[1-^{14}C]octanoate and the tritium to carbon-14 ratio determined directly and by derivatization of a portion of the mixture with *p*-bromophenacyl bromide. The *p*-bromophenacyl esters derived from each mixture were recrystallized to constant activity and constant ratio. In each case, the tritium to carbon-14 ratios obtained directly were identical within experimental error with the ratios obtained by recrystallization of the *p*-bromophenacyl esters. The four samples of doubly labeled octanoate were then administered to *E. coli* and lipoic acid isolated as described above. The lipoic acid obtained from each experiment was derivatized with *p*-phenylbenzyl chloride and the derivatives recrystallized to constant activity and constant tritium to carbon-14 ratio. The bis(*p*-phenylbenzyl) acids were then converted into the corresponding methyl esters which were purified by chromatography and by recrystallization to constant activity and constant ratio. The results of these experiments are shown in Table I.

A number of conclusions can be drawn from the data in Table I. Experiments 1 and 2 clearly show that the introduction of sulfur at C-6 and C-8 of octanoic acid takes place without loss of hydrogen from C-5 or C-7. It therefore seems unlikely that unsaturation is introduced at C-5 or C-7 during the biosynthesis of (+)-lipoic acid from octanoic acid; however, the possiblility of enzymatic removal of hydrogen from C-5 or C-7 followed by replacement of the hydrogen without exchange cannot be excluded. Similar results have been obtained in investigations of the mechanism of sulfur introduction during biotin biosynthesis: the conversion of dethiobiotin (**4**) into biotin (**3**) has been found to proceed without hydrogen loss from C-2 or C-3.[3,11] Experiment 3 shows that the incorporation of sodium [8-^{3}H]octanoate into lipoate proceeds without tritium loss, within experimental error. This result is presumably the consequence of a substantial tritium isotope effect associated with the removal of a hydrogen atom from C-8 of octanoate. In contrast, the incorporation of [1-^{3}H]dethiobiotin into biotin has been found to proceed with little or no isotope effect.[3] Since the nature of the reaction(s) associated with the oxidation of the methyl groups in octanoic acid and dethiobiotin is unknown, it is not possible at present to account for these differences. Experiment 4 reveals that sodium [6(*RS*)-^{3}H]octanoate is incorporated into lipoic acid with about 50% tritium loss. This figure is precisely that expected for the stereospecific removal of one hydrogen atom from C-6 of octanoic acid as a consequence of sulfur introduction, and it parallels the results obtained when [4(*RS*)-^{3}H]dethiobiotin is transformed into biotin.[3] Work is in progress to determine the stereochemistry of the reactions associated with the introduction of sulfur at C-6 and C-8 of **2**.

Acknowledgment. We thank the National Science Foundation for support of this research.

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Book Reviews

Advances in Carbohydrate Chemistry and Biochemistry. Edited by R. STUART TIPSON and DEREK HORTON. Academic Press, New York, N.Y. 1976. Vol. 32: x + 439 pp. $42.00. Vol. 33: x + 464 pp. $44.00.

As expected of this series, these two volumes contain several excellent and definitive reviews of widely scattered literature. There is a reasonable proportion of material for the synthetic chemist and biochemist, a continuing bibliography of crystallographic data, and reminiscences on the lives of W. Z. Hassid and A. Gottschalk. Volume 32 contains articles on Dithioacetals of Sugars, J. D. Wander and D. Horton; Utilization of Sugars by Yeasts, J. A. Barnett; Noncytotoxic Antitumor Polysaccharides, R. L. Whistler, A. A. Bushway, P. P. Singh, W. Nakahara, and R. Tokuzen; Hemicellulases, R. F. H. Decker and G. N. Richards; Crystal Structures of Carbohydrates, Nucleosides and Nucleotides 1974, G. A. Jeffrey and M. Sundaralingham. Volume 33 contains Relative Reactivities of Carbohydrate Hydroxyl Groups, A. H. Haines; Synthesis of C Nucleosides, Analogs and Precursors, S. Hanessian and A. G. Permet; Reactions of D-Glucofuranurono-6,3-lactone, K. Dax and H. Weidmann; Chemistry of Sucrose, R. Khan; Pneumococcal Polysaccharides, O. Larm and B. Lindberg; Pectic Enzymes, L. Rexová-Benková and O. Markovic; Crystal Structures of Polysaccharides 1967–1974, R. H. Marchessault and P. R. Sundarajan.

This wide distribution of subject matter accurately reflects the changing character of carbohydrate research as well as the change in title of the series (in 1969) to include biochemistry. There is today less compartmentalized research on structure proof and transformations, per se, on carbohydrates as food and fiber components. The carbohydrate chemist now asks himself how his discipline advances knowledge on a wider front: the increasingly appreciated role of carbohydrates in information carrying, self and foreign recognition, and growth control mechanisms, in genetics, immunity, allergy, cell surface structure, metabolism, and other areas.

The chapters on crystallography, enzymes, and parts of other chapters call to mind that classic structure proof methods are now greatly supported if not superceded by biochemical, spectrometric, and crystallographic techniques. The specific examples of Larm and Lindberg and the chapter on antitumor polysaccharides emphasize that there are entire classes of important substrates that still await structural clarification. The synthetic chapters emphasize weaknesses and strengths of modern synthetic methodology and the difficult synthetic problems still presented by important natural carbohydrate structures. A review of the relative reactivity of hydroxyls indicates how nonspecific most direct methods of blocking hydroxyl groups still are. The few examples of specific reactions within metal complexes should excite young scientists to explore systematically the reactions of carbohydrates in the form of metal ligands. This research is greatly needed. A similar review of deblocking methods could be equally helpful, and might show even greater gaps.

The current emphasis of this series is to be applauded. Over a period of years it will help research scientists focus on meaningful problems within an expanding interdisciplinary horizon.

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Inorganic Chemistry of the Main-Group Elements (A Specialist Periodical Report). Volume 3. A Review of the Literature Published between September 1973 and September 1974. Senior Reporter: C. C. ADDISON (University of Nottingham). The Chemical Society, London. 1976. xi + 536 pp. $79.75 (£29.00).

This volume, like the first two of the series, is divided into eight chapters corresponding to the eight nontransition groups in the periodic table. Groups I and II (63 and 32 pages, respectively) are covered by R. J. Pulham, group III by G. Davidson (96 pp), group IV by P. G. Harrison and P. Hubberstey (125 pp), group V by A. Morris and D. B. Sowerby (90 pp), group VI by M. G. Barker (67 pp), and groups VII and VIII by M. F. A. Dove (27 and 10 pp, respectively), all authors of the University of Nottingham. The coverage appears to be generally good, although not comprehensive, the space devoted to each group appearing to be fairly consonant with the significant research activity in the area. In the interest of economy, work deemed to be of minor interest was not reported. The authors feel that there was a diminution of significant research in the area during the period covered. The topics receiving the most attention were organoalkalies, boron, the inorganic chemistry of carbon including one-carbon compounds such as methane and its one-carbon derivatives, silicon, nitrogen, phosphorus, and sulfur.

The policy of incomplete coverage leaves the evaluation of what is important up to the authors and resulted in 12% of the volume being devoted to boron (not necessarily undeservedly), while the very interesting addition compounds of C_5H_5In with Lewis acids, involving the donation of the nonbonding pair on the In(I) atom to the acid, were given very short shrift (3 lines).

A number of cases of archaic nomenclature were noted: "barium pernitride" (p 91), borohydride and aluminohydride (p 51), for example; and inconsistent nomenclature: "di-imine" and "di-imide", both used in the same paragraph for N_2H_2 on p 320 (the usual term, diazene, was ignored). On page 410 the term "trifluoroperacetic acid" is used for "trifluoroperoxyacetic acid". On page 37 is a discussion of the spectral properties of CsO and RbO (unnamed), but confusingly, lower on the page the term "monoxide" is used apparently to refer to Cs_2O. A number of typographical errors of some consequence were found, such as "nitrite" for "nitrile" (p 67), $BaCu_2S$ for $BaCu_2S_2$ (p 91), and $[(Me_3Si)_2]_2$ for $[(Me_3Si)_2]_2Mg$ (p 75); the first formula below the figures is also incorrect. On page 156 the compound referred to in the text as (55) is presumably a dimethyl compound, but is shown in the figure as monomethyl. Figure 11 (p 419) has two atoms omitted. Although this error did occur in the original journal article, the omission was too obvious for an alert reviewer to miss.

Many unbalanced equations occur, for example on pages 47, 65, 109, 114, 125, 233, and 426, to mention a few.

One wonders at the utility of spending a third of a page (p 61) reporting on equilibria, complete with equilibrium constants, for "acid-base reactions in the Lux sense" involving such ions as PO_3^- and O^{2-} which probably have no real existence in such a system even at the temperature (700 °C) reported. On page 36, no indication is given as to whether the data on the Li_2O-Na_2O system are given by weight or mole percent.

Although errors and omissions of the sort mentioned above are to some extent unavoidable, the number seems to be excessive, considering that by no means was an exhaustive search made for them. Nevertheless, the Report is a most useful compendium and contains some excellent treatments. The report on boranes and carboranes is very comprehensive and well presented, as can be said also for aluminum and silicon. There are good treatments of transition metal carbonyl compounds (p 187), x-ray photoelectron spectra of small carbon-containing molecules comparing experimental and calculated values for the core electrons and showing good agreement with bond orders (p 190), the natural formation of diamond, graphite, and other carbons, their hydrogenation and oxidation, and intercalation (graphite) (pp 192 and 216).

Table 5 (p 40) gives a concise synopsis of the work done during the period on the alkali complex halides of Al, Ga, V, Cr, Fe, Co, Sn, Sb, and Bi. The treatment of the work on metal azides (p 44) is considerably enhanced by inclusion of data from earlier work for comparison. There is an extensive discussion of the various oxides of hydrogen (pp 406–9). There is an excellent resume of sulfur–nitrogen and sulfur–fluorine chemistry (pp 412–430).

In a review of such a book it is obviously impossible to cover all of the points which should be mentioned. The subjects chosen for comment, however, are reasonably representative of the nature of the Report. The errors, though fairly numerous and frequently significant, are nevertheless seldom of major importance, and the balance overall is strongly positive. The volume is a valuable reference for anyone seriously interested in the main-group elements and is well worth the price.

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Chemistry of Hazardous Materials. By E. MEYER (Lewis University). Prentice-Hall, Inc., Englewood Cliffs, N.J. 1977. xiv + 370 pp. $14.95.

This volume appears to be a chemistry text for fire fighters in that it discusses various hazardous materials that they are likely to encounter, with a concise and reasonably thorough review of the chemistry involved. Fire, its history and character, is described briefly in the introduction and first chapter as are the various DOT hazard labels. Chapter Two covers matter and energy and the concept of flammability is discussed. The author then moves to chapters dealing with subdivisions of matter, principles of chemical reactions, the chemistry of some common elements, chemistry of corrosive materials, chemistry of water-reactive materials, toxic materials, oxidation-reduction phenomena, organic compounds, plastics, resins and fibers, chemical explosives, radioactive materials, and finally the appendices.

Overall, it is a book well worth having either as a text or as a quick-reference volume. It does accomplish its mission of discussing the chemistry of hazardous materials. However, the chemistry of the "dry chemical" type of fire extinguishers could have been discussed in more detail, and a few errors were noted (e.g., the structure for TNT should be the 2,4,6 isomer not the 2,5,6 isomer as shown on p 315). The reader should be cautioned to check *current* TLV's, as the threshold limit values of some common monomers, as shown in Table 11-5 (p 294), are rather out of date. The current TLV for vinyl chloride, which is now under review, is considerably less than the 500 ppm shown. Also the new OSHA emergency TLV for benzene is 1 ppm, not 25 as shown in Appendix III (p 360).

The chapter on toxic materials is excellent and something not normally found in most chemistry texts. The chapter on radioactive materials is also quite good. However, this reviewer would like to have seen some mention made about biological hazards such as aflatoxin and other bioactive materials such that the reader would know that there is a possibility of encountering such materials and thereby be warned to take appropriate precautions. Admittedly, however, this may be well outside of the scope of chemistry, although, in the main, the effects from radioactive materials are as well. Aside from the caution on TLV's, the appendices are quite good.

In summary the author has done an excellent job of putting together a book which describes hazardous materials and their chemistry. It would be a valuable addition to the library of anyone interested in this field.

William C. Kuryla, *Union Carbide Corporation*

Electronic and Atomic Collisions. Abstracts of the IXth International Conference on the Physics of Electronic and Atomic Collisions. Volumes 1 and 2. Edited by J. S. RISLEY and R. GEBALLE (University of Washington). University of Washington Press, Seattle, Wash. 1975. xl + 604 pp (Vol. 1), xl + 604 pp (Vol. 2). $40.00 (two volumes, soft covers).

