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BOOK REVIEWS

Chemical and Biochemical Applications of Lasers. Volume II. Edited by C. BRADLEY MOORE, Academic Press, New York, 1977. 280 pp., $15.00

This book is the second of a series of review articles on areas of active research. Review articles should attempt to serve varied purposes. They should be an introduction to the intelligent naive reader. As such, they must be comprehensive by starting from basics and developing the material in an orderly manner. The reader should be left with a sense of the accomplishments and pitfalls of the material with a list of references which will allow the person to proceed further. At the same time, the article must contain enough depth and breadth to interest the experienced reader. I am happy to say these articles meet these criteria excellently. The authors of each article are prominently associated with the material they are reviewing.

This book, with the exception of one article (5), may not be in the general areas of interest to the readers of this Journal. Three of these articles can best be described as chemical physics (1, 2 and 3). The remaining two articles are concerned with the thermodynamics of chemical lasers and new laser sources (4 and 6). With this disclaimer, let me hasten to say that several of these articles involve areas and techniques which will be in more general use in the years to come.

1. *Laser Spectroscopy in Supersonic Jets* by D. H. Levy, L. Wharton and R. E. Smalley. 41 pp. (57 references). This article reviews the technique and results in the field. A review of the current state of nozzle mechanics and their cooling abilities is discussed with references to the molecular beam work which developed them. Signal size with laser excitation and various forms of detection is estimated. Practical details and results of the spectroscopy of iodine, nitrogen dioxide, s-tetrazine and various van der Waals molecular complexes are described. The cooling ability in all degrees of freedom is truly remarkable and allows tremendous simplification of gas phase spectra. Spectra of nitrogen dioxide originate almost entirely from the ground state providing much needed information for this classically difficult problem. Rotational broadening of a large molecule like s-tetrazine is effectively "frozen" out giving one of the few highly resolved gas phase spectra for such a large molecule. Future outlook for this area is presented.

2. *Vibrational Relaxation in Matrices* by F. Legay. 43 pp. (67 references), and

3. *Picosecond Investigations of Dynamic Processes in Polyatomic Molecules in Liquids* by A. Laubereau and W. Kaiser. 56 pp. (45 references). Both of these articles deal with the dynamics of vibrations. Each article describes methods and results in an experimental domain where direct probing of vibrational dynamics is possible.

Article 2 observes small molecules by matrix isolation techniques at low temperatures (1–50 K). Various methods of vibrational excitation and detection are discussed. Some vibrational lifetimes are so long (seconds) that direct IR emission monitoring is possible. Theoretical review of various vibrational relaxation mechanisms are presented for relaxation to phonons, vibrations and librations. A review of experimental results is then presented with these models in mind. The most interesting result to this reviewer is that vibration lifetimes are unexpectedly long and temperature insensitive in many cases. A model is presented for this on the basis of librations being the major relaxation mechanism.

Article 3 looks at vibrational relaxation of room temperature liquids with picosecond laser techniques. Much work has been done by the authors to distinguish between phase relaxation (denoted in the article by the NMR notation T_2) and vibrational lifetime (T_1). In contrast to the previous article, little theoretical work is presented on the causes of liquid vibrational relaxation. Excellent discussion is given of the experimental techniques for measuring both T_1 and T_2. A coherent phased vibrational population is produced by stimulated Raman emission with an ultrashort optical laser pulse. Phase lifetimes are measured with delayed probe pulse measurements of either stimulated Raman or stimulated antistokes Raman. Vibrational lifetime measurements are made with normal antistokes Raman. Theoretical development of coherent Raman probe scattering is given. This is necessary to appreciate the difficulties and subtleties in making these measurements. Full discussion is made of the importance of laser coherence and wave matching. Results are presented for several simple organic liquids illustrating the large difference between T_2 and T_1 lifetimes. Beat frequencies are observed with coherent Raman probing from isotope effects. Excellent agreement between Raman linewidths and T_2 times is observed in many non-hydrogen bonding liquids. Demonstration of a factor of eleven inhomogeneous broadening in methanol with its implications for other similar solvents such as water was most interesting. The article ends with a discussion of experimental techniques necessary to the production of ultrashort pulses in the IR. This will allow extensions of these techniques to dipole active vibrations.

