TABLE I. Nuclear disintegrations at 30,000 feet pressure altitude (312 gms air) at 40° magnetic latitude.

Mev energy loss in chambers	Flight No. 2 Total no. of events	Flight No. 2 Events per hour	Flight No. 6 Total no. of events	Flight No. 6 Events per hour	Flight No. 7 Events per hour	Average events per hour
>4.2	···	···	···	···	1412±38	1412±38
>5.8	834	535±19	1024	512±15	525±23	514±11
>5.8 two channels	816	523±18	955	477±15	···	
>6.9	525	338±14	653	326±13	334±19	332±9
>8.0	418	268±13	479	239±11	···	252±8
>10.6	252	162±10	···	···	140±12	153±8

TABLE II. Nuclear disintegrations at 30,000 feet pressure altitude (312 gms air) at magnetic latitudes greater than 55° north.

Mev energy loss in chambers	Flight No. 3 Total no. of events	Flight No. 3 Events per hour	Flight No. 4 Total no. of events	Flight No. 4 Events per hour
>5.8	1893	644±15	1588	794±20
>5.8	2028	689±15	1520	760±19
>6.9	1371	467±12	1023	511±16
>8.0	1050	357±11	···	···
>10.6	566 in 134 min.	253±11	458	229±10

TABLE III. Factor of increase L of nuclear disintegration rate between 40° and 55°N magnetic latitude at 30,000 ft. pressure altitude.

Integral Mev energy loss in chambers	Using flight No. 3 and table C	Using flight No. 4 and table C	Fast or slow neutrons
	L	L	
>5.8	1.30	1.49	
>6.9	1.41	1.54	1.5
>8.0	1.42	···	
>10.6	1.65	1.51	

In addition to these measurements the production of showers was measured by covering the chambers with lead hemi-cylinders 2.5 cm thick corresponding approximately to the optimum thickness for maximum electronic shower production.[4] The number of events observed with lead over the chamber divided by the number of nuclear events without the lead may be called R; R at 55° has an average value of 1.9 and at 40° has a value of 2.4. Using these ratios and the observed latitude factor of increase for nuclear events from Table III, it is found that the number of events produced by the lead shows little or no decrease in going from 55° to 40°. This is in substantial agreement with the observed three-fold shower coincidences and present knowledge of the latitude dependence of electronic showers.[5] It was shown by measurements with additional absorbers around the ion chambers that the contribution of nuclear disintegrations in the lead to the chamber counting rate was negligible.

The dependence of nuclear bursts upon *altitude* at 55° was in agreement with the burst measurements of Bridge[3] and the production of neutrons in air.[1]

Measurements of both thermal neutrons and moderately fast neutrons were made concurrently with the ion chamber measurements. Since these neutrons were slowed down before detection they are incoherent; therefore, a comparison of the latitude factors for neutrons and for nuclear disintegrations is only significant when a wide range of energy losses in the chambers is measured at the different latitudes. Thus, the integral rates have been used in Tables I, II and III.

In Fig. 1 the ion chamber data have been fitted to the fast neutron latitude curve at 40°. This curve is characteristic of a nucleonic component in the cosmic-radiations particularly with respect to the factor of increase of 1.4 to 1.5 between 40° and 55°N at 30,000 feet. Although recently Tongiorgi[6] has found that neutrons are produced in extensive showers, the present experiment indicates that the most predominant process for the formation of most of the neutrons in the atmosphere with energies below 20 Mev appears to be the emission of neutrons and protons from nuclear disintegration or "star" events. These star events, in turn, may be produced predominantly by higher energy nucleons.[1]

Additional flights to the magnetic equator were not entirely successful due to equipment failures at the low latitudes. However, more than a three fold-increase in nuclear disintegration rate between 0° and 55°N magnetic latitude has been obtained and is to be compared with a factor of 3.5 for the neutron densities. Measurements at the low latitudes are being repeated.

