Letters to the Editor

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Production of Positive Electrons by β-Particles

IN a previous note[1] we described some experiments carried out with a weak source of radium placed inside an expansion chamber, and showed that the ordinary β-radiation is accompanied by an emission of positrons. It is quite impossible to ascribe the origin of these positive electrons to the internal conversion of γ-rays or to any other known mechanism by which positively charged particles are created. It seemed to us to be most plausible to assume that the appearance of these positively charged particles is closely connected with the phenomenon of β-disintegration. However, more recent experiments have shown that the number of positrons depends to a large extent upon the nature of the walls surrounding the source examined.

In a series of consecutive experiments with the same source of radium, the latter was alternately enclosed in either a lead or a carbon tube with different thicknesses of wall provided with different slits for the escape of the β-rays. With a carbon tube, the number of positrons observed was two to three times greater than in the case of a lead tube. This would lead to the conclusion that the emission of positrons is due, at least in part, to the bombardment of the walls by β-rays.

We verified this assumption in the following way. The glass tube containing the active deposit, and surrounded by another tube of lead, was filled with pulverised carbon; in this case we observed a threefold increase in the yield of positive β-rays (each time compared with the yield of ordinary β-rays due to disintegration escaping through the given aperture).

Quite conclusive evidence was obtained by using a lead cylinder with walls 4 mm. thick and internal diameter 6 mm. A window 4 mm. wide in the walls was closed by a carbon filter, 3 mm. thick, for absorbing any positrons emitted by the active source, and for stopping all the ordinary β-rays of energy less than *c.* 1,000 ekv. Under these conditions, the carbon filter emits very fast positrons (12 tracks with an energy between 200 ekv. and 700 ekv.; 7 tracks with an energy between 700 ekv. and 1,200 ekv.) their number constituting 5–10 per cent of the total amount of β-rays which *penetrate* the filter.

If we assume, on the basis of the present data on the absorption of β-rays, that all the β-rays of initial energy above *c.* 1,000 ekv. are able to penetrate the filter, and that these are the only rays which are effective, the results obtained must mean that, on the average, one positron corresponds to every 10 or 20 β-particles and that the radius of the 'effective cross section' is of the order of 10^{-12} cm.

The number of β-particles which strike the filter, and are responsible for the appearance of positrons, may exceed the number of particles which emerge. However, if we take into account the geometry of the experimental arrangement as well as the intensity of the source under examination, we shall be justified in concluding that the percentage yield of positrons is scarcely less than 2 per cent, the critical energy being taken as 1,020 ekv. In this case the radius calculated for the effective cross section is not less than $0{\cdot}5$–1×10^{-12} cm. per atom, which exceeds the corresponding value for the γ-rays of thorium C″ some ten times.

Thus it is obvious that the above phenomenon has nothing in common with the mechanism considered by Furry and Carlson[2]. We here encounter an entirely new relativistic effect which is outside the scope of the present theory.

It may be added that the above results are in good agreement with previous observations made by one of us[3].

At the present moment it would be premature to decide whether the positrons are emitted by the radioactive substance itself. The observed facts seem to indicate that the output of positrons is greater for the lighter elements. Definite conclusions must be deferred until new experiments have been carried out, since the geometrical conditions up to the present could not be controlled sufficiently.

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[1] D. Skobeltzyn and E. Stepanowa, NATURE, 133, 565, April 14, 1934.
[2] W. H. Furry and Y. T. Carlson, *Phys. Rev.*, 44, 237; 1933.
[3] D. Skobeltzyn, NATURE, 133, 23, Jan. 6, 1934.

Isomorphism and Chemical Constitution: Constitution of Formic Acid and Formates

THAT formic acid differs from its higher homologues (acetic, propionic, etc.) in many salient chemical characters is well known to chemists. The break in the serial order as regards the absorption curves of the saturated monobasic fatty-acids has been observed in the case of formic acid by V. Henri, Hantzsch and Wright.

The reducing character of formic acid, generally explained by the presence of an aldehydic group in the molecule, as distinguished from acetic acid and its homologues, the absence of a chloride and anhydride corresponding to acetyl chloride and acetic anhydride, the acid character of its nitride (HCN) differing from the indifferent nitrides of homologous acids, the strength of the acid twelve times stronger than acetic and propionic acids as shown by the affinity constants derived from electrical conductivity (Ostwald), have rightly induced Richter to differentiate it from acetic acid and its homologues. Dr. P. B. Sarkar, working in the inorganic department of my laboratory, has, in continuation of his work on chemical homology and isomorphism[1,2], recently arrived at the conclusion that these discrepancies are to be sought for in the difference in the constitution of the acid itself. In other words, in the case of formic acid, the ionisable hydrogen is not the hydrogen atom of the hydroxyl group, as in the case of other fatty acids, but the hydrogen attached to the carbon atom.

The classical synthesis of formates from CO and KOH is explained by Dr. Sarkar on the modern electronic conception in the following way: