Chemistry Chat -Focusing on the Elements-

Naming New Elements

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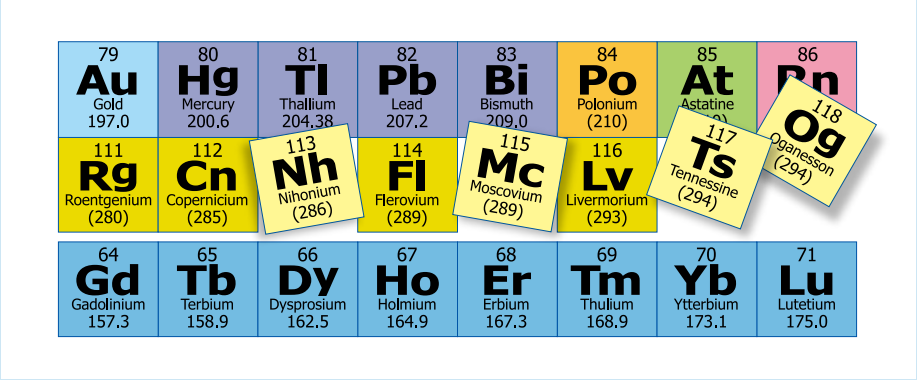

In November 30, 2016, International Union of Pure and Applied Chemistry (IUPAC) announced that it formally approved the names for the elements 113, 115, 117, and 118. The element 113 was named **nihonium** as proposed by the discoverers (with the symbol **Nh**). It is delightful that the name of my country has been added to the periodic table at last (Nihon means Japan in Japanese). The proposed names for the other three elements were approved as well: the element 115 as **moscovium** (symbol **Mc**), the element 117 as **tennessine** (symbol **Ts**), and the element 118 as **oganesson** (symbol **Og**).

Almost a year ago I wrote about how nihonium was proposed for the element 113. This time, let me share the stories of how some of the other recently discovered elements were named.

When a new element is discovered, the discoverer is not allowed to pick a random name. According the IUPAC guidelines, new elements are supposed to be named based on: (1) a mythological concept or character, (2) a mineral or similar substance, (3) a place or geographical region, (4) a property of the element, or (5) a scientist.

There were once many examples where elements were named after minerals from which they were isolated, such as **zirconium** and **molybdenum**. However, since new elements are synthesized by nuclear reactions nowadays, mineral-derived names have become obsolete.

Elements having a name with mythological origins include **helium** (named after Helios, the Greek god of the sun) and **thorium** (named after Thor, the Norse god of thunder). This tradition, however, has become uncommon too and not been followed after the element 94.

The elements such as **astatine** (meaning unstable), **radon** and **radium** (both meaning radioactive), and **actinium** (meaning ray) are named after their property, but these properties actually apply to all of the recently discovered elements. Also, heavy elements with an atomic weight greater than 100 can be synthesized in quantities of only a few to a few hundred atoms, therefore, it is naturally difficult to understand their properties. For these reasons, property has not been adopted either to name elements in recent years.

Accordingly, all of the manmade elements beyond the element 94 have names originating from either a place/ country or a scientist. The naming processes, however, were far from straightforward and sometimes involved controversies.

The heaviest naturally occurring element is **uranium** (the element 92) and heavier elements are synthesized by either bombardment of an atomic nucleus with neutrons or collision of atomic nuclei against each other. Note: Precisely speaking, **neptunium** (the element 93) and **plutonium** (the element 94) were later found to exist in natural uranium ore in minute quantities. From the element 93 to 103, the discoveries were dominated by American scientists. The element 95 was named **americium** and the elements 97 and 98 were named **berkelium** and **californium**, respectively, after University of California, Berkeley, where the discoveries were made.

Instead of just celebrating their nation and university, the American scientists did not forget to credit the great scientists of the past. The element 96 was named **curium** after Marie Curie, the element 99 was named **einsteinium** after Albert Einstein, and the element 100 was named **fermium** after Enrico Fermi.

