tains its interest especially as a recent X-ray study[3] has shown that the four phenyl substituents are not coplanar with the ring system.

Cycloaddition reactions utilizing the "masked" 1,3-dipole of mesoionic ring systems[4] provide a convenient synthetic route not only to **3** but also to its benzolog, the thieno[3,4-*f*]benzo[*c*]thiophene system (**5**). The latter is another example of a stable tricyclic 14π-electron system containing a "tetravalent sulfur" in a five-membered ring, the properties of 2,4,5,7,8-pentaphenylthieno[3,4-*f*]benzo[*c*]pyrazole (**6**) being described earlier,[2c] the other known example of this type of system being unstable.[2a] Other examples, however, are known where the sulfur atom is in a six-membered ring, as in the naphtho[1,8-*cd*]thiapyran[5] and acenaphtho[5,6-*cd*]thiapyran[6] ring systems.

Condensation of anhydro-4-hydroxy-2,3,5-triphenylthiazolium hydroxide (**1**) with dibenzoylacetylene (DBA) in refluxing benzene over 30 hr gave,[7] in 42% yield, yellow irregular prisms (from ethanol) of 3,4-dibenzoyl-2,5-diphenylthiophene (**2**), mp 139–141° (ν_{CO} 1660, 1640 cm^{-1}; $M\cdot^+$ 444 (100); $\lambda_{max}^{CH_3OH}$ 198 nm (log ϵ 4.81), 262 (4.66)). Treatment of **2** with P_2S_5 in refluxing pyridine for 90 min, followed by quenching the reaction in ice–water, gave purple needles (from acetic anhydride) of 1,3,4,6-tetraphenylthieno[3,4-*c*]thiophene (**3**), mp 245–247° (83%) ($\lambda_{max}^{CHCl_3}$ 258 nm (log ϵ 4.30), 262 sh (4.27), 292 (4.15), 551 (3.92); $M\cdot^+$ 444 (100), M^{2+} 222 (10)), in agreement with the physical constants reported previously.[1] Although **3** and dibenzoylacetylene gave 5,6-dibenzoyl-1,3,4,7-tetraphenylbenzo[*c*]thiophene (**4**), it was more readily available from **8**, prepared from 5-methyl-1,3,4,6-tetraphenylthieno[3,4-*c*]pyrrole (**7**) and dibenzoylacetylene in refluxing benzene over 15 hr.[8] Oxidation of **8** with *m*-chloroperbenzoic acid in methylene chloride resulted in a 90% yield of **4**, obtained as yellow irregular prisms from acetic anhydride, mp 299–300° (ν_{CO} 1670 cm^{-1}; $M\cdot^+$ 646 (100)).

1,3,4,5,7,8-Hexaphenylthieno[3,4-*f*]benzo[*c*]thiophene (**5**) was obtained in 74% yield from **4** and P_2S_5 in refluxing pyridine over 5 hr and working up the reaction by pouring it into 10% sodium hydroxide solution. The highly insoluble greenish blue product was purified by digestion with hot dioxane, finally being obtained as finely matted, blue needles, mp 348–350° ($\lambda_{max}^{CHCl_3}$ 245 nm (log ϵ 4.59), 259 sh (4.50), 316 (4.38), 370 sh (3.48), 793 (4.06), 877 (3.25)). The most intense ion in the mass spectrum was the molecular ion, *m/e* 646, the only other significant ions being M^{2+} 323 (18) and $PhC\equiv S^+$, *m/e* 121 (27). Additional evidence in support of structure **5** comes from the formation of a 1:1 cycloadduct with *N*-phenylmaleimide in refluxing xylene over 9 hr. This adduct, obtained as yellow, irregular prisms (from chloroform–hexane) in 82% yield, mp 373–375° (dec) ($\lambda_{max}^{CHCl_3}$ 287 nm (log ϵ 4.39), 371 (4.03); ν_{CO} 1710 cm^{-1}), was assigned the exo configuration (**9**) on the basis of the chemical shifts of the protons α to the imide carbonyl groups [τ 5.20 (s, 2)]. No endo isomer was detected under these reaction conditions.

Acknowledgment. Support of this work by U. S. Public Health Service Research Grant CA 08495, National Cancer Institute, is gratefully acknowledged.

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(3) M. D. Glick and R. E. Cook, *Acta Crystallogr., Sect. B*, **28**, 1336 (1972).

(4) K. T. Potts, E. Houghton, and U. P. Singh, *Chem. Commun.*, 1129 (1969).

(5) M. P. Cava, N. M. Pollack, and D. A. Repella, *J. Amer. Chem. Soc.*, **89**, 3640 (1967); R. H. Schlessinger and J. S. Ponticello, *ibid.*, **89**, 3641 (1967); R. H. Schlessinger and A. G. Schultz, *ibid.*, **90**, 1676 (1968).

(6) R. H. Schlessinger and J. S. Ponticello, *ibid.*, **89**, 3641 (1967); *Tetrahedron Lett.*, 4057 (1967); R. H. Schlessinger and J. M. Hoffman, *J. Amer. Chem. Soc.*, **91**, 3953 (1969); J. S. Ponticello and R. H. Schlessinger, *ibid.*, **90**, 4190 (1968).

(7) All products described here gave satisfactory analytical data.

(8) K. T. Potts and D. McKeough, *J. Amer. Chem. Soc.*, **95**, 2749 (1973).

(9) Sterling–Winthrop Fellow, 1971–1973.

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Book Reviews

Molecular Evolution and the Origin of Life. By S. W. Fox (Institute of Molecular Evolution, University of Miami) and K. Dose (Johannes Gutenberg University). W. H. Freeman and Co., San Francisco, Calif. 1972. xi + 359 pp. $16.00.

