graph on coupled reactions. But I am not too happy about the treatment of a simple phosphate transfer reaction such as that from adenosine triphosphate to arginine as a coupled reaction. Biochemists prefer to reserve the term *coupling* for transmission of potential between different groups, and in particular from electron transfer to group potential, to which *coupling* and *uncoupling* refer almost specifically.

The book contains ingenious applications of thermodynamics. For example, tre ΔG for hydrophobic bonding is deduced from a comparison of solubilities of a series of amino acids in ethanol with glycine. It appears that to shift a mole of isoleucine from alcohol to water, 3 kilocalories have to be expended. This kind of treatment offers a background for evaluating the much-talked-about functioning of clusters of hydrophobic side chains in enzyme proteins.

I like most the last section, on the relationship between energetics and molecular statistics. It deals in a commonsense manner with problems that are often submerged by high-powered formalism. It makes one realize one is in the presence of a person who is enviably familiar with his tools and able to use them ingeniously.

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Sites of Photosynthesis

Biochemistry of Chloroplasts. Proceedings of a NATO Advanced Study Institute, Aberystwyth, Wales, Aug. 1965. T. W. GOODWIN, Ed. Academic Press, New York. Vol. 1, 1966, xvi + 476 pp., illus., $18; vol. 2, 1965, xviii + 776 pp., illus., $29.

These two volumes provide a striking demonstration of the proliferation of studies on chloroplast biochemistry that has occurred since the announcement in 1954 of photosynthesis by isolated chloroplasts. Before this time the study of chloroplasts was not generally regarded as a branch of biochemistry. Goodwin was fortunate in being able to assemble at the conference of which these volumes are the published record a large proportion of the workers who have contributed to this field in recent years, so that the books represent a summary of current results and thinking on chloroplast structure and function which should be useful both to the student entering the field and to the researcher who is trying to keep up with the flood of papers which now appear on chloroplasts and their activities.

The first volume is concerned with the structure and composition of chloroplasts. The first seven papers, dealing with studies of the ultrastructure of chloroplasts, done mostly by electron microscopy, but also with the use of x-ray scattering, fluorescence properties, and other physical methods, illustrate vividly the variations on a basic structural theme which can be derived by different investigators from quite similar data. Most current work on the ultrastructure of chloroplasts is concerned with attempts to make models of the chloroplast lamellae, regarding whose organization there is not as yet general agreement, at least not in detail. The fact that the method of isolation of the chloroplasts may have a great influence on the structure observed is being increasingly recognized.

Studies of the chemical composition of chloroplasts, including the lipids, the proteins and nucleoproteins, the nucleic acids, and the pigments, comprise the remainder of the first volume. Since most of the investigators are interested in the localization of these components in the chloroplast structure, these studies often merge closely with the more strictly structural investigations described in the first few chapters, and, on the other hand, lead into the studies on the biochemical activities of chloroplasts to which the second volume is devoted. Subjects of papers in this section include elucidation of the unusual types of lipids found in chloroplasts; the organization of these with proteins and lipoproteins in the lamellae; description of a distinctive DNA in chloroplasts, providing support for earlier suggestions from genetic experiments that at least some chloroplast syntheses and functions may be independent of nuclear control; the observation of RNA, ribosome-like particles, and protein synthesis in chloroplasts; and last, but by no means least, continuation of studies on one of the most important types of chloroplast components, the photosynthetic pigments.

Anyone familiar with the photosynthesis literature of a few years ago who had not followed the field since would probably be surprised at the small amount of space in the second volume devoted to the subject of carbon dioxide fixation, although the papers in this section, like most of the others, are careful and detailed. The greatest portion of this volume is concerned with the biosynthesis of the various chloroplast components, including the carbohydrates (some of this is closely related to CO_2 fixation), lipids, proteins, and amino acids. These subjects are treated in considerable detail from many points of view, and, like the chemical studies of volume 1, are often related to ultrastructure. The biochemistry of photosynthetic phosphorylation, which provides the energy to drive the biosynthetic mechanisms in the light, receives considerable attention, with particular emphasis on naturally occurring cofactors of the reactions involved and on a possible relation between cyclic (only ADP formed, no oxygen liberated) and noncyclic (ATP and NADPH both formed, oxygen liberated) photosynthetic phosphorylation and the two light reactions of photosynthesis. The work finally comes full circle with a consideration of biosynthetic mechanisms in relation to morphogenesis.

