Letters to the Editor

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Communications should not in general exceed 600 words in length.

Relative Abundances of the Oxygen Isotopes

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January 18, 1941

ASTON[1] gave the abundance ratios $O^{16}/O^{18}=536$ and $O^{18}/O^{17}=4.2$. Mecke and Childs[2] give for atmospheric oxygen $O^{16}:O^{18}:O^{17}=630\pm20:1:0.2$. Smythe[3] has measured $O^{16}/O^{18}=503\pm10$. A little later Bleakney and Hipple[4] reported values for this ratio clustering around 500 in over a hundred analyzed samples, but gave no estimate of error.

A new determination of the O^{18}/O^{17} ratio has been made, with the 60° mass spectrometer of Nier[5] to separate the singly ionized molecular oxygen ions of masses 32, 33 and 34. Though the present work is to fix more closely the O^{18}/O^{17} ratio which has generally been taken as 5, a check was also made on the value of O^{16}/O^{18}. Commercial oxygen from two different tanks was analyzed several times, ten readings being taken for each analysis. Air samples also were analyzed. As a test for discrimination in the mass spectrometer, runs were made under a wide variety of conditions and at different times. At no time did the O^{16}/O^{18} ratio as computed from the relative heights of the mass 32 and 34 peaks differ by more than 3 percent from 500.

It thus appears that the apparatus does not discriminate appreciably, and that the samples analyzed are representative of the samples analyzed by Smythe and Bleakney and Hipple. In each of ten separate measurements of the O^{18}/O^{17} ratio, a complete mass spectrum of the 33 peak and its adjacent valleys has been taken in order to obtain an accurate determination of the background. From the ratio of the deflections corrected for background, the average value of O^{18}/O^{17} is 4.9 ± 0.2.

From the values $O^{16}/O^{18}=500\pm15$ and $O^{18}/O^{17}=4.9\pm0.2$, one is able to calculate the physical-to-chemical mass scale conversion factor to be 1.000275 ± 0.000009. By far the larger part of this uncertainty is due to the possible error in the ratio O^{16}/O^{18}.

My thanks are due to Dr. A. O. Nier for his suggestion of the problem and for aid in working it out.

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[2] R. Mecke and W. H. J. Childs, Zeits. f. Physik **68**, 362 (1931).
[3] W. R. Smythe, Phys. Rev. **45**, 299 (1934).
[4] W. Bleakney and J. A. Hipple, Phys. Rev. **47**, 800 (1935).
[5] A. O. Nier, Rev. Sci. Inst. **11**, 212 (1940).

Radioactive Isotopes of Germanium

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January 13, 1941

WE have studied the radioactive isotopes of germanium produced by deuteron and neutron bombardment of germanium, fast neutron bombardment of arsenic and selenium, and deuteron bombardment of gallium. We were able to make isotopic assignments for four germanium periods and to establish the existence of a pair of isomers in Ge^{71}.

Ge^{71}: 40±2 hours and 11 days.—Sagane[1] has reported a 26-hour and a 6-day period from both slow and fast neutron bombardment of germanium; without chemical separation he assigned the positron active 26-hour activity to Ge^{71} and suggested that the 6-day period may be due to a gallium isotope. In an alpha-particle bombardment of zinc, Mann[2] obtained chemically identified germanium isotopes with half-lives of 37 hours and 195 days and an intermediate period whose half-life, although not given by Mann, turns out, from his curves, to be 11 days. These three periods have to be distributed between Ge^{67}, Ge^{69}, and Ge^{71}.

Bombarding gallium with 8-Mev deuterons we found in the germanium fraction a 40±2-hour positron-emitter and an 11-day activity. These are almost certainly due to Ge^{69} or Ge^{71}, produced by the d, $2n$ reaction from the only stable gallium isotopes, Ga^{69} and Ga^{71} (d, n reactions would lead to stable germanium isotopes). But since the bombardment of germanium with 16-Mev deuterons also produced a 40±2-hour and an 11-day germanium period, both periods must be assigned to Ge^{71}, formed by the d, p reaction from Ge^{70}. Absorption measurements show that the positrons of the 40-hour activity have an energy of 1.2 Mev, which agrees with Sagane's 1.15 Mev for his 26-hour period.[3] The 11-day activity emits particles of about 0.6-Mev energy, and no gamma-rays. The absence of annihilation radiation indicates that very few, if any, positrons are emitted; the particles may be conversion electrons following K-electron capture.

Ge^{75}: 89±2 minutes.—In slow neutron bombardments of germanium Amaldi *et al.*[4] obtained a 30-minute period, while Sugden[5] reported a 2-hour activity. Pool, Cork, and Thornton[6] found a 1.3-hour activity in fast neutron bombardment of germanium. Sagane[1] found a negative beta-emitter of 81 minutes half-life in slow and fast neutron and in deuteron bombardments of germanium and assigned it to Ge^{75}. No chemical analyses were reported in any of the experiments quoted. We found that 16-Mev deuteron bombardment of germanium produced a 90-minute period in the germanium fraction. To fix the assignment we bombarded arsenic with fast neutrons. The germanium fraction decayed with a period of 89±2 minutes over about 10 half-lives. This activity must be formed from the only stable arsenic isotope, As^{75}, by the n, p reaction, and must therefore be due to Ge^{75}. We also found the same period (about 90 minutes) in the germanium fractions of fast neutron bombardments of germanium and selenium, where Ge^{75} can be formed by the reactions $Ge^{76}(n, 2n)Ge^{75}$