The book contains a foreword by A. Oparin, eleven chapters, an appendix, and an index. Chapters are titled: (1) History of Concepts (15 pp), (2) Cosmology (17 pp), (3) Geological Conditions on the Primitive Earth (31 pp), (4) Micromolecules (68 pp), (5) Macromolecules (60 pp), (6) Self-assembly of Polyamino Acids and Other Substances into Microsystems (40 pp), (7) Interpretations of Experiments with Proteinoid Microsystems (24 pp), (8) Origin and Evolution of Optical Activity (7 pp), (9) Perspectives on Molecular Evolution in Organisms (14 pp), (10) Organisms and Molecular Fossils in Ancient Sediments (30 pp), (11) Extraterrestrial Molecular Evolutions (28 pp). An appendix contains directions for preparations in the laboratory and suggestions for investigations (3 pp). A general index takes up eleven pages; author and compound indexes have unfortunately been omitted.

The authors offer an analysis of the evolution of carbon compounds from their cosmic origin through the stages of Darwinian selections followed by speculations on extraterrestrial evolution. Data have been gathered from astronomy, biology, chemistry, geology, and physics to support the authors' viewpoint of constructionism, which is defined as "the science of synthesis of molecules and assembly of systems from those molecules."

There is no scarcity of books, essays, reviews, publications, and other treatments on different aspects of the orgin of life. "Molecular Evolution and the Origin of Life," along with many others, introduces the general reader not only to the background information but also to current theories and investigations in the several scientific disciplines.

The specialist may be critical of a lack of rigor in the handling of data from his own field. Sometimes for lack of critical evaluation of material presented, the nonspecialist reader will be unable to separate speculation from fact. For example, chemists will be critical of the recognition of aminocyanocarbene ($H_2N\ddot{C}CN$) for the structure of the dimer of HCN (pp 110, 179, 180), but will the nonspecialist have reason to believe that the carbene structure for the dimer is neither established fact nor reasonable speculation? (J. P. Ferris, D. B. Donner, and W. Latz, *J. Amer. Chem. Soc.*, **94**, 6968 (1972), give a brief but critical review and new support for the alternative traditional assignment as iminoacetonitrile (HN=CHCN).)

Within chapters material is presented by topics followed by an overall section on conclusions or general discussion. This has achieved neatness in organization, but sometimes at the sacrifice of clarity. Consider the following quotation from the General Discussion Section of Chapter 4, pp 124, 125: "In some experiments, amino acids have been identified only by comparing chromatographic R_f values. The assumption made, then, is that the amino acid formed is identical with one of the common types. Many of these results need to be confirmed, because inferences drawn on the basis of a single R_f value have in a number of those instances that have been investigated proven to be erroneous." Surely the reader, both specialist and nonspecialist, is now uncertain about the value of the earlier section "Production of Amino Acids and Related Compounds by Reactions in the Gaseous Phase" and a similar section on the condensed phase, since the discussion does not specify which are the unconfirmed results. Attributing the stability of adenine to ultraviolet irradiation to a "particularly high resonance energy" (p 111) was made without stating that in one of the two references cited (the other reference does not give the page number) the resonance energy was calculated (but the value was not given) and was not measured. Claiming that only two (rather than three) oligomers of HCN are well characterized (p 178) may be a trivial oversight—or needs to be clarified. All readers may be annoyed by the repeated use of the adjectives: proteinlike, enzymelike, cell-like, lifelike, and peptide-like.

A valuable aid to others with related research interests will be found in the many references given at the end of each chapter. To this group the book is recommended.

J. H. Boyer, *University of Illinois, Chicago Circle Campus*

My First Hundred Years. By E. Emmet Reid (Johns Hopkins University). Chemical Publishing Co., Inc., New York, N. Y. 1972. xiv + 206 pp. $10.00.

Emmet Reid's roots in this country are deep, his progenitors on both sides having fought in the Revolutionary War. His father was a Southern Baptist minister. Reid's first 13 years were scattered among Arkansas, Kentucky, and North and South Carolina as his father changed pastorates. There was almost no formal schooling until 1885, on return to Virginia. This may have been an asset, for he was taught by his parents. In 1885 he attended an academy, and from 1888 to 1892 he studied at Richmond College. His first teaching job was at Mt. Lebanon College in Louisiana. Two years later, on a scholarship, he enrolled for graduate study at Johns Hopkins. He earned his Ph.D. degree under Ira Remsen in 1898. Then he taught at College of Charleston (S. C.), transferred in 1901 to Baylor University (Tex.), and returned to Johns Hopkins in 1908 for 3 years on research appointments. For another 3 years he was in the employ of Colgate and Co. (N. J.). Then, in 1914, he accepted an offer to be associate professor at Johns Hopkins. This productive association lasted for 22 years. Dr. Reid is charitable, and he devotes less than a page to June 30, 1936, a most unfortunate day for Johns Hopkins and its president of one year, Isaiah Bowman. On that day, without warning, Reid was called into Bowman's office to receive a letter of dismissal. He was 64, hence only a year from normal retirement, but this means of balancing sagging university finances was shocking to Reid's many friends throughout the land. Characteristically, Reid makes no mention of this, but it was true. His continued contributions for these extra 36 years demonstrate how myopic Bowman's vision was at the time.

The above brief chronology gives no glimpse whatever of the charm or the scope of the book. The latter is filled with anecdotes about life in the south, interest in Baptist affairs, living expenses and frugality, good teachers and bad, descriptions of schools and laboratories of 7 to 8 decades ago, and descriptions of life in Charleston, Richmond, Waco, Fincastle, Jersey City, and Baltimore. Comments about such chemists as these provide interesting insights: Remsen, C. L. Reese, H. G. Byers, H. C. Jones, S. F. Acree, M. H. Ittner, W. A. Patrick, Neil Gordon, H. T. Clarke, J. C. W. Frazer, Emil Ott, J. Sam Guy, J. R. Sampey.