4. *Thermodynamics of Molecular Disequilibrium* by R. D. Levine and A. Ben-Shaul. 525 pp. (125 references). This is an entirely theoretical article which attempts to study the thermodynamics of gas reactions with special emphasis on chemical lasers. Experimental results from the literature are presented for comparison but with no detail. The thermodynamics of disequilibrium are derived from an information theory concept of entropy. Systems are modeled on gas phase bimolecular chemical reactions which produce nonequilibrium excited state distributions. A concept of available work is introduced. A "heat bath" concept in terms of individual collisions is used. The effect of excited reagents before chemical reaction is considered. Finally, a thermodynamic method of determining the time development to molecular equilibrium is developed without the introduction of individual level kinetic parameters. This reviewer found this article somewhat unclear in indicating the significance of some of the basic concepts such as available work and surprisals although it may be due to my own inexperience.

5. *Applications of Laser Velocimetry in Biology and Medicine* by B. R. Ware. 40 pp. (91 references). The uses of laser doppler velocimetry on macromolecules and organisms is reviewed in this article. Measurements are made by cross correlation of scattered laser light and the unscattered beam as they meet at a photomultiplier tube. Experimental problems such as beam coherence and angular selectivity are discussed.

Major applications have been in four areas: electrophoresis, organism motility, blood flow and protoplasmic streaming. Laser doppler velocimetry appears to be the detector of choice for the analytic use of electrophoresis.

Analysis is immediate and made within the bulk of the media. Application has been diverse and currently ranges from the analytic separation of blood proteins to discrimination between normal and leukemic lymphocytes. Application to organism motility has been made for swimming speed distributions. The present theoretical models in this area are discussed with experimental evidence for human spermatozoa and *E. coli* presented. Blood flow velocity has been measured in capillaries as small as 10 μm in diameter. These laser methods have allowed the measure of velocity distributions within capillaries. Scattering off skin is a useful technique to measure microcirculation just under the skin surface. The ability to highly focus laser beams has allowed the measurement of intracellular hydrodynamics. Applications are presented for the streaming of various algae and slime molds. Periodic streaming is observed in the slime mold *Physarum polycephalum* in its travel. Models are discriminated in the intracellular dynamics of this flow.

6. *New Laser Sources* by J. J. Ewing. 37 pp. (137 references). This article discussed the recent advances in laser sources with emphasis on the UV and IR. Half the article is written about the rare gas halide ultraviolet sources. Excitation techniques, spectroscopy, theoretical analysis, and rate constants are all fully discussed. The high efficiency of these lasers is only second to CO_2 gas lasers and makes them prospective fusion sources as well as of general interest to photochemists. Other sources of UV such as noble gas excimers and halide diatomics are more briefly mentioned. Advances in the various techniques of IR lasing are outlined. These now include molecular emissions, parametric down conversion, tunable diodes, frequency mixing and spin flip Raman. Special attention is given to 16 μm lasers and those producing tunable output. A final section deals with expected future developments.

Department of Chemistry
Texas Tech University
Lubbock, TX 79409, U.S.A.

ROY AUERBACH

Laser Spectroscopy III. Springer Series in Optical Spectroscopy. Volume 7. Edited by J. L. HALL and J. L. CARLSTEN, Springer, Berlin, 1977. 468 pp. $29.50.

This book contains papers from the Third International Conference on Laser Spectroscopy held July 4–8, 1977. The reports center around current research using the unique properties of laser excitation as a spectroscopic tool. Topics covered by the 71 papers in this volume include optical transients, multiphoton dissociation, double resonance, sub-Doppler techniques and Raman spectroscopies. Areas of manifest practical import which are discussed include the development of new laser sources, the determination of laser frequencies and the application of lasers to fundamental problems in analytical chemistry, astronomy and metrology.

This collection of short papers can be a useful survey for keeping abreast of developments in laser spectroscopic techniques. Most of the papers retain the learning flavor of an oral presentation as contrasted to a journal communication. As the list of topics suggests, the researches involve experimental spectroscopy and are of primary interest to laser and chemical physicists. Due to the developmental nature of the research, discussions are confined mainly to small molecules and atoms for which a thorough understanding and testing of the techniques can be attained.

