Book Reviews

Countercurrent Chromatography: Theory and Practice. Chromatographic Science Series. Volume 44. Edited by N. Bhushan Mandava (Todhunter, Mandava and Associates) and Yoichiro Ito (NIH). Marcel Dekker: New York and Basel. 1988. 752 pp. $115.00. ISBN 0-8247-7815-4.

This book is a "must" book for beginning and expert chromatographers. There a four main sections in this book: Introduction to Chromatography, Theory and Instrumentation & Countercurrent Chromatography, Applications, and Appendix.

The introduction gives a brief but good background to historical developments and chromatographic principles and techniques, including distribution isotherms, resolution, theoretical plates, Gaussian distribution, and more.

In the second part, Theory and Instrumentation, there are three chapters that describe in detail the origins, instrumentation, and theoretical aspects of countercurrent chromatography (CCC). All countercurrent techniques are described, from the classical methods of separatory funnels to the modern procedures such as countercurrent centrifugation. This part of the book includes more than half of the total pages.

The third section deals with applications and is comprised of 8 chapters totaling 312 pages. Chapters 5–7 describe the use of countercurrent techniques such as droplet, rotation locular, and centrifuged droplet as they apply to the isolation and purification of natural products. The natural products that are discussed seem to be all-inclusive, from pigments through alkaloids to flavonoids.

Chapter 8 considers the application of CCC to agricultural chemistry, with the primary focus on plant-growth regulators (indole auxins, gibberellins, cytokinins, and abscisic acid), herbicides (triazines and phenoxy classes), and insecticides (organophosphorus class).

Drug applications are dealt with in Chapter 9. Here applications for CCC isolation and purification for such compounds as valinomycin, concanamycin, actinmycin, quinomycin C, toyocamycin, and aciuicin are discussed.

The next two chapters are concerned with the biological applications of CCC. The first has to do with peptides. This is a rapidly growing area for CCC applications, due to the emphasis and progress in the biotechnology field. Presently the best system is the horizontal flow-through coil planet centrifuge, with newer instruments in the developmental stage. Such peptide applications as bombesin, cholecystokinon, and bovine insulin are discussed. The second chapter has to do with the applications of CCC to the isolation of cells and organelles. The development of CCC in this area has been slow, but it is one that holds a bright future because of low cost, automation, and high sample recoveries.

Finally, the last chapter in the applications section deals with countercurrent chromatography/mass spectrometry. This chapter is divided into three main parts. The first two describe the developments of gas chromatography/mass spectrometry (GC/MS) and liquid chromatography/mass spectrometry (LC/MS). The third part of this chapter is concerned with CCC/mass spectroscopy and how it is in its infancy because the developments are connected to the LC/MS field. It appears that the greatest potential for CCC/MS applications will be in the areas of biomolecules and synthetic polymers.

The appendix is the last major section, and it is divided into four parts: (1) four tables that list applications of CCC according to technique and solvent, (2) a glossary of terms that define general chromatographic and countercurrent chromatographic words, (3) a list of symbols used in the book, and (4) a section listing the companies, addresses, phone numbers, and countercurrent products that they have for sale.

Overall this book is excellent in dealing with a form of chromatography that is usually overlooked and forgotten. The 15 contributors fully cover CCC from theory, applications, and instruments. It is a must for anyone using or teaching chromatography.

Rodney J. Bushway, *University of Maine*

Complexation Reactions in Aquatic Systems: An Analytical Approach. By J. Baffle (University of Geneva). John Wiley and Sons: New York. 1988. xxi + 692 pp. $145.00. ISBN 0470-20830-9.

In this ambitious undertaking the author, who has obviously worked successfully in this area for quite some time, succeeds commendably in not only covering the methods used in this active and difficult area of research but also in detailing the limitations of differing approaches.

