The Periodic Table: Past, Present, and Future

by Geoff Rayner-Canham, World Scientific Co, Singapore (2020); ISBN 978-981-121-848-4

reviewed by Jan Reedijk

With the International Year of the Periodic Table just behind us (www.iypt2019.org), it was a pleasure to learn that a new book has appeared dealing with the Periodic Table of chemical elements. In this case it is a book focused on the chemistry of the chemical elements, or more precisely on trends in the chemical properties of the elements of the periodic table. In fact, the extended book titles could well have been **"The Periodic Table for Chemistry**", or "**The Chemistry behind the Periodic Table"**, as the book is primarily written to show chemical relationships between the different chemical elements.

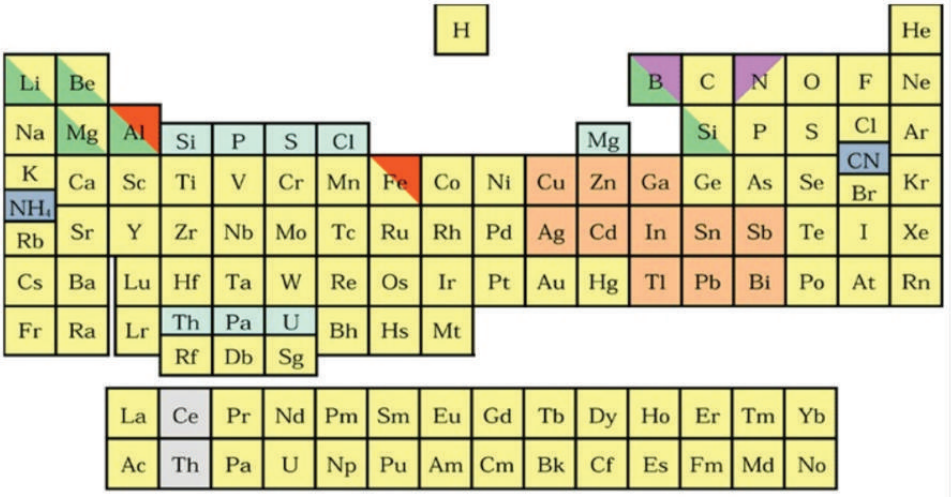
A specially composed periodic table on the front cover of the book, visualizes in multicolor coding how certain groups of elements are related chemically. As a result, certain elements even occur in two different positions of the periodic table! And also pseudo-elements, like ammonium and cyanide, are presented. Perhaps somewhat surprisingly, this Periodic Table ends at meitnerium, as from later elements not enough is known about their chemical properties.

A logical question, that I also asked myself, is: *Why has another book on the Periodic Table been written?* We have already so many, and why do we need to describe what Mendeleev devised over 150 years ago and which is worldwide shown in classrooms and cover pages of textbooks. But this is not just another book, as the author claims—and I do agree.

- There are many ways of organizing and grouping the elements based on their chemical properties. Some of these are generally seen as challenging, and they even may reveal philosophical thoughts. The present book shows much more, however, and deals with intriguing questions, like:
- What is the best position for hydrogen in the Periodic Table? Left, Right, Center?
- Could it be that an element may occupy more than one location on the periodic chart?
- Which elements are to be seen as the 'metalloids'?
- Why does vanadium behave so much like molybdenum, even in Mother Nature?
- Which elements should form Group 3 in the Periodic Table?
- Does aluminum belong in Group 3, or does it better fit in group 13?
- Why do silver(I) compounds resembling so closely those of thallium(I)?

Indeed, many of such questions are dealt with in a clearly written way in this stimulating and innovative book. The reader will quickly become interested in the subject and will be taken on tour through this Periodic Table in a very readable way, both for students and teachers.

The book comprises 14 chapters, starting with isotopes and nuclear patterns, including the long-known Ni-Co and Te-I anomalies in atomic weights, and the additions of the latest new element additions (2016). From the 118 currently known elements, only 80 of them have at least one stable isotope. A second



Cover Figure of The Periodic Table: Past, Present, and Future; used with permission from the book author.

introductory chapter deals with electronegativities and their discovery, but also with oxidation states and relativistic effects, all properly documented with almost 60 original references. As the author states: "the book is designed to make the many concepts of elemental relationships become alive and stimulating, not boring and soporific." It appears that the author has been quite successful in that approach, and I trust that students and chemistry teachers will find this a great set of introductions.

