viously reported study,[1] a value of 0.07 cm^{-1} for the half-width of the CO lines, pressure-broadened by N_2 at atmospheric pressure. This value agrees with that suggested by Plyler, Benedict, and Silverman[6] from their studies in the overtone region.

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Ionization by Cosmic-Ray Mesons in Argon*

G. W. McClure
Bartol Research Foundation, Franklin Institute, Swarthmore, Pennsylvania
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An electron collection ionization chamber designed primarily for use as a detector of relativistic α-particles in the primary cosmic radiation has been tested at sea level and has yielded results which are capable of rather complete explanation in terms of the present theory of ionization and the known features of the sea-level cosmic radiation.

The ionization chamber consists of a cylindrical cathode 2.5 in. in diameter and 8.0 in. long, and an axial center wire 0.010 in. in diameter encased in a 3.0-in. diameter cylindrical pressure vessel filled with 20 atmospheres of 99.9 percent pure commercial argon. The cathode was operated at 1.2 kv—about 300 volts above the minimum potential required for saturation of the pulses produced by a Po-α calibration source located at the cathode.

A fourfold coincidence G.M. counter telescope, A, B, C, D (Fig. 1) with 10 cm Pb interposed between counters A and B

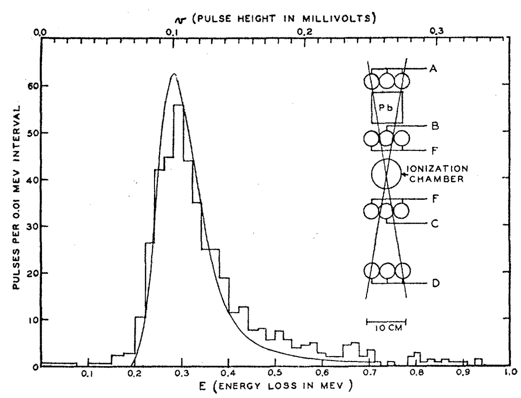

FIG. 1. Distribution of energy losses of cosmic-ray mesons in the ionization chamber. Histogram—experimental distribution; smooth curve—calculated distribution.

selected a meson beam which traversed a well-defined path length through the ionization chamber. Four anti-coincidence counters F provided partial discrimination against air showers and multiple-secondary events originating in the Pb absorber. Each anti-coincidence event ($ABCD$-F) initiated a 100-μsec oscillograph trace displaying the associated ionization chamber pulse.

The differential pulse-height distribution shown in Fig. 1 was obtained from 761 oscillograph traces photographically recorded over a period of 14.1 hours. The top abscissa scale v represents pulse amplitude at the collector electrode of the chamber. The energy loss in the argon E (bottom scale) was assumed to be a linear function of the pulse height v with a proportionality constant $K=E_\alpha/v_\alpha f$, where E_α is the energy of the calibration Po$-\alpha$-particle (5.3 Mev), v_α is the Po$-\alpha$ pulse height, and f is a calculated factor of numerical value 0.84 introduced to correct for the positive ion inductive effect.[1]

The Bethe[2]-Bloch[3] theory of energy loss by ionization as extended by Landau[4] and Symon[5] was applied together with the sea-level meson momentum spectrum of Wilson[6] to the problem of calculating the distribution of energy losses of the sea-level mesons in the ionization chamber. The smooth curve in Fig. 1 represents the calculated distribution.

The following points of comparison between the histogram and the calculated curve may be noted:

(1) The most probable energy loss (0.3 Mev) determined by the measurement is in close agreement with the value predicted by the theory.

(2) The half-width of the experimental distribution is approximately 10 percent greater than that of the calculated distribution. A broadening of this nature is expected to arise from the amplifier noise which introduced a statistical uncertainty of approximately ± 0.01 millivolt in the amplitude of the measured pulses.

(3) The tail of the histogram ($E>0.4$ Mev) contains relatively more events than the tail of the calculated distribution. This may result in part from neglect in the calculation of the unknown high energy end of the sea-level meson spectrum which comprises about 6 percent of the total sea-level intensity, and in part from the accompaniment of a small percentage of the mesons by knock-on electrons produced in the material above the chamber.

(4) The experimental results are consistent with the relativistic increase in specific ionization predicted by the Bethe-Bloch theory. If the specific ionization is taken as a constant above the minimum, one obtains a calculated pulse-height distribution about one-half as broad as the histogram. The relativistic increase in specific ionization in gases has been previously confirmed by Hereford[7] and by Kupperian and Palmatier.[8]

The present results indicate that it is feasible to utilize a high pressure ionization chamber together with a G.M. counter train for discriminating between various high energy particles on the basis of specific ionization. A device based on this principle has been developed for balloon investigations of the alpha-particle component of the primary cosmic radiation.[9]

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The Energy Spectrum of the Electrons in the Extensive Cosmic-Ray Showers

Carmelo Milone
Physical Institute, University of Catania, Catania, Italy
(Received May 26, 1952)

The energy spectrum of the electrons in the extensive air showers has been studied by means of G.M. counters arranged as in Fig. 1, at Catania (40 m above sea level). Each of the counters A, B, C had an area S. Six values of S were used, namely $S=140$, 240, 400, 800, 1600, 3200 cm^2. Coincidences $T=A+B+C$ were recorded and interpreted as due to showers whose core landed within a few meters from the center 0 of the apparatus, and whose average density there was $\bar{\Delta}\simeq 1/S$. Corresponding to the values of S, $\bar{\Delta}$ varied from 70 to 3 particles per m^2. Counters D and E were covered with absorbers of either Pb or H_2O of thickness t variable from 0 to 56 g cm^{-2}. Counters D had surface S, counters E had surface S when there was no absorber; when covered with an absorber of thickness t, the surface was adjusted to a value $S_E(t)$, such as to make $S_E\Delta_E=$constant, (Δ_E being the density of the shower present under the thickness t). Preliminary