in memory, and allows the addition of add new data to a digitized plot recalled from disk.

Un-Plot-It has both advantages and disadvantages. It is a fairly inexpensive package, extremely simple to set up and operate. It works reliably and accurately when the given directions are followed. However, it is considerably slow (especially in raster mode), and in the line-follow mode the graph must be "cleaned up" prior to digitization. All in all, the best feature of Un-Plot-It is its modest price. It can be a very useful and valuable tool for those users who would like to have the capability to digitize data (i.e. spectra, chromatographs, voltammograms, strip-chart, and *xy* recorder outputs) without investing a fortune on more sophisticated digitizing hardware.

G. M. **Bommarito**, *Cornell University*

*Book Reviews**

Transport Properties of Ions in Gases. By Edward A. Mason (Brown University) and Earl W. McDaniel (Georgia Institute of Technology). John Wiley & Sons: New York and Chichester. 1988. xvi + 560 pp. $54.95. ISBN 0471-88385-9.

This is an excellent book on the kinetic theory of weakly ionized plasmas that I found to be enjoyable reading. I believe this monograph qualifies to be one of the many "classics" that should be on the shelves of most chemical physicists. I was introduced to kinetic theory in the mid-1960s, and my teacher was none other than Prof. Edward Mason. His classes were a real delight in savoring how a good scientist seeks to combine physical insight with mathematical manipulation. Mason relished emphasizing the physical aspects of kinetic theory. He loved to embellish his lectures with anecdotes from his substantial store of kinetic theory folklore. This style of teaching is one that surfaces continually even in a text as complicated as this one. I remember one beautiful example of Mason's classroom style (and by extension his writing style) where he asked us students the question which of the three laws of Newtonian physical dynamics is the law that contains the most physical content. The answer is the third law. In this case, the physical concepts of potential energy and the idea of action at a distance are invoked while the other two laws introduce definitions.

McDaniel has his own way of looking at nature that resonates readily with Mason's style. Early on, I heard a story of how McDaniel went about taking his French language exam in graduate school. Having procrastinated in preparing for the written exam, the time came when McDaniel had only a weekend to go and the whole book to study. Whereupon he purchased a bottle of French wine, a loaf of French bread, and commenced his studies in front of his fireplace. When completing the mastery of a page, he would rip it out of his book and tossed it crumpled up into the fireplace, the rationale being that this way he would be sure to learn the material. Needless to say, McDaniel went on to greater things.

It is no surprise then that the two have produced a gem of a book. The work is beautifully written and well organized. The book is a delightful mixture of penetrating discussions combining numerical and analytical mathematical techniques with relevant physical insight. Although at first glance the book may seem highly mathematically oriented, this is not really true. Quite a bit of experimental work is reviewed, and almost every page contains explicit reference to experimental result, whether as a guide in developing the theory or whether as a standard that determines how well the theoretical development might be working.

Chapters 1–4 contain the core of the experimental sections centering upon a discussion of the drift tube apparatus and the theory of analysis of the data. These introductory chapters emphasize the description of the various methods that measure ion transport kinetic parameters. The drift tube instrument, in particular, has produced important laboratory measurements of critical ion-neutral reactions that represent the core of our understanding of the interface between the weakly ionized plasma and the neutral atmosphere. Also included is a review of the laboratory techniques pertaining to the study of the afterglow which also represent an environment of weakly ionized plasma. The appendices contain a wealth of information on experimental parameters such as mobilities, transverse diffusion coefficients, transport cross sections for several model potential functions, and polarizabilities for numerous atoms and molecules. Added to this is a substantial list of data references suitable for most needs.

Then, the emphasis of the book turns to a thorough review of the theoretical developments pertaining to the calculations of the transport properties of partially ionized gases. Substantial improvements in the rigor of the kinetic theory emerged in the last 15 years, and these are all brought together with a standard notation and the same even level of treatment throughout.