The IXth International Conference on the Physics of Electronic and Atomic Collisions (ICPEAC) was held at the University of Washington, Seattle, July 24–30, 1975. This series of conferences brings together physicists and chemists who are exploring experimentally and theoretically a variety of basic phenomena broadly classified under the heading "Electronic and Atomic Collisions". The 60 invited papers and 566 contributed papers from this conference are represented in these volumes by abstracts, many complete with selected figures, equations, and references. The typical abstract is one to two pages in length, so that the information content is appreciable. The areas into which these abstracts are grouped, together with the number in each group, are: photodissociation and dissociative ionization (11), electron loss in atomic collisions (8), vibrational and rotational excitation of molecules in low-energy collisions with atoms and ions (15), scattering theory, including semiclassical and eikonal (10), electron transfer involving hydrogen and hydrogen-like ions (7), electron-impact excitation of molecules (18), atomic collisions involving positrons and muons (10), H^+-Xe collisions and related systems (5), electron transfer in fast collisions including multiply charged ions (8), electron-impact excitation of autoionization states near threshold and the post-collision interaction (8), scattering theory including level crossing (10), electronic excitation transfer and quenching in low-energy atomic collisions (9), electron–molecule collisions (22), photon continua in heavy ion collisions (17), reactive scattering of atoms and molecules (23), photodetachment (6), electron–ion collisions (10), x-ray and Auger-electron spectra from heavy ion collisions (10), scattering of excited atoms (9), elastic scattering of electrons by noble gases (9), multiphoton processes (4), differential ionization cross sections by electron impact (9), direct inner-shell excitation cross sections (10), fine and hyperfine transitions in atomic collisions (13), formal scattering theory (10), photoelectron angular distributions (4), low-energy ion–molecule reactions (14), molecular aspects of outer-shell excitation (14), electron scattering on atomic oxygen and related atoms (7), scattering theory including discrete bases (10), electron–hydrogen atom collisions (12), photon interactions including photoelectron spectroscopy (9), dissociation of molecules in atomic collisions (9), long-range interactions in ion–atom collisions (7), ionization by hydrogen and helium ions (8), excitation of autoionization and resonant states in electron impact (16), dissociative collisions of electrons with molecules (15), electron excitation of helium (10), collisions of Rydberg atoms (6), excitation of autoionization states in ion–atom collisions (11), electron-impact ionization cross sections (12), low-energy electron transfer and mutual chemiionization (10), fluorescence yields and related topics in inner-shell ionization (7), special experimental techniques (12), polarized electron production and interactions (5), excitation in heavy particle collisions (9), electron scattering of atoms and molecules (13), generalized oscillator strength (10), molecular aspects of K-shell excitation (10), Penning and associative ionization (13), electron excitation of atoms (14), photoionization (6), coherence effects in atomic collisions (6), molecular aspects of inner-shell excitation including L-shell (10), and photoionization theory (7).

As this enormous list suggests, one fault of the proceedings is their poor organization in that groups of abstracts on closely related topics, such as various aspects of photoionization and photoelectron spectroscopy, are scattered throughout the two volumes. There is an author index, but no topical index other than the Table of Contents. Despite these shortcomings, researchers interested in any of the fields listed in the previous paragraph will want to browse through these abstracts as they describe a great wealth of recent experimental and theoretical results.

Lawrence L. Lohr, Jr., *University of Michigan*

Advances in Inorganic Chemistry and Radiochemistry. Volume 18. Edited by H. J. EMELÉUS and A. G. SHARPE (University Chemical Laboratory, Cambridge, England). Academic Press, New York, N.Y. 1976. viii + 414 pp. $35.50.

This established series of outstanding reviews in inorganic chemistry continues with the present volume containing seven articles. The first two of these, namely, that entitled "Structural and Bonding Patterns in Cluster Chemistry", by K. Wade, and that entitled "Coordination Number Pattern Recognition Theory of Carborane Structures", by R. E. Williams, are very closely related in that both are discussions of the structural systematics of boranes, carboranes, and their analogues. The former article is the more general, as it treats a number of hydrocarbon and organometallic compounds as well, while the latter article explores the carboranes in great depth. Other articles in this volume are: "Preparation and Reactions of Perfluorohalogenoorganosulfenyl Halides", by A. Haas and U. Niemann; "Correlations in Nuclear Magnetic Shielding. Part I", by J. Mason, a review of the theory and physical models of shielding, and of the measurement of absolute shielding for protons and other magnetic nuclei; "Some Applications of Mass Spectroscopy in Inorganic and Organometallic Chemistry", by J. K. Miller and G. L. Wilson, a review containing both experimental details of sample handling and extensive chemical inferences about rearrangements; "The Structures of Elemental Sulfur", by B. Meyer, a fascinating discussion of the numerous (about 45) allotropes that have been reported and of the established structures of a dozen of these; and "Chlorine Oxyfluorides", by K. O. Christé and C. J. Schack, a very thorough review of the synthesis, structure, and physical properties, with particular emphasis on spectroscopic and thermodynamic data, of not only the neutral closed-shell chlorine oxyfluorides, but also of cation, anion, and radical species.