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Quantum Substances

The Properties of Liquid and Solid Helium. J. WILKS. Oxford University Press, New York, 1967. xii + 703 pp., illus. $24.

Experimental and theoretical investigations of the quantum liquids, liquid helium-3 and liquid helium-4, have a long history of rich accomplishment. Intensive study of the quantum solids, solid helium-3 and solid helium-4, which is relatively more recent, promises to be very fruitful for basic solid-state research. Most of this monumental book by John Wilks is devoted to quantum liquids (chapters 1–19, 560 pages); the last three chapters deal with quantum solids. Wilks, a major contributor to the experimental literature on both liquid and solid helium, approaches the exposition of the properties of these substances as an experi-

mentalist. In all his discussion of the wide variety of investigations he has taken care to emphasize the contribution to the research of advances in experimental technique. On almost every page there is a diagram of apparatus or data. These diagrams are clearly labeled and carefully discussed. A chronicle of the progress that has been made in the study of quantum liquids and solids would read like a history of cryogenic technology. The flavor of such a chronicle is found in this book. The emphasis is always on the physics of the properties of liquid and solid helium, however. In the early chapters those aspects of the theory which lead to a useful intuition about the behavior of the "excitations" in quantum liquids are well handled. The text is extensively referenced, showing the author's great and critical awareness of the vast literature in this research area.

Wilks's book supersedes all previous books on liquid or solid helium. It would be an excellent text for a low-temperature physics course (lasting three or four semesters); it should certainly be on the bookshelf of every serious low-temperature physicist.

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Biotoxicology

Animal Toxins. Papers presented at the first international symposium, Atlantic City, N.J., 1966. FINDLAY E. RUSSELL and PAUL R. SAUNDERS, Eds. Pergamon, New York, 1967. xiv + 428 pp., illus. $18.50.

Participants will remember this meeting with pleasure as one that was well organized. Fewer than 100 people attended. The talks, almost all of which are presented in the volume under review, were given and attended by immunologists, chemists, taxonomists, physicians, anatomists, and physiologists. Almost half the participants came from foreign countries, their visits made possible by federal grants. *Animal Toxins* reflects the happy mixture of these different fields of endeavor. About 160 pages are devoted to invertebrate and about 230 to vertebrate toxins. Each paper is well edited and has a summary. The discussion and questions are not reproduced. The individual presentations vary in quality, but the overall standard is high. Included in the volume are the microphotographs of black-widow venom glands, by David S. Smith, showing that the secretion of the glandular epithelium leads to the disintegration of the cells, a finding that indicates a source of complexity of the venom. Unfortunately the publisher has placed legends and explanations of abbreviations in the plates several pages away from them. Of particular interest is the presentation by J. H. Barnes on Australian cubomedusae. The sting of *Chironex fleckeri*, only 18 by 18 by 24 centimeters, with 13 to 15 tentacles 1 meter long when partially contracted, can cause the death of a healthy adult in less than 3 minutes. Venom research on this difficult group of jellyfish has been made possible by new extraction methods. Washed human amnions salvaged from local hospitals are used because the nematocysts do not discharge on artificial membranes. R. Endean, with other Australian researchers, reported that only piscivorous conid snails cause serious injury to humans, directly paralyzing skeletal muscle; those conids that feed on mollusks and worms are not dangerous. The anatomy of *Echinothrix* sea urchin spines and their biologically active substance, probably noradrenaline, is described. There is a paper on the feared South American freshwater rays by M. N. Castex. H. Michl and collaborators, from Austria, describe the toxin of skin secretions of the European newts (*Triturus*) and unks (*Bombina*), which not only provide protection against predators but also keep the animal's skin moist and contain an antibiotic that prevents the growth of mold and microorganisms on its surface. There are, as befits any volume on toxins, numerous pages on snakes, again by specialists from various fields. The neurotoxic fractions of a number of venoms studied, including those of black widows and *Centruroides* scorpions, were found to be proteins of low molecular weight. An unfortunate omission from the subjects discussed is the biological implications of the evolution of venoms in various animals. What are the selective factors responsible? Of what importance are the poisons to the animals? Despite this shortcoming, the general biologist will find valuable information in this book; it will be essential to those working with venoms.

