BIOENERGETICS

Albert Szent-Györgyi. Academic Press Inc., New York, 1957. x + 143 pp. 28 figs. and 4 tables. 15 × 22.5 cm. $4.50.

EVERY three or four years Albert Szent-Györgyi puts out a little book, full of theories, experiments, and speculations about the nature of biological processes as they currently seem to him. These books are invariably entertaining and stimulating, for no one is quicker than Szent-Györgyi to invent a new theory, or more spritely than he in presenting it. They are invariably controversial, too, for his theories are by no means universally accepted.

In this volume Szent-Györgyi takes up the problem of the mechanism of the conversion of chemical energy (in ATP) into other forms of energy, or as he puts it, "how energy drives life." He postulates that chemical energy is first converted into molecular excitation energy, which is probably electronic, rather than vibrational or rotational, and that the excited molecules then release mechanical, electrical and light energy.

Since ordinary electronic excitations involve more energy than is available from ATP, and, moreover, do not last long enough to effect biological action, Szent-Györgyi proposes that the activated electrons go into the rare triplet state, which is less energetic but longer-lasting than the usual singlet state of excitation. The triplets are presumed to be stabilized by the formation of ice, or of the analogous ordered water structures which have been shown to exist at temperatures up to about 37°C.

This theory is supported by many observations, mostly on the fluorescence and phosphorescence of substances of biological importance; substances which fluoresce or phosphoresce are *ipso facto* known to be capable of electronic excitation, while substances which alter the luminescence must affect the excitation. From this point of view, the fluorescent and phosphorescent compounds are the energy transmitters, and substances which alter their properties are regulators of activity, either naturally occurring, like hormones, or artificially introduced, i.e., drugs.

Szent-Györgyi applies these ideas to muscular contraction, the roles of ATP, riboflavin, and glutathion, alcohol toxicity, oxidative phosphorylation and its uncoupling, narcosis, depolarization of cell membranes, the effects of iodine and chlorpromazine, the Pasteur effect, the role of the thymus gland, and several diseases, including cancer and myotonia.

One of Szent-Györgyi's most interesting observations is that oxygen, by virtue of its paramagnetism, alters the excitation of other substances, and thereby exerts an influence on life far transcending its role as an oxidizing agent.

Space does not permit the reviewer to criticize the theory in detail, but in view of the tremendous amount of ground covered, the reader will not be surprised to find that the theory as presented is only preliminary and incomplete, qualitative rather than quantitative, and lacking in means of predicting in any detail the biological activities of new substances. These criticisms would of course apply to any new theory.

Everyone who is interested in biological chemistry will want to read and reread this book, and then to design some experiments to prove Szent-Györgyi right or wrong. One gets the impression that Szent-Györgyi will not be too unhappy even to be proved wrong; he will be back with another theory, happy to have stirred the scientific pot and kept it boiling. As for the reader, he will not only be stimulated to attack or defend the theory; he will also be inspired with the feeling that science is fun. Most scientists assert that it is, but Szent-Györgyi is a man who obviously believes it, and is having the time of his life. It is a pleasure to contemplate his example.

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ENERGETICS IN BIOCHEMICAL REACTIONS

Irving M. Klotz, Professor of Chemistry, Northwestern University. Academic Press Inc., New York, 1957. vii + 64 pp. 18 figs. 2 tables. 15 × 22.5 cm. $3.

THE purpose of this little book, as stated in the preface, is to give the biochemist a "reading knowledge" of the language of thermodynamics.

The book opens with chapters on the First and Second Laws of Thermodynamics (i.e., the concepts of energy and entropy) and then turns to discussions of free energy, equilibrium, and the use of free energy concepts in the derivation of equations for electrode potentials, osmotic pressure, and sedimentation equilibria. There is a chapter on group transfer potentials ("high energy bonds"), and the book concludes with a chapter on the relationship of entropy to probability, including the elementary theory of molecular statistics, together with several applications.

Whether anyone can acquire even a tenuous grasp of the principles of thermodynamics and molecular statistics from so brief a course as this is necessarily a matter of opinion. The present reviewer thinks not, but the book is valuable nevertheless, both for the refreshing novelty of its approach to many thermodynamic concepts, and for its well-chosen (and well worked-out) applications of these concepts. The teacher of thermodynamics will surely find here some fresh ideas; he may not wish to incorporate all of them into his teaching methods, but he will certainly want to consider most of them.

As for the biochemist, he may not learn the whole of thermodynamics from this book, but if he has even a slight background, he will gain enormously from the excellent chapter on group-transfer potential and from the fine discussion of molecular statistics.

Incidentally, Dr. Klotz, in his chapter on group transfer potential, has made quite explicit just what is meant by "high energy bonds." It is to be hoped that the purists will now cease to deride the hoi polloi, who have probably always had a good notion what they were about when they used the term, but who must now be presumed to know exactly what they mean by it.

All in all, this is a stimulating little book.