While a good background in metal complexation and modern analytical techniques is helpful, the author, however, is so meticulous in defining and presenting topics that a person with little background would benefit appreciably. The author begins with a list of symbols for easy reference, a list of definitions, the components of aquatic systems and their reactivity, as well as the composition, origin, and characteristics of aquatic organic compounds. This is followed by chapters on interpretation, properties, choice of measuring methods, and experimental determination of metal complex equilibria. The last chapters carefully analyze the study of metal ion complexation in aquatic systems via potentiometric, voltammetric, and non-electrochemical methods.

The above is a logical progression, and the comprehensive nature of the book is supported by an excellent and extensive list of references (36 pages). The liberal use of figures, tables, and illustrations is helpful as is the care in which they are presented.

In summary, an authority in the field has successfully written a comprehensive treatise on an intriguing and difficult area of research that will undoubtedly become increasingly important as environmental issues come to the fore.

Robert Nakon, *West Virginia University*

Transport Phenomena: A Unified Approach. By Robert S. Brodkey and Harry C. Hershey (The Ohio State University). McGraw-Hill: New York. 1988. XIX + 847 pp. $49.95. ISBN 0-07-007963-3.

This comprehensive treatment of transport phenomena in fluids is an excellent compilation of material essential for undergraduate and beginning graduate students. The treatment of the subject and its classification and organization in the book makes it admirably appropriate as a text. Each chapter is appended with a set of problems and a list of references. The instructors and students will thus find it a convenient and appropriate book from both the teaching and learning points of views. With proper selection of chapters, it can be adapted for a one-semester course; however, two semesters may be needed to emphasize all the major topics included in this book. The authors ought to be congratulated for their successful effort.

The subject matter in the book is arranged in three parts, each having several chapters. Part I on Basic Concepts in Transport Phenomena has 8 chapters. The reader is introduced to the subject of transport phenomena in the context of unit operations, and with the concepts of equilibrium and rate processes, intermolecular forces, etc., in Chapter 1. The microscopic mechanisms of the transport of mass, energy, and momentum and of the three corresponding transport coefficients are discussed in Chapter 2. The general balance equation is discussed at length both physically and mathematically in Chapter 3, and its detailed treatment is particularly appropriate in view of its basic importance in formulating any transport phenomena problem. The general property balance equation is treated in the context of several specific flow problems, with zero and finite convective flux momentum in Chapters 4 and 5, respectively. The topics of turbulent flow and the integral balance equation concept in solving the flow problems constitute the subject matter of Chapters 6 and 7. In Chapter 8, the dimensionless numbers and similarity ratio based procedures are outlined by resorting to simple examples. In summary, these authors through these well-planned eight chapters have presented a very lucid treatment of the increasingly complex principles of transport phenomena which students will find simple and interesting to follow and grasp. The authors should be complimented for this contribution.

The subject of applications of transport phenomena is treated in Part II of the book in five chapters. The topic of agitation is discussed in Chapter 9 including the aspects of equipment design and scaleup. The steady-state fluid flow (laminar and turbulent) through pipes (straight and curved) of smooth and rough surfaces is dealt with in Chapter 10 which also includes discussion of pipe fittings, valves, complex flow systems, noncircular conduits, and flow meters. In all these developments, the relevant transport equations derived in Part I are adequately referenced and employed. This is significant from the pedagogical viewpoint. The logical extension of heat and mass transfer in flowing fluids through ducts is treated in Chapter 11. This treatment is systematically developed starting from simple basic concepts of heat and mass transfer and their analogies. The chapter concludes with a detailed discussion on heat exchangers. The topic transport past the immersed bodies receives a detailed discussion in Chapter 12. This includes flow

over cylinders and spheres, banks of tubes, fluidization, etc. The unsteady-state transport phenomena is discussed in Chapter 13 and presents a systematic development of this intricate subject. These application oriented chapters of Part II are very well organized for their overall coverage and chronological development of the subject matter from basic concepts and transport equations derived in Part I. This is an attractive feature of this text.

A unique feature of this book is Part III on estimation of transport properties. The transport properties formulation based on simple mean-free-path kinetic theory and the results of the more rigorous mathematical theory of nonuniform gases are given in a ready form to use and illustrated by numerical examples. The status of knowledge in relation to liquids for all three transport coefficients is adequately described. Non-Newtonian fluids, so important to the chemical industry, are discussed in Chapter 15, which includes their rheological characteristics and measurements.

