hydride with the transient N_2 complex could then give an adduct (such as a diimide complex) which could subsequently be reduced stepwise to ammonia. The recent studies of Armor and Taube on the π-bonded state of N_2–transition metal complexes[14] and our confirmation of the π-bonded structure for this RN=NR complex provide models for consideration of the possible role of π-bonded diimide in the biological nitrogen fixation process.

(14) J. N. Armor and H. Taube, *J. Amer. Chem. Soc.*, 92, 2560 (1970).

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*Book Reviews**

Chemical Kinetics. Second Edition. By B. STEVENS. Chapman and Hall, Ltd., London. 1970. viii + 110 pp. $2.00.

Note from the publishers: The review of this title in the April 7th, 1971 issue of this Journal contained reference to a printing error which the reviewer surmised was present in all copies. We would like to take this opportunity of stating that this is not the case, that, in fact, the error will be found in exceptionally few copies, and that we will undertake to replace those offending copies returned to us.

In view of the above assurance from the publishers, the reviewer can now recommend this book as a conveniently concise exposition of the essentials of kinetics, suitable for students reviewing the subject.

Chimie. Volume I. Mesures, Constantes physiques des corps chimiques. 69th Edition. By J. JOUSSET. Dunod, Paris. 1971. xxix + 248 + XL pp. 9.6 francs.

This European minihandbook fits into a hip pocket and carries a remarkable amount of information in its twelve chapters: Measures; The Atom; Thermal Data; Optical Data; Densities, Vapor Pressure and Azeotropes; Solubilities; Solvents; Viscosities; Surface Tensions; Toxicology; Physico-chemical Relationships. Since it is composed almost entirely of tables, language need be no barrier, and the headings are obvious in meaning. An example of the useful tables is one listing organic compounds in formula-index order, and giving for each the molecular weight, state, specific heat, heat of formation, melting point, boiling point, heat of vaporization, heat of combustion, expansion coefficient, and thermal conductivity. There is also a useful pair of tables giving melting points and boiling points in numerical order by five-degree intervals in astonishingly compact form. At $2.50, one can't go wrong!

The Condensed Chemical Dictionary. Eighth Edition. Edited by G. G. HAWLEY. Van Nostrand-Reinhold Co., New York, N. Y. 1971. xiii + 971 pp. $27.50.

With this edition, this useful reference work has passed its fiftieth birthday. The entries vary in size from one line to the larger part of a column, and average twenty to a page. The types of subjects included cover a broad range of technical descriptions and uses, definitions, and identification of a very large number of trade names and abbreviations. A few examples taken from the letter "R" will illustrate the scope: Reaumur (a temperature scale); refinery gas; relaxin (a hormone obtained from pregnant sows); Reppe process; resonance; RFNA (biochemicalese for red fuming nitric acid); Rossville Alcohol (ethanol); Rubinol (an alizarin dye); Rust (a form of dusting sulfur); Rutherford, Sir Ernest. The definitions and descriptions are generally excellent, being concise and accurate, although inevitably there are a few that fall short, such as the entry for nitrilotriacetic acid, which does not suggest its large-scale use in the detergent field. The Dictionary is fascinating to browse through as well as being a reference source.

* Unsigned book reviews are by the Book Reviews Editor.

Industrial and Specialty Papers. Volumes I to IV. Edited by R. H. MOSHER (R. M. Associates) and D. S. DAVIS (University of Alabama). Chemical Publishing Co. Inc., New York, N. Y. 1970. xii + 328 pp., x + 330 pp.; vi + 375 pp., and iv + 240 pp. $12.00 per volume.