A few chemical reactions are discussed in sufficient detail to be very informative: synthesis of saccharin, rates of hydrolysis of substituted benzamides, esterification of carboxylic acids by mercaptans, making mustard gas, the peroxide effect in the addition of mercaptans to 1-alkenes, ethylation of benzene, synthesis of tetraethyllead, and the preparation of thiokol.

The real charm of the book, however, is the way it is written. When Reid's "Introduction to Organic Research" was published in 1924, it was a treat to encounter his style of writing. There he wrote, for example: "The organic chemist who can not handle Beilstein with facility is simply mistaken about being an organic chemist. We would become suspicious if we would see a preacher fumbling through the Old Testament looking for the Gospel of John and doubts arise when we notice an organic chemist pick up the wrong volume of Beilstein." In this biography, speaking of a certain professor of analytical chemistry, he writes: "He lectured only occasionally, as he would get mired down in details, but he really knew his subject." At the beginning of the Chemical Warfare Service in 1917: "Just think of it: for a couple of weeks, until the organization of the Chemical Corps of the Army, I had been given the sole responsibility of finding toxic agents. My only equipment was a pack of franked envelopes and a book of travel orders." Again, Reid notes: "My car was struck three times when I was not in it. I was unhurt which leads to the conclusion that, in danger, absence of person is even better than presence of mind."

Who else in this whole world, regardless of age, could have written or even conceived "Chemistry Through the Language Barrier," a book that tells chemists how to scan chemical articles in all major languages except Chinese. Emmet Reid did this at age 99.

Here then is a biography of a great organic chemist. In a foreword, Paul H. Emmett states: "In my humble opinion it recounts the road travelled by a great scientist, teacher, research worker, and withall a dedicated Christian gentleman." I concur wholeheartedly.

Charles D. Hurd, *Northwestern University*

Physical Methods of Chemistry. Part IIIA. Interferometry, Light Scattering, Microscopy, Microwave and Magnetic Resonance Spectroscopy. Edited by Arnold Weissberger and Bryant W. Rossiter (Eastman Kodak Co.). Wiley-Interscience, New York, N. Y. 1972. xii + 791 pp. $34.95.

This volume is Part IIIA of Volume I in the "Techniques of Chemistry" series. It contains eight chapters on interferometry, light scattering, light microscopy, electron microscopy, microwave spectroscopy, electron spin resonance, nuclear magnetic resonance, and X-ray microscopy. According to the preface, "the aim of authors treating the more sophisticated methods is to provide the reader with a clear understanding of the basic theory and apparatus involved, together with an appreciation for the value, potential and limitations of the respective techniques. Representative applications are included to illustrate these points, and liberal references to monographs and other scientific literature providing greater detail are given for readers who want to apply the techniques."

While this is a good characterization of the contents, the authors vary in their emphasis of the different aspects. In general, they discuss theoretical concepts, instrumental and practical aspects, and applications, but to differing degrees. P. H. Rieger (esr), G. C. Cocks and E. E. Jelley (light microscopy), and R. G. Scott and A. N. McKee (electron microscopy) present extensive discussions of instrumentation and techniques from both a practical and theoretical viewpoint. R. N. O'Brien directs his attention toward understanding the various types of interferometers and their applications. G. Oster (light scattering) largely separates the theory of scattering from the instrumentation with more discussion of the former. W. H. Flygare (microwave spectroscopy) and R. V. Ely (X-ray microscopy) are oriented toward a survey and discussion of selected recent results and applications along with an introduction to the field. N. Muller (nmr) has little discussion of instrumentation and presents largely the principles involved in interpreting nmr spectra. Because of the differing emphasis, it is difficult to briefly summarize the value of the overall volume; in general, it will be a useful introduction, survey, and/or review of the respective areas.

Robert L. Kuczkowski, *University of Michigan*

ORD and CD in Chemistry and Biochemistry. An Introduction. By Pierre Crabbé (Syntex, S. A., Universidad Nacional Autonoma de Mexico, and Universidad Iberoamericana Mexico). Academic Press, New York, N. Y. 1972. x + 230 pp. $7.95.

The title of this book would better describe it as a compendium rather than an introduction to optical rotatory dispersion and circular dichroism. The literature is exhaustively covered from 1965 to 1971 with citations to significant historical developments. This monograph is a valuable summary of recent studies which adds to the author's book published in 1965, and access to these works is essential for almost every investigator of optically active molecules.

The organization uses a classical functional group approach based on the chromophores which absorb uv and visible light. The emphasis lies on sector rules for predicting configuration or conformation by methods analogous to those used with the Octant Rule for ketones. The new investigator should read a more detailed introduction before using this book, and the first group of references includes useful reviews. The author limits the discussion of polypeptides and proteins, whereas this is probably the most active area of current investigation. The biochemist may find that the functional group models and nomenclature require review.

Chapters on solvent effects, polymers, and metal complexes cover chiral molecules, and a chapter on the developing areas of magnetic ORD and MCD is a useful introduction to induced chirality. The book is slightly more comprehensive than its predecessor entitled "An Introduction to the Chiroptical Methods in Chemistry" which was based on the author's lecture notes in a course and published in Mexico. A chapter of problems completes the text followed by a valuable table of rules applicable to chiral molecules with a wide variety of key-word indexing. The comprehensive literature coverage and brief descriptions of sector rules make this volume valuable to the research worker using chiral molecules.

Gloria G. Lyle, *University of New Hampshire*

Insect Sex Pheromones. M. Jacobson (U. S. Department of Agriculture, Agricultural Research Service, Beltsville, Md.). Academic Press, Inc., New York, N. Y. 1972. xii + 382 pp. $22.50.

