considering the possibility that this is due to an extremely rare chance coincidence, Sinha suggests that the thin tracks may be interpreted as pairs of (oppositely charged) electrons emitted from excited nuclei at the end of their paths. He emphasizes, though, that it is difficult to understand why the electrons should be emitted in diametrically opposite directions.

If we grant that tracks 1 and 4 are due to fast-moving nuclei with Z equal to or greater than 3, tracks 2 and 3 could be due only to singly charged particles (hydrogen isotopes), if conservation of charge is assumed in the disintegration of the oxygen nucleus ($Z = 8$). However, our present knowledge of the properties of the hydrogen isotopes leaves little room for the possibility that they may have excited states of sufficiently long life to emit electron pairs at the end of their paths.

If we still assume a causal relationship between the thin tracks and tracks 2 and 3—which will remain an open question until it is decided by further experiments—we are forced to conclude that a hitherto unknown process takes place. In such a situation we have only the most generally valid principles, like conservation of charge and momentum, as a guide. The simplest hypothesis compatible with these principles which would account for Sinha's picture appears to be the following. In the collision of a neutral cosmic ray particle with an oxygen nucleus, two new particles of opposite charge are created (2 and 3), and the oxygen nucleus broken up into two parts (1 and 4). To judge from their great ionizing power, the particles 2 and 3 have each double electronic charge and a mass which is considerably larger than that of two electrons. They are therefore intrinsically unstable, but apparently have a sufficiently long life, so that they do not decay until they have lost their kinetic energy. Each then decays into a pair of electrons, both negative in one case, and both positive in the other. Conservation of momentum requires that the decay electrons are emitted in diametrically opposite directions, and with equal velocities (equal specific ionization).

Disintegrations of nuclei by cosmic rays, or 'stars', have been studied by many observers in photographic emulsions. These stars appear to consist of proton and α-particle tracks, yet different observers disagree on the relative frequency of these particles[2]. When the number of particles in the 'star' is small, this type of disintegration may be pictured as a Bohr evaporation process[3]. However, where the number of singly or doubly charged particles approaches or exceeds[4] the atomic number of the original nucleus, it would seem necessary to assume the creation of new strongly ionizing particles. Sinha's picture may give a clue to the nature of these particles, which may have an ionizing power intermediate between that of a proton and that of an α-particle (for equal range). In this case they might have been identified with protons by some observers and with α-particles by others.

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[1] Sinha, M., NATURE, **152**, 568 (1943).
[2] For a detailed bibliography on this work, see Shapiro, M. M., *Phys. Rev.*, **61**, 115 (1942).
[3] Bagge, E., *Ann. Phys.*, **39**, 512 (1941).
[4] Blau, M., NATURE, **142**, 613 (1938). Idanoff, A., NATURE, **143**, 682 (1939).

Relationship between Dielectric Constant of Liquids and Solids and Dipole Moments

IT has been found that the molar electric susceptibility of liquids,

$$P = (\varepsilon - 1) \times M/d = 4\pi N(\alpha + \mu^2/kT),$$

where ε is the dielectric constant of the pure liquid and μ the moment. The derivation of this follows if we regard the dipole as needle-shaped. This assumption is inherent in the Debye equation for gases. In solids and liquids, owing to hindered rotation, molecular orientations are distributed according to the Boltzmann function μ^2F/kT, because the dipoles can become oriented only in two directions, along and opposite to the direction of the electrical field. This relationship is found to hold good for all normal liquids from hydrogen bromide ($0\cdot8D$) to nitrobenzene ($4\cdot2D$), and for solids such as hydrogen chloride, hydrogen sulphide, hydrogen bromide and hydrogen iodide which show molecular rotation at low temperature. In the case of associated liquids and divalent salts, kT is $\frac{1}{2}$. In ionic crystals the moment calculated from the dielectric constant has to be multiplied by the co-ordination number to give the same value as obtained by the molecular beam method. The results show that the alkali halides are 2/5 ionic or 'dipolar' in the gaseous and 1/15 in the solid state.

Details of this work will be published jointly with Miss Nagamani and Mr. Sathe.

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Levine's Hypothesis of Maternal Iso-immunization

MY recent letter on "Mutation and the Rhesus Reaction"[1] has provoked two replies. In one of them[2], Prof. J. B. S. Haldane raises an objection with which I hope to deal elsewhere at length when pressure of official duties is less exacting. In the course of the other[3], Prof. R. A. Fisher, R. R. Race and Dr. G. L. Taylor say that they "dissociate ourselves from the statement that 'Levine's hypothesis postulates a form of adverse selection . . .' ". Levine's hypothesis postulates that the blood of an $Rh(-)$ mother who bears $Rh(+)$ offspring by an $Rh(+)$ father produces an antibody which plays havoc with the red cells of the fœtus. The result may be miscarriage, stillbirth or neonatal hæmolytic anæmia with possibly fatal consequences. Since such offspring are necessarily heterozygous, the hypothesis that erythroblastosis fœtalis, a condition lethal in a certain percentage of cases, is due to maternal iso-immunization also implies the existence of the adverse form of selection with which Haldane's letter mainly deals, as does the article of Wiener cited therein. Owing to present difficulties arising from dispersal of libraries for safe storage, I was not aware of the existence of Haldane's paper[4] in which he develops several conclusions which I have derived independently, though it now appears later. Otherwise I should have cited his own prior treatment of the type of adverse selection implicit in Levine's hypothesis.

The main point I was concerned to stress in the latter half of my letter may have eluded Prof. Fisher and his colleagues because it touches on a misunderstanding which, though very elementary, is also very prevalent in medical circles, with results of some public