Book & Media Reviews

Biological Inorganic Chemistry

edited by Ivano Bertini, Harry B. Gray, Edward I. Stiefel, and Joan S. Valentine

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reviewed by Daniel Rabinovich

I approached the review of this book with a healthy dose of skepticism, prompted by the somewhat pretentious claim on its back cover that it is "the long awaited text for 21st century courses in biological inorganic chemistry". The editors are undoubtedly preeminent researchers in bioinorganic chemistry, and three of them published a similar textbook (with S. J. Lippard) a few years ago *(1),* a cumulative experience that certainly bodes well for the preparation of a new authoritative title in this burgeoning field. While the book by Bertini, Gray, Stiefel, and Valentine (BGSV) boasts an additional 128 pages and the number of contributors has increased from 15 to 58, it is far more than an expanded or revised 2nd edition of its previous incarnation. The original material has been completely overhauled and its rather different organization has warranted the production of a brand new book, an effort for which the editors should be commended.

The book is divided in two major parts, with the first presenting an overview of the fundamental concepts that ought to be included in every course on bioinorganic chemistry. Introductory sections on the essentiality, origin, and abundance of the elements are followed by a good outline of the well-known carbon, oxygen, hydrogen, nitrogen, and sulfur cycles. The interaction of amino acids and metal ions is explained in Chapter 3, where the structures and stability of representative metalloproteins are discussed using metrical parameters extracted from the Protein Data Bank (PDB). A summary of the structures, occurrence, and biological functions of widely distributed metal cofactors such as iron–sulfur clusters and tetrapyrrole (heme) groups is presented in Chapter 4. General properties of the transport and storage of metal ions in biological systems are delineated in Chapter 5, which includes interesting sections on the bioavailability of iron and the intracellular distribution of copper facilitated by metallochaperones. An introduction to the fascinating subject of biomineralization, the biological process whereby inorganic materials such as bones, shells, and teeth are formed, is covered in Chapter 6. Not surprisingly, the first part of the book concludes with an excellent chapter dedicated to medicinal inorganic chemistry, an active area of research that encompasses the use of inorganic compounds and metal complexes as therapeutic and diagnostic agents. Thus, cisplatin and other anticancer agents, gold antiarthritic drugs, bismuth antiulcer compounds, technetium-99m radiopharmaceuticals, and gadolinium MRI contrast agents are all discussed in this useful chapter.

The second part of the book, which accounts for about 80% of the pages, is composed of more thorough studies on specific biological systems and often relies on the latest research results to provide a fresh and insightful look at these essential processes. Hence, Chapter 8 introduces the diverse roles that transferrins, ferritins, siderophores, and metallothioneins play in metal ion transport and storage. Hydrolytic enzymes (e.g., lyases, hydrolases, ureases, aconitases) and catalytic nucleic acids, a novel class of metalloenzymes discovered in 1994, are discussed at length in various sections of Chapter 9. The nature of electron transfer, respiration, and photosynthesis, essentially the chemistry of life, are thoroughly treated in Chapter 10. Ironically, Chapter 11 (despite its number...) is arguably the richest, and certainly the longest (124 pages), in the book. It deals with all aspects of oxygen metabolism, from the structure and function of superoxide dismutases and reductases to the catalytic oxidation of biological substrates by hydrogen peroxide and peroxidase enzymes. Also featured in this chapter are detailed sections on different biological oxygen carriers (e.g., hemoglobins, hemocyanins, hemerythrins) and dioxygen activating enzymes, including the ubiquitous cytochrome P450 and bimetallic monooxygenases. Several ingenious model compounds have been synthesized in recent years to better understand these complex enzymes and are described and illustrated in the text. It is also worth noting here how quickly the field of bioinorganic chemistry is evolving. Although the book states that a crystal structure is not yet available for tyrosinase, the only known monooxygenase containing a dicopper active site (pp 394–395), this milestone has recently been achieved *(2, 3)*. The remainder of the chapter summarizes the main characteristics of the reduction of dioxygen to water by cytochrome *c* oxidases and multicopper oxidases. Chapter 12 covers the metabolism of hydrogen, carbon, nitrogen, and sulfur, with an emphasis on hydrogenase and nitrogenase enzymes and their relevance to biological nitrogen fixation and denitrification, perennial but quite challenging areas of research in biological inorganic chemistry. Whereas the focus of Chapter 13 is on metalloenzymes with radical intermediates (e.g., cobalamins, amine oxidases), Chapter 14 reviews the principal facets of metal ion receptors and signaling, including, of course, the multiple roles of nitric oxide in biological systems. The book also contains two outstanding tutorials on biochemistry and coordination chemistry, an insert with 24 pages of color illustrations and four appendixes, namely (i) a table of abbreviations, (ii) a glossary, (iii) a useful (if not comprehensive) survey of the bioinorganic chemistry literature, and (iv) a brief introduction to the PDB. Finally, the book concludes with a reasonably complete nine-page index in which the occasional shortage of subheadings may be annoying to some readers (e.g., there are 33 different pages or page ranges given for the entry "cysteine").

So, is this really the "textbook of the century" in bioinorganic chemistry, as the editors eagerly proclaim? As much as I am reluctant to believe such assertion this early in the century, it is undeniable that they are setting the bar quite high for current and future competing textbooks. This appears to be, after all, the most comprehensive book on the subject published to date and features an innovative balance of standard topics and contemporary research, thereby appealing to those looking for a thoughtful text or a discriminating source of reference material. The latter is evident in the more than 1,500 citations from the primary literature that are listed at the end of the 14 chapters, all

of which are remarkably even in style and presentation, particularly for an edited volume with so many contributing authors. Reasonably priced, the textbook has been carefully produced, and I have not been able to identify a single typographical error during my cursory reading while preparing this review. Of the several bioinorganic chemistry textbooks currently in the market, the recently published work by Kraatz and Metzler-Nolte *(4)* is perhaps the most similar to BGSV's, more selective in its choice of topics and inclusion of references, but equally diligent in its organization and delivery of the material. In summary, I enthusiastically recommend this book to everyone interested in this interdisciplinary field, including undergraduate and graduate students, instructors, researchers, and even those in allied fields who would like to have a single book on this exciting subject as part of a personal chemistry library.

Literature Cited

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