Part of the reason for this progress is that the drift tube experiment seeks to measure kinetic parameters for steady-state conditions. The thrust of the theoretical developments recognizes that for this experiment the Boltzmann equation provides too general a description. Hence, if one were willing to accept a trade of less physical information for a more precise and manageable theory, then the Boltzmann equation may be revised to get theoretical relations connecting the transport coefficients measured in the drift tube experiment with the properties of a model two-body potential. Then it becomes possible to calculate the needed parameters without having to do each and every experiment to get the necessary data.

The details of this transformation represent the heart of this book. The concept of moment equations, which represents the expansion of the Boltzmann equation with respect to the distribution function, is shown to represent a powerful method by which one can choose the level at which the physical description of the weakly ionized plasma may apply. One seeks to close the hierarchy of equations by introducing the proper basis function and truncating the series at the appropriate level. The question of the rate of convergence becomes essential to evaluating the success of the approach chosen.

Up to the middle of the 1970s, the kinetic theory of weakly ionized gases was caught up with the problems of working out these relations for nearly equilibrium situations where the distribution function is very nearly Maxwellian. This work formed the body of results that has become identified as the one temperature theory. Then a breakthrough came by reworking the theory to accept basis functions that allowed an adjustable "basis" temperature to be applied to describe separately the behavior of the ion population. This modification of the theory, designated as the two temperature theory, was greatly successful in moving the bounds of application of the theory to higher electric field strengths. Then the concept of the basis temperature was further modified and extended in a "three temperature theory" to allow for the effects of molecular anisotropy that become manifested by the behavior of these ions in the presence of an electric field.

The pathways throughout the enormous thicket of mathematical developments are well marked. Again and again, one gets the feeling of being led along these paths by an eloquent tour guide that stops at sightseeing positions along the way to point out the particular difficulties of the climb to that vantage point. Throughout, the authors take pains to bring their physical insights into play as a way of making easier the understanding of the complicated mathematical developments. In doing so, a useful tool of the narrative presentation is the embediment of dry humor that provides a nice change of pace to the flow of the narrative.

The authors are careful to point out that creativity and ingenuity are important assets in the choice of the path's continuation. Also, the authors continue to remind us that one has the computational power of the computer at one's disposal. Sometimes a sequence of complicated analytical manipulations may be necessary to reach the goal sought, but one forgets that the goal is not the elegance of the theory but to achieve a result. The authors often will point out how this goal may be achieved more readily through the computer which, for example, can be applied to provide numerical evaluations of difficult integrals easily by brute force calculations.

The book closes with a chapter on special topics relating to the applications of the several layers of the theory on gaseous transport. The ion mobility spectrometer is an instrument that uses a time-of-drift technique to separate for identification ions of different mobilities. This technique is similar to that of gas chromatography and can be quite sensitive to small traces of various species. The large ions relating to smokes and aerosols is another type of weakly ionized plasma that can

*Unsigned book reviews are by the Book Review Editor.

be handled with the theory of this book. However, there are times when a state of runaway exists, which refers to the conditions under which the moment equations do not converge with the basis set chosen. An example provided is the case of a mixture of H^+ ions in helium. A section on ion-molecule reactions closes the last chapter survey by reviewing how the rate constant for a particular ion-molecule reaction may be calculated from a measurement of a kinetic transport parameter. Indication as to how accurate this calculation may be is also provided.

In summary, this book is a fitting testament to the work of a lifetime.

John W. Meriwether, *Geophysics Laboratory (AFSC)*

The Determination of Trace Metals in Natural Waters. Edited by T. S. West (The Macaulay Institute) and H. W. Nürnberg (Institut für Chemie der Kernforschungsanlage). Blackwell: Oxford and Palo Alto. 1988. xviii + 362 pp. $52.50. ISBN 0-632-02021-0.