In summary this volume continues the high standards of this series, and the articles in it should be carefully studied by interested inorganic chemists.

Lawrence L. Lohr, Jr., *University of Michigan*

Chemical Bonds and Bond Energy. Second Edition. By R. T. SANDERSON (Arizona State University). Academic Press, New York, N.Y. 1976. xii + 218 pp. $19.50.

The first edition of this monograph appeared in 1971 and was reviewed in this journal (*J. Am. Chem. Soc.*, **95,** 6513 (1973)). It presented a semitheoretical analysis of the bonding and heats of atomization for a wide variety of elements, inorganic compounds including binary solids, and organic compounds. The analysis followed the author's "principle of electronegativity equalization", with the particular electronegativity scale used being related to atomic compactness. The present revised edition is basically the same as the first, but it has been significantly improved in its organization. Much of the text has been rewritten, and the lengthy but very useful tables have been condensed. The success of the reorganization is reflected by the fact that the revision, while containing new material, is actually a few pages shorter than the original. The author is careful to emphasize in the present edition that his previous use of the term "bond energy" does not in general refer to the energy to break a given bond if there is more than one bond per molecule. He now distinguishes "contributing bond energies" from "dissociation bond energies". The interesting discussion at the end of the first edition on why methane burns has been replaced with a longer discussion on the combustion of ethane.

This reviewer again finds this monograph to represent a unique and highly readable contribution to the theoretical chemistry literature. It would make excellent supplementary reading for students in advanced organic and inorganic courses.

Lawrence L. Lohr, Jr., *University of Michigan*

Mathematical Techniques in Chemistry. By J. B. DENCE (Washington University). Wiley-Interscience, New York, N.Y. 1975. xi + 442 pp. $14.50.

This book is essentially a review of the basic mathematics required by people working in chemistry and the related sciences. It has been written primarily for undergraduates majoring in chemistry who have had a year of calculus, but it should also be useful to others interested in improving their mathematical skills in independent study. It differs from most other books on applied mathematics in that all of its illustrations and applications are chosen from some area of chemistry.

The topics covered include basic algebra, differential and integral calculus, series expansions, differential equations, matrices, vectors, and tensors, and special functions. The only major omissions are probability and statistics, and group theory. One of the most useful aspects of the book is the large number of worked examples. There are also numerous exercises at the end of each chapter, separated into the categories routine, somewhat harder, and very challenging. The answers are not given in the book, but instructors can obtain a separate solutions manual "Hints and Answers to Selected Exercises". The text is written in an informal, almost conversational style with, for example, a lot of interesting historical information on the techniques being discussed. The book concludes with a long annotated bibliography as well as the usual author index and subject index.

Anyone in the chemical sciences interested in improving his mathematical background will find this book to be extremely useful. It will also provide a good foundation for studying some of the more advanced books in this area.

J. E. Mark, *University of Michigan*

Free Radicals in Biology. Volume I. Edited by WILLIAM A. PRYOR (Louisiana State University). Academic Press, New York, N.Y. 1976. xv + 287 pp. $27.50.

This series fulfills a need for reviews on free-radical topics of interest to chemists, biochemists, biologists, and physicists. It is successfully directed toward a broad audience including students, specialized investigators, and interdisciplinary scientists. In the first of six chapters, William A. Pryor reviews the organic chemistry of free radical reactions and directs attention to many biochemically important problems. This chapter is an example of the aim of this series; it stimulates interdisciplinary thinking. Organic and physical chemists can relate to biochemical problems and biochemists can relate to chemical mechanisms. James F. Mead gives a brief review of recent developments in free radical oxidative damage to lipids in relation to membranes. Donald C. Borg provides the equivalent of a minicourse in electron spin resonance and its application to biochemical and biological problems. The examples on chlorophyll and related compounds tie in with a subsequent chapter. Paul A. Loach and Brian J. Hales summarize the experimental evidence of the free radical and other reactions in the primary photochemical events of photosynthesis. Ian C. P. Smith, Shirley Schreier-Muccillo, and Derek Marsh present spin labeling from introduction to state of the art. They appropriately concentrate on spin labels for lipid systems and emphasize applications to membranes. Developing knowledge of the superoxide dismutase protective system offers new insights into problems of the cellular toxicity of oxygen radicals and hydrogen peroxide. In his review of this topic, Irwin Fridovich uses his first-hand knowledge of the superoxide dismutases as a basis to describe the interrelationships between chemically damaging species and enzymic protector systems.