These volumes are subtitled "Technology," "Manufacture," "Applications," and "Product Development." Each is composed of contributed chapters of widely varying authorship, of largely industrial origin. In our prepackaged, gift-wrapped world, specialty papers have become an essential to existence, and range from disposable diapers through alteration-proof bank checks to cigarette filters, and it is appropriate for chemists to become familiar with the foundations of the subject. The chemistry covered in this work is not generally very sophisticated, but the applications are often ingeniously so. There are chapters on such subjects as "Theory of High Polymers and Their Application to the Paper-Converting Industry" and "Laminating and the Theory of Adhesion," as well as sections on the engineering and marketing aspects of the subject. There is much of interest to the general reader, and the set could be invaluable to the chemist contemplating employment in a new field. Substantial bibliographies, and separate indices for each volume, support the reference value of the work.

Photochemistry. By R. P. WAYNE (Oxford University). American Elsevier Publishing Co., Inc., New York, N. Y. 1971. iii + 263 pp. $12.00.

For many years the field of photochemistry had been poorly represented in terms of published textbooks. Fortunately, this condition has been alleviated recently by the publication of fine compendia at the research level. For the undergraduates and nonspecialist research students, however, there still existed no suitable introductory text in photochemistry.

To meet this need R. P. Wayne has produced an admirable text, providing a good survey of the basic areas of photochemistry but also including the excitement of detailed involvement. A well-written book, "Photochemistry" brings together the various areas of physical chemistry such as spectroscopy, energy transfer, and kinetics.

Chapters 1 and 2, Basic Principles of Photochemistry and Absorption and Emission of Radiation, in themselves afford students a good, yet uncomplicated foundation. Photodissociation, which is covered in Chapter 3, is a fine introduction to this important process and includes many illustrative examples. In Chapters 4 and 5 the author explores the complexities of the emission process. The author then expands his coverage in the next two chapters on Reaction of Excited States and Techniques in Photochemistry. In the final chapter, Photochemistry of Action, a host of applied examples, *e.g.*, atmospheric photochemistry, polluted atmospheres, photosynthesis, vision, photochromism, optical brighteners, etc., makes one marvel at the details of the photochemical process. For the inspired student the carefully chosen bibliography is an excellent guide for further study.

H.-G. Gilde, *Marietta College*

Molecular Quantum Mechanics. By P. W. ATKINS (Lincoln College, Oxford). Clarendon Press, Oxford, England. 1970. x + 482 pp. Cloth, $17.75; paper, $5.50.

This introductory book, which is written primarily for advanced undergraduate and beginning graduate students, consists of two main parts: the development of elementary concepts and principles of quantum theory and the applications of the theory to atomic and molecular structure, spectra, and other properties. The two parts are given about equal space, although the former contains seven and the latter contains four chapters.

The book has a number of strong features. There is a good balance between descriptive material and mathematical formulation, whereby the emphasis in the text is on the physical aspects of the theory and detailed mathematical developments are placed in appendices at the end of each chapter. There are numerous good figures, many of which use shading, to help the student visualize subtle points. One of the most useful features is the presence of numerous problems of varying degrees of difficulty at the end of each chapter (383 problems total). The author has chosen to use the *Système International d'Unités* (SI units), which has both advantages and disadvantages. Group theory is introduced in the fundamentals section and is used throughout the remainder of the book.

From this book the beginning student can get an introduction to a large number of theorems and physical concepts related to molecular structure and properties in addition to elementary quantum theory. Possibly the greatest weakness of the book, however, is the lack of greater depth in the development of fundamentals. This, together with several misleading statements and mathematical errors in the early chapters, increases the probability that quantum theory will still be a great mystery when the student finishes the book. Nevertheless, it helps to fill a long-existing gap in quantum chemistry texts.

William **Rhodes**, *Florida State University*

Chemical Specialties. By H. BENNETT (B. R. Laboratory). Chemical Publishing Co., Inc., New York, N. Y. 1969. iii + 465 pp. $16.50.

