at about 56 degrees caused Millikan to assume that the incoming radiation must consist of electrons.

However, proton energies cannot be directly read off an electron energy scale. This may be verified by using the formula employed by Lemaitre and Vallarta[4] to calculate, in stormers, the particle energy, x, necessary to penetrate the field of a magnetic dipole of moment M to a distance, r, equal to the radius of the earth (6370 km).

$$x = r(mv/eM)^{\frac{1}{2}},$$

where e, v, and m are, respectively, the charge, velocity, and relativistic mass of the particle.

Assuming that any atom of mass M_A emits a pair of oppositely directed particles each of mass m', with an energy due to the complete annihilation of the remainder of the atom, then

$$\tfrac{1}{2}(M_A - 2m')c^2 = m'c^2[(1-\beta^2)^{-\frac{1}{2}} - 1].$$

From this, it may readily be seen that the relativistic mass $m'/(1-\beta^2)^{\frac{1}{2}} = \frac{1}{2}M_A$. Thus the relativistic mass, m, is constant for any particle emitted by a given atom-annihilation process. In particular, electrons or protons emitted in a helium-annihilation process have a relativistic mass of 3.32×10^{-24} g.

Accepting the values of $M = 8.04 \times 10^{25}$ e.m.u. and $e = 1.6 \times 10^{-20}$ e.m.u., then $x = 0.177\sqrt{\beta}$, where β has been written for v/c, and may be calculated from the relativistic and rest mass values. For an electron of 1.87×10^9 ev, $\beta = 0.999$, whence $x = 0.177$ stormers. For a proton of 0.93×10^9 ev, $\beta = 0.864$, whence $x = 0.165$ stormers, which corresponds to an electron energy of 1.61×10^9 ev.

On referring to the Lemaitre-Vallarta curves, it is seen that the difference in these particle energies, for vertical incidence, corresponds to a latitude difference of about $1\frac{1}{2}$ degrees, which is within the uncertainty limits of existing data on the latitude of the helium incoming radiation. Thus there is no experimental evidence to suggest that protons could not form the majority of the incoming radiation, thereby removing the principal objection to Millikan's atom-annihilation hypothesis.

[1] R. A. Millikan, Neher, and Pickering, Phys. Rev. **63**, 234 (1943).
[2] Millikan, Neher, and Pickering, Phys. Rev. **61**, 397 (1942).
[3] G. Lemaitre and M. S. Vallarta, Phys. Rev. **50**, 503 (1936).
[4] G. Lemaitre and M. S. Vallarta, Phys. Rev. **43**, 809 (1933).

Primary Cosmic-Ray Protons and the Atom-Annihilation Hypothesis

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In a paper which appeared in the Physical Review [**61**, 397 (1942)] we stated in discussing the atom-annihilation hypothesis (see reference 4, page 398): "It would make no difference so far as all the results considered in this paper are concerned whether the charged particles are electrons, mesotrons, or protons, for at the very large energies here involved the effect of a magnetic field is essentially the same upon them all."

But in a paper in the Physical Review [**63**, 234 (1943)] we incorrectly stated (see page 245): "If, then, the transformation of rest mass energy in the case of the helium atom gave rise to a pair of protons rather than a pair of electrons, then the latitude of first entrance of these helium annihilation rays would be considerably north of Saskatoon instead of at mag. lat. 54 N computed from the Lemaitre-Vallarta curves as the first latitude of entrance of helium annihilation rays on the assumption that the whole rest mass of the helium is transferred into an *electron* pair."

In a subsequent article found in the same journal [Phys. Rev. **66**, 295, reference 1 (1944)] this last statement was corrected, as follows: "The only choice is between an electron pair and a proton pair, but the difference between the latitude of entrance of electrons and protons entering the earth's magnetic field from this mode of origin is in no case, not even in the case of He annihilation rays, large enough to be detected with the resolving power of the experimental techniques we have so far used."

In other words, we here corrected the contradiction between the two statements made in the 1942 and 1943 articles, reaffirming the validity of the 1942 statement and admitting our slip in the 1943 statement after recomputing the latitude of entrance of protons and finding it, within the limits of our observational uncertainty, the same as the latitude of entrance of electrons.

Further, Dr. Dana T. Warren in an article in Phys. Rev. **66**, 252 (1944) also called attention to the contradictory character of our two statements and made essentially the same computations which Mr. Turner has herein made and reached a conclusion identical with his. Therefore it is probably desirable now to emphasize the fact that there is no disagreement by anybody on the point here involved.

Microwave Spectra of Linear Molecules

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Work on the spectra of certain linear molecules near 1.25-cm wave-length has continued in these laboratories. Some results not previously reported are described below.

The $O^{16}C^{12}S^{33}$ transition $J = 1 \rightarrow 2$ has been found at 24020.3 ± 0.1 Mc. The interval between this line and the $O^{16}C^{12}S^{32}$ line is 305.75 ± 0.05 Mc. Combining this result with the value 594.59 ± 0.04 obtained by others[1,2] for the interval between the $O^{16}C^{12}S^{32}$ and $O^{16}C^{12}S^{34}$ lines, one can compute the ratio of the mass differences $(S^{33}-S^{32})/(S^{34}-S^{32})$ to be 0.49985 ± 0.0001. The result is only in fair agreement with the value 0.50038 ± 0.0002 obtained from Mattauch.[3] This calculation assumes the quadrupole couplings for S^{33} and S^{34} (to be discussed below) are zero.

It should be pointed out that the inter-nuclear distances for the OCS molecule given by other workers[1,2] have not included the effects of zero-point vibrations, and that the actual errors for the inter-nuclear distance determinations