Al Tappel, *University of California, Davis*

Free Radicals in Biology. Volume II. Edited by William A. Pryor (Louisiana State University). Academic Press, New York, N.Y. 1976. xv + 303 pp. $27.50.

This volume continues this series with up-to-date reviews of high quality. In the subject area in which he has made a number of advances, Edward M. Kosower reviews in the first of nine chapters the chemical and spectral properties of pyridinyl radicals. Concerning the major enzyme cofactors, the nicotinamide adenine nucleotides, the evidence is against involvement of pyridinyl radicals. Nechama and Edward Kosower describe the glutathione–glutathione disulfide systems from the perspective of the physical, chemical, and biochemical properties and reactions. Enzymic and biological interactions of glutathione were only tabulated. Christopher S. Foote presents the main knowledge of photosensitized oxidation and singlet oxygen. Important reactions in biochemistry and biology are described in this well-balanced chapter. Observations of free radicals in dry biological systems are described by Robert J. Heckly. This is the most limited and specific topic of this volume. In the topic of free radical reactions in the production of photochemical smog, J. Alistair Kerr, Jack G. Calvert, and Kenneth L. Demerjian describe the usefulness of computer modeling in understanding complex free radical reactions. They point to hydroxyl and hydroperoxyl radicals as key reactants. In reviewing the toxic oxidant reactions of the air pollutants, nitrogen oxides and ozone, Daniel B. Menzel describes the peroxidation of polyunsaturated lipids of membranes and the oxidation of thiols. The protective effect on membranes of vitamin E acting as a free-radical chain breaker is also emphasized. J. B. Mudd reviews the biochemical reactions and physiological effects of peroxyacyl nitrates. Thormod Henriksen, Thor B. Melø, and Gunnar Saxebøl describe ionizing radiation induced free radicals in amino acids and dipeptides. Thormod Henriksen, Ragnar Bergene, Anders Heiberg, and Einar Sagstuen describe radiation induced free radicals in DNA components. Both of these chapters concentrate on selected applications of electron spin resonance spectroscopy and will probably be of interest to specialists.

Al Tappel, *University of California, Davis*

Essentials of Medicinal Chemistry. By A. Korolkovas (University of Sao Paulo) and J. Burckhalter (University of Michigan). John Wiley & Sons, Inc., New York, N.Y. 1976. 697 pp. $22.50.

This book attempts to provide a bridge between general chemistry and pharmacology. It is presumably aimed at students of medicine and pharmacology. The volume is organized by a modified pharmacological classification, with sections on drugs of the CNS, PNS, CVS, chemotherapeutic agents, vitamins, hormones, and miscellaneous drugs.

The tone of the volume is quite appropriate for a general introductory text. No attempt is made to provide a comprehensive literature treatment. Rather, selected recent reviews are provided at the end of each section. The literature is relatively complete through 1972, and a number of '73 and '74 references are included. Sections on drug synthesis and mechanisms are generally oversimplified and will not find wide appeal among chemists. The individual drug classes are treated with variable degrees of sophistication. The chapter on antimalarial agents is quite good (as would be expected), while that on antineoplastic agents is particularly disappointing. Too often, sections read like a rewrite of the Merck Index.

The book is well illustrated and data are tabulated nicely, for ready reference. An excellent index is provided, greatly enhancing the practical value of the book. In summary, it is unlikely that most chemists would find this a particularly valuable volume. However, the format of the book strongly suits it for an introductory course in pharmacology for students of medicine or pharmacy.

George McLendon, *University of Rochester*

Peptides 1976. Edited by A. Loffet (UCB Bioproducts). Editions de l'Universite de Bruxelles, Brussels, 1976. 660 pp. (price not given).

This volume presents collected papers of the 14th annual European peptide symposium. As with earlier members of the series, the present volume contains much that may be of value to workers directly involved in peptide chemistry, particularly peptide synthesis. The material is organized into sections on peptide chemistry, structure–activity relationships, and peptide conformation. It provides an interesting, although hardly thorough overview of current problems and strategies in peptide chemistry. It cannot be expected, of course, to serve as a general guide to peptide chemistry. Its utility is hampered by the presentation format. The bulk of the papers (some 83 in all) are too short to include meaningful experimental sections. Many papers if not all are being published in a modified form in the literature. No attempt has been made to provide any subject indexing. The utility of the book as a reference is correspondingly reduced. Although reproduction quality was generally high, a number of errors abound, the most serious being the total omission of pp 617–632 in the volume reviewed. In summary, the book might be a valuable addition to a science library, but cannot be strongly recommended on an individual basis.