Five appendices contain useful information and references relevant for computation of transport phenomena problems. In conclusion, this book is a promising potential candidate for adoption, as a text, and will be liked for its organization, presentation, and treatment of the subject matter.

S. C. Saxena, *University of Illinois at Chicago*

Inorganic Reactions and Methods. Volume 2. The Formation of Bonds to Hydrogen. Part 2. Edited by J. J. Zuckerman (University of Oklahoma). VCH: Weinheim and New York. 1987. xxvi + 476 pp. $150.00 (subscription price $120.00). ISBN 0-89573-252-1.

This is one of an 18-volume series dedicated to the synthetic, rather than the structural, aspects of inorganic chemistry, and deals specifically with the methods available for preparing compounds. This series, and the volume under review, is organized systematically in terms of the elements to which a given element can be (or in some cases cannot be) bonded, and so in the present volume one finds an extensive review of the methods available for the formation of M–H bonds, where M is an element of Group VB (N-Bi), IVB (C-Pb), IIIB (B–Tl), IA (Li–Fr), IIA (Be–Ra), IB (Cu–Au), IIB (Zn–Hg), or a transition metal. This series was guided and edited by the late Prof. J. J. Zuckerman, whose untimely death is so widely regretted; in this work, he was supported by a distinguished Editorial Board.

The approach taken here is in contrast to those compilations which are based on structure or bonding, and of course any inorganic chemist must acknowledge that from a practical point of view synthesis precedes the determination of structure. Given this justification, the reviewer must ask whether the approach works. It must be acknowledged that the present volume does not encourage the casual reader, partly because it contains so much material, but then, most reviews of structural data are not readily digested either. Regarded as a work of reference, this volume is easy to use. The individual sections are clearly identified and each has its own list of references, and in addition, there is an author index, a compound (formula) index, and a general subject index, so that it is not difficult to find the material covering a specific topic. By these criteria then, the present volume achieves its purpose. I have minor reservations about the page layout and presentation, which I thought cramped and unattractive, and I noted a number of minor errors, including the horrendous use of phosphorous for the name of element 15 in some places.

If this is a typical example of the series as a whole, inorganic synthetic chemists now have a useful, accessible set of reference handbooks. The price ensures that few (other than reviewers) will have their own individual copies.

Dennis G. Tuck, *University of Windsor*

Nuclear Magnetic Resonance. Volume 17. Edited by G. A. Webb (University of Surrey). The Royal Society of Chemistry: London. 1988. xii + 484 pp. $239.00. ISBN 0-85186-402-3.

This volume belongs to the Royal Society of Chemistry's *Specialist Periodical Reports* series. It is a review of the literature in various areas of nuclear magnetic resonance (NMR) covering the period from June 1986 through May 1987. Each of the 12 chapters is contributed by a different reporter or group of reporters, all of whom are active researchers in their respective areas. The topics covered include the theory and applications of chemical shielding, the theory of spin–spin coupling, nuclear spin relaxation, solid-state NMR, multiple-pulse (solution state) NMR, NMR studies of natural macromolecules and synthetic macromolecules, the applications of NMR to conformational analysis, NMR studies of living systems (spectroscopy and imaging), NMR studies of oriented molecules (liquid crystalline systems and field-induced orientation), and NMR of heterogeneous systems. In addition, there is a list of books and review articles dealing with NMR and a useful author index for the entire volume.

Some of the chapters are primarily lists and classifications of papers published in the specified year, while others offer critical evaluations of issues, trends, and progress in their areas and therefore have something of the character of bona fide review articles. In particular, the chapters by C. J. Jameson and J. Oddershede on the theory of nuclear shielding and of spin–spin couplings provide good overviews of the state of the art in those areas. The chapter by D. L. Turner on multiple-pulse NMR is a good review of high-resolution, two-dimensional spectroscopic techniques and covers an extended period, from June 1984 to May 1987. The chapter by T. K. Halstead on heterogeneous systems should be of interest to anyone who would like a survey of the many applications of solid-state NMR to materials characterization.

