whole, Rao has a hands-on approach, and at each stage he urges his young readers to carry out simple experiments and observe what happens: for example, add a small quantity of zinc powder to a solution of copper sulfate. In the final chapter there are recipes for making aspirin (from salicylic acid and acetic anhydride) and nylon fibres (from sebacoyl chloride and hexamethylene diamine).

I must admit that from the title I had expected a somewhat different content. No one is going to understand chemistry from reading this book. What it can do is to help the reader to understand what chemistry is about. Rao's book is definitely not directed towards readers of this journal, but if it encourages a single young person to pursue chemistry with anything like Rao's own enthusiasm and creativity, then it will have fulfilled its purpose.

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The Biological Chemistry of the Elements. By *J. J. R. Frausto da Silva* and *R. J. P. Williams.* Oxford University Press, Oxford 2001. 575 pp., softcover £ 39.95.—ISBN 0-19-850848-4

With this second edition the authors have provided a significant update to their 1991 textbook. That earlier edition has trained many students and researchers in the area of the biological impact of the inorganic elements. This new edition is even better than the original, both in terms of organization and content. It is easier than before to use as a textbook or as a reference source owing to the detailed indexing. It provides the most up-to-date and extensive compilation of operational concepts in bioinorganic chemistry of any single textbook available today.

The authors have retained the original structure of the text, which has two parts: six chapters on the physical and chemical factors that control the elements within living systems, and 12 chapters on specific groups of elements. Two other chapters (7 and 20) deal with networks of interactions and feedback within cells and between cells and the environment. These chapters are unique and are not found in any other popular textbook on bioinorganic chemistry. Chapter 7 provides a holistic approach to the operation of a cell, including internal spatial localization and timing of cellular functions. Chapter 20 extends this systems approach by further developing the concept of a total cellular "metallome" (free and chelated), which is in contact with the environment through exchange. The authors suggest how the metallome is integrated with the genome and proteome to create an interactive system that can compete for survival. The beginnings of evolution are suggested here.

Like the original text, this edition is not written in a traditional style based on structures or physical properties of isolated molecules found within a biological context. Instead the pedagogical style emphasizes the functional value of the elements in living organisms. Thus, the first seven chapters are organized in the form of a discussion of living systems as a network of flows of material, energy, and information, both within a structured cell and between it and the environment. The revisions to Chapters 9–19 focus primarily on including a section on the networking of interactions of the elements and on genetic control of the cellular molecules involved in the uptake and distribution of the elements.

The significant advances that have been made in determining the structures of the molecules of life are not uniformly emphasized in this new addition. However, this material is readily available to readers in the form of several monographs (including two handbooks of metalloproteins published in 2001 by Huber et al. and Bertini et al.) and databases (Braunschweig Enzyme Database (BRENDA); Protein Data Bank (PDB); PRosthetic groups and Metal Ion SitEs in proteins (PROMISE); Metalloprotein Database at Scripps; The Inorganic Crystal Structure Database (ICSD); The EF-Hand Calcium-Binding Proteins). With the additional help of these structure databases, the educator can present an up-to-date survey of bioinorganic chemistry using the new edition of this textbook as the conceptual framework for understanding how biological systems use chemical principles to thrive.

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Heme, Chlorophyll, and Bilins. Methods and Protocols. Edited by *Alison G. Smith* and *Michael Witty.* Humana Press, Totowa 2002. 340 pp., hardcover $ 125.00.—ISBN 0-896-29111-1

The "pigments of life" perform essential tasks as cofactors in many biological transformations. Their importance for the evolution of life on our planet and for maintaining the processes of life is overwhelming. Research into the structure, functions, and processes catalyzed by this extraordinary family of pigments has long fascinated many eminent scientists. Published results have described details of the variations in structure and the determination of biosynthetic routes, and many of the central proteins containing "pigments of life" as cofactors have even been crystallized. One can assume that the exploration of these pigments is now a mature field of research. The amount of knowledge acquired over more than 100 years is huge. It is probably correct to say that the research centered around the tetrapyrrole-based pigments is no longer the hot topic that it used to be. Nevertheless, many important fundamental questions are still unsolved, and tetrapyrroles have found an ever growing number of new applications. It is fair to say that research around the "pigments of life" continues, and the number of published papers is so great that no scientist is able to follow all the developments in detail. As in many other fields, monographs have been published regularly to help the newcomer and the experienced researcher. In particular, *The Pophyrin Handbook,* a ten-volume work, was published in 2000.

