

FIG. 2. Intensity of entire reflected beam from glass mirror; incident beam filtered through 25 cm BeO.

beams. The drop d of a neutron of velocity v passing through slits at 0, l_1 , and l_2 is given by

$$d = (g/2v^2)(l_2^2 - l_1 l_2).$$

Therefore, the separation of two beams of velocity distributions v_1 , v_2 is

$$\Delta = d_2 - d_1 = \frac{1}{2}g(l_2^2 - l_1 l_2)[\langle v_1^{-2} \rangle_{Av} - \langle v_2^{-2} \rangle_{Av}].$$

For the thermal beam the average over the maxwellian distribution is $\langle v_1^{-2} \rangle_{Av} = v_{max}^{-2}$. The velocity distribution of the filtered beam was not truly maxwellian, because inelastic scattering in the filter is greater for longer wavelengths. It was therefore measured by reflected intensity from a glass mirror vs incidence angle, as shown in Fig. 2. If the flux

$$N(v)dv \propto v^n dv$$

(where $n=3$ for a maxwellian distribution), then reflected intensity beyond the critical angle for 4.4A neutrons should vary as $1/\theta^n$. It was determined from plots of $n=5$ and $n=6$, as seen in Fig. 2, that $n=5.5 \pm 0.5$. An average over the velocity range 0 to 9.00×10^4 cm/sec (∞ to 4.4A) then gives

$$\langle v_2^{-2} \rangle_{Av} = n + 1/n - 1(9.00 \times 10^4)^2 = 6.5/4.5(9.00 \times 10^4)^2.$$

These velocity values, together with the average $\Delta = 1.22 \pm 0.06$ mm, from a number of measurements, give

$$g = 935 \pm 70 \text{ cm/sec}^2$$

in agreement, within the experimental error, with the usual value 980.

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High Altitude Measurements of the Penetrating Component Intensity of Cosmic Radiation Near the Geomagnetic Equator

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THE vertical intensity of cosmic radiation penetrating 10 cm of lead absorber at high altitudes was measured by the authors near the geomagnetic equator (Bangalore 3°N mag.) using free balloon ascents during 1950-1951. The measurements were made with quadruple coincidence GM counter telescopes whose vertical half angles were 13.5° and 24.5° . The most inclined ray

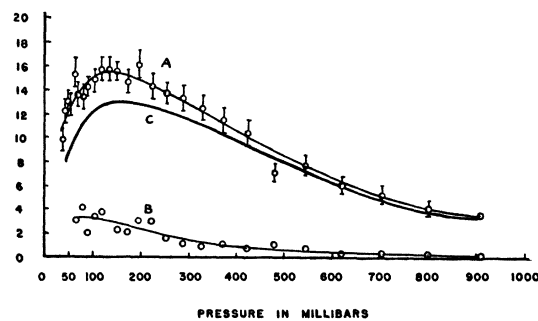


FIG. 1. Vertical intensity of cosmic radiation penetrating 10 cm Pb at Bangalore 3°N mag. A: Composite curve of flights made on 11/21/50, 11/24/50, 2/1/51, 2/8/51, 2/26/51, and 3/8/51. B: Shower intensity curve. C: Difference curve between A and B.

recorded by the telescope had a path length only 10 percent greater than that of a vertical ray. The temperature inside the gondola which contained the apparatus was maintained above 10°C throughout the flight using the "greenhouse effect." Quadruple coincidences, together with atmospheric pressure and temperature inside the gondola were transmitted continuously over a single ultra-high frequency radio carrier to the ground receiving apparatus which recorded the information automatically on a moving paper tape.

The telescopes were tested on the ground for many hours before they were sent up. Their performance was also checked at the highest altitudes reached to insure that they were working satisfactorily during the flight in the following manner. The apparatus always floats for several hours at or near the minimum pressure reached, and a χ^2 test could therefore be applied to the statistical fluctuation of counts recorded in small equal intervals of time during the floating period. It is interesting to note that for the curves in which the scatter of the points was rather large during ascent, the χ^2 fit for the floating region was also poor. This was taken to indicate a possibly defective performance of the equipment, and the entire data of such flights was therefore rejected.

A composite curve of six good flights made at Bangalore is given in Fig. 1, with the root mean square deviation marked for each point. From the composite curve given in the figure and the individual curves, which are not shown here, it is seen that the vertical intensity of cosmic radiation penetrating 10 cm of lead absorber at Bangalore 3°N (mag.) rises continuously down to a pressure of about 120 millibars, and then falls gradually down to the lowest pressures reached by the apparatus. This is contrary to the observations of most of the previous workers,¹⁻⁴ who made their measurements at higher magnetic latitudes and observed a monotonic rise of penetrating intensity up to the greatest heights reached. The hard component intensity curve was corrected for side showers and accidentals by making separate flights with identical telescopes, but with the second counter tray of the quadruple coincidence telescope displaced sideways so that at least two particles are necessary to make a coincidence. The shower and accidental intensity curve and the difference curve, which represents the penetrating component intensity, are also given in the same figure. Although the correction due to side showers and accidentals is rather appreciable at pressures below 200 millibars, it is nevertheless obvious that this does not affect the shape of the penetrating component intensity curve which reaches a maximum at about 120 millibars and then falls with decreasing pressure.

A detailed paper on the results and the experimental technique will be published soon elsewhere.

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² Schein, Wollan, and Groetzinger, *Phys. Rev.* **58**, 1027 (1940).

³ Schein, Jesse, and Wollan, *Phys. Rev.* **59**, 615 (1941).

⁴ M. A. Pomerantz, *Phys. Rev.* **75**, 69 (1949).