Certain research areas are not given attention in proportion to their degree of current activity and interest. Chief among those is the application of both solution and solid-state NMR to biochemical problems. Because of the great quantity and potential impact of biochemical and biophysical research involving NMR, it seems that more than the allotted one chapter could be devoted to critical evaluations in this area. More coverage could also be given specifically to novel solid-state NMR techniques that are of current interest, such as dynamic nuclear polarization and two-dimensional techniques for studying molecular structure and slow molecular motions.

Robert Tycko, *AT&T Bell Laboratories*

Spectral Theory and Differential Operators. By D. E. Edmunds (University of Sussex) and W. D. Evans (University College, Cardiff). Oxford University Press: Oxford and New York. 1987. xvi + 574 pp. $115.00. ISBN 0-19-853542.

Oftentimes a text written for serious scholars in one discipline can also be of use to scholars in another discipline. In my opinion, this highly specialized and highly abstract text in the area of spectral theory and differential operators written by mathematicians for mathematicians can also be put to use by mathematically inclined chemists with research interests in quantum chemistry, statistical thermodynamics, or theoretical chemical kinetics. However, a considerable investment of time and careful study would be required to become familiar with the principles, the mathematical notation, and the plethora of definitions, corollaries, lemmas, theorems, proofs, and remarks. Indeed, one estimate of the effort involved to work through the text is one year for an advanced graduate student in mathematics.

The authors stated objective is to present recent results that have been obtained during the last decade. The language of the book is functional analysis, and a sound basic knowledge of Banach and Hilbert space theory is assumed as background. Let us turn to some details of the book. The text is composed of 12 chapters. The beginning four chapters deal with bounded linear operators in Banach spaces, closed linear operators, and sesquilinear forms in Hilbert space. In Chapter V, a treatment of Sobolev spaces is developed. The remaining seven chapters deal with second-order differential operators. Chapter VI concentrates on the weak or generalized forms of the Dirichlet and Neumann boundary-value problems. Chapter VII discusses second-order properties on arbitrary open sets; the Hamiltonian operator arises here as a special case. Chapter VIII has as the central result that the Hamiltonian operator with a real potential function and bounded below has a wholly discrete spectrum. Chapter IX studies, in part, the essential spectra of closed operators in Banach and Hilbert spaces. Chapter X develops a Decomposition Principle for partial differential operators as a perturbational result and this is then used to locate the essential spectra of a general second-order operator. The last two chapters deal with eigenvalues and singular values of the Dirichlet and Neumann problems for the Hamiltonian operator and may be the sections of most use to the chemists who tackle this book. The case of the potential function being real and hence the Hamiltonian being self-adjoint is presented in Chapter XI. The main result here is the determination of the number of eigenvalues less than a given eigenvalue. In Chapter XII the potential function is complex and estimates of the number of singular values less than a given eigenvalue are obtained.

In summary, the text is written at a very advanced mathematical level. Given that one can invest considerable time and careful study, a firm up-to-date foundation in differential operators should be established by working through this book. The effort should be well worth it for those so inclined.

Daniel Zeroka, *Lehigh University*

Basic Principles of Colloid Science. By D. H. Everett (University of Bristol). The Royal Society of Chemistry: London. 1988. xv + 243 pp. £9.95. ISBN 0-85186-443-0.

This paper-back book is well organized and very well written. There is a good mix of theoretical treatment and practical applications. Of necessity in such an introductory work, all of the treatments are fairly condensed and do not go into great depth but are easy to follow in general. The book will be very useful as an introduction to the subject of colloid chemistry.

It is organized along the lines of principles of stabilizing and preparing colloidal systems, methods of investigation of colloidal systems, and ways of destroying colloidal systems by coagulation etc. Methods of investigation discussed include kinetic studies, scattering of radiation, and rheological studies. Associational colloids are covered nicely as are foams, films, and emulsions. Industrial applications are given a reasonable perspective, but basic principles are emphasized. Numerous suggestions for further reading in the various subject areas are organized by chapter and included in an appendix.

