As the year 2015 ended, on 30th December the Joint Working Party (JWP) of the fourth International Union for Pure and Applied Chemistry (IUPAC) gave the news that the elements having atomic numbers 113, 115, 117, and 118 had fulfilled all the criteria of a new element. Those criteria were set up the IUPAC Transfermium Working Group (TWG) 1991.

These elements completed the 7th row of the periodic table of the elements. According to IUPAC, the discoverers of these elements from Japan, Russia and the USA will be invited to suggest permanent names and symbols for these four elements. “The chemistry community is eager to see its most cherished table finally being completed down to the seventh row,” said Professor Jan Reedijk, President of the Inorganic Chemistry Division of IUPAC.

In March 1869, Dmitri Mendeleev, a Russian chemist was the first to draw up a successful periodic table. The periodic table, however, was not accepted warmly by the scientists of that time. Chemist Robert Bunsen even made a caustic remark, “One can draw any number of such generalizations on the basis of figures printed in stock-exchange bulletins.”

But with time Mendeleev was able to prove the great importance and utility of the periodic table. It was like a compass for the chemists at that time, seeking new elements in the boundless sea of chemistry. It helped them discover nearly a dozen new elements predicted by Dmitri Mendeleev.

Unfortunately, Mendeleev did not realize that a group of elements had been missing from his periodic table. Those were the noble gases, and were discovered by Lord Rayleigh and William Ramsay. Those were Helium and Argon. By 1899,
they had found three more gases: neon, krypton, and xenon. The group was completed with the heaviest member, radioactive radon, when this was discovered by Fredrick Dorn in 1900 at Halle in Germany. It accumulated inside sealed ampoules of radium from which it is formed.

In 1904, the Swiss chemist Alfred Werner proposed a long form of the table to accommodate those elements. The modern version of the periodic table was created by Nobel Prize-winning chemist Glenn Seaborg in 1944. It is elegant in its simplicity and powerful in its ability to enlighten us. But for the last fifty years or so, this periodic table has been remained incomplete. After the discovery of these four new members the period seven gets its complete form.

The periodic table is laid out in rows to illustrate recurring (periodic) trends in the chemical behaviour of the elements as their atomic number increases: a new row is begun when chemical behaviour begins to repeat, meaning that elements with similar behaviour fall into the same vertical columns. So, from periodic property it was quiet easy for scientists to predict the number of elements in the 7th period or their chemical behavior.

As predicted, the seventh period contains 32 elements, tied for the most with the 6th period, beginning with francium and ending with the element having atomic number 118. This element 118, currently discovered, is the heaviest element so far. As a rule, period 7 elements fill their 7s shells first, then their 5f, 6d, and 7p shells, in that order; however, there are exceptions, such as uranium.

Elements after uranium on the periodic table are radioactive and hence unstable. These elements with more than 104 protons are classified as “super-heavy” and have to be synthesised in the laboratory. These man-made new elements were created by using particle accelerators to shoot beams of nuclei at other, heavier, target nuclei following up on the successive decay of the radioactive super-heavy elements. Similar to other like elements that constitute the table, the new elements also exist for a fraction of a second before they decay into other elements. “A particular difficulty in establishing these new elements is that they decay into hitherto unknown isotopes of slightly lighter elements that also need to be unequivocally identified,” says Paul Karol, chairman of the IUPAC’s Joint Working Party. Finally, however, the scientists won the battle.

The new elements are most likely to be named after a mineral, a country or place, a mythological creature, a scientist, or a property. Earlier, generally new elements were named after the name of the element belonging to the same group of its just preceding period, after adding a prefix “eka” as proposed by Dmitri Mendeleev. For example, before 1979, element 118 was known as eka-emanation (emanation is the old name for radon).

Currently, elements 113, 115, 117, and 118 are known as Ununtrium, Ununpentium, Ununseptium, and Ununoctium, respectively as per IUPAC naming rule of 1979. Now, after confirmation of their identity, the discoverers of the elements will propose names, which will be scrutinized and finally approved by the IUPAC.

The Element 113 will be the first one to be named in Asia because the element 113 was discovered by researchers at the RIKEN laboratory in Japan. As per IUPAC rule, these researchers will be able to propose a name and atomic symbol for their discovery. The leading scientist of this Institute is Kosuke Morita. The discovery of the elements 115, 117, and 118 was the joint venture of the Joint Institute for Nuclear Research in Dubna, Russia, Lawrence Livermore National Laboratory in California, and Oak Ridge National Laboratory in Oak Ridge, Tennessee. Interestingly, the Lawrence Livermore National Laboratories and the Joint Institute for Nuclear Research in Dubna each have their own element, Lawrencium (103) and Dubnium (105) named after them.

The naming of element 118 has a great attraction because it falls within group 18 of the periodic table, it is a noble gas, with a particular naming pattern. Each of the elements in group 18 end with the suffix “-on” (helium is the exception to this rule due to a historical precedent). Whether element 118 will use the “-on: suffix is up for debate; current IUPAC rules say all new elements should end with “-ium”, but recommendations have been published to name all group 18 elements with the “-on” suffix. This is an interesting matter which we have to wait and watch.

Another interesting question may arise now: “Is this the end of the periodic table?” Certainly not by any means. It is possible that elements with higher atomic numbers can be synthesized. In fact, the experiments to synthesize element 119 have so far come up short, and the predicted properties of element 119 put it at the limits of what current technology is able to detect. The leading scientist Kosuke Morita at Riken now plans to “look to the unchartered territory of element 119 and beyond”.

“There are a couple of laboratories that have already taken shots at making elements 119 and 120 but with no evidence yet of success,” says JWP chair Professor Paul J. Karol. He also adds: “The eighth period should be very interesting because relativistic effects on electrons become significant and difficult to pinpoint. It is in the electron behavior, perhaps better called electron psychology, that the chemical behavior is embodied.”

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