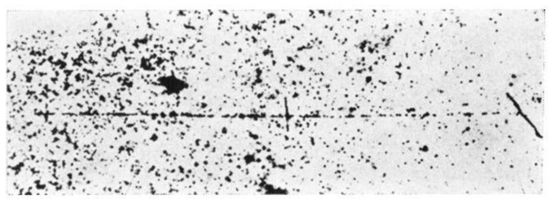

FIG. 1. Photomicrograph of event 2. Observer: Mrs. B. D. Mathieson. The long range light particle leaves the emulsion at the surface. The heavy fission fragments are wholly contained in the emulsion.