THOMAS A. CAUGHEY

Department of Chemistry
Texas Tech University
Lubbock, TX 79409, U.S.A.

Photosynthesis. Second Edition, D. O. HALL and K. K. RAO. Edward Arnold Limited, London, 1977. 71 pages. £2.80 net Boards, £1.40 net paper.

Photosynthesis is the process through which green plants convert solar energy into chemical energy and provide us with molecular oxygen, food, fuel and fiber. Hall and Rao's book provides an excellent basic understanding of this process.

This compact book on "photosynthesis" is a part of a series published by the Institute of Biology in the U.K. which contains 75 diverse topics; some topics relevant to the present theme include Ecological Energetics, Understanding the Chemistry of the Cell, Plants and Water, Chloroplasts and Mitochondria and the Structure and Function of Enzymes. Although small in size (71 pages), Hall and Rao's book provides a fairly thorough coverage of the field of photosynthesis. It explains both the basic principles as well as current research developments including their possible practical implications.

There are nine chapters in the book. The first two provide an introduction to photosynthesis, and the third describes the structure, composition, and isolation of the photosynthetic apparatus. (Chloroplast is the organelle where complete photosynthesis occurs.) The fourth and the fifth chapters deal with the steps involved in the transformation of light energy into chemical energy in the form of the reducing power (reduced nicotinamide adenine dinucleotide phosphate, $NADPH_2$), and the adenosine triphosphate (ATP); the sixth chapter is specifically concerned with the fixation of carbon dioxide into carbohydrates, etc. (food). Bacterial photosynthesis, which is quite distinct from green plant photosynthesis because here no oxygen is evolved, is treated separately in the seventh chapter. The eighth chapter surveys very sketchily the main areas of current research; a brief section on the mechanism of excitation energy transfer, and, its regulation, and the primary photochemistry of photosynthesis should have been included here. Also, photorespiration should have been explained in terms of the oxygenase activity of the ribulose biphosphate carboxylase. The final chapter lists some possible laboratory experiments. There is also a short bibliography which lists the standard sources of information in the field.

In comparison to the first edition (published in 1971), the 1977 edition includes, as pointed out by the authors themselves in their preface, some new information on energetics, membrane structure, electron transport, photorespiration and CO_2 fixation into 4-carbon containing acids (e.g. oxaloacetic acid) in the so-called C-4 plants. These changes are, however, minor, but make the book up-to-date in its content.

There is a conceptual problem with the description of the two light reaction scheme of photosynthesis. Although the authors are aware (p. 35) that excitation of Chl *b* sensitizes both PS I and II, their figures (4-7 and 5-2) and descriptions (p. 32, 40 and 41) are not quite consistent with this idea. The major difference between the excitation of

the two photosystems lies in the fact that the long-wavelength absorbing forms of Chl *a* sensitize preferentially the PS I. Other problems in the two light reaction scheme are: (1) cytochrome *b* has not been proven to be in the chain as the rate of its reduction by PS II is too slow for it to be involved in the main pathway; (2) most of the evidence suggests that plastocyanin should follow cytochrome *f*; (3) there is no evidence for two sites of phosphorylation between cytochrome *b* and plastocyanin; (4) P690 is usually referred to as P680 because in chloroplasts and subchloroplast fragments (enriched in PS II) its absorption peak is at 682 nm.

