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The report herein contained is of a preliminary character, and is intended to exhibit only the first steps of the problem in hand.

At the Des Moines meeting of the American Physical Society on Dec. 31 last, the writer presented a paper in which were set forth details of a method of treating the observations of Millikan and Cameron upon the absorption of the cosmic-rays, in order to render them susceptible to adjustment by the method of least squares.

In the observation equations, based upon the absorption measurements, provision must be made for two unknowns for each component cosmic-ray wave length assumed to be present. These unknowns are the initial intensity and the absorption coefficient of the component.

In order that the least-square adjustment may be practicable, the equations must first be reduced to an equivalent linear form, and it was with this process that the Physical Society paper was concerned. The method employed requires that approximate values of the constants be already known. Millikan and Cameron [1] have made estimates of the absorption coefficients of the three principal components. The present report deals with an inquiry, first, as to the magnitude and character of such part of the radiation as is not included in these three components, and, second, as to the initial intensities of the three components themselves, expressed in terms of ionizing power.

Presumably the residual radiation is of the same type and subject to the same absorption law as the three principal components. It is clear that these three components must include most of the energy responsible for the ionization. There cannot be any very intense radiation of high penetrating power, because of the small ionization obtained at great depths; and if there were much other radiation of low penetrating power, its effect would be observable in the form of the ionization curve. Therefore we may assume that whatever rediation remains when the three main bands are subtracted from the total, is of small intensity and of low mean absorption coefficient.

1 Millikan and Cameron, *Phys. Rev.* 31, p. 921 (1928).

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As a first approximation, this residual radiation may be considered as a linear function of the depth H, with small slope, over the range of the observations. Then if it is represented by AH+B, the total ionization at any depth may be expressed by the equation

$$G(0.35H)I_1 + G(0.08H)I_2 + G(0.04H)I_3 + AH + B = i.$$

$G(\mu H)$ is the Gold integral appearing in the absorption equation, and the three values of μ are the absorption coefficients estimated by Millikan and Cameron from a study of their curve. I_1, I_2, I_3 are the unknown initial intensities of the three principal components, making, with A and B, five unknowns in all.

We now select five typical observations at intervals along the absorption curve, namely at H=8.45, 17.45, 28.60, 48.60, and 67.45 meters, and substitute their results in the above equation, using the table of the Gold integral to calculate the coefficients of I_1, I_2, I_3. The solution of the five simultaneous equations thus obtained gives, as the preliminary or approximate values sought,

$$I_1 = 612.9 \qquad A = 0.006$$
$$I_2 = 23.9 \qquad B = 1.96$$
$$I_3 = 13.7$$

It is thus evident that A is probably very small, especially since it turns out positive, whereas it should be negative; which suggests that this value is altogether fictitious, arising from errors in the three assumed absorption coefficients, and that its actual value is negligible. Now if A is assumed to be zero and four of the equations are solved for the remaining unknowns, B turns out to be very close to 2.4, which is the value given as the zero of the electroscope, due to leakage. It therefore seems reasonable to assume that the three principal components constitute practically all there is of the cosmic radiation, at least all that remains at altitudes within the range of the observations; and that the constants for these three components are, approximately: I_1=612.9, μ_1=0.35; I_2 = 23.9, μ_2 = 0.08; I_3 = 13.7, μ_3 = 0.04.

Professor Millikan states, however, that his subsequent results, which he hopes to report within a few weeks, will modify these values somewhat. Therefore this work is held in abeyance for the time being.

Meanwhile it may be noted that it has been found necessary to calculate the Gold integral

$$G(\mu H) = \int_1^\infty x^{-2}\, e^{-\mu H x} dx$$

at shorter intervals than those of Gold's published table,[2] and to extend it somewhat beyond the limits of the table. For valuable assistance in this task, the writer is indebted to his colleague, Professor L. M. Coffin.

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2 Gold, *Proc. Roy. Soc.* A82, p. 62 (1909).