George McLendon, *University of Rochester*

Analytical Applications of Complex Equilibria (Ellis Horwood Series in Analytical Chemistry). By J. Inczedy (University of Chemical Engineering, Veszprem, Hungary). Wiley/Halsted Press, New York, N.Y. 1976. xv + 400 pp. $44.00.

This volume is a well-written, comprehensive treatment that would be of use to analytical chemists or anyone involved with complexation (or to a lesser extent, acid–base, precipitation, or redox) equilibria.

The first chapter deals with complexes and their properties, general treatment of equilibria, conditional equilibrium constants, and the kinetics and thermodynamics of complex formation and stability. The second chapter considers determination of equilibrium constants for protonation and complex formation. Both theory and practical considerations are included for use of potentiometric, spectrophotometric, polarographic, extraction, and ion-exchange methods. Also discussed is the determination of stability constants for mixed-ligand complexes and polynuclear complexes. The third chapter concerns application of complexation and acid–base equilibria to analysis via gravimetry, titrations, membrane electrodes, polarography, spectrophotometry, and separation (extraction, ion-exchange, and electrophoresis).

The book contains a well-written Index and Table of Contents, an extensive list of 880 references, and 70 pages of tables of equilibrium constants. Scattered throughout the book are a total of 82 worked examples which give the reader practice in application of the principles presented. The inclusion of the worked examples makes the book possibly attractive as a textbook (although somewhat expensive for that use) on the graduate level.

Timothy A. Nieman, *University of Illinois*

Fundamentals of Electrochemical Analysis. By Z. Galus (Warsaw University). Wiley/Halsted, New York, N.Y. 1977. xviii + 520 pp. $49.00.

In this updated translation of a monograph originally published in

Polish in 1971, Professor Galus critically discusses the theory and applications of a number of techniques employed for electrochemical analysis as well as for studies of heterogeneous electron-transfer kinetics, homogeneous chemical reactions associated with electron transfer, and adsorption phenomena.

After a short first chapter dealing with the nature of the electrical double layer, the second chapter introduces principles and some experimental techniques of chronoamperometry, chronocoulometry, polarography, stationary electrode (cyclic) voltammetry, rotating disc voltammetry, and chronopotentiometry. A treatment of the theory of the rates of both reversible and irreversible electron-transfer processes is presented in the third chapter, and the fourth chapter summarizes the equations governing diffusion for important geometrical situations encountered in electrochemical experiments. Most of the remainder of the book indicates how the techniques identified in the second chapter are utilized to investigate diffusion-controlled electron-transfer reactions, processes governed by the rate of charge transfer, electron-transfer processes preceded or followed by a variety of homogeneous chemical reactions, coordination compounds, and electrode processes complicated by adsorption of reactants or products. In the final four chapters, cyclic methods of electrochemical analysis are considered along with pulse polarography and alternating current polarography.

Without doubt, the unique and best feature of this book is the intercomparison of electrochemical methods of analysis. Specifically, what Professor Galus does is assign to individual chapters each of a roster of electrochemical processes (such as the ece mechanism and electron-transfer steps followed by dimerization or by disproportionation) and discuss comparatively the virtues and shortcomings of the various electroanalytical techniques. Major emphasis is placed on the mathematical relationships underlying each electrochemical method and on the treatment of experimental data. There is only sparse mention of actual chemical systems which illustrate the various kinds of behavior treated in the book, though a comprehensive bibliography at the end of each chapter does provide a rich source of practical examples. Coverage of the original literature, including many articles by East European workers, is thorough up to at least 1970, and there are a number of references to papers published as recently as 1975. If more moderately priced, this book would be an excellent text for an advanced course dealing with modern methods of electroanalytical chemistry. Nevertheless, enthusiasts of electrochemistry will find that the novel organization, completeness, and succinct exposition make this book highly worthwhile and desirable.

Dennis G. Peters, *Indiana University*

Macromolecules, Structure and Properties. Volume 1. By HANS-GEORG ELIAS (Midland Macromolecular Institute). Translated from German by JOHN W. STAFFORD. Plenum Press, New York and London. 1977. lxxx + 532 pp. $39.80.

The first volume of the two-volume set is the first English translation of the third German edition (1975). This book is intended for graduate and advanced undergraduate students in polymers.

Although many mathematical derivations have been simplified, a good undergraduate knowledge of physical, organic, and inorganic chemistry is assumed. Structure is presented first because solution and solid state properties are a function of structure.

