Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Photography of Penetrating Corpuscular Radiation

SINCE Skobelzyn [1] discovered the tracks of particles of high energy on photographs taken with a Wilson cloud chamber, this method has been used by him and others in a number of investigations [2] of the nature of penetrating radiation. Such work is laborious, since these tracks occur in only a small fraction of the total number of expansions made. We have found it possible to obtain good photographs of these high energy particles by arranging that the simultaneous discharge of two Geiger-Müller counters due to the passage of one of these particles shall operate the expansion itself. On more than 75 per cent of the photographs so obtained (the fraction depending on the ratio of the number of 'true' to 'accidental' coincidences) are found the tracks of particles of high energy.

Mott Smith and Locher [3] had previously found a correlation between the occurrence of these tracks and the discharge of a tube counter, and recently Johnson, Fleicher, and Street [4] have used the coincidence of the discharges of two counters to operate the flash which illuminates a continuously working cloud chamber.

The chamber we used has a diameter of 13 cm. and has its plane vertical, with one tube counter above and one below, so that any ray which passes straight through both counters will also pass through the illuminated part of the chamber. A magnetic field is applied at right angles to the plane of the chamber. When the cloud chamber has been made ready for use, the arrival of a coincidence is awaited. After an average wait of about two minutes, a coincidence occurs and a relay mechanism starts the expansion.

The tracks have a definite breadth due to the diffusion of the ions during the time between the passage of the ray and the attainment of supersaturation. The chamber was designed so that this time

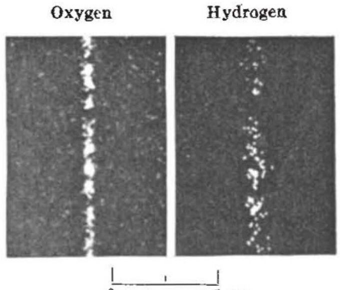

FIG. 1.

should be very small; it was in fact 0·01 sec. The observed breadth of the tracks in oxygen at 1·5 atmospheres pressure was 0·8 mm., and in hydrogen 1·8 mm. (Fig. 1). These breadths are in close agreement with the values calculated from the theoretical relation $\overline{x^2} = 2\,D\,T$, giving the mean square displacement in terms of the diffusion coefficient and the time. In spite of this breadth, the tracks in oxygen are admirably suited for accurate measurement.

The method is very economical in time in comparison with the usual method. Though the track of a fast particle may be obtained every tenth random expansion, only a few of such tracks are of use if an accurate determination of the energy of the particles is to be made. For this purpose it is desirable that a track shall lie in the plane of the chamber, for this ensures that it will be long, in perfect focus, and at right angles to the field. The fraction of random expansions which show such tracks is very small. Again, it is easier to adjust a chamber to take a few good photographs than it is to maintain the adjustment while taking many thousand.

The method has one disadvantage. The technical problem of obtaining a very large magnetic field over the whole chamber, such as has been obtained by

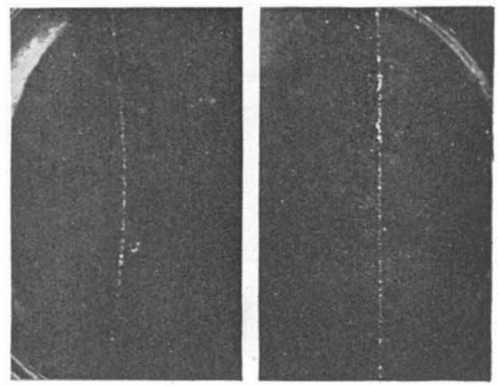

FIG. 2.—Tracks of high-speed particles. (*a*): $H\rho$ about 68,000 gauss cm., corresponding electron energy 20×10^6 volts; (*b*): $H\rho$ probably about 2×10^6 gauss cm., corresponding electron energy 600×10^6 volts.

Millikan and Anderson, is difficult, since the field must be maintained for periods of some minutes, while, when making expansions at random, it is only needed for a fraction of a second.

Among one hundred stereoscopic pairs of photographs, 59 showed the track of a single high speed particle passing through both counters (Fig. 2, *a* and *b*); 17 showed either multiple tracks of varying degrees of complexity, such as have been found by other workers, or else a single track passing through one but not both counters; 24 showed no tracks. Only about ten per cent of the tracks were markedly bent in a field of about 2000 gauss. Assuming them to be electrons, their energies lay between 2 and 20 million volts. To estimate the energy of the particles producing the main group of nearly straight tracks, the angular resolving power of the apparatus was determined by measurement of tracks obtained with no magnetic field. It was found in this way that a *mean* deviation of $\frac{1}{2}°$ could be considered as significant. Since the tracks obtained with the magnetic field of 2000 gauss showed no such deviation, it was concluded that the *mean* $H\rho$ of these particles must have been greater than 2×10^6 gauss cm. If the particles were electrons, their *mean* energy must have been greater than 600 million volts, or if protons, greater than 200 million volts.

P. M. S. BLACKETT.
G. OCCHIALINI.
The Cavendish Laboratory,
Cambridge,
Aug. 21.

[1] Skobelzyn, *Z. Phys.*, **54**, 686; 1929.
[2] Skobelzyn, *Comptes rendus*, **194**, 118; 1932. Auger and Skobelzyn, *Comptes rendus*, **189**, 55; 1929. Millikan and Anderson, *Phys. Rev.*, **40**, 325; 1932.
[3] Mott Smith and Locher, *Phys. Rev.*, **38**, 1399; 1931: **39**, 883; 1932.
[4] Johnson, Fleicher, and Street, *Phys. Rev.*, **40**, 1048; 1932.