Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 956.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Chemical Detection of Artificial Transmutation of Elements

IT has been our aim for years to prove the result of transmutation experiments by chemical analysis, and in a brief report[1] we have described our failure to find chemical evidence for the production of hydrogen or neon by bombardment with α-rays. In the meantime, many new ways of artificial transmutation have been found, and the discovery of artificial radio-elements has enabled Curie and Joliot[2] to use the methods of radio-chemistry, that is, the combination of radioactive measurement with chemical operations, for the investigation of the chemical character of products of artificial transmutation. This line of work has been extended by Fermi and his collaborators and by many others. The quantity of newly formed matter has in general been much too small for any attempt at a purely chemical detection; the claim[3] of having separated and spectroscopically observed helium of atomic weight 3, made from heavy hydrogen, has been disproved by later work[4].

At present, for various experimental reasons, the best choice for the chemical detection of an artificially-produced element seemed to be helium originating from boron according to the reaction[5]

$$_5B^{10} + {}_0n^1 = {}_3Li^7 + {}_2He^4.$$

In a closed copper vessel we bombarded the methyl ester of boron with neutrons. These were produced near the centre of the spherical vessel by the decay of radon, mixed with beryllium, and were slowed down by the hydrogen atoms of the ester and of the water surrounding the metal flask. In a first experiment, by the decay of 450 mC. of radon, sufficient helium was produced for a spectroscopic observation. During a second experiment, lasting seven weeks, we procured enough radon to allow 2,200 mC. of it to decay in our apparatus. This time we were able not only to observe spectroscopically the helium produced but also to measure it; we found, to an accuracy of about 20 per cent, $1{\cdot}3 \times 10^{-7}$ c.c. helium. A blank test run afterwards for nine weeks under exactly the same conditions, but without radon-beryllium tubes, showed not the slightest sign of helium production.

The copper vessel was a sphere of only 7·5 cm. radius; it is unlikely that more than half of the neutrons formed in the beryllium tubes were caught by the boron inside the vessel. A new experiment, making use of a larger flask, is in progress; but it can already be concluded from our preliminary figures (as one helium atom, according to the above equation, needs for its production one neutron) that a millicurie of radon, mixed with beryllium, produces more than 3,000 neutrons a second[6].

In this experiment—for the first time, so far as we are aware—an artificially produced element has been separated, spectroscopically observed, and measured. We presume that the old alchemistical goal can be achieved to-day in other cases also.

We wish to express our sincere thanks to Prof. F. L. Hopwood, director of the Radium Department, St. Bartholomew's Hospital, London, to Prof. S. Russ, director of the Radium Department, Middlesex Hospital, London, and to Prof. Stefan Meyer, director of the Institute for Radium Research in Vienna, for kindly supplying the radon-beryllium tubes; and also to Dr. E. Glückauf for assistance in the experiments.

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[1] F. A. Paneth and P. L. Günther, NATURE, **131**, 652; 1933. See also *Z. phys. Chem.*, *A*, **173**, 401; 1935.
[2] I. Curie and F. Joliot, *C.R.*, **198**, 559; 1934.
[3] G. P. Harnwell, H. D. Smyth and W. D. Urry, *Phys. Rev.*, **46**, 437; 1934.
[4] H. D. Smyth, G. P. Bleakney and W. W. Lozier, *Phys. Rev.*, **47**, 800; 1935. F. A. Paneth and G. P. Thomson, NATURE, **136**, 334; 1935.
[5] J. Chadwick and M. Goldhaber, NATURE, **135**, 65; 1935. *Proc. Cam. Phil. Soc.*, **31**, 612; 1935. H. J. Taylor and M. Goldhaber, NATURE, **135**, 341; 1935. E. Amaldi, O. D'Agostino, E. Fermi, B. Pontecorvo, F. Rasetti and E. Segrè, *Proc. Roy. Soc.*, A, **149**, 522; 1935.
[6] The ordinarily assumed yield of neutrons under these conditions is 1,000 neutrons per sec. (See, for example, E. Fermi and collaborators, *Proc. Roy. Soc.*, A, **146**, 483; 1934.) According to R. Jaeckel's observations (*Z. Phys.*, **91**, 493; 1934) the value 10,000 neutrons per sec. is more likely.

Absorption of Residual Neutrons

AMALDI, D'Agostino, Fermi, Pontecorvo, Rasetti and Segrè have discovered that certain elements strongly absorb neutrons which have been slowed down by paraffin wax[1]. They report, for example, that thin sheets of cadmium or indium of 0·013 gm./cm.² and 0·3 gm./cm.² thickness respectively cut down the intensity of a beam of slow neutrons to half its value and find for iodine a half-value thickness of 4 gm./cm.².

Thick sheets of a strongly absorbing element, such as cadmium, will, however, still transmit an appreciable fraction of the incident heterogeneous beam, and in these circumstances it appeared to be of interest to investigate the absorption of such residual neutrons in some elements.

In one set of experiments, I filtered slow neutrons by a sheet of cadmium, 1·6 mm. (1·4 gm./cm.²) thick, and determined the absorption of the residual neutrons in several elements, using radioactivity induced in indium (54 min. period) as an indicator of the neutron intensity. The residual neutrons from the thick cadmium filter are scarcely absorbed by cadmium itself—a 0·5 mm. thick cadmium absorber will absorb perhaps less than 10 per cent of the residual neutrons. Yet I find that these residual neutrons are strongly absorbed by some elements—for example, a thin indium absorber of less than