Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 518.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Radioactivity produced in Scandium by Fast Neutrons

ON irradiating scandium (^{45}Sc) with fast neutrons of energy $\leqslant 20 \times 10^6$ e.v., Pool, Cork and Thornton[1] observed two positron-emitting radioactive isotopes of scandium of half-lives 52 hours ('strong intensity') and 4 hours ('very strong intensity') respectively. With neutrons of $< 10 \times 10^6$ e.v., neither period could be observed. Previously Walke[2] had given the following assignment of radioactive isotopes of scandium: ^{44}Sc (52 hours), ^{43}Sc ($4 \cdot 0 \pm 0 \cdot 1$ hours), ^{42}Sc ($4 \cdot 1 \pm 0 \cdot 1$ hours). These he attributed to the reactions: ^{39}K$(\alpha,n)^{42}$Sc, ^{41}K$(\alpha,n)^{44}$Sc, ^{40}Ca$(\alpha,p)^{43}$Sc, ^{42}Ca$(d,n)^{43}$Sc and ^{43}Ca$(d,n)^{44}$Sc. Pool, Cork and Thornton suggested that the two periods which they observed were due to the formation of ^{44}Sc and ^{43}Sc resulting from the reactions

$$^{45}\text{Sc} + n = {}^{44}\text{Sc} + 2n - Q_1 \quad (1)$$

and

$$^{45}\text{Sc} + n = {}^{43}\text{Sc} + 3n - Q_2 \quad (2)$$

From the mass defect curve one can expect for the threshold energies the values $Q_1 = (10 \pm 2) \times 10^6$ e.v. and $Q_2 = (18 \pm 2) \times 10^6$ e.v. Energetically, therefore, both reactions might be possible, but the following discussion shows that it is difficult to understand why reaction (2) should take place more frequently than reaction (1).

Consider ^{45}Sc to be bombarded by homogeneous neutrons of energy E and denote by $P_1(E)$ and $P_2(E)$ the probabilities of reactions (1) and (2). P_2 will be zero for $E \leqslant Q_2$, and for $E > Q_2$ the 'evaporation' model indicates that it will increase rapidly with increasing E. It is not until $E - Q_2$ reaches values of the order of a few million electron volts that P_2 and P_1 will be of the same order. Furthermore, with a neutron source of the type used (a thick lithium target bombarded by deuterons of 6×10^6 e.v.), the neutrons of energy $E > Q_2$ will be very small in number compared with those of energy $E > Q_1$. Thus, the number of radioactive nuclei formed according to reaction (2) will be very small compared with the number formed according to (1).

We are therefore led to suspect that the two periods observed must be ascribed to ^{44}Sc and that this nucleus exists in two isomeric forms of half-lives 52 hours and $4 \cdot 1$ hours respectively. This would be consistent with the fact that both periods are obtained by bombarding potassium with α-particles, though previously[2] the $4 \cdot 1$-hr. period has been ascribed to ^{42}Sc. The 4-hr. period observed when calcium is bombarded with deuterons may be partly due to ^{44}Sc and partly to ^{43}Sc.

To test the hypothesis of isomerism we have bombarded scandium with neutrons of maximum energy 14×10^6 e.v. (obtained by bombarding lithium with 950 kv. deuterons) for which reaction (1) only, and not reaction (2), should be energetically possible. We have observed both the 52-hr. and 4-hr. periods with similar initial intensities (corrected for bombarding time). The particles emitted were found to be positrons. The isomerism of ^{44}Sc seems therefore established and the assignment of the radioactive isotopes of scandium should be as follows: ^{44}Sc (52-hr. and 4-hr.), ^{43}Sc (4-hr.). As to the radioactivity of ^{42}Sc, no evidence exists at present.

Gentner[3] has recently observed a 4-hr. period produced in scandium by γ-rays of 17×10^6 e.v. This he ascribes to ^{43}Sc formed in a $(\gamma, 2n)$ reaction. According to our results it appears that this activity should be attributed to ^{44}Sc formed in a (γ, n) reaction.

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[1] Pool, Cork and Thornton, *Phys. Rev.*, **52**, 41 (1937).
[2] Walke, *Phys. Rev.*, **51**, 439 (1937); **52**, 669 (1937).
[3] *Naturwiss.*, **26**, 109 (1938).

Deviations of Short Radio-Waves from the London–New York Great Circle Path

THE propagation of short radio-waves from England to New York has been found to involve many anomalous effects. Studies have been made of transmissions from Rugby, directed toward New York, and of broadcasts from Daventry using various transmitting arrays. Three multiple unit steerable antennæ (musas) located at the Holmdel, N.J. experimental receiving station of the Bell Telephone Laboratories have been used. One of these is the end-on musa described in a recent paper[1]. The other two are broadside musas steerable horizontally to permit explorations in azimuth. The British Broadcasting Corporation has kindly provided details of the transmitting antennæ in use during the various transmissions. These B.B.C. antennæ, together with the British Post Office transmitting antennæ in use on the London–New York radio telephone circuits, have provided simultaneous comparisons, which are, to a limited degree, representative of the effects of steerable transmitting directivity. Employment of the above facilities during the past eight months has disclosed the following characteristics:

(1) During 'all-daylight' path conditions, the usual multiplicity of waves distributed in or near the great circle plane, which constitutes normal propagation, has invariably been predominant. Neither ionosphere storms nor the catastrophic disturbances associated with short-period fade-outs seem to affect the mode of propagation.

(2) In contrast to (1), during periods of dark or partially illuminated path conditions, the great circle