This volume is an enlarged, revised, and updated version of the author's 1965 reference work entitled "Insect Sex Attractants." This new edition contains approximately 1400 references (compared to 425 in the 1965 volume), including a few from 1972. There are chapters which deal with the occurrence of sex pheromones, the anatomy and physiology of the glands which produce the pheromones, the mechanism of pheromone perception and the responses to sex pheromones, biological factors which influence the production of and response to pheromones, the identification and synthesis of sex pheromones, and the use of sex pheromones in insect survey and control. Throughout, the coverage of the subject matter is comprehensive and encyclopedic, rather than critical or synthetic. The author's straightforward, low-keyed style of presentation accurately reveals the character and flavor of research in this area, its vast scope and potential, the problems and pitfalls, and the probable role of an organic chemist. In the Preface, the author states that "This expanded review of the world literature should be extremely valuable to research and economic entomologists, insect physiologists, chemists, and ecologists." This reviewer concurs.

Michael M. Martin, *University of Michigan*

Research Techniques in Biochemistry and Molecular Biology. By Robert E. Thach (Washington University School of Medicine) and Mary R. Newburger. W. A. Benjamin, Menlo Park, Calif. 1972. xxii + 181 pp. $7.50.

This laboratory manual is a welcome addition to the available texts for introductory courses in biochemistry. The writing is easy and relaxed throughout and should strike a responsive chord in students who are often less than impressed with erudite works cast in laboratory jargon. The illustrations are well chosen and clearly executed. Lists of materials are presented for the instructor, as well as down-to-earth analyses of the expense involved in some of the experiments.

The choice of experiments should be exciting to the student. In the first part of the book, polynucleotide phosphorylase is isolated and examined. Routine analyses for protein and RNA are introduced, as well as paper chromatography and photometry. A second part of the text outlines brief studies of enzyme kinetics, after which the isolated enzyme is employed to synthesize polynucleotides. Characterization of the polynucleotides introduces ion-exchange chromatography and viscometry. In a third part of the book the Nirenberg and Matthei experiment is repeated, allowing the student to synthesize polyamino acids using his own polynucleotides as templates. Radioactivity, liquid scintillation spectrometry, separations on density gradients of sucrose, and solubility properties of nucleic acids and homopolymers of amino acids are introduced. Finally, the fourth part of the manual examines the activation of amino acids to form their t-RNA–amino acyl adducts. A final section directs the superior student to further work, which he is challenged to attack on his own.

If there is any serious flaw to be found in the book, it lies in the choice of the title. This is not really a manual for biochemistry; no experimental work is carried out with carbohydrates, lipids, vitamins, etc. One wonders if a manual such as this, while carefully constructed and clearly reflecting one very important facet of modern biochemistry, does not do the student an injustice in failing to provide a more general background.

William O. McClure, *University of Illinois*

Pharmaceutical Applications of Thin-Layer and Paper Chromatography. Edited by Karel Macek (Charles University). Elsevier Publishing Co., Amsterdam, The Netherlands. 1972. xvi + 743 pp. $78.50.

This monograph is an extensive descriptive survey of the literature to the year 1970 which includes about 2,500 references and over 4,000 compounds of pharmaceutical interest. The chapters on chromatographic applications to medicinal and natural products present noncritical reviews subdivided into sections such as sample preparation, detection, solvent systems, R_f data, quantitative analysis, and applications. Particularly attractive are the tabular summations of literature R_f values.

Less attractive is the price of the book. Also the chapters on chromatographic techniques add little to reviews already available in the more general chromatographic monographs. For the most part there is only limited discussion as to the application of systems to biological problems and dosage forms. This together with the lack of data and conclusions as to the choices of systems on the basis of the chemistry of the compounds to be chromatographed makes the use of this monograph with new compounds and systems more difficult. Thus, this reviewer certainly cannot agree with the editor's statement that "On the basis of these data, readers with an understanding of the principles of the techniques described can solve any analytical problems they may encounter in drug analysis."

Joseph E. Sinsheimer, *College of Pharmacy*
The University of Michigan

Photochromism. Edited by G. H. Brown (Kent State University). Wiley-Interscience, New York, N. Y. 1971. xii + 853 pp. $47.50.

Reversible, light-induced processes that result in a relatively rapid color change are always fascinating phenomena and have attracted an increasing amount of interest among chemists during the past decade. In addition to the scientific interest in the phenomenon (which is commonly termed "photochromism"), there has been a considerable amount of commercial interest, and, in fact, much of the fundamental research in photochromism has been done at industrial laboratories.

This book constitutes Volume III of the series "Techniques of Chemistry" under the general editorship of Arnold Weissberger and is undoubtedly the most comprehensive volume that has yet appeared on the subject of photochromism. After a concise introductory chapter by the editor, the general behavior of photochromic systems is described by R. Livingston. Next follow five chapters in which the photochromic processes are classified on the basis of their mechanisms. The mechanisms include heterolytic cleavage (R. C. Bertelson), homolytic cleavage (G. Eigemann), cis–trans isomerization (D. L. Ross and J. Blanc), tautomerism (J. D. Margerum and L. J. Miller), and the development of color centers in inorganic systems (S. K. Deb and L. J. Forrestal). Photochromism in living systems is discussed by L. P. Vernon and B. Ke in a chapter which relates this process to photosynthesis and vision. There are also two chapters which deal with the applied aspects of photochromism; the first describes photochromic glasses (R. J. Araujo) and the second is a very useful review by R. C. Bertelson on the applications of photochromic materials in self-developing photographs, information storage and display, microimaging, decorations, and laser technology (Q-switches). It is recommended reading for anyone who teaches or takes a course in photochemistry.

