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Pierre Braunstein and Robert Guillaumont

Editorial to the Thematic Issue of *Comptes Rendus Chimie* dedicated to the Periodic Table of the Elements

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Variations around the Periodic Table / *Variations autour du tableau périodique*

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To celebrate the 150th Anniversary of the publication of *The Principles of Chemistry* by Mendeleev, UNESCO has declared 2019 the International Year of the Periodic Table. A multitude of events have been organized around the world and the Académie des sciences also contributed to this celebration through a Symposium, "Variations around the Periodic Table", that was held in Paris on 19 November 2019.

The classification of the elements provided by the Periodic Table certainly represents one of the most impressive and fruitful achievements in modern science. Using the international language of chemistry, the Periodic Table is used worldwide and occupies an iconic position in chemistry. Its current form is reproduced in most undergraduate inorganic textbooks and displayed in almost every chemistry classroom and lecture theatre.

Through the publication of his book *The Principles of Chemistry* in 1869, Dmitri Ivanovitch Mendeleev offered a classification of the 63 elements known that allowed him not only to rationalize several properties and explain similarities between elements but it also to predict the existence of elements that remained to be discovered. Although Mendeleev has been given the major credit for this achievement, it actually resulted from the combined efforts by several dedicated and imaginative individuals over a 80-year timespan, with contributions from *i.a.* Lavoisier, Dalton, Berzelius, Prout, Döbereiner, Dumas, Cannizzaro, von Pettenkofer, Gmelin, Odling, Béguyer de Chancourtois, Newlands and Meyer.

The predictive power of Mendeleev's classification was beautifully demonstrated when François Lecoq de Boisbaudran discovered gallium in 1875, the existence of which had been predicted by Mendeleev 6 years earlier as *eka-aluminum* (eka: that comes next), when Lars Fredrik Nilson discovered scandium in 1879 (*eka-boron*) and Clemens Winkler discovered germanium in 1886 (*eka-silikon*). In 1875 Mendeleev published in the *Comptes Rendus de l'Académie des sciences* a version of his classification that prefigures the Periodic Table as we know it today, with 118 elements organized in 7 periods and 18 columns.

If the Periodic Table is known to almost everybody, the history of each element, the origin of its name, the scientific bases that led to the stepwise establishment of its current version, the false discoveries that accompanied these adventures and the recent developments dealing with the actinide and transactinide elements are less known to the non-experts. To shed light on these diverse aspects was the main objective of the session held in the Académie des sciences.

Pierre Avenas will show that the names of the elements were often inspired by astronomy, mythology, geography, or mineralogy. Some chemists and physicists have been particularly creative. In general, the names have Greek or Latin origins, sometimes German or Arab. For the transuranic elements, the names reflect the major personalities or laboratories involved in nuclear physics and radiochemistry. **Marco Fontani** will show that with each true discovery of an element, there are, at least, a couple of false starts. The stories behind the false discoveries can be as interesting as the real ones and often reveal jealousy, greed, or vanity. False discoveries also provide important ethical lessons. The major developments that have led to the extension of the Periodic Table beyond uranium around 1940 will be illustrated by **Robert Guillaumont**. Efforts to find the missing elements and the transuranic elements were in vain because these are all artificial. A key step was the synthesis of the first transuranic element, which displayed unexpected properties according to the ranking of the elements in the Periodic Table. All the elements beyond actinium have been included in the actinide series (5f elements). Ended in 1961, their discoveries were followed by that of the first 6d element: the rutherfordium ($Z = 104$). Element 118, Oganesson was synthesized in 2006. **Valeria Pershina** will discuss the spectacular developments in the relativistic quantum theory and calculational algorithms that have occurred in the last couple of decades and allowed for accurate calculations of the electronic structure and properties of heavy and superheavy elements, as well as of their compounds. These investigations have proven that relativistic effects determine periodicities in physical and chemical properties for elements beyond the 6th row of the Periodic Table. However, the predictive power of the Periodic Table at its upper end may be lost and challenges associated with the elements beyond the 7th row will be discussed. Furthermore, **Armand Lattes** will show how in 1890, Paul Sabatier, then a young professor of Chemistry at the Faculty of Sciences of Toulouse used the classification of "corps simples" in education and approached this classification, graphically, from the periodicity of the curve representing the maximum valencies of the elements as a function of their atomic weights.

We are most grateful to these authors for their contributions and we wish you all an enjoyable reading.

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