Transuranium Elements: A Half Century

Remarks by Glenn T. Seaborg
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We have reached the 50th anniversary of the synthesis and identification (i.e., the "discovery") of the first transuranium elements, neptunium and plutonium. The intervening years have seen the addition of 15 more transuranium elements with the result that this group now consists of 17 known elements, extending from neptunium (atomic number 93) through the unnamed element with atomic number 109.

Thus the addition of the transuranium elements to mankind's natural heritage of elements has led to an expansion of nearly 20% in the fundamental building blocks of nature. Investigation of these manmade elements beyond uranium has led to a tremendous expansion of our knowledge of atomic and nuclear structure. Each of these elements has a number of known isotopes, all radioactive, the overall total being about 200. Predictions indicate an additional 500 should have half-lives sufficiently long to allow identification (greater than 10^{-6} seconds). Synthetic in origin, they are produced in a variety of transmutation reactions by neutrons or charged particles, including heavy ions. (Neptunium and plutonium are, in addition, present in nature in very small concentrations.) There is a total of some 30 isotopes with half-lives long enough to be available in macroscopic (weighable) quantities.

Many of the transuranium elements are produced and isolated in large quantities through the use of neutrons furnished by nuclear fission reactions: plutonium (atomic number 94) in ton quantities; neptunium (93), americium (95), and curium (96) in kilogram quantities; berkelium (97) in 100 milligram quantities; californium (98) in gram quantities; and einsteinium (99) in milligram quantities. Transuranium isotopes have found many practical applications--as nuclear fuel for the large-scale generation of electricity, as compact, long-lived power sources for use in space exploration, as means for diagnosis and treatment in the medical area, and as fools in numerous industrial processes. Of particular interest is the unusual chemistry and impact of these heaviest elements on the periodic table.