In Chapter 3 the author discusses some old problems of locations of the elements, like the "First-Period problems," in particular dealing with the question: Where should hydrogen be placed? Like some other recent textbook writers, the author defends the view that it should be central, as shown in the figure above.

Chapter 4 discusses in some detail "The Group 3 problem;" this case in fact is still very actual, also within IUPAC; but in the end the author gives strong arguments for the 15 lanthanoids and 15 actinoids, as used in the current IUPAC Periodic Table, grouped below the 7th row. [See *CI* January 2021]

Chapters 5 to 14 deal with topics based on the chemical properties of different elements and the similarities, even if placed in different positions of the Periodic Table. Chapter 5 is the one on "categorizations of the elements," and it is interesting to note how the author discusses and classifies such groups as: *Metals, chemically week metals (amphoteric), non-metals, metalloids, supermetals, refractory metals, noble metals, rare earth metals, superheavy elements and even ephemeral elements* (*i.e.* elements living very short, or less than a day).

Chapter 6 deals with isoelectronicity. Chapter 7 with main group elements (group and period patterns). This chapter is the largest one of the book; the author correctly concludes that periodic patterns and trends are the fundamental basis of the periodic table. The author makes clear that several limitations of periodicity exist, as illustrated by numerous examples.

In chapter 8 "Patterns among the transition metals" are discussed and the author shows that smooth patterns, systematic trends and continuities are in fact rare in this group of elements, and that their chemistry is largely unpredictable. In chapter 9 relationships between groups are discussed, like it was originally done in the "small form" of the periodic table, *i.e.* before the international community moved to groups 1-18 30 years ago, based on IUPAC initiatives; see E. Fluck, *Pure Appl. Chem*. 1988, **60,** 431-436 (https://doi.org/10.1351/pac198860030431).

Less common relationships between elements (chapter 10) are perhaps the so-called "Knight's Moves", *i.e.* two places to the right, and one place down, like Ag to Tl and Zn to Sn. It is shown that Ag(I) and Tl(I), have quite similar chemical properties, and the same holds for Zn(II) and Sn(II).

The last chapter deals with "pseudo-elements", *i.e.* combinations of elements that form ions that resemble the halogen ions (*e.g.* cyanide, thiocyanate), or resemble alkali metal ions (ammonium).

The number of illustrations is good, and they are clear, albeit largely in black and white; perhaps more colors could have been used for some figures. This book is indeed unique and quite thought-provoking. Looking backwards it is just a pity that it had not appeared in 2019 during the International Year of the Periodic Table.

Nevertheless, this book is highly recommended for students, teachers, researchers and not only chemists! Geologists, biochemist and also physicists will find it very interesting to read.

https://worldscientific.com/worldscibooks/10.1142/11775

EuroMedChemTalents

reviewed by Gerd Schnorrenber

The European Federation of Medicinal Chemistry (EFMC) celebrated its 50th anniversary in 2020. The EFMC was founded to promote science in Medicinal Chemistry and to support networking across European countries and their Medicinal Chemistry Societies.

From the early days, EFMC and IUPAC worked closely together, *e.g.* by organizing scientific congresses and educational events. Over the years EFMC accompanied developments in Medicinal Chemistry, including changes in indicational focus, or the emergence of new therapeutic modalities and technologies.

The recent foundation of the Young Scientists Network needs also to be acknowledged. It aims to support early career researchers in Medicinal Chemistry by stimulating networking and publishing of their results.

IUPAC congratulates EFMC and its representatives for their significant and impactful achievements made over half a century and looks forward to a continued and fruitful collaboration in the future.

The impressive history of EFMC is reviewed in a special edition of *ChemMedChem* published in December 2020, online at **https://chemistry-europe.onlinelibrary.wiley.com/doi/toc/10.1002/(ISSN)1860-7187.EuroMedChem-Talents.**