Cosmic-Ray Increase at High Altitude on February 23, 1956*

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A vertical telescope with a stopping power of 22 g/cm² was flown to an atmospheric depth of 10 g/cm² at Minneapolis seventeen hours after the beginning of the giant solar flare and cosmic ray increase of February 23, 1956. The cosmic-ray intensity was normal below 300 g/cm², but at 10 g/cm² was five times the normal intensity at Minneapolis. The particles apparently have energies less than one Bev, presumably originated near the sun and reached the earth by scattering from magnetic fields near the solar system.

A HIGH-ALTITUDE observation was made by means of a vertical telescope following the solar flare which began at 0335 GMT on February 23, 1956. The flight was sent from Minneapolis (geomagnetic latitude 55.4°N) and ascended to 10 g/cm² atmospheric depth during the period 1900–2100 GMT.[1] The counting telescope is described in Fig. 1. It has a total stopping power (including the box) of 0.2 g/cm². Because of the small stopping power, the unit will respond to radioactive γ rays as well as to incident charged particles because of coincidences produced by the Compton recoils. The efficiency for detection of Co^{60} γ rays is 0.05% (vertically incident on the top counter tray). The efficiency for detecting charged particles is assumed to be 100% if the traversal lies within the solid angle of 9.38 steradian cm². The apparatus used for the flight was carefully checked prior to launching and was returned later and found to be in good working order, so that considerable reliance is placed in the observation.

The flight results are given in Fig. 2. The lower curves are given for comparison and represent an average of soundings with the same equipment at Minneapolis over the period July–October, 1955. Also shown is a flight made February 29, 1956 after the flare, which is close to normal. The flare data follow the normal curve to 300 g/cm² and then rapidly increases until at 10 g/cm² the flux is about 5×normal. The dead time of the telemetering system introduces an appreciable correction, as shown. Because the transmitted pulse length shortens somewhat as the flight reaches very high altitude, this correction becomes somewhat less and the true curve emerges with a weak maximum at about 40 g/cm². This may be either a time decay or an atmospheric transition effect. It is clear that the radiation at this time is of low energy, 1 Bev or less for protons, as shown by the absence of a strong transition maximum normally seen at about 80 g/cm², and by the failure of the radiation to produce any effect deeper than 300 g/cm² in the atmosphere.

If one assumes that the acceleration process occurred only during the visual outburst which lasted from 0334 to 0414 GMT as observed in Tokyo[2] then the large effect remaining at high altitude 17 hours later implies that the cosmic-ray beam suffered considerable scattering and/or trapping in magnetic fields in or near the solar system.

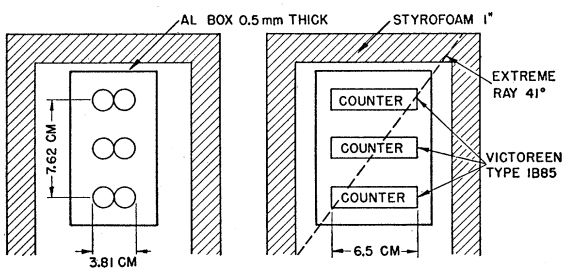

FIG. 1. Vertical counter telescope used for flare observation. The arrangement subtends a solid angle of 9.38 steradian cm² for isotropic radiation.

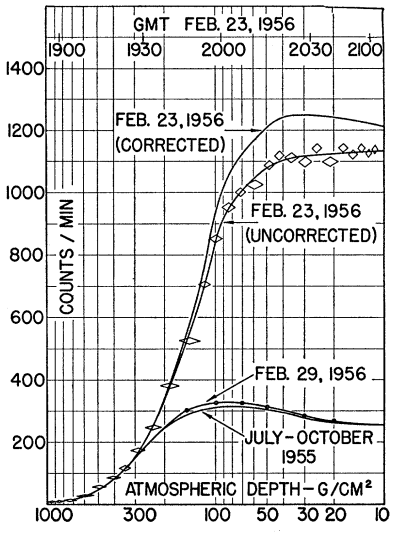

Fig. 2. Flare sounding of February 23, 1956 compared with normal soundings at Minneapolis.

The flare produced tremendous world-wide increases in cosmic-ray intensity recorded on practically all types of counting devices operative at the time. World-wide information is being collected by Professor T. Gold of Royal Greenwich Observatory and will be summarized and distributed.

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[1] We are indebted to Professor J. A. Simpson for notifying us that the cosmic-ray increase was in progress.

[2] "Preliminary report of solar activity," High Altitude Observatory and National Bureau of Standards, Boulder, Colorado. March 2, 1956 (unpublished). Prepared by Dorothy E. Trotter and Walter Orr Roberts.