This book, which focuses primarily on the determination of 10 biosignificant trace metals (Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Se, and Zn) in natural waters, was evolved by the Analytical Chemistry Division of the IUPAC several years ago and written by some 31 international experts. It is divided into 10 sections: (1) Spectrophotometric and Fluorimetric Methods, 62 pages, is given at the level of practical detail as in a laboratory manual because such methods are likely to be applicable in most laboratories; it is arranged by element. (2) Atomic-, Mass-, X-ray-Spectrometric Methods, Electronparamagnetic and Luminescence Methods, 60 pages, includes discussion of arc, spark, ICP, and MIP emission sources; atomic absorption; and spark-source mass spectrometry. (3) Voltammetric Methods, 28 pages, includes details of sampling and sample preparation and preservation techniques. (4) Neutron Activation Analysis, 10 pages. (5) Measurement of pH in Natural Waters, 18 pages, discusses fundamental and practical considerations, and procedures for freshwaters and seawaters.

Speciation, which is of profound importance for the chemical, biological, and physical reactivity of trace metals, is discussed in detail in the next five sections. (6) Electroanalytical Measurement of Trace Metals Complexation, 54 pages, includes potentiometric and voltammetric methods. (7) Trace Metal Complexation by Inorganic Ligands in Sea Water, 22 pages. (8) Adsorption of Trace Elements by Suspended Particulate Matter in Aquatic Systems, 32 pages. (9) Physicochemical Speciation of Trace Elements in Oxygenated Estuarine Waters, 36 pages. (10) Chemical Mechanisms Operating in Sea Water, 34 pages, includes discussion of redox, biological, adsorption, and solubility mechanisms.

As to be expected with any multi-author-edited work, there are drawbacks—some variation in depth and degree of detail, organization, and focus. Nevertheless, the book reads fairly smoothly, attesting to considerable work on the editors' part. The time and logistical complexity required to put together such a work is evident in the dates of references in the various sections: Few references are later than 1982, and the latest seems to be only one from 1986. Therefore, some of the discussion is probably somewhat dated.

Despite these minor complaints, I would strongly recommend this book for any laboratory or research group involved in the quality control or analysis of natural waters for trace metals and in metal-ion speciation. Many of the sections offer a wealth of experimental detail and practical considerations which should prove invaluable for such laboratories. These are good reviews, compiled and written by acknowledged experts in their areas. Approaches, techniques, and choice of methods are critically evaluated, and guidelines for reliable methodology are generally given.

James E. O'Reilly, *University of Kentucky*

Symmetry in Molecules and Crystals. By M. F. C. Ladd (University of Surrey). John Wiley & Sons: New York and Chichester. 1989. 274 pp. $51.95. ISBN 0-470-21376-0.

I feel the title of this book will be somewhat misleading to U.S. chemists. The emphasis of the coverage is heavily directed toward crystal symmetry. Thus, an advanced undergraduate or graduate student in chemistry approaching this text to learn about molecular symmetry would have to skip and pick judiciously. For example, the major emphasis on the Hermann–Mauguin nomenclature will find little sympathy among instructors offering courses on molecular symmetry.

Be that as it may, as a crystallographer who has difficulty finding texts that provide a clear and detailed treatment of symmetry in crystals, I can offer a warm welcome to this book. It takes the reader clearly and with sufficient rigor through crystal geometry, point symmetry, the introduction of the repeating motif, and the development of space groups. The book concludes with chapters on X-ray diffraction, an introduction to group theory, and a brief discussion of its application in chemistry. I consider these last chapters to be the least valuable part of the text, since Dr. Ladd has already collaborated with R. A. Palmer on an excellent text on X-ray analysis, and the applications of group theory to chemistry have been covered in much greater depth elsewhere, beginning with Cotton's landmark text. I wish I could share the author's optimism about spectroscopists and crystallographers agreeing to a common nomenclature.

However, as an introduction to the symmetry of crystals, Dr. Ladd's text definitely deserves to find a place in all chemistry, materials science, and mineralogy libraries, and on the shelves and desks of all crystallographers. It is clearly written, effectively illustrated with a liberal use of stereoscopic views of crystals and molecules, and serves as an excellent guide to the aspiring student in crystallography. I consider it to be an invaluable primer for someone who wishes to use the crystallographer's bible *The International Tables for X-ray Crystallography*. Worthy of special mention is the development of the crystallographic point groups. The possibilities for combinations of symmetry elements are explained in depth, not as is usually the case just presented to the reader. This section is also appropriately illustrated with stereoviews of molecules (real or hypothetical) that adopt the 32 crystallographic point groups.