The book edited by Smith and Witty about natural tetrapyrroles is a collection of chapters written by 20 different authors and experts in the field. With just over 330 pages, it is obvious that one cannot expect a comprehensive treat-

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ment of natural tetrapyrroles. The editors have chosen their authors based on their expertise. The authors have been asked to give a concise introduction to their special fields, and a careful description of the best reproducible methods used. The choice of subjects and authors reflects the scientific interests of the editors.

An introductory chapter is followed by two chapters on the synthesis of tetrapyrroles and on general laboratory methods for tetrapyrroles. The remaining 260 pages are almost exclusively dedicated to biochemical preparations and analytical methods useful in the context of biochemical studies. An excellent chapter describes the enzymatic preparation of tetrapyrrole intermediates. The following two chapters treat analytical aspects of the identification of intermediates in the heme biosynthesis and in the chlorophyll biosynthesis respectively. The next three chapters are devoted to heme and to heme-containing proteins: "Analysis of Heme and Hemoproteins", "Hemoproteins Purification and Characterisation Using Aqueous Two-Phase Systems", and "Structural Study of Heme Proteins by Electron Microscopy of 2-Dimensional Crystals". The analysis and reconstitution of chlorophyll proteins and the 2D-crystallization of chlorophyll proteins are treated in the next two chapters. Bile pigments are the subject of the last three chapters, which deal with the biosynthesis and analysis of bilines, the analysis and reconstitution of phytochromes, and the analysis and reconstitution of phycobiliproteins. The editors have been able to recruit experienced experts for many of the chapters.

The authors have been asked to write only a short, concise introduction to the special field, giving most space to a rather extensive discussion of the experimental methods used, and then describing some chosen experiments in great detail. This is certainly a format which is more often used in biochemistry than in chemistry. The editors justify their approach in the preface, indicating that today methods and experimental details are often (too often) only described in an extremely shortened version. They then describe vividly the difficulties encountered when a scientist begins experimental work on a new subject. The loss of technical expertise and know-how when an experienced member of a research group leaves and has to be replaced by a newcomer is huge. The editors also comment on the fact that often only so-called modern, "trendy" methods are used, neglecting many well established and very useful traditional techniques. These problems are not confined to the field of tetrapyrroles, and are a consequence of modern publication policies. Short communications are in vogue, whereas solid full papers containing all the experimental details are less valued. Despite, or maybe because of the fact that more scientific papers are published today than ever before, many publications report results that are not reproducible or can only be reproduced after a lot of effort. That fact alone certainly justifies the approach of this book, and one could wish for books like this one to be written in many other fields.

The most important function that such a book should fulfill is to make the topic and the experiments in the field accessible to everybody. Or in short: will a beginner be able to start to do good experiments using the protocols described in this book? To give a general answer to this question is almost impossible. The reviewer can only give a partial answer related to the fields where he has experimental experience. In the context of the questions mentioned above, the choice of chapters and the choice of experiments described in the chapters is crucial. If a newcomer's interests are different from those of the editors, he will perhaps find some useful hints, but the problems he is primarily interested in will not be treated. This dilemma has been clearly recognized by Kevin Smith, the author of the chapter on tetrapyrrole synthesis. In his last paragraph he warns the reader that although he has concentrated on describing some simple and reproducible methods for the synthesis and isolation of tetrapyrroles, a high level of competence in synthetic methodology and a fully equipped organic laboratory are necessary to carry out the experiments described. Smith, in his last sentence, makes a call for collaboration. Interesting current problems in the field of the "pigments of life" will require the use of widely different methods, and investigations will have a strong interdisciplinary character.

There is no doubt that this book can and will be helpful for somebody working in the field of tetrapyrroles, but it is highly improbable that just by reading through this book a biologist will become an expert in organic synthesis or that a chemist will suddenly be able to isolate chlorophyll proteins and perform 2D-crystallizations without massive help from experts. I found some valuable hints in the book, but on the other hand a few of the preferred methods used in our laboratory are not even mentioned.

In view of the above comments, who should be recommended to buy this book? It is obviously a must for all groups working experimentally in the field of tetrapyrroles. On the other hand, the book will not enable a postgraduate student or a postdoc starting for the first time to begin work on tetrapyrroles successfully without additional help. The problem described above will stay with us: how to adapt experiments and special techniques described in the literature without undue loss of time. Contacting the experts personally via e-mail, exchanging scientists, and scientific collaboration are still the most efficient way to solve such problems. The editors have obviously recognized an important area of difficulty in modern scientific activities. To try to solve this problem with the help of a book is certainly one positive contribution. The book is mainly very well written, and the editing process has been well done. However, although the choice of subjects is certainly optimal for the editors themselves, the world of tetrapyrroles is so broad that many other interesting options did not find their way into this book, or were not covered adequately.

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