Letters to the Editor

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Artificial Disintegration by Neutrons

FOLLOWING up the experiments already reported,[1] I have recently taken 1490 pairs of photographs of the tracks produced in an expansion chamber filled with oxygen (97 per cent by volume) when a source of polonium and beryllium was placed in the centre. The conditions of experiment and the source itself were the same as in the previous work, the initial pressure of the gas being roughly atmospheric.

About sixty recoil tracks were obtained and, in addition, seven or eight examples of paired tracks, providing certain evidence of disintegration. These numbers may be compared with about a hundred recoil tracks and thirty disintegration pairs recorded in the nitrogen photographs (1740 in number). It appears, therefore, that the disintegration probability for neutron-oxygen nucleus encounters, though doubtless somewhat smaller, is yet of the same order of magnitude as that which characterises similar encounters with nitrogen nuclei. This is in itself an interesting result, for hitherto no certain evidence has been obtained for the artificial disintegration of oxygen —either by α-particles or protons.[2]

The disintegration photographs have been examined and measured by the stereo-reprojection method previously employed. It appears likely that in all cases so far observed, disintegration has occurred with capture of the incident neutron. If that be accepted, then the disintegration particle is almost certainly an α-particle. The nuclear reaction may be written

$$O^{16} + n^1 \longrightarrow C^{13} + He^4.$$

(From momentum relations alone it is practically impossible to distinguish this process from that in which the resulting nuclei are C^{12} and He^5, but for the present this latter possibility may be passed over.) In the accompanying table, E, the kinetic energy of the responsible neutron, and W, the energy absorbed in the disintegration process, are given as deduced for the eight cases observed. The energy unit employed is 10^6 electron volts.

No.	1	2	3	4	5	6	7	8
E	7·0	7·0	6·2	7·6	4·2	5–7	4–7	2·2
W	2·2	4·3	3·5	5·2	1·7	1·0	2·5	1·2

Numbers 1 to 4 may be regarded as satisfactory, with a probable error of $0{\cdot}5$–$0{\cdot}7 \times 10^6$ e.v., numbers 5 to 7 carry somewhat less weight, and number 8 is rather doubtful.

The results as a whole, however, show that the capture disintegration in question takes place with the absorption of energy, the amount absorbed being different on different occasions. This probably means that in some cases the nucleus C^{13} is left temporarily in an excited state, afterwards emitting a quantum of γ-radiation in its return to the normal. Now, this nucleus is also produced in the artificial disintegration of boron by α-particles, and the existence of proton groups having an energy separation of 3×10^6 e.v. and of the accompanying γ-rays are established facts.[3] Some such energy difference as this is consistent with the values of W given above.

The neutron energies given in the table are in general somewhat greater than those deduced in most of the cases of capture disintegration in nitrogen. The energies deduced from recoil track measurements, on the other hand, were in complete accord with the nitrogen results. It is possible that the smaller disintegration yield in oxygen is the necessary consequence of the greater mean energy required for disintegration; moreover, the present results confirm the suggestion that a small fraction of the radiation from beryllium is of higher energy than was previously believed to be the case. This suggestion was first made by Curie, Joliot, and Savel from other considerations.[4] We may conclude, in fact, that the upper limit of energy of $6{\cdot}4 \times 10^6$ e.v. previously obtained is appreciably too low.

The experiments here described are being continued with oxygen at greater dilution, in the hope of increasing the accuracy of measurement and further investigating the disintegration phenomena which occur.

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Cavendish Laboratory,
Cambridge, July 28.

[1] *Proc. Roy. Soc.*, June 1932.
[2] Cockcroft and Walton, *Proc. Roy. Soc.*, A, **137**, 229; 1932.
[3] Chadwick, Constable, and Pollard, *Proc. Roy. Soc.*, A, **130**, 463; 1931. Becker and Bothe, *Z. Phys.*, **76**, 421; 1932.
[4] *C.R.*, **194**, 2208; 1932.

The Oldoway Human Skeleton

DR. L. S. B. LEAKEY'S claim that the Oldoway man of *Homo sapiens* type was buried in Bed 2 of his succession, before the formation of the overlying Beds 3 and 5, rests on his statement that no material from Beds 3 and 5 was found in intimate association with the skeleton in the burial, although such material is found lying on the present surface-slopes of the gorge at and near the site.[1]

On discussing the matter with Prof. D. M. S. Watson and Mr. A. T. Hopwood, I came to the conclusion that more thorough investigation of this critical evidence was desirable, especially as subsequent alteration of rock-material in the neighbourhood of the skeleton might have rendered it less easily recognisable than in its unaltered condition. I therefore suggested that the deposits of Beds 2, 3, 4, and 5, as well as the material found within the ribs of the skeleton, should be carefully re-examined. Mr. Hopwood kindly supplied typical samples of Beds 2, 3, 4, and 5 collected by him at Oldoway. The petrological investigation of the deposits was undertaken at the Imperial College by Dr. J. D. Solomon, who had formerly worked with Dr. Leakey in East Africa and was familiar with the occurrence of similar beds in the field. Dr. Solomon found that each of the deposits possessed distinctive lithological and mineralogical characters. The way now being clear for a useful examination of the grave-contents, Prof. Reck, at Mr. Hopwood's request, persuaded Prof. Th. Mollison of Munich to send us a sample of material which, he assures us, was part "of the material in which the Oldoway skeleton had been embedded". Dr. Solomon, Mr. Hopwood, and I together examined this material. It contains (*a*) pea-sized bright-red pebbles like those of Bed 3, and (*b*) chips of concretionary limestone indistinguishable from that of Bed 5 and enclosing at least one mineral (an amphibole), in relative abundance, not found in Beds 2 and 3, but present in Bed 4.

Assuming, therefore, that the provenance of the materials supplied to us is as stated (and we have no reason to doubt it), the Oldoway interment is not contemporaneous with Bed 2 containing Chellean-