The writing is, in general, of high quality, and the editor has done an excellent job of keeping overlap and duplication between the various chapters to a minimum. Although there is no author index, the subject index is sufficiently detailed so that information is still relatively easy to find. There is, however, one point on which the reviewer feels obliged to comment. One of the chapters contains 387 pages and comprises almost half of the book. In this chapter are thirty-nine consecutive pages of tables describing the photochromic spiropyrans and related compounds. Since many of the listings reflect only minor structural modifications within a group, one wonders if it might have been desirable to shorten these tables considerably by providing fewer, yet representative examples, especially since the literature reference for many of the compounds is to unpublished work or to special government reports which are relatively difficult or inconvenient to obtain.

This large volume can be recommended as a reference work for all workers in the field of photochromism and certainly should be included in the library of any institution which has an active interest in photochemistry.

Anthony M. Trozzolo, *Bell Laboratories*

Angular Scattering Functions for Spheroids. W. Heller, M. Nakagaki, and G. Langolf (Wayne State University). Wayne State University Press, Detroit, Mich. 1972. xi + 105 pp.

The tables in the book contain parameters relevant to the theory of light scattering by spheroidal bodies.

The brevity of the introductory text part of the book makes it difficult to understand and (I assume) use without supplementary reading. One of the references needed is to work by two of the authors (W. H. and M. N.), *to be published.* In my opinion, the book could have been improved if the introduction to the tables had been made self-contained, with a statement of the main results of the theory and presentation of all formulas whose parameters are contained in the tables.

I cannot comment on the usefulness of the tabulated parameters to workers in this field.

A. B. Ritchie, *University of Alabama*

Mass Spectrometry for Organic Chemists. By R. A. W. Johnstone (University of Liverpool). Cambridge University Press, London. 1972. xi + 174 pp. $6.95 paper; $14.95 clothbound.

In his introduction, Johnstone points out that "to write a simple introductory text to this subject is a somewhat uncomfortable task since it becomes necessary to cut corners. . . ." While such is the case, the author nevertheless does cover the general areas of instrumentation, theory, and structure elucidation sufficiently well to whet the appetite of the reader. Further, his coverage of "specialized areas" such as field and chemical ionization, ion cyclotron resonance, isotope analysis, and metastable defocusing should be helpful in learning the value of some "newer" techniques of mass spectrometry.

However, this book does not avail the reader of specific references to subjects discussed in the test, *e.g.*, the "toluene problem." In fact, there are numerous cases where references, if added, would have made the book more valuable to the reader. The author does offer a modest bibliography, but unless the reader is familiar with these references, it is difficult to obtain key leads into the subject.

In addition, there exist to this reader some errors in formulas and *m/e* values, *e.g.*, page 64 reads "$C_5H_{13}N^{+}\cdot \rightarrow C_5H_{11}\cdot + CH_4N^{+}$, but I presume to read $C_5H_{13}N^{+}\cdot \rightarrow C_5H_9\cdot + CH_4N^{+}$; and page 56 lists formulas $C_4H_7O_3$ (*m/e* 103) and C_9H_7O (*m/e* 131), but the structures shown correspond to $C_4H_6O_3$ (*m/e* 102) and C_9H_8O (*m/e* 132), respectively.

Nevertheless, this book does present a sound introduction to mass spectrometry for the organic chemist and is probably the most up-to-date book of its type that I have read.

Alan Siegel, *Indiana State University*

The Prostaglandins: Progress in Research. Edited by S. M. M Karim (Makerere University). Wiley-Interscience, New York, N. Y. 1972. viii + 327 pp. $12.50.

The editor clearly states the intent of this volume. The book attempts to fulfill the need for a one-volume collection "of information from individual experts actively engaged in different aspects of prostaglandin research." The authors and their contributions are: introduction and general pharmacology (S. M. M. Karim and K. Hillier), reproduction in subhuman primates (K. Kirton), human reproduction and clinical uses (S. M. M. Karim), cardiovascular and renal actions (S. M. M. Karim and K. Somers), gastrointestinal effects (A. Bennett), respiratory system (A. P. Smith), platelets (N. J. Mody), prostaglandin antagonists (K. E. Eakins and J. H. Sanner), and chemistry (W. P. Schneider). The recent interest in therapeutic applications of prostaglandins in reproductive physiology is reflected in the extra attention given to this and related topics. In fact, the three chapters authored or coauthored by Dr. Karim constitute in excess of 50% of the volume. These chapters are of consistent quality and value (if somewhat too thick in references and thin on discussion of the possible physiological roles of these substances). The remaining chapters are not of consistent quality ranging from the poor treatment given to the effect of prostaglandins on platelet function to an excellent, but limited, account of prostaglandin antagonists. The chapter devoted to the chemistry of the prostaglandins is quite short and consists almost exclusively of unenlightening summaries of the total syntheses of prostaglandins and their analogs.

This volume should be welcomed as the most complete review to date and for its up-to-date collection of references (coverage to mid-1971). Unfortunately the areas of greatest interest to the chemist (biosynthesis, metabolism, synthesis, molecular basis of action, and antagonism) are given rather poor treatment. This is particularly unfortunate since a discussion of related chemistry in a general work on prostaglandins would be invaluable to the major market for this work, the clinicians and physiologists working with these intriguing substances.

N. H. Andersen, *University of Washington, Seattle*

The Chemistry and Biochemistry of Nitrogen Fixation. Edited by John R. Postgate (University of Sussex, U.K.). Plenum Press, London and New York. 1971. xi + 326 pp. $20.00.