Iain C. Paul, *University of Illinois*

Schrödinger, Centenary Celebration of a Polymath. Edited by C. W. Kilmister (University of London). Cambridge University: Cambridge. 1989. ix + 253 pp. $22.95. ISBN 0-521-37929-6 (paperback).

This volume includes 19 well-written contributions, illuminating different aspects of Schrödinger's life-work and its consequences. The emphasis is on science (though three well-written biographic chapters are present), Schrödinger's irrelevant personal eccentricities being ignored. Among the highlights of the work: chapters by Karplus, Fukui, Buckingham, Lewis, McConnel, Hittmair, Hawking, Salam, Kibble, and Seaton reveal the modern consequences of Schrödinger's work on every branch of science, from molecular dynamics and chemical reactions to particle physics, cosmology, and astronomy. Surely almost no other scientist (Newton, Maxwell, and Gibbs being among the very few exceptions) has had his work impact so wide a range of fields.

Among the other chapters, Pauling and Perutz each discuss Schrödinger's essay *What is Life*?, leaving the impression that this work was more influential when less carefully read. Thirring's chapter on rigorous consequences of the Schrödinger equation becomes a catalogue of standard errors in physical chemistry texts; it should be mandatory reading for would-be textbook authors. Dorling takes the role of an advocate, inquiring how the original interpretation of Ψ might be revived under modern conditions; in doing so, he reviews a wide variety of disturbing results, such as Barut and Kraus's demonstration that the Dirac equation for an extended electron (a nonlinear problem) predicts the Lamb shift without requiring second quantization. C. N. Yang emphasizes the historical significance of $i = \sqrt{-1}$ and its appearance in a physical picture of the world. All-in-all, this volume is a worthy tribute to one of the great scientists of this century.

George D. J. Phillies, *Worcester Polytechnic Institute*

Topics in Current Chemistry 147. Synchrotron Radiation in Chemistry and Biology II. Edited by E. Mandelkow (Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.). Springer Verlag: New York and Berlin. 1988. 166 pp. $69.50. ISBN 0-387-19040-6.

This is the second of three volumes devoted to applications of the unique features of intense X-ray sources to specific chemical and biological problems, using X-ray diffraction absorption and spectroscopy. It captures the unique international scope and flavor of synchrotron radiation research by combining reports from work done in six different world-class national facilities.

The material falls within three different broad groupings: structure of biological materials, overlayers on metal and semiconductors, and new instrumentation.

The article (K. J. V. Poole, G. Rapp, Y. Maëda, and R. S. Goody) on static and dynamic studies of mechanisms associated with insect flight muscle is of special interest to those seeking a critical overviw on the cross-bridge mechanisms of muscle contraction. This is followed by another informative article on the remarkably successful technique of X-ray crystallographic analysis of protein structures (I. D. Glover, J. R. Helliwell, and M. Z. Papiz). Use of the Laue diffraction method combined with synchrotron radiation provides a sufficient rate of data collection to investigate effectively the crystal kinetics and catalytic intermediate reaction rates in the subsecond regime characteristic of protein structural transformations.

The following article (K. S. Bartels, G. Weber, S. Weinstein, H.-G. Wittmann, and A. Yonath) describes how an intense X-ray source provides an important approach to the difficult problem of investigating the chemical and physical properties of ribosomes. These materials comprise a unique assembly of several strands of RNA and of a large number of different proteins. One larger and one smaller subunit associate to form the actin cell organelle that reads genetic information from the messenger RNA and translates it into a specific polypeptide chain. The article reviews how synchrotron radiation studies make a significant contribution

to a more exact understanding of the function of ribosomes.