This book is intended as "a guide to all those who would like to build up a chemical specialty business." It is not concerned with chemical reactions, but with compounding and formulation of products from commercially available chemicals. There are sections on handling chemicals for those with no chemical training, on processing for those without engineering experience, and on business principles, from bookkeeping to labor relations. A large section of the book is a formulary, which is full of useful recipes, and gives one a fascinating, and at times alarming, insight into the actual composition of common cosmetics, food preparations, etc. It also gives a formulation for a military explosive primer containing 35% lead azide; it is to be hoped that no chemically unsophisticated entrepreneur tries this one! A substantial appendix describing the properties and handling of common hazardous chemicals is a valuable feature (but it omits lead azide).

Electronic Absorption Spectroscopy in Organic Chemistry. By E. S. STERN (Imperial Chemical Industries Ltd.) and C. J. TIMMONS (University of Nottingham). St. Martin's Press, New York, N. Y. 1971. vi + 277 pp. $20.00.

This book is the Third Edition of Gillam and Stern's original work of the same title. Its object is "to introduce ultraviolet and visible spectrophotometric techniques to graduates entering on research . . . ." Such a statement might lead one to expect this to be a textbook, but it is more accurate to call it a reference work; there are no exercises and although the authors are careful to explain or define all special terms and concepts, they do so succinctly, more in the way of refreshing the reader's memory.

There is a short discussion of instruments, accessories, and their calibration, and then a series of chapters devoted to various types of compounds with increasingly more complex chromophores. The number of small tables throughout the work is enormous. They are used primarily to illustrate structural effects but are also of much value for reference. There is a chapter on quantitative determination of organic compounds, with much information of practical value, but strangely, no example of the isosbestic phenomenon is illustrated, nor does the term appear in the index. The final chapter is devoted to representative problems in molecular structure.

Every chapter contains a substantial list of references, and there is an Appendix listing collections of spectra, indexes for their location, and books and reviews. There is an author index, which would seem to be of little use, and a seven-page subject index. The book could have been made much more useful if the index had been more comprehensive. Although there is an entry under "guano", very few of the large number of compounds whose spectra are given in the widely scattered tables are listed in the index. The title subjects of the tables are for the most part listed, but a table of the $n \rightarrow \pi^*$ bands of acetone in various solvents (on p 43) is totally omitted from the index, as is a table on enyne carbinols (p 223), and there are possibly other such omissions. Another but less important shortcoming is the fact that structural formulas are printed with dots for bonds in some instances, lines in others, and worst of all, a mixture of the two in still others. Although these features detract from the book, it is still a useful volume to have available.

Physical Methods of Chemistry, Part IA, Components of Scientific Instruments, and Part IB, Automatic Recording and Control, Computers in Chemical Research. Edited by A. WEISSBERGER and B. W. ROSSITER (Eastman Kodak Laboratories). Wiley-Interscience, New York, N. Y. 1971. Part IA: xi + 433 pp. $19.95. Part IB: xi + 330 pp. $17.00.

These two volumes begin a new series, "Physical Methods of Chemistry," successor to "Physical Methods of Organic Chemistry," which has appeared in three editions, the last dated 1959. Parts IA and IB, together with Parts II, III, IV, and V yet to come, apparently constitute Volume I of the master series, "Techniques of Chemistry," but the hierarchy is not exactly transparent. The new aspect, in which the former separation of organic from inorganic chemistry is abandoned, realistically recognizes how the two branches of chemistry have become intertwined and use largely the same methods.

Part IA contains five chapters: Introduction, Basic Electrical Principles, and Electronic Components, all by Leon F. Phillips, and Mechanical Components and Sources and Modulation of Electromagnetic and Sonic Energy, by Leroy L. Blackmer. Part IB contains four chapters: Detection (Transducers), by Phillips; Automatic Recording, by David R. Simonsen; Automatic Control, by D. E. Smith, C. E. Borchers, and R. J. Loyd; and Computers in Chemical Research, by M. C. Goddard and J. Figueras. Part IA has a subject index, and Part IB has a combined index for both parts. The chapters follow the familiar pattern of the parent work, and start by presenting the fundamental principles in terms suitable for the nonspecialist, and advance to a practical, critical presentation of methods, construction and operation of apparatus, etc. There are many diagrams and illustrations, and a goodly number of references, heavy on the side of books. There is much explanatory and practical detail given from the chemists' standpoint about subjects that are not so commonly written about with a chemical orientation. The result is of both educational and reference value, very useful for introductory, orientation, or refresher purposes.

