

## Prefission and Fission

Our initiation into the realm of the transuranium elements came in the spring of 1940, when Edwin M. McMillan and Philip H. Abelson (1) proved that the radioactive product of their fission experiments was actually a new element--the first identifiable member of the transuranium family. In the 50 years following that discovery, teams of scientists have tried to increase our knowledge of nature by expanding the periodic table of the elements. Looking at the events since late 1938 when fission was discovered not only illustrates how much more has been learned, it also helps dispel the idea that good scientists--even top scientists working together--don't miss the obvious answer on occasions.

To really appreciate the number of false starts--the erroneous paths we took toward the discovery of the new elements--we need to go back to the beginning. And the beginning was in 1869, when Dmitri Ivanovich Mendeleev, a Russian chemist, proposed an arrangement of chemical elements that not only took into account similarities among known elements but also provided the framework for predicting then-unknown entries.

Using the periodic table (Figure 1) of the 1930s, Enrico Fermi, the great Italian physicist, thought that if he could operate on uranium some way--transmute it--why couldn't he produce element 93, and maybe element 94? According to this periodic table, elements 93 and 94 would have chemical properties similar to those of rhenium and osmium, respectively. Fermi and coworkers (Emilio Segrè, Edoardo Amaldi, Franco Rasetti and O. D'Agostino) planned to start with the heaviest element, actually bombarding it with neutrons, and then hoped that after it captured a neutron it would emit an electron (that is the same thing as increasing its charge by one), losing a negative charge, and that way go up to element 93. So they bombarded uranium with neutrons, forming a number of radioactive isotopes. It was, of course, expected that these isotopes would be radioactive because they do not exist on Earth; they had decayed away.

Fermi and his coworkers in 1934 thought that they chemically proved that one of the isotopes, with a half-life of 13 minutes, had chemical properties like those expected for element 93, i.e., chemical properties like those of rhenium (2).

For several years the so-called transuranium elements were the subject of much experimental work and discussion. Experiments in Germany by Otto Hahn, Lise Meitner, and Fritz Strassmann seemed to confirm Fermi's view (3). A series of papers published between 1935 and 1938 reported not only eka-rhenium--that which resembles rhenium--but also eka-osmium, eka-iridium, and eka-platinum (atomic numbers 93, 94, 95 and 96).