Editorial

It is appropriate in the thirtieth anniversary year of the artificial production of radioisotopes to reproduce the original report that appears below. It would be presumptious to attempt further comment on this monumental discovery on which The Society of Nuclear Medicine is based—except as an editor to point out that it contains only 603 words! *G.E.T.*

ARTIFICIAL PRODUCTION OF A NEW KIND OF RADIO-ELEMENT

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Some months ago we discovered that certain light elements emit positrons under the action of alpha-particles (1). Our latest experiments have shown a very striking fact: when an aluminium foil is irradiated on a polonium preparation, the emission of positrons does not cease immediately, when the active preparation is removed. The foil remains radioactive and the emission of radiation decays exponentially as for an ordinary radio-element. We observed the same phenomenon with boron and magnesium (2). The half-life period of the activity is 14 min. for boron, 2 min. 30 sec. for magnesium, 3 min. 15 sec. for aluminum.

We have observed no similar effect with hydrogen, lithium, beryllium, carbon, nitrogen, oxygen, fluorine, sodium, silicon, or phosphorus. Perhaps in some cases the life period is too short for easy observation.

The transmutation of beryllium, magnesium, and aluminum alpha-particles has given birth to new radio-elements emitting positrons. These radio-elements may be regarded as a known nucleus formed in a particular state of excitation; but it is much more probable that they are unknown isotopes which are always unstable.

For example, we propose for boron the following nuclear reaction:

$$_5B^{10} + {}_2He^4 = {}_7N^{13} + {}_0n^1$$

$_7N^{13}$ being the radioactive nucleus that disintegrates with emission of positrons, giving a stable nucleus $_6C^{13}$. In the case of aluminium and magnesium, the radioactive nuclei would be $_{15}P^{30}$ and $_{14}Si^{27}$ respectively.

The positrons of aluminium seem to form a continuous spectrum similar to the beta-ray spectrum. The maximum energy is about 3×10^6 e.v. As in the case of the continuous spectrum of beta-rays, it will be perhaps necessary to admit the simultaneous emission of a neutrino (or of an antineutrino of Louis de Broglie) in order to satisfy the principle of the conservation of energy and of the conservation of the spin in the transmutation.

The transmutations that give birth to the new radio-elements are produced in the proportion of 10^{-7} or 10^{-6} of the number of alpha-particles, as for other transmutations. With a strong polonium preparation of 100 millicuries, one gets only about 100,000 atoms of the radioactive elements. Yet it is possible to determine their chemical properties, detecting their radiation with a counter or an ionisation chamber. Of course, the chemical reactions must be completed in a few minutes, before the activity has disappeared.

We have irradiated the compound boron nitride (BN). By heating boron nitride with caustic soda, gaseous ammonia is produced. The activity separates from the boron and is carried away with the ammonia. This agrees very well with the hypothesis that the radioactive nucleus is in this case an isotope of nitrogen.

When irradiated aluminium is dissolved in hydrochloric acid, the activity is carried away with the hydrogen in the gaseous state, and can be collected in a tube. The chemical reaction must be the formation of phosphine (PH_3) or silicon hydride (SiH_4). The precipitation of the activity with zirconium phosphate in acid solution seems to indicate that the radio-element is an isotope of phosphorus.

These experiments give the first chemical proof of artificial transmutation, and also the proof of the capture of the alpha-particle in these reactions (3).

We propose for the new radio-elements formed by transmutation of boron, magnesium and aluminium, the names *radionitrogen, radiosilicon, radiophosphorus.*

These elements and similar ones may possibly be formed by the capture of a deutron in $_6C^{12}$, followed by the emission of a neutron.

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1. IRENE CURIE AND F. JOLIOT: *J. Phys. et. Rad.* **4**, 494; 1933.
2. IRENE CURIE AND F. JOLIOT: *C.R.* **198**, 1934.
3. IRENE CURIE AND F. JOLIOT, *C.R.*, meeting of Feb. 29, 1934.