SCIENCE NEWS OF THE WEEK

Elements 116 and 126: Claim of Discovery

The heavier and more neutron rich an atomic nucleus is, the more likely it is to be unstable. Uranium is the heaviest element with a known stable isotope. This means that the heavier elements are unlikely to be found in nature because even if they are made in astrophysical processes, they are likely to disappear before they can be caught. In fact, all the elements from atomic number 93 to 106 have been manufactured out of lighter nuclei.

Nuclear theorists have pointed out, however, that a so-called island of stability—or at least relative stability—should exist for a group of numbers beyond 106, say 110 and up. Exactly how stable is a moot point, but maybe stable enough for some of these elements to be found in nature. A number of unsuccessful searches have been undertaken.

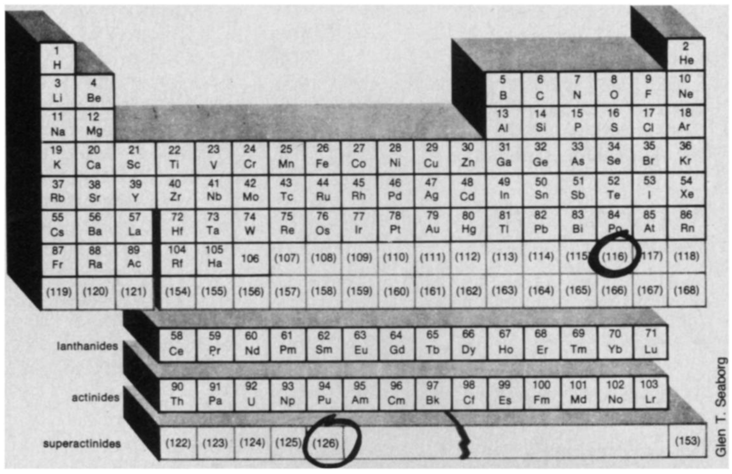
Now an apparent success has been announced, evidence for the existence of elements 126 and 116, possibly 124, and, though less likely, maybe even three other heavy transuranic elements in a sample of ancient mica from Africa.

The work was done by a group of physicists working with a tandem Van de Graaff accelerator at Florida State University in Tallahassee. They included Thomas A. Cahill of the University of California at Davis; Neil R. Fletcher, Henry C. Kaufmann, Larry R. Medsker and J. Willian Nelson of Florida State; Robert C. Flocchini, who started the work with Cahill at UCD, and Robert V. Gentry of Oak Ridge National Laboratory, whose puzzlement over the significance of certain "haloes" in the mica samples led to the experimental work. The claim was reported last week at a joint meeting of North American physicists in Québec city. The report will be published in the July 5 PHYSICAL REVIEW LETTERS.

The haloes are evidences of radiation damage by something radioactive in inclusions in the mica. These particular haloes are giant haloes, bigger than those commonly seen, and they seemed to indicate the presence of a previously unknown source of radioactivity, which just might possibly be one or more of the long-sought ultraheavy elements.

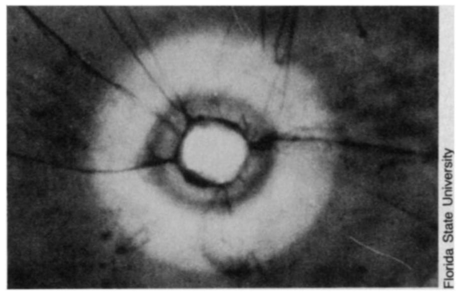
Probing the rock samples with low-energy protons might cause whatever was there to identify itself. Cahill and Flocchini began experimental work at UCD. They were using the same cyclotron that had been used at Berkeley in the production of many of the known transuranics. It had been moved to Davis after the Lawrence Berkeley Laboratory declared it surplus.

The work moved to Florida State because of the capabilities of the Van de Graaff machine there. Steve Edwards, chairman of the FSU physics department, describes the machine as a "proton microprobe." It has a specially designed proton source that gives it a narrow and intense beam and focusing elements that bring the beam to a width of only 30 microns. The inclusions in the mica that were to be surveyed for the unknown sources of radioactivity were only 100 microns across on the average. The 30-micron beam could scan across them.



Futuristic periodic table places element 116 below polonium and element 126 in a third rare-earth series, the superactinides, below plutonium.

Below right, the piece of mica with its large halo.



When the low-energy protons from the Van de Graaff machine strike an atom, they energize its electrons. As the electrons de-excite themselves, they give off X-rays. Each element has its own characteristic pattern of X-ray wavelengths, and the spectrum for any known or hypothetical atom can be predicted from well-established principles of atomic theory. "All you need to know," says Edwards, "is the charge number," the amount of electric charge in the hypothetical nucleus, and you can determine the configuration of electrons around it and the spectrum they will emit when excited.

Statistically, the evidence looks best for elements 126 and 116, good for 124 and possible for three others, numbers as yet unspecified. Lifetime estimates in numbers of years are not yet given, but the finding of the putative elements in ancient rocks indicates values up to and possibly beyond the age of the earth.

Glenn T. Seaborg of the University of California at Berkeley, who has spent more than 30 years in the search for transuranic elements and is the discoverer or a codiscoverer of 10 of them (elements 94 through 102 plus 106), describes the Florida experiment as "a very interesting and exciting piece of work, done very carefully." Seaborg believes the work should be confirmed before it is generally accepted, and he would especially like to see some evidence based on the nuclear structure rather than the extranuclear structure of the supposed elements. He also finds it a little bit surprising that element 126 appears. Nuclear theorists had expected a peak of stability around 110 or 111, and there has been talk of lifetimes as old as the earth for them, but "we haven't heard of such a long lifetime for 126." Nevertheless, Seaborg says, "It would be wonderful if the work could be confirmed. It would open a tremendous field of investigation for chemists and other scientists."

If confirmed, the work would be the first discovery of a new element in nature since 1925. It might also indicate a new island of stability around 126. The theory of islands is based on "magic numbers." Protons and neutrons in nuclei are believed to be arranged in concentric shells. Magic-number nuclei are those with completely filled shells, and they should be stabler than those with a partially filled outer shell. But 126 is not one of the magic numbers (110 and 114 are) so its high stability would be puzzling.

The experimenters intend to improve the sharpness of the Van de Graff probe and look for stronger evidence of what they have found and possibly new things as well. Edwards says he expects that everyone who has such rock samples in his drawers will check them for large haloes that might be candidates for examination. □