Of a more tutorial flavor is the subsequent article (S. Hasnain) which reviews various EXAFS and XANE applications to a variety of biochemical systems. In comparison to X-ray absorption techniques is the complementary application of diffraction studies using synchrotron radiation (Y. Amemiya, Y. Satow, T. Matsushita, J. Chikawa, K. Wakabayashi, and J. Miyahara). Using a storage phosphor imaging plate detector, new results on the structure determination of a variety of important biological systems are described including contracting muscle, cytochrome, an ω-amino acid and stretched polymer sheet. The present and future possibilities of a new synchrotron radiation technique called "photoacoustic spectroscopy" used in the X-ray region is reviewed next. A variety of possible modes for the application of this novel approach to the structure analysis of inorganic or metal systems is covered. The spectroscopic study of the associated heat generation effect is used to reveal hitherto difficult-to-measure crystallographic and electronic features of relatively simple metal systems. It is premature to predict how effective applications of X-ray photoacoustic spectroscopy will prove to be.

The structure, dynamics, and growth mechanisms of the very interesting class of materials comprising metal–metal and metal–semiconductor interfaces by means of surface extended X-ray absorption fine structure (SEXAFS) comprises the last article. The authors (D. Chandesris, P. Roubin, and G. Rossi) present an authoritative review of the recent advantages of studies of the atomic arrangements at the early stage of formation of metal–metal, metal–semiconductor, and semiconductor–semiconductor heterojunctions together with the structure of the electronic states. It is a remarkably clear and self-contained presentation of these important technological phenomena.

In summary, this relatively slim and modest volume presents a collection of cogently presented overviews of recent advances in the structure of a variety of specific biological and inorganic systems made possible by innovative applications of the unique features of synchrotron radiation.

Thor N. Rhodin, *Cornell University*

Analytical Profiles of Drug Substances. Volume 18. Edited by Klaus Florey (Squibb Institute for Medical Research). Academic: San Diego and New York. 1989. viii + 646 pp. $69.95. ISBN 0-12-260818-6.

This series provides additional information to supplement official compendia of drugs. In this volume, 16 drugs are described by mentioning uses and properties, and giving alternative names, structural formulas, physical characteristics (including extensive spectroscopic data), synthesis, pharmacology, and methods of analysis. Among the important drugs included are cycloserine, fluorouracil, and thiamine hydrochloride.

Organometallic Chemistry: Volume 16. Edited by E. W. Abel (University of Exeter) and F. G. A. Stone (University of Bristol). The Royal Society of Chemistry: London. 1987. xviii + 525 pp. $240.00. ISBN 0-85186-641-7.

This Specialist Periodical Report, covering the year 1986 and employing essentially the same reviewers, continues the pattern established in previous volumes. The chapter headings are essentially unchanged and consist, once again, of the following (some abbreviated): [number of references, any significant increase (up) or decrease (down) of activity in this area since Volume 10, 1980, as approximated by the change in number of refs provided]. 1, Group I (79 refs); 2, Group II (67); 3, Boron, excluding carboboranes (137, down); 4, Carboboranes (88); 5, Group III (73); 6, Group IV (73, down); 7, Group V (35, up); 8, Metal carbonyls (152, up); 9, Organometallic compounds containing metal–metal bonds (479 refs, up); 10, Ligand substitution reactions of metal and organometal carbonyls (213, up); 11, Complexes containing metal–carbon σ-bonds, Sc to Mn, including carbenes and carbynes (307, threefold increase!); 12, Complexes containing metal–carbon σ-bonds, Fe, Co, Ni (310, up); 13, Metal–hydrocarbon π-Complexes (excluding π-cyclopentadienyl and π-arene) (320); 14, π-Cyclopentadienyl, π-arene, and related complexes (332); 15, Homogeneous catalysis by transition metal complexes (378); 16, Structures of organometallic compounds determined by diffraction methods (1382, almost doubled). The useful chapter Organometallic Compounds in Biological Chemistry is not provided; it will apparently revert to a biennial offering. An awesome 1869 structures were determined by diffraction methods, underlining the increased activity in this area. Yet another revealing statistic: approximately 157 of the book's 525 pages, (*some 30% of the book's space*) are devoted to reporting 4762 references.