Surface and Colloid Science. Volume 3. Edited by EGON MATIJEVIC (Clarkson College of Technology). Wiley-Interscience, New York, N. Y. 1971. ix + 296 pp. $16.95.

This is a multi-volume series on topics of contemporary interest in the field of colloid science. An international advisory board apparently selects the particular colloid science topics that are dealt with in this volume and the other volumes of the series. At present, four volumes of this series have been announced for 1971 publication. Other volumes are in preparation.

Volume III covers the following topics: Statistical Mechanics of the Capillary Layer (F. C. Goodrich), Dynamic Surface Tension (R. Defay and G. Petre), Dielectric Properties of Disperse Systems (S. S. Dukhin), Thin Liquid Films (J. S. Clunie, J. F. Goodman, and B. T. Ingram), and Colloidal Microcrystal Polymer Science (O. A. Battista, M. M. Cruz, and R. F. Ferraro).

The articles, however, are all in English. Each topic is treated historically and critically to bring the reader up to date in current theory and research relating to the topic. Three of the articles, Thin Liquid Films, Dynamic Surface Tension, and Colloidal Microcrystal Polymer Science, have portions devoted to experimental methods relating to the topic. The topics chosen for a particular volume are not necessarily closely related. The first chapter is entitled "Statistical Mechanics of the Capillary Layer." The last topic in Volume 3 of this series is titled "Colloidal Microcrystal Polymer Science." Clearly, both are topics of interest in colloid science though otherwise remotely related. This series will probably never become a comprehensive treatise on colloid science. The topics, as the editor states, are not in a logical sequence. This is obviously impractical with multiple authorship and is an acceptable compromise, since the authors of the individual articles are

eminent researchers and scholars in their specialties. Each article appears to be very well written.

On a minor matter, the reviewer was somewhat disconcerted by F. C. Goodrich's referral to equation 26 of reference 10. Reference 10 turns out to be Volume 1 of this series, which apparently is not yet available.

Each article is provided with a glossary of symbols and, in general, with an up-to-date bibliography. This series of small volumes should provide industrial and academic researchers in colloidal science with well correlated and comprehensive information on various special topics of contemporary interest.

Arthur C. Thompson, *Marietta College*

Rotation-Vibration of Polyatomic Molecules. By G. AMAT, H. H. NIELSEN, and G. TARRAGO (University of Paris and The Ohio State University). Marcel Dekker, Inc., New York, N. Y. 1971. vi + 441 pp. $19.50.

This book is based primarily upon the series of detailed theoretical papers on the topic of rotation–vibration spectra of polyatomic molecules published by the authors during the past twenty years or so. The collection within the covers of a single volume of the theory and formulas now scattered through the literature and in doctoral dissertations will greatly aid practicing spectroscopists concerned with the analysis of high-resolution data.

The contents of the present text are organized into three parts. The first describes the expansion of the Hamiltonian and contact transformations involved in the perturbation treatment (to fourth order) for linear, axially symmetric, and asymmetric top molecules. The second part deals with nonvanishing matrix elements, and the book concludes with tabulations of explicit expressions for the energy levels of linear molecules, and of symmetric top molecules having three- and fourfold axes of rotation. The notation developed by Professor Nielsen in his 1951 paper has been used throughout. The discussion of spherical top molecules was considered beyond the scope of the book and has been omitted.

Robert C. Taylor, *The University of Michigan*

Crystallographic Computing. Proceedings of an International Summer School. Edited by F. R. AHMED. Munksgaard International Booksellers and Publishers Ltd., Copenhagen. 1970. viii + 383 pp. $25.00.