Although it is still as much of an unfulfilled mission as it was ten or twelve years ago, the exploration of chemical mechanisms in biological nitrogen fixation has advanced, during the past decade, towards a stage where a solution to its tasks is no longer totally out of sight. The stated purpose of the present volume is to put into perspective the advances made during the period between 1960 and 1970. Probably the most successful one in meeting this objective is the introductory chapter by P. W. Wilson, which contains, in an excellent account of the development of nitrogen fixation research since the turn of the century, lots of hard-to-come-by background information. The two subsequent chapters, on non-biological nitrogen fixation and N_2 complexes, contain little material of possible biochemical significance which had not been repeatedly reviewed already. This lack of novelty is not so much the fault of the authors; rather, there appears to be surprisingly little systematic activity on the whole in this area of abiological modelling of biochemical nitrogen fixation. Quite to the contrary, the following chapters on the enzyme chemistry and the physiology of nitrogen fixation in free-living microorganisms have to try to assess the knowns and unknowns in a rapidly advancing field. In this area, some of the most striking research results, both on the physical characterization of the enzymes and on their connection with the metabolic electron transfer pathways, have surfaced only since the completion of the volume.

The last two chapters, on symbiotic nitrogen fixation in leguminous and non-leguminous plants, are probably the most potentially useful ones in the volume. This area, although obviously of major relevance, has apparently received less widespread research attention than the experimentally more amenable free-living nitrogen-fixing microbes. The research account in these chapters on symbiotic nitrogen fixation could well serve to both stimulate and serve as an introduction for future studies in this area. Two appendices, one concerning research by Soviet scientists on nitrogen fixation, the other about the use of the acetylene test for nitrogenase, provide somewhat anticlimactic but convenient additional information.

On the whole, the authors (most of whom are affiliated with the British Agricultural Research Council's Unit of Nitrogen Fixation at Sussex; some of the foremost American research groups are not represented) have nevertheless managed to give a rather complete and coherent picture of the state of nitrogen fixation research at the beginning of the present decade. The remarkable accordance between the results obtained in various research groups around the globe concerning these highly complex enzyme systems attests to both the consistency of nature in her approach toward the task of reducing N_2 molecules from the atmosphere, and to the objectivity and competence of the biochemists trying to unravel her puzzling ways.

H. H. Brintzinger, *University of Michigan*

Interaction of Metals and Gases. Volume II. Kinetics and Mechanisms. By J. D. Fast (Phillips Research Laboratories and the Technical University of Eindhoven). Barnes and Noble Publishers, New York, N. Y., and Phillips Technical Library, Eindhoven. 1972. ix + 318 pp. $32.50.

In Volume 1 of this title (published by Phillips Technical Library, Eindhoven, 1965), gas–metal interactions are discussed under the general heading of "Thermodynamics and Phase Relations." Extensive coverage of this area and of gas–metal surface interactions are avoided in Volume 2, though both topics are included to a sufficient degree to make a full understanding of the kinetics and mechanisms of bulk phase gas–metal interactions possible without immediate recourse to further references.

The subject is presented under the chapter subheadings: Solutions of Gases in Metals, Diffusion in Interstitial Alloys, Internal Function of Metals, The Snoek Effect and Its Significance for Metal-Gas Problems, and Interaction of Interstitials and Other Lattice Imperfections. The treatment reveals a close familiarity with the relevant literature with references to 1970, though, as has already been indicated, the text is completely self-contained. Thus in the chapter on gas solution in metals, a brief but adequate description is provided of the band theory of metals.

Throughout the text a strenuous effort is made to avoid the unnecessary use of mathematics, an important factor in its readability and one that is by no means easy to accomplish, particularly when dealing with such a complex phenomenon as the Snoek effect. The book is aimed at "metallurgical students, industrial metallurgists and chemists"; however, while a few specialists might prefer a greater in-depth treatment, this volume probably has a much wider value and may be recommended to anyone interested in solid-state theory, ultrahigh vacuum attainment, and gas purification through metal membranes and to those interested in heterogeneous metal catalysis, as almost essential background material. Typically, the volume would make an excellent reference text for related graduate or even undergraduate courses. In short, the reader can easily make his personal evaluation of the value of this book, since if the topic proves of interest to him, he may be assured it has been well presented.

D. A. Cadenhead, *State University of New York at Buffalo*

Recent Developments in the Chemistry of Natural Carbon Compounds. Volume IV. Edited by R. Bognar, V. Bruckner, and Cs. Szantay. Hungarian Academy of Sciences, Budapest V, Hungary. 1971. 327 pp. $12.00.

This volume consists of three articles, the first of which is a review (47 pp, 727 references) on aldehydrogenic lipids (plasmalogens) by N. A. Preobrazhenskii and G. A. Parfenov. After an outline of the types of aldehydogenic lipids that may be encountered, their occurrence in nature and methods of extraction are discussed. The reactions used for the determination of the structures of this group of compounds are given briefly, and this is followed by a section on synthesis in which both already realized and potential routes are examined. Brief chapters on the metabolism and biological roles of plasmalogens conclude this account.

The second article is by N. K. Kochetkov and A. F. Bochkov on sugar orthoesters and their synthetic applications. In contrast to the first review, these authors examine in detail (110 pp, 150 references) one particular class of compound and its reactions. This treatment is particularly welcome since it makes available for the first time a unified account of this previously neglected group. In addition to sections on the synthesis, structure, and reactions of these compounds, extensive tabular data are provided on all known orthoesters.

The third article by N. M. Mollov, H. B. Dutschewska, and V. St. Georgiev is on Thalictrum alkaloids. This article is of rather different form to the others, consisting of four sections [biogenesis and pharmacological activity; structure and properties; spectral properties (mass spectra, nmr, ir, and uv); stereochemistry] with independent references. Those on structure and properties (50 pp, 176 references) and on spectral properties (43 pp, 48 references) constitute the bulk of the article (115 pp, 280 references) throughout which many tables of useful data are given.