Lawrencium, the element 103, was named after Ernest Lawrence, who is known as the inventor of cyclotron. Lawrence was the founder and director of the Radiation Laboratory at UC Berkeley, where a number of transuranium elements were discovered. This laboratory was later renamed to the Lawrence Berkeley National Laboratory to honor his name. The Lawrence Livermore National Laboratory, the hub for the recent research on superheavy elements in the US, also recognizes his name.

As I mentioned so far, a majority of the names are taken from the names of nuclear physicists. An exception is the element 102, which is named **nobelium** after Alfred Nobel, who was a chemist. Of course, Nobel did not contribute to the field of nuclear physics directly, but one could say that the well-known prize he established helped advance science in general, including atomic science.

The naming of the element 101 was somewhat controversial, when the scientists at UC Berkeley named it **mendelevium** after Dmitri Mendeleev, the father of the periodic table. The time was 1955 in the midst of the Cold War, so there was uncertainty as to whether it was appropriate for Americans to honor Mendeleev, a Russian scientist. The name was approved nevertheless, and the acceptance perhaps showed openness of the American scientists at that time.

The lead the US had over other nations in the race for discovering new elements suddenly disappeared in 1964. The Russian group led by Georgy Flyorov claimed that they had succeeded in synthesizing the element 104, which they named **kurchatovium** after fellow Russian nuclear physicist Igor Kurchatov.

The report, which had a "Sputnik Crisis-like effect in nuclear physics", stunned the American physicists. They argued back that the Soviets lacked sufficient supporting data and countered by synthesizing the element 104 themselves and named it **rutherfordium**. This name was chosen in honor of physicist Ernest Rutherford.

Over a few decades after this incident, both Americans and Soviets continued to give independent names to the next few elements as they competed to claim the discoveries, creating confusions in scientific world. In particular, the Americans named the element 106 **seaborgium** after Glenn Seaborg, who was still alive at that time. Even though there was no rule that prohibited it, it seemed like a clear political move and the universal respect symbolized once by mendelevium seemed to have vanished.

In 1980's, West Germany joined the race and the three-way competition resulted in continuing confusions and disputes. When IUPAC stepped in and assessed the data to finally determine the names of the elements 104 to 109, it was already 1997, years after the end of Cold War.

Afterwards, the research on superheavy elements in the United States experienced the fabrication incident regarding the element 118 and major budget cuts. Consequently, the American scientists are now forced to work within joint programs with Russia and their national program has slowed down inevitably. Of the four elements for which names have just been approved, the element 117 was named **tennessine** (after Tennessee, where important laboratories such as Oak Ridge National Laboratory and Vanderbilt University are located), while the elements 115 and 118 were named **moscovium** (after Moscow, the Russian capitol) and **oganesson** (after Yuri Oganessian, a leading figure in elements research in Russia), respectively. Oganessian is still alive and was the leader of the Russian research on the aforementioned element 106. The fact that his name was chosen can be viewed as something of a retaliation, as the US took the naming right for the element 106 a few decades ago.

There are many giants in science history whose names have not been used to name new elements, such as Erwin Schrödinger, Werner Heisenberg, and Wolfgang Pauli, to name a few. And I would personally think that for the element 118, which is a group 18 element, a name to honor Sir William Ramsay, the father of noble gases, might have been a good alternative. Amidst intense competitions, it seems that it will take a little longer until scientists regain open-mindedness when naming new elements.

Introduction of the author :

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[Brief career history] He was born in Ibaraki, Japan, in 1970. 1995 M. Sc. Graduate School of Science and Engineering, Tokyo Institute of Technology. 1995-2007 Researcher in a pharmaceutical company. 2008-Present Freelance science writer. 2009-2012 Project assistant professor of the graduate school of Science, the University of Tokyo. 2014-present Publicist for π-system figuration, scientific research on innovative areas.
[Specialty] Organic chemistry
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