This book contains the proceedings of an International Summer School held in Ottawa at Carleton University prior to the 8th International Congress of Crystallography held at Stony Brook, N. Y. The contributors comprise an illustrious array of crystallographers who discoursed about their particular specialties. Nine topics were treated fairly thoroughly, ranging from computer-controlled X-ray diffractometers through phase determination and least-squares refinement to aspects of protein structure analysis. These are discussed on their merits and also as they relate to implementation on computers. Most of the topics cover extensively used methods and techniques; however, several topics pertaining to potentially effective new procedures are also included, particularly direct methods of phase determination and the systematic examination and interpretation of vector maps. The material is presented on an advanced level and in a concise manner, with much of it being well known but distributed in many places. The virtue of compilation is that it assembles these important topics, all of which have excellent and comprehensive lists of up-to-date references, within one volume. The book is of broad scope and authoritative and will be very useful to X-ray crystallographers.

A. Tulinsky, *Michigan State University*

Proceedings of the IIIrd Analytical Chemical Conference (Budapest, August 24–29, 1970). Edited by I. BUZAS. Akademiai Kiado, Budapest. 1970. Two volumes, 318 and 459 pp. $21.60.

The volumes contain the English-language printing of the papers presented at this conference, devoting about six printed pages, as an average, to each paper. A good selection of equations, tables of data, and figures embellish most of the articles. The typography is clean and easily readable. Each volume has a Table of Contents and Volume II concludes with a complete Author Index.

The first volume includes 45 papers concerned with separation techniques, and these divide about equally within the three areas of ion-exchange, chromatography, and liquid–liquid extraction. The second volume contains 27 papers on methods of organic analysis and 36 on the various branches of thermal analysis. The work provides a useful summary of contemporary effort (especially, as practiced in this region of the world) within these areas of analytical chemistry. Some differences in the available instrumentation are evident; *e.g.*, relatively little attention is given to computerized data treatment.

These presentations are reasonably complete short articles, in contrast to the rather cryptic abstracts familiar in this country. While some foreign work is presented, the representation by middle-European authors is heavily predominant.

Charles L. Rulfs, *University of Michigan*

Encyclopedia of Industrial Chemical Analysis. Volume II. Edited by F. D. SNELL and L. S. ETTRE. Wiley-Interscience, New York, N. Y. 1971. xiv + 617 pp. $45.00 ($35.00 by subscription to the series).

This volume is subtitled "Corn Products to Dry Cleaning Agents" which somewhat obscures the actual content. There are 21 chapters, each of which is thoroughly supplied with tabular and graphic reference data, sample procedures, and an extensive bibliography. The longest chapter, and probably the most "relevant" today, is that on analysis of detergents (86 pp), but there are important chapters on cosmetics and dental materials, and on a considerable number of organic chemicals: cyclic alcohols, diamines and higher amines, dienes and polyenes, etc., as well as cotton, diamonds, and diatomaceous earth. Unfortunately, there is no index, and the chapters have no individual tables of contents, with the results that the reader may have to do a lot of tedious reading in order to determine what, if anything, may be said on a particular point, such as, for example, analysis of detergents for arsenic.

Mass Spectrometry of Heterocyclic Compounds. By Q. N. PORTER and J. BALDAS (University of Melbourne). Wiley–Interscience, New York, N. Y. 1971. xvii + 564 pp. $24.95.

This is the first volume in a new series, called "General Heterocyclic Chemistry," companion to the series "The Chemistry of Heterocyclic Compounds;" both series are under the supervisory editorship of Weissberger and Taylor. Whereas the older series is organized according to specific heterocyclic ring systems, the new one is arranged according to general phenomena applied to the whole field of heterocyclic compounds. Future volumes on other types of spectrometry, photochemistry, application in synthesis, etc., are planned.

