Editorial

Alan F. Williams

150 Years of the Periodic Table

It was in 1869 that Dmitri Ivanovitch Mendeleyev proposed his periodic table of the elements and it is to commemorate the sesquicentenary of this event that 2019 has been declared the International Year of the Periodic Table. It is interesting to relate this to Charles Darwin's publication, ten years earlier, of the Origin of Species. Both were major achievements of science and were based on the collation and analysis of a great number of observations. Both changed the vision of their respective sciences but neither offered an explanation of the principles they had proposed, which would only come much later.

Before the acceptance of the periodic law, each element was regarded as an isolated individual, even if certain 'families' of elements such as the alkali metals or the halogens had been identified. Afterwards the position of an element in the periodic table became an indicator of its properties, with the elements of a given column or group showing many similarities, and only small changes on descending a column, while properties varied more dramatically but fairly regularly upon crossing a period. The periodic table has thus become one of the most effective aids to learning in science, largely justifying its presence in almost all chemistry lecture rooms and on the end papers of most inorganic chemistry text books. It was by no means the first attempt to systematise the elements, but rapidly established itself as the most effective, supported by Mendeleyev's prediction of three new elements whose expected properties were later confirmed by the discoveries of scandium, gallium and germanium. History has largely forgotten a number of his less successful predictions.

The present edition of CHIMIA seeks to give a contemporary overview of the periodic table. There are three basic themes. The first is historical and conceptual. ***Johnson and Williams*** look at the historical development of the periodic table which has continued to evolve over the past 150 years. Mendeleyev considered the question of valence in his work, and the development of bonding theory has been essential for the productive use of the periodic table. ***Mingos*** discusses the way in which the subtleties of the table were brought into conformity with modern quantum theories. Although the power of modern computers now allows very high quality calculations to be made on specific compounds, chemists are still attracted by simpler models, often based on simple ideas such as the Lewis pair, which have wide application. He reviews one of the oldest notions, namely the isostructurality of isolectronic compounds which on the one hand allows the correlation of a huge number of apparently unrelated structures, but which cannot always be applied uncritically.

The second theme concerns two families of elements, the lanthanides and the actinides and post-actinides, whose description in Mendeleyev's table was either unsatisfactory or, in the case of the actinides, absent. Some of the lanthanides were known but fitting them into the table was less obvious, and was only achieved satisfactorily with the acceptance of a theory of atomic structure. In recent years their chemistry has developed remarkably and a view of the modern lanthanide chemistry is given by ***Piguet***. Although two actinides, thorium and uranium, were known they were assigned to a transition metal series by Mendeleyev. It was only with the development of nuclear chemistry that the other actinides were discovered. The recent synthesis of several new elements is by any standards a remarkable achievement and is reviewed by ***Türler***.

The final theme looks at aspects of chemistry which Mendeleyev completely ignored. One property totally neglected in his periodic table was lability and the kinetics of reactions. In the first half of the 20^{th} century organic chemistry developed an understanding of kinetics and mechanism which would form the basis of organic synthesis. For elements other than carbon, kinetic data were generally unavailable until the second half of the 20^{th} century but the reactivity patterns that have been discovered have allowed chemists to understand the basis of catalysis by metal complexes and its application to organic synthesis and biological chemistry. ***Helm and Merbach*** review some of the trends in reactivity within the periodic table. In the nineteenth century, the idea that 'inorganic' elements could be important for 'organic' living systems would have seemed ridiculous but the last fifty years have seen explosive growth of the somewhat oxymoronic subject of bioinorganic chemistry and ***Freisinger and Sigel*** show how biology uses the periodic table as a palette of elements to create the functioning systems of life.

After 150 years, the periodic table still gives us a framework for chemistry. I am very grateful to the authors of this number of CHIMIA for their contributions illustrating this and hope that the readers of CHIMIA will enjoy reading this special edition.

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The cover shows Dimitri Ivanovich Mendeleyev surrounded by four representations of the periodic table. The portrait by Ilya Repin is in the State Tretyakov Gallery, Moscow. The top image is the representation by Hans Erni in the Institute of Chemistry of the University of Fribourg.

The Editorial Board of CHIMIA thanks Prof. Alan Williams for creating this interesting and very accessible issue commemorating the 150-year anniversary of Mendeleyev's ground-breaking proposal and the 'International Year of the Periodic Table'