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The Penetration of High Energy Electrons in Aluminum*

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PREVIOUS determinations of the range of monoenergetic electrons in matter have extended up to electron energies of 2.6 Mev. These data as well as measurements of the end points of beta-ray spectra have served as the basis for various empirical range-energy relations.[1-3] In the absence of experimental data at higher energies Fowler, Lauritsen, and Lauritsen[4] have carried through a calculation extending these results to 25 Mev. They integrate the theoretical energy loss in aluminum adjusting the integration constant to yield normalization with Bleuler and Zunti's semi-empirical relation at 3 Mev.[2] Despite the fact that radiation losses introduce straggling at higher energies, the concept of maximum range in the region which they consider remains defined. For moderate energies ($<800/Z$ Mev) an appreciable fraction of electrons will not experience radiative collisions and hence will penetrate to the maximum depth allowed by ionization losses. Though the curve given by Fowler, *et al.* is for maximum range (R_0) *versus* electron energy, they also give an expression for the *practical* maximum range (R_p). This latter quantity, which is obtained by straight line extrapolation of the linear portion of the absorption curve of a monoenergetic electron beam is the most conveniently measurable range in practice. According to Bleuler and Zunti it is less than the maximum range (R_0) of a monoenergetic beam by 0.14 g/cm² Al.

In order to check the calculations of Fowler, *et al.*, we have carried through measurements of the absorption in aluminum of monoenergetic electrons in the range from 3 to 12 Mev. To this end we have used the B^{12} beta-spectrum (produced through the $B^{11}(d,p)B^{12}$ reaction) analyzed by the 90 degree magnet normally used for the Van de Graaff beam (resolution ~4 percent). Using a triple coincidence train of G-M counters, absorption curves in aluminum of the analyzed beam were obtained. Calibration of the magnetic analyzer was checked by running the B^{12} momentum spectrum and matching the distribution with that given by Hornyak, Dougherty, and Lauritsen.[5] A Kurie plot of the data yielded an end point at total energy 27.3 m_0c^2 (13.4 Mev). The excellent agreement with the result of Hornyak, *et al.* (27.30 m_0c^2) is added assurance that the energy values subsequently used in the range measurements are correct.

In determining the absorption curves threefold (1, 2, 3) and twofold (1, 2) coincidences were recorded simultaneously with the aluminum absorbers placed immediately in front of counter 3 (Fig. 1). The twofold coincidence rate was employed to monitor

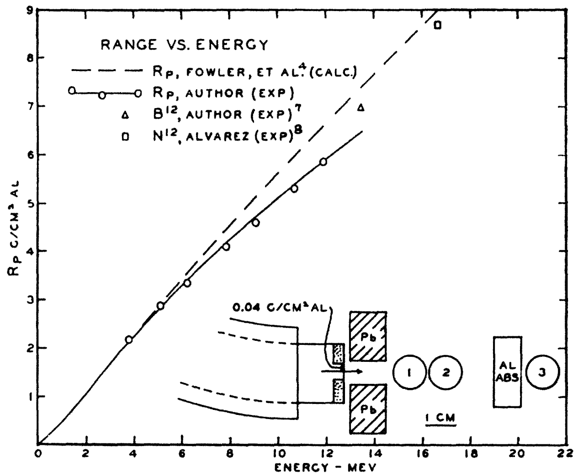

FIG. 1. The practical maximum range in aluminum (R_p) *versus* electron energy. The counter arrangement relative to the magnetic analyzer is shown in the lower right corner.

the electron beam emerging through the 0.04 g/cm² aluminum window of the spectrometer. The results yielded a family of absorption curves (corrected for counter wall thicknesses) for various electron energies selected by the spectrometer. The shape of these curves agreed well with that of computed curves[4] and the linearity near the end point allowed accurate determination of the practical maximum range. These values of R_p are shown in Fig. 1 plotted against the corresponding electron energies.