That this is a splendid, most useful series is not a matter of question. The present volume tersely fulfills the general aim "to provide systematic and detailed review coverage of progress in the major areas of chemical research". But this reviewer is troubled by the following thoughts: The present volume, 16th in the series, costs over $200. And it is no longer sufficient to note that it is out of reach of most of even the more serious researchers for his/her private library. With the current sharp curtailment of library budgets, purchase of *all* admirable reference materials is no longer practiced. In an increasing climate of cost-accounting, how does one rank the various Specialist Periodical Reports against alternative annual reports, reviews, or surveys? (A very approximate count of the Specialist Periodical Report series gave a total of 320 volumes under 40 different titles.) Obviously, this concern cannot be seriously addressed here. It should however be addressed, formally, and in detail, beyond letting the marketplace, traditional considerations (and, perhaps, nonsystematic book reviewing) resolve it.

Volume 16, like its predecessors, admirably fulfills its goals.

J. H. Stocker, *University of New Orleans*

Organometallic Chemistry Reviews, Journal of Organometallic Chemistry Library 20. Edited by A. G. Davis (University College, London) E. O. Fisher (Technische Universität, München) and O. A. Reutov (University of Moscow). Elsevier: New York and Amsterdam. 1988. 364 pp. $155.25. ISBN 0-444-42950-6.

Five reviews are provided: (a) Synthesis and Properties of Carbaboranes (12) Containing Boron-Element Bonds, by Grushin, Bregadze, and Kalinin (Moscow), 68 pages and 204 references of which approximately 150 are to the USSR literature. Coverage is barely into 1985, no later references were observed. This extensive coverage of the USSR literature may well be the chapter's greatest value to a U.S. audience.

(b) Pyridine and Quinoline Derivatives of Group IVB Elements, by Lukevics and Segal (Riga), 142 pages and 423 broad-ranging references. A highly systematic coverage of the synthesis, the physical, chemical, and biological properties as well as some of the application of the Si, Ge, Sn, and Pb derivatives. Some tables of vertical ionization potentials and chemical shifts (^{1}H, ^{29}Si, and ^{119}Sn) of appropriate compounds are included.

(c) Phase-Transfer Catalysis in Organosilicon Chemistry, by Goldberg, Dirnens, and Lukevics (Riga), 37 pages and 85 references, which range broadly and into 1986. Some of the coverage is devoted to the Ge and Sn analogues. This chapter effectively complements the previous one.

(d) Rhenium Carbonyl and Organometallic Compounds: Analysis and Classification of Crystallographic and Structural Data, by Holloway (Ontario) and Melnik (Bratislava), a very meaty 94 pages with a significant number of the 217 references right up to the submission date in 1987. Extensive tables are employed.

(e) Metallocendichalkogenolen-metallocyclen Chelatkomplexe Electronenarmen Übergangsmetalle, by Klapötke and Köpf (Berlin). A short (22 page) report, in German, 59 references.

The several chapters have been edited for smooth reading and no gross typos were noted. There are minor differences in style (e.g., reporting of references) that are not important.

This volume is not one of the series' familiar Annual Surveys nor is it a symposium or common theme report. Accordingly, it is somewhat difficult to target its intended audience. While it is clearly directed to the specialist, it seems unlikely that any potential candidate would be uniquely interested in more than one or two of the chapters.

The individual chapters provide responsible (and occasionally extended) coverage of their titles. Where budgets permit, the book is recommended for library purchase.

J. H. Stocker, *University of New Orleans*

The Chemistry of Antitumor Antibiotics. Volume 2. By William A. Remers (University of Arizona). John Wiley & Sons: New York and Chichester. 1988. viii + 290 pp. $49.95. ISBN 0471-08180-9.

This volume is the second in Remers' review series on antitumor antibiotics and focuses on some newer antibiotic classes that were not covered in the first volume. These include streptozocin; pyrrolo(1,4)-benzodiazepines; saframycins, renieramycins, and safracins; naphthyridinomycin, cyanocyclines and Quinocaricin; CC-1065; nogalamycin and related compounds; and streptonigrin and lavendamycin.

