Letters to the Editor

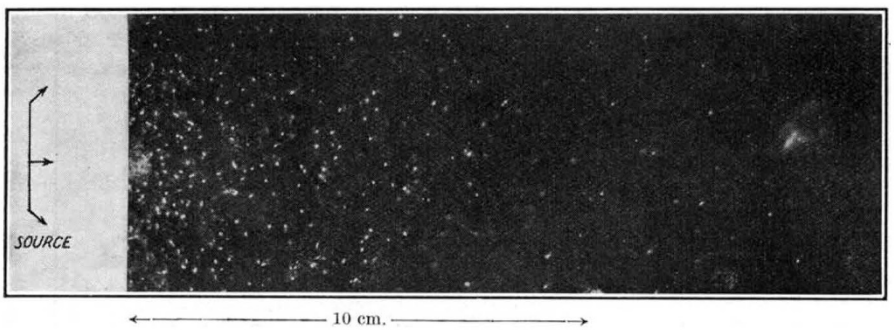
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 207.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nuclear Transformation by *K*-Electron Capture

THE theoretical expectation that a nucleus which emits positive electrons may, as an alternative mode of transformation, change by capturing a *K*-electron, was recently demonstrated experimentally by Alvarez[1], who was able to detect by means of a counter arrangement the fluorescent X-radiation which follows *K*-capture. Earlier experiments by Jacobsen[2], using an active isotope of scandium in an expansion chamber, had not shown any evidence of such fluorescent radiation. Alvarez's observations were made on titanium which had been bombarded by fast deuterons. Walke[3] had previously shown that one of the products of the bombardment is an isotope of vanadium, of mass number 48 and half-life 16 days, which emits positrons and thus transforms to ^{48}Ti. Alvarez concluded from his experiments that ^{48}V also transforms to ^{48}Ti by the capture of a *K*-electron, the two modes of transformation being about equally probable.



We have recently been able, through the kindness of Mr. Walke, to examine, in the expansion chamber, the activity of a specimen of titanium which had been bombarded by fast deuterons about five months ago. (This source was activated in the Radiation Laboratory, Berkeley, and was a gift to Mr. Walke from Prof. E. O. Lawrence.) The photographs obtained showed a number of tracks due to negative electrons, but very few due to positive electrons. When a magnetic field was applied to bend away these electrons, a large number of very short tracks was observed. These tracks show that a soft X-radiation is emitted from the titanium specimen, indicating, in a striking way, a *K*-capture transformation. The energy of the photo-electrons produced by the *K*-radiation of titanium (or of a neighbouring element) is only about 4,000 volts, so that their tracks appear as spots in the photographs. In the photograph reproduced here there are about 300 of these short tracks.

The photographs show the decrease in intensity of the radiation due to absorption in the gas of the chamber. This gas was oxygen at a pressure of 66 cm., which for titanium *K*-radiation has a linear absorption coefficient of about 0·07 cm.$^{-1}$. Preliminary counts of the spots in photographs taken with a collimated source, to avoid errors due to the limited depth of focus, gave an absorption roughly in accordance with this, indicating, actually, a parent atom of atomic number 21 ± 1 (Ti = 22). Further experiments will enable us to decide definitely the atomic number of the element responsible for the radiation.

The noteworthy feature of this example of *K*-capture is its large probability compared with that of the alternative process of positron emission. Indeed, unless positrons of very low energy are emitted, this ratio is of the order of 1000 : 1. Even this estimate assumes that the few positrons observed represent the same nuclear transformation. This may well not be the case, and it is not unlikely that the transformation by positron emission is energetically impossible (its threshold being about 2 mc^2 higher than that for *K*-capture).

In Alvarez's experiments on newly activated titanium, the number of *K*-captures was approximately equal to the number of positrons from ^{48}Ti. The latter decays with a period of 16 days and would thus have now about 1/1000 of its initial activity. The fact that we find about 1 positron for every 1000 *K*-captures is not inconsistent with Alvarez's results if we assume that the positrons are due to ^{48}Ti and the *K*-capture to a nucleus with a very long period. We should also mention that the recoil electrons produced by the γ-rays from the present source bear a much smaller ratio to the fluorescent quanta than in Alvarez's experiments, indicating that the bulk of the initial γ-ray activity is not associated with the *K*-capture process. Further observations will be made to elucidate the origin of the various radiations emitted by the source.

E. J. WILLIAMS.
E. PICKUP.

George Holt Physics Laboratory,
University, Liverpool.
Dec. 22.

[1] Alvarez, L. W., *Phys. Rev.*, **52**, 134 (1937).
[2] Jacobsen, J. C., NATURE, **139**, 879 (1937).
[3] Walke, H., *Phys. Rev.*, **51**, 1011 (1937).