The following additional points are worth noting: (1) *p. 13*: The rate of the limiting dark reaction depends upon temperature, i.e. it varies from 0.04 to 0.4 s as temperature varies from 25° to 1°C. It is, therefore, essential that the temperature be mentioned for the value (0.06 s) quoted here. Emerson and Arnold did not calculate quantum yield of O_2 evolution from flashing light experiments, as mentioned here. (2) *p. 20, 21*: The discrepancy in the absorption peaks for the Chls in acetone and ether should be corrected; Fig. 3–4 (p. 20) shows peaks at 660 and 643 nm for Chl *a* and *b* in acetone (see the legend), but on p. 21 the same peaks are cited for diethyl ether and the peaks in acetone are noted to be at 663 and 645 nm, respectively. (3): *p. 22*: The cited method for the calculation of Chl concentration seems to be that of Bruinsma. (4) *p. 26*: Why certain plants are called C-3 and others C-4 should be clearly defined here. (5) *p. 29*: The existence of triplet states of Chl *a* has been demonstrated *in vivo* but these states are formed only when the main pathway of photosynthesis is blocked. (6) *p. 30*: For the definition of action spectrum of photosynthesis (P), a clear distinction should be made between P/incident quantum and P/absorbed quantum; also add "minimum" before quantum requirement. (7) *p. 34*: Lines 5–11 could be replaced with a description (condensed from that presented later on p. 40, 41) of the antagonistic effect of light I and II on the redox state of cytochrome *f*; this remains the best evidence for the scheme presented. (8) This chapter should be renamed "Photosynthetic Electron Transport and Phosphorylation" as it discusses a great deal of electron transport pathways. (9) *p. 40*: When describing pigment systems I and II, absorption peaks *in vivo*, instead of in solutions, should be given. (10) *p. 42* and elsewhere: DSPD, DCMU, FMN, etc. should be spelled out. (11) *p. 43*: The current scheme for O_2 evolution (i.e. the concept of charge accumulation) should be briefly described. (12) *p. 58*: On line 22, a or d should read a or b, and on line 23, b or c should read c or d. (13) *p. 65*: In Fig. 8-1 the demarcation for site I should start at the plastoquinone level, i.e. further to the right of the present line.

The above minor corrections should not deter the reader as the book is well written and the diagrams and illustrations facilitate its use as an introductory text. Several of the key experiments in photosynthesis are described in a simple fashion and provide a useful insight into the development of the field. This book is successful in combining the theoretical and experimental aspects. It is particularly good as an introductory text because it stimulates further interest in the field.

Department of Botany
University of Illinois
Urbana, IL 61801, U.S.A.

RITA KHANNA;
GOVINDJEE

The Amphibian Visual System. Edited by KATHERINE V. FITE. Academic Press, New York, 1976. 374 pp., $29.50.

The scope of the studies performed on the amphibian visual system exceeds that for any other single class of vertebrates or invertebrates. This book does a commendable job of compiling, summarizing and interpreting much of the work. The contributors discuss the anatomical and electrophysiological findings in both the retinal and central visual areas, behavioral results, and work on development of the visual system. There are also chapters on taxonomy and on laboratory standards for the care of amphibians. The editor has succeeded in accomplishing her stated goals of creating a "compendium of summary and review articles, bound together by a common theme which sets forth the major issues, data and theoretical schemata which guide and stimulate research." In contrast to many multi-authored tomes, this book is well edited and very readable; there is only a minimum of overlapping or redundant material.

Two of the eight chapters focus on behaviorial aspects of spatial vision and pattern recognition in frogs and toads, elucidating most of the general findings in visual behavior. The chapter on toads by J-P. Ewert is the more comprehensive and includes correlative electrophysiological findings which go some way towards providing a neurophysiological basis for visually induced responses.

The chapter devoted to the anatomy and physiology of the frog retina is a good review. Although fairly well balanced between anatomy and electrophysiology, the electrophysiological results do predominate and the reader is given a slight overdose of the distinction between different classes of ganglion cells. A separate chapter on the central visual pathways in the frog provides a good overall picture of the visual pathways. Many of the methods of tracing and identifying these pathways are described. The reader without a basic knowledge of neuroanatomy will find this chapter the most technically difficult; the other chapters include more background and explanatory information.

The chapter on the salamander visual system is an outstanding distillation of numerous research efforts. The discussion on the retinal neurophysiology is particularly compelling. Because of the large cell sizes, more intracellular recordings have been made from urodele retinae than from any other vertebrate order. The use of the amphibian visual system as a model for developmental neurobiology is the focus of another chapter. Studies of amphibian visual system development not only contribute a major part to our knowledge of regeneration, neurogenesis and cell to cell mapping, but they have provided also the framework for developmental studies in many other systems over the last 20 years. In this chapter the authors do a creditable job of taking the reader from the basic concepts through the complex issues of development.

