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Abstract: Turning their Cold War expertise to more peaceful pursuits, scientists at top American and Russian nuclear laboratories have created two new elements. "This just opens up the horizon on the periodic table," says physicist Ken Moody. The story of the periodic table begins in 1863 when a young French geologist, Alexandre-Emile Beguyer de Chancourtois, wrote a list of the then known elements in increasing atomic weight. This past February, scientists took advantage of the way the nucleus of an atom behaves when it is bombarded to create the two newest elements. The first of these was element 115, which was created when americium, a metal used in smoke detectors, was bombarded with a radioactive form of calcium. Artificial elements tend to be short-lived because the large number of protons and neutrons in their nuclei makes them inherently unstable.

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Building Atoms

A metal found in smoke detectors helps scientists find two new elements.

TURNING their Cold War expertise to more peaceful pursuits, scientists at top American and Russian nuclear laboratories have created two new elements. If researchers elsewhere confirm their results, the new elements will be christened ununtrium and ununpentium. Difficult names aside, chemists and physicists are smitten with the new additions. "This just opens up the horizon on the periodic table," says Ken Moody. He led the American team, which is based at the Lawrence Livermore National Laboratory (LLNL) in Livermore, Calif.

The periodic table to which Moody refers is the familiar chart that decorates the walls wherever chemists congregate. Most of us probably remember it from high school or college chemistry. The chart explains why different elements combine the way they do. It neatly arranges elements according to their weight and chemical properties. An element's position predicts how well it plays with its companions. With the creation of elements 113

and 115, the number of known elements rises to 116.

The story of the periodic table begins in 1863 when a young French geologist, Alexandre-Emile Beguyer de Chancourtois, wrote a list of the then known elements in increasing atomic weight. He then wrapped the list around a cylinder. When he did this he saw that chemically similar elements lined up. It was a step beyond the trial-and-error approach used by chemists up to that point, but not much better.

About the same time, a young English chemist, John A.R. Newlands, was also experimenting with ways of arranging elements. He noticed that chemical groups repeated every eight elements. Thinking he was on to something big, he proudly reported his work to the English Chemical Society. The older, more conservative members of the group branded his idea absurd, and it was pretty much forgotten.

RUSSIAN REVIVAL

Scientific communications were slow in the 19th century. So, it is not surprising that another 20 years passed before the idea was revived. This time the notion struck Russian chemist Dmitri I. Mendeleev and German chemist Julius Lothar Meyer. Working separately, these two arranged the elements into seven columns. Each element's position was determined by its chemical and physical properties. And, as de Chancourtois and Newlands had observed earlier, the elements grouped themselves into what might be called "chemical families."

Mendeleev delved deeper into why this should occur. The result was a table with blanks showing precisely where undiscovered elements would be found. The discovery is all the more amazing because at the time, scientists had no idea how the atom was constructed.

In the century that followed, chemists found more ways to make the periodic table useful. Simple tables, like the one shown here, were expanded to include an element's density, magnetic properties, oxidation states, and melting and boiling points. They also contain information about how electrons are distributed about an atom, and they list the weights of the element's heavier chemical twins or isotopes.

ARTIFICIAL ELEMENTS

Perhaps the single most important contribution of the early charts was showing chemists there were undiscovered elements.

By the start of the 20th century, physicists had an inkling that much of what they believed about the structure of the atom was wrong. For starters, atoms were not solid, but mostly open space. Slowly the vacant slots began to fill in. But holes remained.

Knowing where to look sped the discovery of the naturally occurring elements. With the emergence of an accurate theory of how the atomic nucleus was constructed, came the possibility of creating "artificial" or synthetic elements by bombarding metals with streams of energy.

Adding neutrons, which are electrically neutral, has no effect on an element's chemical behavior — it just makes the element heavier. But as atoms gain weight, they become less stable and, generally speaking, more easily break apart. This process spews neutrons and energy into space. Most of the protons, neutrons and electrons, however, remain and reorganize themselves into lighter elements.

THE NEW ARRIVALS

This past February, scientists from the LLNL and the Joint Institute for Nuclear Research (JINR) in Russia took advantage of the way the nucleus of an atom behaves when it is bombarded to create the two newest elements.

The first of these was element 115, which was created when americium, a metal used in smoke detectors, was bombarded with a radioactive form of calcium. Four atoms briefly appeared, then after 90 milliseconds they decayed into the second new arrival, element 113. These four atoms lingered for 1.2 seconds, before decaying into lighter-weight elements that scientists had previously discovered. Artificial elements tend to be short-lived because the large number of protons and neutrons in their nuclei makes them inherently unstable.

Now, about those odd names. Several years ago the International Union of Pure and Applied Chemistry in Research Triangle Park, N.C., decided that new elements should have culturally neutral names. To do this, they use the Latin pronunciation of an element's atomic number. Hence, the numbers 1,1,5 are read as "un, un, pent." The "ium" ending indicates the element is a metal.

Briefly as they existed, the discovery of elements 115 and 113 does more than raise the count of known elements. "It allows us to expand the fundamental principles of chemistry," says Livermore's Moody. "From new chemistry comes new materials and new technology."

"An element's position predicts how well it plays with its companions."

PHOTO (COLOR): SHORT-LIVED: After 90 milliseconds, ununpentium decays into ununtrium, which lingers for 1.2 seconds.

PHOTO (COLOR): NEWEST MEMBERS: When the discoveries are confirmed, the number of elements will rise to 116.

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By Jim Wilson

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