Each class (chapter) is treated in a similar manner. This begins with Discovery, Isolation and Characterization, followed by Structure Elucidation and Chemical Transformations, and Mode of Action. These subsections set the stage for those on Synthesis, Biosynthesis and Transformations, and Structure–Activity Relationships. Finally, a generous bibliography closes each chapter.

This work serves as a good illustration of the process of drug discovery through development in this interesting and diverse class of compound types. Remers does an excellent job of weaving together the areas of natural products chemistry, biochemistry, organic synthesis, and medicinal chemistry, using the subject classes as a platform. Of the numerous compounds mentioned in this work, streptozocin is the only one that is currently in use (in cancer chemotherapy), as most of these compounds

are too toxic for clinical use.

James A. Thomas, *Warner Lambert Co.*

Cauldrons in the Cosmos: Nuclear Astrophysics. By C. E. Rolfs (University of Munster) and W. S. Rodney (National Science Foundation). University of Chicago: Chicago and London. 1988. xviii + 561 pp. $34.95. ISBN 0-226-72457-3 (paperback). $74.95. ISBN 0-226-72456-5.

This book represents an impressive effort by Rolfs and Rodney to create an up-to-date account of the underlying principles and problems encountered in the field of nuclear astrophysics. As best summarized by W. A. Fowler in his foreword, this book constitutes an invaluable reference source for those who wish to understand how nuclear processes generate stellar energy and, in so doing, synthesize the chemical elements from the hydrogen and helium ashes of the big bang explosion that formed our universe.

This book is divided into 10 chapters, and some familiarity with quantum and statistical mechanics, as well as the basic principles of nuclear physics, is a helpful, although not essential, prerequisite for the reader. In the first two chapters the authors review the observational foundations of nuclear astrophysics—stellar classifications, the abundances of chemical elements and the characteristics of our expanding universe—and also address big bang cosmology and nucleosynthesis of the lightest elements in the early universe. Chapter 3 presents a good general primer on the salient nuclear principles required for nuclear astrophysics and thermonuclear reaction-rate theory (which chemists will find quite familiar). In the following chapter, rate theory and the role of resonances are dealt with in depth, and the discussion is primarily of interest to the those with a more theoretical bent.

One of my few criticisms of this book is the placement of Chapter 5, which deals with the equipment and methods employed in experimental studies of nuclear astrophysics problems; it comprises nearly 25% of the book. The authors do an excellent job of bringing to light the complexities involved in the nuclear measurements—this is something rarely found in such accounts and the authors are to be commended for its inclusion. However, for all but the specialist, I suspect that this chapter will serve to break up the continuity of the narrative.

In Chapters 6–9, details of the various stages of stellar evolution are traced from hydrogen burning in Main Sequence stars to helium burning in Red Giants to the explosive phenomena responsible for heavy-element synthesis in novae and supernovae. At the end of this discussion, the principles of cosmochronology, through which we date the history of our solar system, are reviewed. The final chapter examines the three current topics in which chemists have played an active role: measurement of solar neutrinos, the study of isotopic anomalies as they relate to the history of the solar system, and the nucleosynthesis of Li, Be, and B in galactic cosmic-ray interactions.

The book is well illustrated and contains many helpful diagrams. The appendices, references, and index seem to be thoughtfully prepared.

In addition to its value as a reference source, this book is designed to serve as a textbook for a two-semester course in nuclear astrophysics (although it includes no problems for this purpose). It could also be readily adapted to a one-semester graduate course for students in nuclear, physical, and geochemistry. Chapters 1–3 and 6–10, properly abbreviated, could serve such an audience quite well. In this regard the authors have sectioned the chapters in such a way as to accommodate the logical assignment of selected topics.

In summary, this book is a valuable contribution to the field of nuclear astrophysics, both as a reference source and a text.

V. E. Viola, *Indiana University*

Purification of Laboratory Chemicals. Third Edition. By D. D. Perrin and W. L. F. Armarego (Australian National University). Pergamon: New York. 1988. xii + 391 pp. $75.00. ISBN 0-08-034715-0.

