is the velocity of light in air, and D is the length of the light path along the axis of the tube.

In my apparatus D has a value of 89.4 cm, and a shift in the position of the interference pattern of 1/10 of a fringe can be detected. It should then be possible to detect a difference in an ether drift between the inside of the tube and the outside of 1 km/sec.

On September 1, 1934, the apparatus was set up on the top of a high hill about two miles south of Moscow, and many observations were made in all azimuths during the daylight hours of September 1, 2 and 3. No shift of the interference fringes was observed, although conditions were very favorable, and a shift of 1/10 fringe would easily have been seen.

I conclude that Professor Miller's explanation of the difference between his results and those of the other investigators is not correct.

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July 27, 1935.

[1] D. C. Miller, Rev. Mod. Phys. **5**, 203–242 (1935).
[2] R. J. Kennedy, Astrophys. J. **68**, 367 (1928); A. Piccard and E. Stabel, Comptes rendus **183**, 420 (1926); Naturwiss. **16**, 25 (1928); A. A. Michelson, F. G. Pease and F. Pearson, J. Opt. Soc. Am. **18**, 181 (1929); G. Joos, Ann. d. Physik (5) **7**, 385 (1930).

Heavy Particles from Lead

During an investigation of cosmic-ray showers with a large cloud chamber,[1] one photograph was obtained showing a dense track originating in a lead plate supported in the center of the chamber. The particle traveled a distance equivalent to a path of 10 cm in air at which point it passed out of the illuminated region. This event in conjunction with the recent ionization chamber results of Clay[2] led us to investigate the phenomenon more fully. An estimate from Clay's data indicates that if such particles exist, they should be expected in the ratio of one heavy particle to every 100 to 200 penetrating electrons. In the ordinary operation of the cloud chamber the time interval during which the chamber is sensitive is approximately a tenth of a second. A calculation, based on our knowledge of the frequency of occurrence of cosmic-ray electrons, shows that, on the average, one penetrating electron through the lead (area 280 cm^2) should be observed on a photograph taken at random. If we assume that both upper and lower surfaces of the lead are effective, we should expect one heavy track in 75 photographs. In order to increase the probability of observing these particles we adjusted the apparatus so that the sweeping field was removed about 0.3 sec. before the expansion. With this adjustment three of 38 photographs showed heavy particles. They had air equivalent ranges as follows: 9 cm ending in the illuminated space, 12.9 cm passing out of the lighted field, 12.6 cm ending in the gas. The latter is reproduced in Fig. 1. In the 38 photographs three short range heavy tracks (presumably alpha-particles) were observed leaving the lead. Thus it seems impossible to ascribe the long range particles to any ordinary radioactive contamination because of the relatively small number of shorter tracks observed. The heavy particle observed on the shower photograph was definitely not coincident in time with the cosmic-ray shower.

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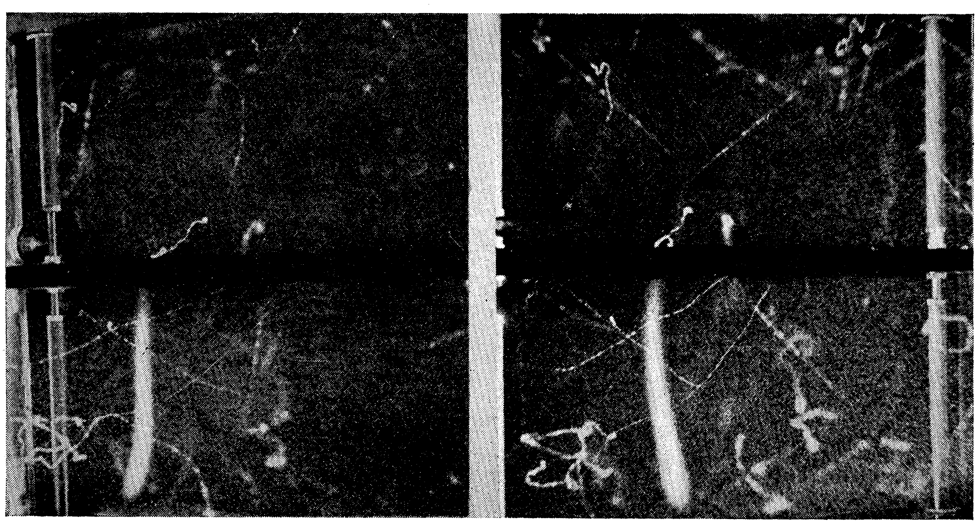
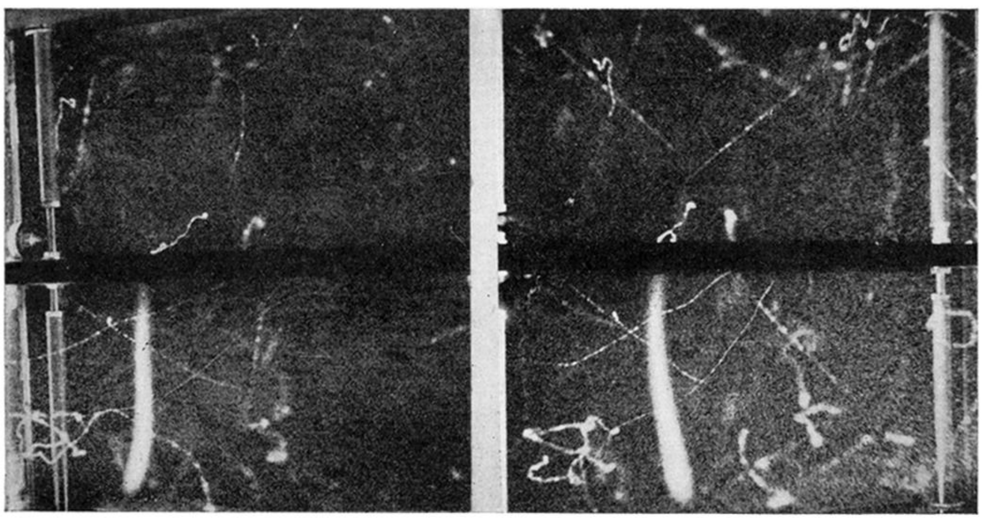
August 2, 1935.

[1] E. C. Stevenson and J. C. Street, Phys. Rev. (this issue).
[2] J. Clay, Physica **2**, 111 (1935).



A B

Fig. 1. The heavy particle emerging from the lower side of the lead plate is quite evidently old, occurring one or two tenths second before the expansion.



A B

FIG. 1. The heavy particle emerging from the lower side of the lead plate is quite evidently old, occurring one or two tenths second before the expansion.