This volume makes available convenient summaries of three diverse fields, but it must be said that the literature references are not particularly current. This is very noticeable in the article on plasmalogens where, despite the number of citations, 1967 is the latest year quoted.

Guy G. S. Dutton, *University of British Columbia*

Macromolecular Science (Volume 8. Physical Chemistry Series One, MTP International Review of Science). Edited by C. E. H. Bawn (University of Liverpool). University Park Press, Baltimore, Md. Butterworths, London. 1972. x + 369 pp. $24.50.

According to the Publisher's Note, the subject coverage should be extensive, systematic, and critical; according to the contents, it is neither extensive nor systematic. This new review volume contains rather eight reviews on selected topics: Anionic Polymerisation and Block Copolymers (M. Morton), Cationic Polymerisation (J. P. Kennedy), Morphology of Lamellar Polymer Crystals (A. Keller), Stereoregular Polymerisation (I. Pasquon and L. Porri), Viscosity of Polymers (A. Peterlin), Fracture of Polymers (E. H. Andrews), Polymer Degradation (N. Grassie), and Diffusion in Polymers (V. Stannett, H. B. Hopfenberg, and J. H. Petropoulos). The contents of the articles are sometimes less comprehensive than their titles: "Anionic Polymerisation. . . ." is concerned exclusively with dienes and cyclic sulfides, "Cationic Polymerisation" covers hydrocarbons only. As frequent in review volumes, some contributions are very critical (M. Morton, J. P. Kennedy E. H. Andrews), whereas others are hardly more than a useful collection of literature references (I. Pasquon and L. Porri, N. Grassie). All reviews are easy to read, and most of them are amply documented (total of 1667 references) and updated (sometimes until 1971). The result is a better-than-average collection of reviews for which the reviewers' congratulations go to the editor and the authors. To blame is the publisher: the volume does not contain a subject index. The usefulness (besides for the profit of the publisher) of a separate index volume for all 13 volumes of the "Physical Chemistry Series One" is questionable. A "Physical Chemistry Series Two" is planned for 1974, a "Physical Chemistry Series Three" for 1976, and so on. There is, furthermore, an "Inorganic Chemistry Series One" (ten volumes) and an "Organic Chemistry Series One" (ten volumes), and other series are obviously planned for other branches of science. This is a gigantic undertaking and one is tempted to say: think small, publisher!

Hans-Georg Elias, *Midland Macromolecular Institute*

Properties of Polymers: Correlations with Chemical Structure. By D. W. van Krevelen (University of Technology, Delft) with the collaboration of P. J. Hoftyzer (AKZO Research and Engineering N. V.). Elsevier Publishing Co., Amsterdam, The Netherlands. 1972. xii + 428 pp. $30.00.

This book describes methods of estimating values for many of the properties of polymers (mainly synthetic, linear chain polymers) that may be of use to the reader. It is divided into six parts: (a) introduction, which discusses the approach, reviews polymer structure, nomenclature, and classification, and summarizes physical quantities, units, dimensionless groups, and additive functions; (b) thermophysical properties, which includes volumetric, calorimetric, cohesive and adhesive properties, transition temperatures, and solubility; (c) properties in fields of force, which includes mechanical (viscoelastic), ultimate mechanical (strength and hardness), optical electrical, and magnetic properties; (d) transport properties, which includes thermal conductivity, viscosity of solutions and melts, dissolution rate, and permeation of polymers (solubility and diffusivity); (e) physical and chemical change, which includes crystallization, orientation, thermochemical properties (of formation), and degradation; (f) retrospect, which attempts to correlate and interrelate many of the properties and relationships previously discussed. To use the book effectively, the reader should have a comprehensive understanding of the principles of physical chemistry.

The book is intended for those who work on practical problems in the field of polymers. The approach has been semiempirical; *i.e.*, it combines empirical correlations and theoretical concepts when possible for the estimation of polymer properties through the application of the additivity principle using group contributions. Some properties considered could not be estimated in this manner, and for most of those empirical relationships are given. The author's use of a large number of tabulations comparing the experimental and estimated property values was particularly useful since it allows the reader to predict the probable accuracy of his estimate. In addition, the many numerical examples used to illustrate the calculations were quite helpful.

However, there are some inaccuracies in the book of which the reader should be aware. These are mostly of an incidental nature, thus do not seriously detract from the value of the book: for example, the implied equating of the Arrhenius activation energy, E, to the enthalpy of activation, the implied relationship between E and the enthalpy of reaction without reference to E for the reverse reaction, and the statement that the standard free energy of formation is a quantitative measure of the stability of a compound, which does not take into consideration possibly important kinetics factors. Finally, the significance and value of the charts, graphs, and diagrams in the last section of the book appear limited and could have been left out without reducing the value of the book.

In summary, the book generally is comprehendable and well written and should prove helpful to investigators that require values for polymer properties which are not readily available.

Thomas J. Houser, *Western Michigan University*

Enzymes. An Introduction to Biological Catalysis. By ALAN D. B. MALCOLM (Merton College, Oxford). Barnes & Noble, New York, N. Y. Methuen Educational Ltd., London. 1971. v + 74 pp. $2.50.

This book provides an elementary introduction to the topic of enzymatic catalysis. A basic knowledge of organic chemistry is required, but no biochemistry background is needed to read the text.

I have mixed feelings about recommending this book. I found the rather large number of typographical errors disturbing since this is an elementary text. For example, good proofreading should have caught mistakes such as those present in the drawings on the lower half of page 25. Furthermore, although many different topics in enzymology are mentioned, they are treated only superficially. While this book does provide an easily readable introduction to enzymology, its principal useful function, in my opinion, might be to interest the reader in really learning something about the field, for which additional reading of other texts would be necessary.