Professors Perrin and Armarego have done a commendable job in updating what has become a classic reference. Visually this edition has significantly improved from the previous edition. Enlarging the pages and printing the book with a laser printer makes it more aesthetically appealing. More importantly, the amount of information has substantially increased. Additional chemicals have been added to the book and almost every entry now has the Chemical Abstracts registry number and molecular weight. Liquids have freezing point, boiling point, refractive index, and density information. Solids include a melting point and an occasional boiling point. Chiral molecules list a specific rotation. Unique hazards are also listed for some chemicals.

Chapters 1 and 2 cover physical and chemical methods of purification. The most notable revision to Chapter 1 is the inclusion of a small section dedicated to the hazards of chemical manipulation. Chapter 3, The Purification of Organic Chemicals, and Chapter 4, Purification of Inorganic and Metal-Organic Chemicals, comprise the largest section in the book. Some chemists may be tempted to question the relevance of these two sections due to the commercial availability of a wide variety of high-purity chemicals. However, the inclusion of probable impurities and some literature references for at least half of the entries continues to make this book a valuable addition to any bench chemist's library. Chapter 5 covers general methods of purifying classes of organic compounds and is useful in supplying information to aid the chemist who needs to purify a chemical not listed in the previous two chapters. Several sections in this chapter have been updated. The increasing importance of biochemicals has been recognized, and Chapter 6, Purification of Biochemicals and Related Products, is unique to this edition. Each entry contains a brief description of purification methods with a literature reference citing a typical procedure.

The shortcomings of this edition are minor. Some laxity in proofreading is occasionally evident, e.g., there are inconsistencies in the formatting of the Table of Contents, the tenses in the purification of specific chemicals are sometimes mixed, and at least one chemical is misplaced alphabetically (*N*-nitrosodiethanolamine, page 240). The utility of this book could be increased by including more literature references in Chapters 3 and 4.

Robert A. Wade, *Parke-Davis/Warner-Lambert*

Large Scale Cell Culture Technology. Edited by Bjorn K. Lydersen (Hybritech Incorporated). Oxford University: Oxford and New York. 1988. x + 252 pp. $69.00. ISBN 0-19-520765-3.

This book is a monograph on large-scale cell-culture technologies. With the exception of one chapter on plant cells, the rest of the book is devoted to animal cell cultures. The different technologies are presented in a more or less chronological order with respect to their periods of development. Undoubtedly, there are other technologies which no one single book can cover. However, most of the pertinent and major developments have been included. From the fact that a good number of these articles (seven) are written by authors who are associated with commercial organizations, this book should contain the developed, matured, and more importantly, viable technologies.

The first two articles are on the time-honored stirred-tank and airlift reactors. They are followed by an article on microcarrier cultures. All these three technologies make heavy use of equipment developed in traditional fermentation processes. Articles covering immobilized cell technologies occupy the midsection of the book. The first two articles are relatively short and serve to introduce the techniques of cell microencapsulation by either alginate with a polycation membrane or agarose beads. They are followed by three other immobilized-cell technologies: hollow fiber reactor, fluidized bed with collagen matrix particles, and ceramic monolith reactor. All three of these chapters have a strong component on reactor operation and performance. Afterward, a chapter that discusses general problems associated with plant cell culture is added, and the book concludes with an insightful article on safety and regulatory issues that are extremely important but have seldom been addressed, not only in the earlier chapters, but also in many other monographs and books on animal cell technologies.

In general, this book serves as a means to present the alternative methods in large-scale cell culture. Comparisons of different technologies are made here and there within some of the chapters. Nevertheless, the decision of which technology one should choose under a given set of design constraints still rests on the reader.

Despite the fact that most of the authors are associated with companies, the discussion on the most part is candid and supported by plenty of experimental data. With the exception of the chapter on the hollow fiber reactor, which appears to be very specific to a commercial product, the other articles in general are very informative and provide the reader with a clear picture of the technologies. In terms of applications, six of the articles use hybridomas as the example, and the trend is a reflection of the importance of monoclonal antibodies in the current marketplace. All in all, this book is a nice compilation of a wide spectrum of useful cell-culture technologies.

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