The author is British and understandably uses British spelling and examples, which in one or two cases may be a bit strange to those not familiar with the terminology. A much more serious flaw or departure from traditional usage occurs with the use of ΔQ and ΔW instead of the traditional Q and W for the path functions or integrals of the imperfect differentials dQ and dW for heat and work respectively on pages 28 ff.

Raymond L. Venable, *University of Missouri–Rolla*

Iron Transport in Microbes, Plants, and Animals. Edited by G. Winkelman (University of Tubingen) et al. VCH: Weinheim and New York. 1987. xxiv + 533 pp. $125.00. ISBN 3-527-26685-2.

The abundance of iron in the earth's crust, its extraordinarily flexible coordination chemistry, and its ready participation in redox reactions presumably all conspired during the early period of the evolution of life to make this element essential to living organisms. Thus, in virtually all organisms, iron is an essential co-factor for a wide variety of proteins, including cytochromes, and many enzymes involved in oxidation reduction reactions. The organisms' exquisite need for iron was readily satisfied by its high concentration in the environment. Unfortunately, one of the most successful evolutionary developments, photosynthesis, gradually changed this happy primordial picture of biological iron metabolism. Perhaps the first great ecological disaster confronting life on this planet was the gradual and remarkable change of the earth's atmosphere by the introduction of oxygen. The development of an oxidative environment posed a severe threat to all forms of life. Presumably, those life forms that did survive this environmental revolution were specifically selected for their ability to survive in an oxidative environment. The effects of the oxidative nature of the atmosphere were nowhere more dramatically felt than in the area of iron metabolism. The problems of iron metabolism that all organisms now confront were defined by this ecologic change. Two phenomena characterized this iron crisis:

(1) Ferrous iron became oxidized to ferric iron. At neutral pH, the solubility constant for ferric hydroxide is approximately 10^{-38}. This translates to a free concentration of ferric iron at neutral pH of approximately 10^{-18} M. Thus, despite the continued extraordinary abundance of iron, its solubility precluded availability at a level compatible with life. Thus, the first and perhaps most pressing problem encountered by organisms as the earth passed from a reducing to an oxidizing atmosphere was the need to find a way to acquire iron that, because of its insolubility, had become unavailable.

(2) In the presence of oxygen and hydrogen peroxide, iron is a catalytic generator of dangerous hydroxide radicals. Thus, in the new environment, this critical nutrient had also become an extremely toxic agent.

In most organisms, the ability to obtain iron is strictly correlated with the ability of the organism to grow. In fact, for many if not most cells, iron availability is the rate-limiting step for growth. In addition, because of the toxicity of iron, cells have developed mechanisms for the regulation of its uptake, the detoxification of excess iron, and other means to protect cellular components from the oxidative damage that can be generated by this element. Understanding the details of iron metabolism will have profound impact on a number of areas, including agriculture, infectious disease, and problems with the regulation of cell proliferation. In addition, recent work in a variety of systems has established iron homeostasis as a superb model system for understanding mechanisms of gene regulation. Because of the new universality recognized in biology of the problems that organisms encounter in solving the challenges of iron homeostasis, the information about iron metabolism has been accrued in a wide range of disparate disciplines. This poses a problem for the many investigators whose work, either directly or indirectly, concerns iron metabolism: How does one gain access to the far-flung literature about iron metabolism? In the recently published book *Iron Transport in Microbes, Plants, and Animals*, a major step has been taken toward answering this problem. The editors have put together a book that covers an extremely wide range of topics about how organisms acquire iron from our oxidative, and therefore hostile, environment. As stated in the title, this volume attempts to address only one aspect of general iron metabolism, and that is the problem of acquisition of iron. Although this is referred to in the title as iron transport, we know very little about the mechanism of transport and the title should, perhaps, more accurately read "Iron Acquisition...".

