Letters to the Editor

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Considerations on the Existence of Element 61 in Nature

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IN the light of the present controversy[1] over the possibility of existence in nature and the naming of element 61, some calculations on the stability toward beta-decay of isotopes of that element have been made by use of the Bohr-Wheeler theory.[2] This theory gives beta-disintegration energies that agree fairly well in most cases with those obtained by direct observation.

The radioactive isotopes of element 61 which have been definitely assigned have the mass numbers 147, 148, 149.[3-5] They are all beta-radioactive with half-lives so short as to preclude their independent existence in nature, the longest-lived one being at mass 147 and having a half-life of only about four years. Other isotopes which warrant consideration in an examination for possible stable or long-lived isotopes of element 61 are those of masses 143, 144, 145, 146, 150, and 151. Calculating the relative stabilities of these by means of the Bohr-Wheeler theory, we find that all of these isotopes except 145 should be unstable by at least one Mev to beta-decay (or its equivalent). For mass 145 the theory indicates essentially no energy difference between Nd^{145} and 61^{145}. Consequently, if element 61 does exist in nature, it is probably the isotope of mass 145.

Pertinent to these considerations are the reported weak beta-rays found in neodymium by Libby.[6] In this work the radiation was shown to be composed of negative beta-particles of about 11-kev energy. No harder radiations were found with them.

Consequently, it is possible that Nd^{145} is beta-active and forms element 61 as its product. Then this latter isotope may be a fairly long-lived alpha-emitter, explaining the very low abundance or non-existence of element 61 in nature. Alpha-emission is not an unlikely occurrence here since samarium has been reported to be alpha-active;[6,7] this indicates that an event such as a marked change in nuclear radii is perhaps occurring in this region. Since tracer activity of element 61 was available, a verification of the assignment of the alpha-activity to samarium (and not to element 61) was made. The separations of samarium from four-year tracer 61 were performed using the sodium amalgam technique.[8] After each of three such separations the specific alpha-activity of samarium was measured and found to remain constant. (The half-life corresponding to the specific activity obtained is 1×10^{12} years.) Only ten percent of element 61 followed the samarium in each of the separations. Thus, the alpha-activity found in samarium samples has conclusively been shown to be due to samarium and not to element 61.

The existence of an unassigned alpha-ray with a range of 1.8 cm of air should be pointed out. Henderson has examined and discussed its occurrence as a pleochroic halo in several micas.[9]

If the neodymium used by Libby had a few tenths percent of impurity of element 61, it is possible that his observed radiation could be due to element 61, the negative particles being Auger electrons or electrons from internal conversion of a low energy gamma-ray.

It should also be pointed out that there is a possibility of beta-emitting, long-lived independent isomers of element 61 at masses with known shorter-lived periods. For example, the Bohr-Wheeler theory predicts essentially no energy difference between the ground states of the 61 and samarium isotopes of mass 147.

Experiments are in progress to prepare isotope 61^{145} and to examine its radiations. This is being done by irradiating highly purified samarium with slow neutrons. Sm^{145} is formed and decays to 61^{145}; this latter isotope, the only 61 isotope formed as a result of neutron capture in samarium, is obtained pure by removing all the samarium activities by the sodium amalgam method.

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Erratum: Remarks on H. W. Lewis' Paper "On the Reactive Terms in Quantum Electrodynamics"

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A TYPOGRAPHICAL error was made in the above Letter. All φ's should be replaced by a derivative symbol d.