Emil Thomas Kaiser, *University of Chicago*

The Radiation Chemistry of Macromolecules. Volume I. Edited by MALCOLM DOLE (Baylor University). Academic Press, New York and London. 1972. xiv + 369 pp. $23.00.

This is the first volume of what is to be a two-volume series of articles on the chemical and physical effects of high-energy radiation (primarily electrons and γ-rays) on both "synthetic" polymers and biopolymers. This first volume is primarily concerned with the appropriate theoretical background in this area, while the second is to be more descriptive in nature.

The first part of the present volume is entitled "Fundamental Processes and Theory" and contains the following chapters: Introduction (M. Dole), Early Processes in Radiation Chemistry and the Reactions of Intermediates (F. Williams), Energy Transfer in Polymers (R. H. Partidge), Theory of Free Radicals (P. Hedvig), Molecular Mobilities in Polymers (P. Hedvig), Theory of Reactions in the Solid State (H. J. Wintle), Theory of Electrical Conductivity of Polymers (H. J. Wintle), Electrical Conductivity of Irradiated Polymers (P. Hedvig), ESR and Optical Studies of Trapped Electrons in Glasses (R. M. Keyser, K. Tsuji, and F. Williams), Thermoluminescence in Polymers (R. H. Partridge), and Statistical Theories of Cross-Linking (P. Saito). Much of this material is quite general and will be of interest to a variety of readers.

The second part, "Experimental Techniques and Applications to Polyethylene," consists of the chapters Experimental Techniques (M. Dole), Radiation Chemistry of Linear Polyethylene (L. Mandelkern), and Free Radicals in Irradiated Polyethylene (M. Dole). This section of the book is obviously rather specialized, but the emphasis on this particular polymer is well justified; the relatively simple chemical structure of polyethylene makes it very attractive from the theoretical or interpretative point of view while the considerable commercial importance of this polymer makes its detailed study of practical interest as well.

In the opinion of this reviewer, the book is in general well written and contains a great deal of material which should be of interest to people working on the radiation chemistry of small molecules as well as on polymers. As is usually the case in a survey of such a broad field, however, the typical reader will find some chapters to be of very great interest and others to be of no direct interest whatever. Nonetheless, it is a pleasure to recommend this book to anyone wanting to learn more about this area of chemistry and physics.

J. E. Mark, *University of Michigan*

Organic Chemistry: A Concise Approach. By F. M. MENGER, D. J. GOLDSMITH, and L. MANDELL (all of Emory University). W. A. Benjamin, Inc., Menlo Park, Calif. 1972. xii + 450 pp. $9.95.

Many textbooks for short courses in organic chemistry have appeared on the market in recent months. Most of these have tailored their approach to students of nursing, biology, medical technology, or agricultural science. "Organic Chemistry: A Concise Approach" is noteworthy in that it offers a brief, balanced treatment of topics while avoiding sacrifice of integrity in its treatment of reaction mechanisms, spectra, and name reactions. Much descriptive chemistry which might have been treated in the text is included in the problems at the ends of the chapters. The problems, which include numerous natural product chemicals, seem to have been carefully selected for student interest and relevance. Nomenclature rules appear in the appendix where they do not detract from the rapid development of bonding, resonance effects, and functionality in the first three chapters. The authors seem to have achieved a certain harmony between organization of topics, brevity, and rigor.

The most serious defect in the book arises from minor errors in the structural formulas; there are enough typographical errors to be a source of confusion for a beginning student. Also, a professor who wished to maintain emphasis on spectral interpretation would need to supplement; after introduction in Chapter Six, spectra appear to have been abandoned in the problems.

This concise text should be attractive to professors who wish to offer a short, complete, rigorous course in organic chmistry.

Roy A. Shaver, *University of Wisconsin—Platteville*

Practice and Theory of Electrochemical Machining. By JOHN F. WILSON (Rolls-Royce Ltd.). Wiley, New York, N. Y. 1971. xi + 252 pp. $15.95.

The goal of the author in this book was to present electrochemical machining technology in a practical form to facilitate effective use of the process. ECM is a specialized technique of particular value for difficult metal removal problems, and as such it does not have the vast background of field expertise and knowledge that traditional machining enjoys. Learning to use ECM in production can be both time consuming and costly, and therefore a manual supplying detailed operating information serves a real need for those contemplating the use of this process.

The first six chapters discuss the fundamentals of the process, the equipment required, economic considerations and cost analysis, and basic tooling concepts. Included in the latter are construction materials, power distribution, and electrolyte flow. This first segment of the book provides an overall view of the subject of electrochemical machining.

Chapter 7 is the longest single chapter (82 pages) and provides detailed information on designing and using EC tooling, as well as selecting and designing the component to be machined, in order that the process may be used to best advantage. Chapter 8 is directed specifically to electrochemical turning and tapered electrodes, while Chapter 9 is concerned with the electrolyte and with performance evaluation. The operation of the process and the diagnosis and correction of faults are covered in Chapters 10 to 12. Finally, for those who are interested, Chapter 13 presents some of the fundamentals of electrochemistry as applied to electrochemical machining. An appendix lists some proprietary information on insulation coatings, and a glossary defines a number of the commonly used terms.

Numerous photographs and line drawings have been employed throughout the book. The line drawings, in particular, are very well done and are especially helpful for demonstrating the function and operation of the tooling. Significant literature references are shown at the end of Chapter 9, Chapter 13, and the appendix.

The author has effectively fulfilled his stated objective of producing an instructional volume for the ECM field. While other workers have indeed reported on various aspects of the process, Mr. Wilson has assembled here the detailed information that is important for sizing and designing equipment, calculating the fluid flow requirements, avoiding process faults, and assessing the costs. Accordingly, managers, engineers, and electrochemists to whom electrochemical machining offers a means for solving unusual and difficult machining problems will find this book very enlightening and time-saving.

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