Anomalous Heavy Primary Cascades Recorded on Viking 10 Rocket Flight (*).

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Summary. — Emulsions flown to 136 miles on Viking 10 surrounded by only 2 g·cm⁻² of superimposed metallic absorber have recorded two examples of heavy primaries which on collision with emulsion nuclei are not destroyed catastrophically. The heavily charged relativistic fragments emerging from the primary act produce secondary collisions after traversing distances that are small compared with the collision mean free path of the identified nuclei. The first event initiated by a particle of charge 14 ± 1 encompasses a total of 5 collisions which could originate by successive chance deviations from the geometric mean free path with a probability of 1.3·10⁻⁶. The second cascade initiated by a carbon nucleus passes through two stages, and has its charge reduced to Z = 3 before the latter escapes from the detector. Considerations of the relative frequency of different modes of fragmentation and geometric escape further reduce the probability of these events originating by chance and being detected.

1. — Introduction.

On May 7, 1954 a 72.8 cm³ block of Ilford G-5 pellicles measuring 9 × 9 cm³ composed of 6 sheets 1500 µm thick was flown to a peak altitude of 136 miles. The emulsions were mounted horizontally in the upper nosecone of Viking rocket no. 10 encased in a cylindrical shell of Dural aluminum alloy with a

uniform wall thickness of 3.2 mm, as described in Fig. 1. The emulsions were recovered in excellent condition and developed satisfactorily (19 grains per 100 μm at minimum). Since the exposure was very exceptional in being conducted both in virtually complete absence of air and with only an average of 2 g·cm⁻² of superimposed metallic absorber, the emulsions provided a unique opportunity for the study of the composition of the heavy primary flux incident on the top of the atmosphere. After a preliminary survey (¹) 48 particles of charge 6 < Z < 10 and 24 particles of Z > 10 were observed in the stack corresponding to a total flux for heavy nuclei of Z > 6 of (6.6 ± 0.8) m⁻² s⁻¹ sr⁻¹ and $M^0/H^0$ ratio of 1.96 ± 0.5 at the top of the atmosphere for the medium and heavy groups of nuclei when corrected for fragmentation in condensed matter above the emulsions.

In following the heavy primary tracks through the horizontal stack we observed a total of 8 primary collisions initiated by particles of Z > 6, a description of which is given in Table I. Events α and β are noteworthy in that after the primary collision the heavy fragmentation products produce further secondary collisions after traversing comparatively short distances in the emulsion and these events will be referred to as anomalous cascades. Four additional units of emulsion of 63 cm³ total volume were also recovered. These were located symmetrically with respect to position C of Fig. 1 in a vertical plane facing the rocket skin. Radiation directed towards the back of the emulsions, however, encountered about 85 lbs. of instrumentation (chiefly aluminum). The average condensed matter absorption path for both faces is estimated at (15 ± 3) g·cm⁻². Five additional heavy primary initiated interactions were observed in these less favorably exposed preparations, which are described in the lower half of Table I.

All charge determinations are based on 3-ray densities of 3 or more developed grains apparently associated with the trajectory. The primary charge stan-

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Fig. 1. – Nosecone instrument section of Viking 10, showing horizontal block of emulsion A supported on a thin walled aluminum cylinder B. The emulsion housing for A was uniformly 1/8 in. thick and made of Dural. The rocket skin was made of stainless steel 1/32 in. thick. Four additional units of emulsion were exposed vertically in a N-S-E-W position as shown at C.