Finally, two chapters are devoted, not to the visual system, but to issues important to those using amphibians as research animals. There is a requisite chapter on the taxonomy and evolutionary history of amphibia which gives the reader an idea of the complex and diverse adaptations that different class members have performed to survive in their environment. There is also a chapter on standards for laboratory amphibians. Unfortunately the author deals more with the very real problems of the increasing scarcity of animals than with needed suggestions on proper feeding and housing for these animals, the topic implied by the chapter title.

Two areas of vision in amphibia have been neglected in this book. The text only briefly covers the photochemis-

try of visual pigments, and the very recent results on visual transduction mechanisms anJ photoreceptor physiology in *Bufo marinus* are not included. On the whole, however, this book is a very readable and interesting account of the neurobiology of the amphibian visual system.

Department of Ophthalmology DAVID R. COPENHAGEN
School of Medicine
University of California, San Francisco
San Francisco, CA 94143, U.S.A.

The Physiology and Biochemistry of Seed Dormancy and Germination. Edited by A. A. KHAN, North-Holland Publishing Company, 1977. 447 pp., $65.95.

The Physiology and Biochemistry of Seed Dormancy and Germination (Elsevier/North-Holland, 1977) is an assemblage of articles written as reviews by a variety of experts in specific areas of seed germination and dormancy. The articles are very well organized and presented as chapters in four main divisions which include considerations of: I. General Topics, II. Hormones, III Environmental Factors, and IV. Molecular and Metabolic Aspects of Seed Germination. Part I does an excellent job of defining germination with the anatomic, genetic, metabolic and hormonal events associated with it. Detailed comparisons between quiesence and dormancy in seed germination are made and some historical perspective is gained in presentation of changing concepts and theories related to them. Hormonal considerations in Part II contains individual chapters considering the gibberellins, cytokinins, abscisic acid but, interestingly, does not include auxin. Auxin effects are mentioned in other chapters, but its exclusion in this section may leave the reader with the feeling that either the effects of auxin are considered to be fairly universal and therefore lack any uniqueness in the process of seed germination, or that the specific effects and action of auxin in seed germination are not significant. Both may prove to be true, but it is also possible that there is auxin involvement that has not yet been revealed by traditional approaches. The environmental factors considered in regard to seed germination in Part III are: light, cold stratification, seed quality, stress and preconditioning with special consideration given the agronomic or applied view in addition to the basic information available. The molecular and metabolic aspects considered in Part IV include: integrity and synthesis of nucleic acids; stored, residual and newly synthesized messenger RNA; protein synthesis; metabolic control; a hypothesis relating the pentose phosphate pathway to the control of dormancy; and finally a summarizing chapter on hormonal regulation of nucleic acids and proteins in germination.

The editor points out in his foreword to the book that the information available on the physiology and biochemistry of seeds is too extensive to be relegated to one or two chapters in a book on plant growth and development. Although there is considerable overlap in the information covered by different authors in this book, the repetition allows each chapter to stand on its own without forcing the reader with a specific interest to ingulf the entire volume. In some cases, the overlap also allows a slightly different perspective that might otherwise be lost. Despite the diversity of authors, the book is clearly and simply written so that it can be easily used by the beginning student, but is sufficiently complete in its coverage to be of considerable value to advanced students specializing in this area. Although the book is best adapted for use by the former group, its use by non-specialists will doubtless be preempted by the excessive price. Nevertheless, it may be the first truly comprehensive book of its kind in the area of seed germination and dormancy.

Biological Sciences MURRAY COULTER
218 Biology Building
Texas Tech University
Lubbock, TX 79409, U.S.A.

Phytochrome and Plant Growth. Studies in Biology No. 68. Edited by R. E. KENDRICK and B. FRANKLAND, Edward Arnold Ltd., London, 1976. 68 pp., £1.50.