Part I, "Structure" (5 chapters), deals with chemical and physical structure of macromolecules. Included are an introduction (historical, nomenclature, commercial classification), constitution (bonding), configuration (including experimental methods), conformation (crystal and solution), and supermolecular structures (including crystalline and amorphous states).

Part II, "Solution Properties" (4 chapters), deals with solution thermodynamics, transport phenomena, and determination of molecular weight and molecular weight distribution.

Part III, "Solid State Properties" (6 chapters), covers thermal transitions, mechanical properties, compounding and processing of plastics, interfacial phenomena, and electrical and optical properties.

At the end of each chapter a good list of references is given. These are listed by topic and type of publication. An excellent choice of review articles and monographs is presented. Original references are given mostly in the historical sections.

Physical quantities are expressed primarily in SI units, and in most cases the IUPAC recommended symbols for physical quantities are used. Numerous tables and figures including photomicrographs are presented.

An index covering both volumes is included in Volume 1. In addition this volume lists a Table of Contents for Volume 2.

This volume is suitable as a textbook for a course in Physical Chemistry of Polymers. It should also be useful as a reference for practicing polymer chemists. Even though the writing is clear, this reviewer doubts that this book is suitable for self-study for beginning students with no previous experience in polymers.

Sol Shulman, *Illinois State University*

Theory and Practice of MO Calculations on Organic Molecules. By I. G. CSIZMADIA (University of Toronto). Elsevier, New York, N.Y. 1976. 378 pp. $38.50.

The responsibilities of a book reviewer are, first, to read the book being reviewed, then to report sufficient detail of the book's coverage to inform potential readers of its nature, and finally, to evaluate its strengths and weaknesses. Having encountered a recent review of his own book where none of these seemed followed, this reviewer will try to follow these stringent guidelines.

The present book by Csizmadia is a good one. It has strengths and a few weaknesses. Its level is appropriate for people already familiar with basic Hückel and SCF theory. At least, this is the opinion of the reviewer. Also, a good foundation in matrix theory is needed despite the fact that an excellent introduction to matrix operations is presented at the outset of the book. Thus, to the novice, this is a difficult book. To the practitioner in the field, it is a superb reference. It would be a fine text for a graduate course where an instructor would provide discussion of the material. It definitely is a text one would like to have on his shelf for reference and educational purposes. The author may be a bit too optimistic, though, about the ability of an average experimental organic chemist to digest this material without assistance or prior education in the field.

The book begins with a mathematical introduction dealing with vector and matrix operations such as the idea of vector spaces, similarity transformations, eigenvalue problems, and the Jacobi method of diagonalization. This is Chapter 2; Chapter 1 presents the author's philosophical outlook. Chapter 3 provides an assortment of quantum mechanical topics considered as background, such as the uncertainty principle, postulates of quantum mechanics, the nature of orbitals, the Born-Oppenheimer approximation, and the Virial and Hellman-Feynman theorems. Chapter 4 includes discussion of Roothaan's theory, Mulliken population analysis, and treatment of the hydrogen molecule. Chapter 5 treats two- and three-dimensional Hückel theory, Pariser-Parr-Pople theory, and the CNDO method. Chapter 6 covers application of closed-shell theory to open-shell problems. Chapter 7 treats hybrid and localized orbitals. Chapter 8 considers limitations of molecular orbital methods, while Chapter 9 outlines applications of MO methods to closed-shell problems. Chapter 10 treats open-shell theory, and Chapter 11 deals with limitations of these methods. Chapter 12 describes different type basis orbitals. Finally, Chapter 13 gives a tabulation of available computer programs for use.

Throughout the text illustrative examples are given, pedagogical devices for presentation are utilized, results of different methods are compared, and informative illustrations are drawn.

The author is obviously enthusiastic about his subject matter. His suggestion on page 362 that someday organic chemists will use computer programming and quantum mechanics as routinely as present day NMR may be optimistic. Also, fortunately, only those people familiar with what they are doing will penetrate to this point.

On the less positive side, the book is a photocopy of typewritten text. There are relatively few errors and the figures are very well done, but a book involving this much hard work by the author really should have been printed. Most troublesome, there is no index. This coupled with the sparsity of references detracts from the value of the book as a reference text. The reviewer has found that the miscellaneous Tables of Contents constitute a help as a replacement for an index and plans to put xeroxes of these collected Tables in his copy of the text as an index substitute. Finally, the cost ($38.50) makes it difficult to assign as a required text for graduate students. Interestingly, almost all of the negative aspects derive from the publisher and not the author.

In summary, this is a very useful and interesting text done by an excellent and active researcher in the field.

Howard E. Zimmerman, *University of Wisconsin—Madison*