ANOMALOUS ABSORPTION OF COSMIC RAYS IN LEAD*

By W. L. KENNEDY†

Anomalies in the lead absorption curve of the vertical component of cosmic radiation have been reported by several authors using counter telescopes (Aiya 1944 ; George and Appapillai 1945 ; Swann and Morris 1947 ; Kellermann and Westerman 1949 ; Fenyves and Haiman 1950 ; Mazzolli de Mathov 1951 ; Abd El-Wahab Khalil 1952). However, in a recent detailed series of experiments, results of which were published as the experiment to be described here was nearing completion, Heyland and Duncanson (1953) found no evidence of any anomaly in the absorption curve.

In the present experiment, the absorption of the vertical component of cosmic radiation in lead was measured at sea-level, geomagnetic latitude 43·5 °S., using narrow-angle triple-coincidence counter telescopes. Details of the

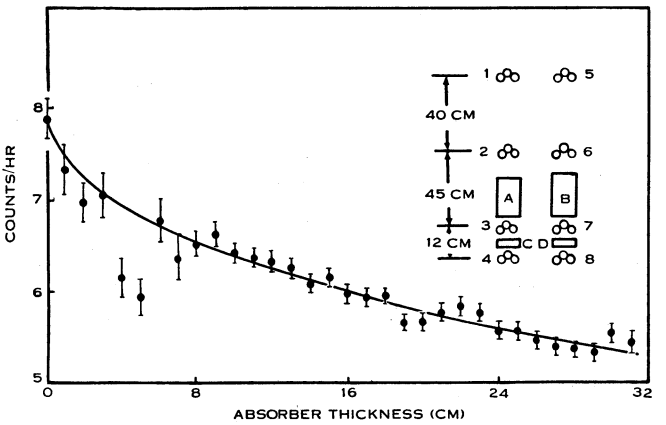

Fig. 1.—Absorption curve of cosmic rays in lead, showing counter arrangement inset.

arrangement of the counters are inset in Figure 1. Four telescopes, consisting of trays 123, 124, 567, and 568, were in operation simultaneously, and results for four adjacent absorber thicknesses were obtained by having $C=D=1$ cm lead, and $B=A+2$ cm. The effective area of each counter tray was 10·6 by 5·7 cm, and the angular aperture of each telescope was thus approximately 13 by 7°.

* Manuscript received August 11, 1953.

† Physics Department, University of Western Australia, Nedlands ; present address : Purdue University, Lafayette, Indiana, U.S.A.

Pressure and temperature coefficients were determined to be $-3 \cdot 0$ per cent./cm Hg and $-0 \cdot 20$ per cent./°C for absorber thickness of 10 cm, and these coefficients were applied as corrections to observations at other absorber thicknesses.

Before combining the results of the various telescopes, a check on relative efficiency was made. As the observed counting rates at the same absorber thickness were very closely in the ratio of the angular apertures, it was concluded that efficiencies were equal, and only a geometrical aperture correction was required. In this connexion, it followed that the shower counting rate was small and also, in view of the results obtained by Swan (1951), no corrections for showers were considered necessary. The accidental triple-coincidence counting-rate was less than $0 \cdot 1$ counts/day, and therefore negligible.

The final results of the absorption measurements are presented in Figure 1. Each point is based on approximately 2000 counts, except for those at less than 8 cm absorber thickness, for these latter were considered to be of lesser importance in the present investigation.

Analysis of the absorption curve of Figure 1 indicates that there are a number of small deviations from the smooth curve occurring in the region from 8 to 31 cm. It appears unlikely that these deviations result entirely from neglect of a shower correction or inaccuracies in applying barometric and temperature corrections ; these should of themselves introduce no maxima or minima in the absorption curve.

As none of the deviations is statistically significant, it is concluded that the present results are in agreement with the assumption of a smooth absorption curve.

Thanks are due to Mr. J. B. Swan for suggesting the project, and acknowledgment is made of a research grant from the University of Western Australia.

References

Abd El-Wahab Khalil, M. (1952).—*Nuovo Cim.* **9** : 1248.
Aiya, S. V. C. (1944).—*Nature* **153** : 375.
Fenyves, E., and Haiman, O. (1950).—*Nature* **165** : 244.
George, E. P., and Appapillai, V. (1945).—*Nature* **155** : 726.
Heyland, G. R., and Duncanson, W. E. (1953).—*Proc. Phys. Soc. Lond.* A **66** : 33.
Kellermann, E. W., and Westerman, K. (1949).—*Proc. Phys. Soc. Lond.* A **62** : 356.
Mazzolli de Mathov, E. (1951).—*Nature* **167** : 192.
Swan, J. B. (1951).—*Nature* **168** : 73.
Swann, W. F. G., and Morris, P. F. (1947).—*Phys. Rev.* **72** : 1262.