This little book is one of the Studies in Biology series (No. 68) sponsored by the Institute of Biology, London. Although many details are obviously left out in this paperback booklet, it contains a surprisingly wide spectrum of topics, which are presented in a manner enjoyable to read. Both photochemical and physiological aspects of phytochrome-mediated photomorphogenesis are presented in a well balanced proportion, so that even a novice could follow the interesting phytochrome story as told in this book. The book contains up-to-date materials and important references, although readers should look for the most recent developments in the chemistry and photobiology of phytochrome during 1976–78 elsewhere, as the book is already 2 years old. At the end of the book, protocols for experiments are described. These experiments are designed to demonstrate the involvement of phytochrome in selected photomorphogenic systems.

This book is an excellent introduction to the subject for students as well as research photobiologists whose expertise is not in the same subject area. Research photobiologists in the phytochrome field will also find this book enjoyable to read.

Department of Chemistry PILL-SOON SONG
Texas Tech University
Lubbock
TX 79409, U.S.A.

The Science of Photobiology. Edited by KENDRIC C. SMITH, Plenum Press, New York and London, 1977. 430 pp. $35 hardcover, $12.50 softcover.

On the whole, this collection of 15 articles represents a successful attempt to introduce the interested reader to the field of photobiology.

Concerned as this field of research is with photochemical transformations (which are the initial events in all of the areas of photobiology discussed in this volume), a chemist will find the treatment of these reactions somewhat elementary. This is not necessarily a shortcoming in a volume that is intended to serve as an introductory undergraduate textbook. However, this book is clearly very useful to established scientists in related fields and thus this review will consider the more stringent criteria implicit in such use.

In the Photochemistry chapter, a good review is given of photochemical transformations, but there is a distinct lack of good demonstrative examples. Also, the simple concept of $k_{reaction}$ *vs* $\phi_{reaction}$ remains well hidden. Elegant but by no means too elementary is the discussion, in the chapter on Spectroscopy, of optical transitions in terms of experimental oscillator strengths. The reader who is unfamiliar with this concept may have some problems with this approach, particularly in view of the Dirac notation used. The chapter on Photomovement is, at 15 pages, the second shortest in the book and does not represent an adequate appraisal of this field of photo-sensory research. The author appears to be unaware of most recent advances in the field, and ignores the work of nearly all research groups presently active. Most other chapters are well-written and depict the state-of-the art, particularly the ones on Environmental Photobiology, Chronobiology, Photomorphogenesis, and Photosynthesis.

When viewed as a textbook, it is apparent that some improvement of this volume would have resulted from a more even level of sophistication at which the subjects of the individual chapters are discussed. However, these gaps can surely be bridged by the experienced instructor, and in any event this reviewer is convinced that no collection of articles by 15 different authors could present a more homogeneous overview of any field of science.

In summary, the book is an auspicious effort of communication across disciplinary lines. Chemists who read it will be introduced to a fascinating field of research that is related to their own, and biologists will gain an elementary yet substantial introduction to chemical events underlying photobiological processes.

Department of Chemistry BODO DIEHN
The University of Toledo
Toledo, OH 43606, *U.S.A.*

Photosensitized Reactions, By M. KOIZUMI, S. KATO, N. MATAGA, T. MATSUURA and Y. USUI. Kagakudojin Publishing Co., Inc., Kyoto, Japan, 1978. 394 pp., $32.00.

This book, which is dedicated to the late Masao Koizumi, is divided into two parts: Part I, Chapters 1 through 8, Fundamental Processes, by M. Koizumi, S. Kato, N. Mataga and Y. Usui, and Part II, Chapters 9 through 12, Photosensitized Reactions in Organic Chemistry, by T. Matsuura.

Chapter 1 introduces fundamental processes and definitions in photochemistry such as excitation, the Franck–Condon principle, fluorescence, radiationless decay, intersystem crossing, phosphorescence, energy and electron transfer, spin–orbit coupling, and singlet-triplet excitation. Chapters 2 and 3 are superb descriptions on energy transfer (singlet state, triplet state, and intramolecular energy transfer) and intersystem crossing. Methods for determinations of quantum yields for intersystem crossing are summarized in the latter chapter. The next chapter deals with hydrogen atom transfer and includes such processes as the Type II reaction of ketones and photoreduction of *N*-heteroaromatic compounds. Electron transfer and proton transfer are described in Chapter 5, where the tremendous difference in acidities of excited states as compared with ground states of certain compounds is stressed. The following two chapters describe photooxidation and photoreduction of dyes in deaerated and aerated solutions and Chapter 8 contains photosensitized oxygenation by singlet oxygen.