In 26 chapters, the volume covers iron acquisition in a wide variety of bacteria, in plants, and finally in animals. The discussion of microbial iron acquisition strategies is the most extensive, comprising approximately two-thirds of the book. The volume is well organized into a variety of sections. The first part deals with the molecular biology and biochemistry of iron acquisition systems. Included are chapters that cover now classic work on the molecular biology of iron uptake systems in bacteria. Although some of these chapters tend to be a bit repetitive of each other, they are generally well-written and filled with information. Not only is there an attempt to describe the genes and gene products involved in regulated iron uptake, but an excellent chapter by Kadner et al. addresses the problem of iron uptake in terms of more general problems of transport. The second section of the book concerns the chemistry of microbial iron transport systems. In particular, chapters in this section deal with the structure, biosynthesis, and function of bacterial siderophores. Two particularly interesting chapters in this section expand the scope of the book. One chapter by Thomas Emery explores the data and arguments in favor of mechanisms that are involved in reduction of ferric iron as a prerequisite for iron assimilation into cells. This is a well-written and extremely useful chapter. The chapter on Mössbauer Spectroscopy by Berthold Matzanke is an excellent description of how this spectroscopic technique can be used to elucidate steps in iron transport.

The third part of the book is one of the most interesting and concerns strategies for iron acquisition in higher plants. These chapters underscore the breadth of this volume. Plants have provided a wealth of information about strategies for iron uptake. The chapters by Fritz Bienfait and Volker Romheld are two of the best in the book. They emphasize both the critical nature of iron availability for plant growth and the wide variety of responses and strategies that different plants utilize to solve the problem of the uptake of this essential nutrient from the soil. For those of us interested in human iron metabolism, the lessons from the plant system are welcome sources of information indeed. The chapter on the relationship between iron metabolism and plant-bacterial symbiosis in the rhizosphere is most interesting and points to an important agricultural application of understanding both plant and microbial iron metabolism.

The final section of the book comprises four chapters dedicated to iron transport in animals. Two of these chapters by Harrison et al. and by Thiel and Aisen are good reviews that focus largely on ferritin. Little in this section really addresses iron acquisition, except for the discussion by Thiel and Aisen on transferrin and the transferrin receptor. Although these are well-written and information-rich chapters, they contain material that has been published in numerous reviews by the same authors. They are somewhat weaker than the rest of the book, only because they do not attempt to address the problems and unanswered questions in cellular iron assimilation. The chapter by Gunther Sawatzki in this section on the role of iron binding proteins in bacterial infections addresses an interesting problem, but one where data are vague, and I think the conclusions drawn in this chapter may be somewhat overstated.

A book like this suffers from the problems inherent in any collection of 26 different chapters. That is, that often there is repetition, nonuniformity in style, and a tremendous range in the quality of each chapter. Despite this, the chapters are generally well-written and well-referenced. My reservations about this book are few and overall I think the editors have put together a superb volume that fills an important need in the scientific literature. I think anybody working either centrally or peripherally in problems of metal metabolism in general and iron metabolism specifically will want to own this volume both as a reference text as well as a source of pleasurable reading that undoubtedly will expand any individual's appreciation of the range and richness underlying the biology of iron metabolism.

Richard Klausner, *Department of Health and Human Services*

Pretreatment in Chemical Water and Wastewater Treatment. Edited by H. H. Hahn and R. Klute (University of Karlsruhe). Springer Verlag: Berlin and New York. 1988. xi + 356 pp. $55.90. ISBN 3-540-19423-1 (Berlin) and 0-387-19423-1 (New York).

This book contains papers presented at the 3rd Gothenburg Symposium in June 1988. It is divided into three major sections: I. Water Supply; II. Industrial Discharges; III. Wastewater and Sludge. The editing job is superior. Each paper is nicely organized and the material is succinctly presented. The work presented is mainly concerned with processes for treating water to meet government standards in various European countries. The overall quality of the papers seems good enough to be of general interest to anyone concerned with chemical water and wastewater treatment.

James S. Fritz, *Iowa State University*