This volume is meant to be a detailed review, and is a reference work rather than a textbook. It is, of course, considerably more extensive than the chapter on the same subject by Spiteller in "Advances in Heterocyclic Chemistry," Volume 7, published four years ago. The literature is stated to be covered completely through 1967, with selected advances up to early 1970 (how good it is to have this clearly stated by the authors!). The chapters are arranged according to ring type, starting with oxirans and ending with systems containing nitrogen, oxygen, and sulfur in the same ring. Many mass spectra are reproduced from the original papers, and paths of fragmentation are shown with a wealth of formulas and equations. There is a good subject index.

Mechanisms of Molecular Migrations. Volume 3. Edited by B. S. THYAGARAJAN (University of Idaho). Wiley-Interscience, New York, N. Y. 1971. xii + 464 pp. $24.95.

This third volume demonstrates that the title series is definitely open ended. Most of the classical rearrangements have been covered in the earlier volumes; reactions of lesser importance, and those of more recent origin, comprise the bulk of this book. There are eight chapters, which treat with reorganizations of spiranes (W. R. Dolbier, Jr.), α-haloepoxides (R. N. McDonald), aromatic nitramines (W. N. White), aziridines (H. W. Heine), abnormal Claisen rearrangements (H.-J. Hansen), the Hofmann–Martius rearrangement (C. L. Stevens, P. M. Pillai, M. E. Munk, and K. G. Taylor), and the Stevens and Sommelet rearrangements (A. R. Lepley and A. G. Giumanini).

As these titles suggest, the focus of many of the chapters is narrower and more detailed than in DeMayo's "Molecular Rearrangements," with which this work must be compared. The stated intent is to supplement the existing literature by covering topics not treated in a similar manner elsewhere, and particularly to survey rearrangements that have been investigated extensively since DeMayo's work. The aim has been achieved, and the "Migration" volumes have become an important aid to the chemist concerned with rearrangements, broadly interpreted.

Although the dates for which the authors closed their literature surveys are regrettably not given, references dated 1969 are abundant, and some dated 1970 are included. Last-minute terminal paragraphs, probably added not long before going to press, alert the reader to some of the more significant developments since the

body of the chapters was written, so that, for example, the recent important evidence for the intermediacy of free radicals in some examples of the Stevens rearrangement, derived from chemically induced dynamic nuclear polarization, is not overlooked. There is an author index (long) and a subject index (short), plus a brief but useful cumulative index to titles and authors of articles in Volumes 1 and 2. Future volumes are promised.

Practical Catalytic Hydrogenation. By M. FREIFELDER. Wiley-Interscience, New York, N. Y. 1971. xxii + 663 pp. $24.95.

This book is a critical review of the practice of catalytic hydrogenation, and is the fruit of the author's long personal experience in the literature and the laboratory (he was associated with Abbott Laboratories for many years). It is not a laboratory manual, and there are no specific experimental procedures. Instead, it deals with the many aspects of the subject from the standpoint of the chemist looking for orientation and guidance for solving his own problem. Lots of reported examples are given, with extensive but selective documentation and many useful critical or comparative comments. Some chapters deal with methods and procedures, catalysts, inhibitors and poisons, promoters, solvents and conditions, equipment. Most of the chapters are devoted to specific functional groups, from acetylenes to heterocycles. The types of products to be expected, how to control their formation, selectivity (site and steric), etc., are covered systematically. The index, only three pages, is short for a book of this size; it contains entries such as "Catalysts, application" that are so broad as to be of little use, and is devoid of any entries under the names of specific metals or types of catalysts (*e.g.*, Adams, Lindlar).

It is interesting to compare Dr. Freifelder's book with "Catalytic Hydrogenation" by Augustine, published in 1965. The latter is less than one-third the size, and is necessarily much lighter in its coverage of a particular topic, and contains fewer references. It does, however, contain many specific laboratory procedures, both in the text and in appendices, which are not paralleled in Dr. Freifelder's book. The Augustine index (19 pp) is enormously better. Both books, however, are good, useful aids to the organic chemist.