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Books Received

Acid Base Physiology in Medicine. A Self-Instruction Program. Robert W. Winters, Knud Engel, and Ralph B. Dell. Programmed by Richard P. Berkson. London Company, Cleveland, Ohio; Radiometer A/S, Copenhagen, 1967. viii + 290 pp., illus. $3.85.

Acute Glomerulonephritis. Proceedings of the 17th annual conference on the kidney, sponsored by the National Kidney Foundation, Boston, October 1965. Jack Metcoff, Ed. Little, Brown, Boston, 1967. xxiv + 437 pp., illus. $15.50.

Advanced Optical Techniques. A. C. S. van Heel, Ed. North-Holland, Amsterdam; Wiley, New York, 1967. x + 678 pp., illus. $35. Wiley Series in Pure and Applied Optics.

Advances in Parasitology. Vol. 5. Ben Dawes, Ed. Academic Press, New York, 1967. xvi + 319 pp., illus. $14.

Advances in Pharmaceutical Sciences. Vol. 2. H. S. Bean, A. H. Beckett, and J. E. Carless, Eds. Academic Press, New York, 1967. x + 329 pp., illus. $14.

Agriculture in the Congo Basin. Tradition and Change in African Rural Economies. Marvin P. Miracle. University of Wisconsin Press, Madison, 1967. xvi + 355 pp., illus. $8.50.

Alcoa Aluminum Handbook. Aluminum Company of America, Pittsburgh, 1967. 297 pp., illus.

America, Russia, and the Cold War, 1945–1966. Walter Lafeber. Wiley, New York, 1967. xiv + 295 pp. Cloth, $6.50; paper, $2.95. America in Crisis Series.

The American College. A Psychological and Social Interpretation of the Higher Learning. Nevitt Sanford, Ed. Science Editions (Wiley), New York, 1967. xx + 1084 pp., illus. Paper, $5.95. Reprint of the 1962 edition.

American Science in the Age of Jackson. George H. Daniels. Columbia University Press, New York, 1968. xii + 282 pp. $7.95.

Annual Review of Information Science and Technology. Vol. 2. Carlos A. Cuadra, Ed. Interscience (Wiley), New York, 1967. x + 484 pp. $15. American Documentation Institute Annual Review Series.

Annual Review of Nuclear Science. Vol. 17. Emilio Segrè, Gerhart Friedlander, and H. Pierre Noyes, Eds. Annual Reviews, Palo Alto, Calif., 1967. vi + 546 pp., illus. $8.50.

The Application of Plasmas to Chemical Processing. Raymond F. Baddour and Robert S. Timmins, Eds. M.I.T. Press, Cambridge, Mass., 1967. xviii + 206 pp., illus. $12.50.

Applications of Fundamental Thermodynamics to Metallurgical Processes. Proceedings of the first conference on the thermodynamic properties of materials, Pittsburgh, Pa. G. R. Fitterer, Ed. Gordon and Breach, New York, 1967. x + 424 pp., illus. Cloth, $26; paper, $12.

Applied Hydrodynamics. H. R. Vallentine. Plenum, New York; Butterworths, London, ed. 2, 1967. xii + 296 pp., illus. $10.

Arid-Lands Research Institutions. A World Directory. Patricia Paylore. University of Arizona Press, Tucson, 1967. xx + 268 pp. Paper, $5.

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