MATCH
Communications in Mathematical and in Computer Chemistry

MATCH Commun. Math. Comput. Chem. **60** (2008) 691-692

ISSN 0340 - 6253

BOOK REVIEW

Number Theory and the Periodicity of Matter

by

Jan C. A. Boeyens and Demetrius C. Levendis

Springer, Berlin, 2008, XV+374 pp. ISBN 978-1-4020-6659-7

This remarkable book will be found interesting by scholars whose expertise lies in one or more of the following disciplines: philosophy, applied mathematics, theoretical, nuclear, and elementary particle physics, as well as physical, theoretical, and mathematical chemistry. In this short review we focus our attention only to those aspects of the book that we consider relevant for mathematical chemists.

The book is written by two South African scientists and outlines the main results of their investigation of the connections between properties of atoms and atomic nuclei and number theory. In their own words: *the theme of this book is to explore the consequences of the serendipitous discovery that stable nuclides obey the same periodic law as the chemical elements, both laws being rooted in elementary number theory*.

The book is divided into *Preface*, eleven chapters entitled as *1. Introduction, 2. Number Theory Primer, 3. Periodic Table of Elements, 4. Structure of Atomic Nuclei, 5. Elements of Cosmography, 6. The Periodic Law, 7. Periodicity and Number Theory, 8. Properties of Atomic Matter, 9. The Grand Pattern, 10. The Golden Excess, 11. Chemical Periodicity*, followed by a *Bibliography* consisting of 152 references, and a subject index.

In the *Preface* the authors reveal their central idea, namely that *the key to understanding of atomic matter through number theory exists therein that atoms consist of whole numbers of protons, neutrons and electrons. The ratio of protons and neutrons in any nuclide therefore is a simple rational fraction, and this quantity . . . is the important factor that determines the stability of nuclides against radioactive decay.* Perhaps the most significant result in the book is the observation that for light nuclei the ratio Z/N is equal to unity, whereas for heavy nuclides it converges to the golden ratio τ. Throughout the entire book, the golden ratio $\tau = (\sqrt{5}-1)/2 = 0.61803\ldots$ plays an outstanding role, because many properties of atoms and nuclei (as well as of a variety of other physical and biological phenomena) are found to be related to it.

In Chapter 2 a concise survey of number theory is given. Because number theory is not much used by scientist doing research in mathematical chemistry, reading this chapter could significantly broaden their mathematical knowledge. In Chapter 3 the history of the discovery of the periodic system of elements is outlined in detail, followed by various (quantum) theoretical approaches to the description of the electron configuration of elements. In Chapter 11 are discussed such chemically relevant notions as electronegativity, chemical bonding (between all kinds of atoms found in the periodic system), and bond order. Chapters 3 and 11 are the only parts of the book that are mainly devoted to chemical topics. Chapters 4, 5, 6, 7, 8, 9, and 10 deal with problems that nowadays belong to nuclear physics. Yet, in Chapter 10 there is an extensive discussion on superconductivity.

At the end of Chapter 11 there is a short subsection 11.4 entitled *Epilogue*, that in fact is the concluding part of the entire book. There the authors say: *Many of the claims made in this work will surely be considered extravagant at first sight. . . . However, there is no doubt that a fundamental relationship between numbers and matter has been identified. This interaction is mediated by the golden ratio that shapes the world.*

In this reviewer's opinion, the book **Number Theory and the Periodicity of Matter** is an exciting and nonstandard feat in the study of Nature. Some of its parts will be found most stimulating by mathematical chemists. Those who intend to get this book should be warned: once you have it in your hands, it is difficult to stop reading it. With this caveat, the book is recommended to the readers of *MATCH Communications in Mathematical and in Computer Chemistry*. Yet, its main readers should be nuclear physicists.

Ivan Gutman