Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 872.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Induced Radioactivity of Short Period

CRANE, Delsasso, Fowler and Lauritsen[1] have reported the existence of radioactive bodies of periods less than a second formed by bombarding lithium or boron with deuterons. They assume the active isotopes to be ^{8}Li and ^{12}B. It might be possible to produce these and perhaps other radioactive nuclei of short period by neutron bombardment, and it was thought desirable to investigate this question by means of a suitable arrangement.

The experiments were performed with an apparatus very similar to that used by Frisch in a search for similar effects produced by α-particles[2]. The neutron source (beryllium–radon) is placed 75 cm. from a thin-walled Geiger counter which is shielded from the direct beam by a 70 cm. bar of lead and from scattered radiation by surrounding with 8–10 cm. of lead. The semi-cylindrical samples of the elements to be examined are held by an arm, and can be swung from a position around the neutron source to a position around one side of the counter in 0·3 sec., the arm passing through a suitable slit in the lead shield. The movement is controlled by a pendulum the period of which can be changed from 1 sec. to 2–4 sec. Such an arrangement is suitable for the examination of induced radioactivity of period greater than 0·3 sec. With a neutron source of initial strength 350 millicuries, the following results were obtained :

Beryllium. Strong activity of half-value period $0{\cdot}9 \pm 0{\cdot}2$ sec. (determined by means of about three hundred oscillograph records of the decay). The effect is reduced to half when the β-rays pass through 0·4 gm./cm.^{2} aluminium, indicating that their maximum energy is of the order of $6\text{–}8 \times 10^6$ e.v. The yield is of the same order as the yield from calcium fluoride bombarded with neutrons when the samples have equal thickness in gm./cm.^{2}; for example, the rate of counting during the counting period was about 400 per minute with a source of 130 millicuries, the γ-ray effect being 40 per minute. Surrounding the source with paraffin wax does not increase the effect.

The process leading to the active nucleus might be capture of the neutron by the ^{9}Be nucleus with the emission of a γ-quantum, two neutrons, a proton, a deuteron or an α-particle, the active nucleus being ^{10}Be, ^{8}Be, ^{9}Li, ^{8}Li or ^{6}He, respectively. ^{10}Be can probably be excluded on account of reliable knowledge of the masses of ^{10}Be and ^{10}B, which are very nearly equal[3]. ^{8}Li is excluded if the active body found by Crane *et al.*[1] is ^{8}Li, for they found a β-ray spectrum with an upper limit of 10×10^6 e.v., which means that the neutrons bombarding ^{9}Be would have to have an energy of some 13×10^6 e.v., assuming the masses given by Oliphant[3]; the beryllium–radon source does not yield such fast neutrons in quantities sufficient to explain the large effect found. It is difficult to decide between the other possibilities so long as the β-ray spectrum of the active body is not known. Experiments with an expansion chamber are intended. But it can be said that if the maximum energy is greater than $5{\cdot}5 \times 10^6$ e.v., the active body can scarcely be ^{6}He, as its mass would then be greater than that of ^{4}He plus two neutrons.

Other elements. The following elements have been examined, but no new activities have so far been found : Li, B, C, N, O, F, Na, Al, Cl, Fe, Ni, Cu, Zn, Se, Ag, Cd, Sn, Pb. Knol and Veldkamp have reported a weak activity induced in lithium by slow neutrons[4], but their experimental conditions (rotating wheel, counting lasting many hours) are difficult to compare with those of the present work.

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[1] Crane, Delsasso, Fowler and Lauritsen, *Phys. Rev.*, **47**, 887 and 971 (1935).

[2] O. R. Frisch, NATURE, **133**, 721 (1934).

[3] Oliphant, NATURE, **137**, 396 (1936).

[4] Knol and Veldkamp, *Physica*, **3**, 145 (1936).

Collision Forces between Light Nuclei

IN the interpretation of experiments on anomalous scattering in terms of a field departing from the inverse square law at the closer distances, it has been usual to use, in the absence of evidence to the contrary, only forces of short range corresponding to e^2/mc^2. We are of the opinion that, if the current method of explanation is to be retained, forces of longer range must also be admitted. We have measured the angular distribution of scattering of the slower α-particles in hydrogen, deuterium and helium under similar conditions. Our calculations indicate that for all three gases the forces would have to act at distances greater than 10×10^{-13} cm., although they need not be large until smaller separations are reached. The reason is, briefly, that in all cases the higher 'phase-constants' are important, so that even those particles which approach less closely can penetrate the anomalous region. We are grateful to Dr. J. A. Wheeler for informing us that he had also reached this result, independently, for helium.

It is perhaps worth noting that even in the collision of two elementary particles such as proton on proton, long-range forces may also be of importance. White[1], in discussing his experiments on the scattering of fast protons in hydrogen, is able to reach only a partial explanation with short-range forces of attraction. We have made approximate calculations using the field described by Infeld[2], and find that this gives a large enough negative phase-constant K_0 to account for the two main features, the large anomaly