In Part II, Chapters 9 and 10 deal mainly with factors to be considered in choosing a suitable sensitizer in a given photosensitization experiment. The description here will mainly appeal to newcomers in the field. Electron and proton transfer reactions in organic photochemistry are the subjects of Chapter 11, while the last chapter in the book describes photosensitized oxygenations through radical-chain autooxidations and through reactions involving singlet oxygen.

Each chapter is extraordinarily well referenced with references both to "classical" experiments and to the recent literature (many references from 1975 and a few from 1976). Well chosen examples are included, but wisely, no attempts have been made to be exhaustive. Throughout the book, the mechanistic information gained from excited state lifetime and quantum yield determinations and from kinetic investigations is pointed out. The division into two parts is somewhat artificial as far as their contents are concerned. Thus, the above mentioned Type II reaction of ketones with γ-hydrogens are found in Chapter 4, while the oxadi-pi-methane rearrangement of β,γ-unsaturated ketones is described in Chapter 9. Electron transfer reactions are found in both Chapters 5 and 11 and for reactions of singlet oxygen the reader has to turn to Chapters 8 and 12, which contain some overlap. The addition of a general index and an author index would increase the value of the book. While most subjects are covered adequately, one might have liked to see a more critical treatment on dioxetane decomposition and a separate chapter on chemical and physical properties of exciplexes. The second part of the book contains some errors, not all of which are typographical. Thus, although correct in Chapter 2, the equation given in Chapter 9 for calculation of diffusion-controlled rate constants is erroneous as is the relation given between these rate constants and the rate constants for exothermic energy transfer. The descriptions, also in Chapter 9, of the 1,2- and 1,3-acyl shifts of β,γ-saturated ketones have been interchanged.

In summary, the book is an impressive treatment of such a broad subject. It should prove highly valuable for researchers and teachers in the field, and the book could perhaps be useful as a textbook supplement in a graduate course in photochemistry. Because of its broad subject matter, the book should be of interest to photochemists, photophysicists and photobiologists.

Department of Chemistry JENS ERIKSEN
University of California
Los Angeles, CA 90024, *U.S.A.*

Bioenergetics of Membranes, Edited by L. PACKER, G. C. PAPAGEORGIOU and A. TREBST. Elsevier, North Holland, 1977. 583 pp., $65.25.

This book represents the proceedings of the International Symposium on Membrane Bioenergetics held in Spetsai, Greece, in July, 1977. It is a multiple author volume, printed by the camera-ready copy method for speed of publication, and contains 53 papers in 538 pages. This type of book is intended to provide an up-to-date compilation of investigations in a specialized research area by an international scientific community. It is best reviewed by outlining content, then asking whether useful new ideas have been generated by the authors.

The papers reflect ongoing research in bioenergetics in twelve countries, with the majority originating in the United States, Israel, Italy, Germany, Greece and England. The papers are organized into sub-topical areas, which include (1) membrane structure and biogenesis, (2) bacteriorhodopsin, (3) quinones and non-heme iron proteins, (4) photosynthesis and (5) electron transport, coupling and phosphorylation. Each of the areas contains 6–17 papers, and both established laboratories and new investigators are represented.

With so many papers, it is not possible to choose even a few for detailed review without revealing one's own biases. However, it is possible to indicate some general impressions of interesting research directions taken by the authors. These include the application of novel optical and fluorescent probe methods to analyse lipid-protein interaction in membranes, measurements of the electrical properties of bacteriorhodopsin, new evidence concerning the role of quinones in membrane function, and mechanisms by which localized conformational changes in membranes may generate transmembrane electrochemical gradients.

In summary, this book represents a collection of highly technical research reports. The papers are clearly written, and the authors are attacking important problems in each of the sub-topical areas. The absence of an index may cause difficulty for some readers, but it is possible to find equivalent information in the table of contents. The book is recommended for the working scientist with research directly in one or more of the sub-topical areas.

Department of Zoology DAVID W. DEAMER
University of California, Davis
Davis, CA 95616, *U.S.A.*