It is seen that in the high energy region the experimental points indicate a practical range somewhat less than that expected on the basis of the theoretical energy loss (dotted line). It seems likely that this may be due to two factors: (1) several cloud chamber investigations[6] have provided evidence that the energy loss of electrons traversing thin foils is greater than that predicted by theory by as much as 40 percent in the region of energy involved here, (2) multiple scattering effects have been shown to give rise to actual path lengths through absorbers which are appreciably greater than the absorber thickness.[6]

Corrected to maximum range ($R_0 = R_p + 0.14$ g/cm²), the solid curve should be satisfactory for energy measurements of monoenergetic gamma-rays by coincidence absorption as outlined in reference 4. However, the data do not necessarily furnish a range-energy curve suitable for end point measurements of beta-ray spectra. It is difficult to correlate the maximum range as determined here with that obtained by extrapolation of a logarithmic plot or by a Feather analysis. In this connection the end point ranges of B^{12} [7] and N^{12} [8] have been indicated in Fig. 1 plotted at energy values corresponding to the spectrometrically determined end point for B^{12} and to that expected from the atomic masses and (p,n) threshold for N^{12}. The good agreement of these points with the modified Feather formula given by Glendenin and Coryell[3] is evidence for the validity of that relation for absorption measurements of high energy beta-rays.

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Hyperfine Structure of Te^{125}

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HYPERFINE structure in the spectrum of singly ionized Te^{125} has been observed with a Fabry Perot etalon. Using 20 mg of 80 percent enriched isotope in a water-cooled Schuler tube, photographs were obtained in three to five minutes on Eastman 103a-F plates. About a dozen lines in the region from 4000 to 6000A show hyperfine structure, all of them giving only two components. The average separation of the components is about 0.2 cm^{-1}. In some of the lines, for example λ5666, the intensities of the two components have the ratio 3:1, with corresponding displacements relative to the single component of the even isotopes. Thus it can be concluded that the spin of Te^{125} is $\frac{1}{2}$. The ratio of intensities in the line λ5708 corresponds to a j value of $\frac{3}{2}$ which does not agree with the classication 6s $^2P_{\frac{1}{2}}$ given by Rao and Sastry[1] for the lower level of this line.

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Spurious Counts in Geiger Counters and the Pretreatment of the Electrodes

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GEIGER-MÜLLER counters and point counters are found under certain conditions to give spurious counts which cannot be attributed to photoelectric emission. It has been found by various observers[1,2] that newly made counters show a marked activity of this kind, which decreases with time until finally the normal background count only remains. Because of this phenomenon, various recipes for the preparation of counter cathodes have been proposed and some workers[1,2] have put forward explanations for this behavior in terms of the conditions existing on the surface of the cathode. In a recent letter to *The Physical Review*, Wiedenbeck and Crane[3] described a very interesting experiment with counters which showed nearly similar effects after having been operated at voltages above the pleateau. These authors concluded that the effect which they observed could be attributed to delayed emission of electrons from the cathode. In view of their method of pretreatment of the cathodes made from various metals (dry polishing with fine steel wool) it seems possible that a connection may exist between their observations and that of J. Kramer.[4] He maintains that the disturbances observed in newly made counters offer a new method for investigating the surfaces of metals, as regards their structure and stability. He concludes from his experiments that electrons are emitted by metals during exothermal processes.

As a result of a previous private communication of Kramer with one of the authors (S.M.N.), in which he proposed the Geiger-Müller counter or the Geiger point counter as new tools for studying metal surfaces, a series of experiments were conducted by the authors as a repetition of those by Kramer, and they were able to confirm his findings for the effects which were tried. The effects studied can briefly be stated as follows:

(1) Metal surfaces which have been ground or polished exhibit strong counting activity when placed in a counter. This activity diminishes with time according to the severity of the pretreatment and differing also in extent for various metals.

(2) On heating such a metal surface inside the counter after the activity has died down to the level of the normal background, a gradual, steep rise in counting rate may set in above a certain temperature. The behavior of the metal depends on the nature of the pretreatment, the time elapsed since treatment, and the particular metal.

Typical curves obtained by us illustrating these two phenomena are given in Figs. 1 and 2.