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THE PRINCIPLES AND APPLICATIONS OF POLAROGRAPHY AND OTHER ELECTROANALYTICAL PROCESSES

G. W. C. Milner, Atomic Energy Research Establishment, Harwell. Longmans, Green and Co., New York, 1957. xxvii + 729 pp. Many figs. 12 × 22.5 cm. $17.50.

SINCE several recent texts on polarography and related subjects are already available in the English language, one might question the present need for another similar publication. However, this is the first time that such a book has come from Great Britain and the resulting emphasis on British contributions in this field is welcome. Another feature of the book is that useful applications are stressed and that discussions of theory and reaction mechanisms are held to a minimum.

Part I is devoted to a brief general introduction of principles, theory, equipment, and newer developments. Among the latter, the treatment of oscillographic polarography and a discussion of polarography in non-aqueous media are outstanding. A special chapter deals with controlled-potential electrolysis and its application in polarography as well as

with coulometric analysis. Part II, inorganic polarography, by far the most outstanding part of the book, is equally divided between a discussion of the polarography of metals and a collection of inorganic polarographic analyses. Considerable personal experience of the author insured a good selection of these methods which are described in sufficient detail so that they may be used without reference to the original literature. In Part III, dealing with organic polarography, an effort was made to include all analytical procedures, available up to 1955, for the determination of organic materials. Since the number of useful applications in this field is definitely limited, it is surprising that the extensive clinical applications, especially those which involve the metal-catalyzed reactions of thiols, have barely been mentioned. Amperometric titrations, either with the dropping mercury electrode or with the rotating platinum electrode is the topic of Part IV. For both types, numerous analyses are described in detail.

The book contains many literature references which are listed at the bottom of the page in all but chapters 9–17 (where they are listed at the end of Chapter 17). Unfortunately the subject index was not prepared carefully enough. It should include at least all those analyses which were described in detail; if possible, all compounds mentioned in the text should be listed.

The reviewer doubts that this book has immediate value for the complete neophyte; however, anyone with some basic knowledge of polarography could use it to good advantage.

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CHANGES OF STATE: A MATHEMATICAL-PHYSICAL ASSESSMENT

H. N. V. Temperley, formerly Lecturer in Physics, Cambridge University, and Visiting Professor, University of Nebraska; now Senior Principal Scientific Officer at Atomic Weapons Research Establishment, Aldermaston, England. Interscience Publishers, Inc., New York, 1956. xii + 324 pp. 72 figs. 15.5 × 25 cm. $7.50.

ACCORDING to the publisher's statement on the dust cover, the aim of this book is to "collate for research workers, teachers and advanced students, notable recent advances and new conceptions which concern such varied topics as freezing, solubilities, ferromagnetism, superconductivity, the condensation of gases and alloy phenomena." To a very large measure, Dr. Temperley has succeeded in his aim and in so doing has bridged a serious gap in the existing literature in this field. No reader who is well acquainted with one or more of these fields can fail to gain new mathematical and physical insights into these problems.

On the other hand, one cannot recommend this book unqualifiedly to the average student or teacher. A fairly extensive understanding of statistical thermodynamics and of the methods of mathematics is a necessary prerequisite. The number of equations is rather modest for a book of this kind, but there is a great deal of discussion of them and many are derived sketchily or not at all. The book is more a critical commentary on and a correlation between existing theories than a detailed presentation of them. Nor will the going be entirely painless even for the researcher well-versed in some of the topics. Dr. Temperley's sentences are long and involved (a "fog index" of approximately 23 on the Gunning scale), and he occasionally runs two sentences together in an ungrammatical way; we have learned to expect better from a British author. However, the reader who perseveres will reap a rich harvest.

After a brief historical introduction, the author classifies changes of state into different categories (in particular, at least three different kinds of behavior have been called "second order transitions") and then outlines some general theoretical considerations which must apply to these. The remainder of the book is devoted to a detailed consideration of various kinds of physical situations in which changes of state may occur: vaporization, fusion, phase separation in solutions, order-disorder phenomena in alloys, adsorption on surfaces, ferromagnetism and anti-ferromagnetism, ferroelectricity, λ-point anomalies in solids, superconductivity, and finally the most amazing change of state of all, the transition in liquid helium.

To me one of the book's most valuable features is the careful way in which Dr. Temperley develops the mathematical similarities between the physically very different situations. At one point he shows how one mathematical model can be applied to a variety of different contexts merely by replacing one set of quantities by another; the method of transcription would not have been obvious even to someone familiar with both problems separately.

In short, this new book is recommended reading for anyone who has considerable experience in one of the fields discussed and wants a broad understanding of related fields as well as a new perspective on his own.

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CHROMATOGRAPHY: A REVIEW OF PRINCIPLES AND APPLICATIONS

Edgar Lederer, Professor of Biochemistry, Sorbonne, and Directeur de Recherches, Institut de Biologie Physico-Chimique, Paris, and *Michael Lederer,* Maitre de Recherches, Institut du Radium, Paris, Second Edition, Revised. Elsevier Publishing Co., New York, 1957. xx + 711 pp. 139 figs. and 175 tables. 16 × 23.5 cm. $12.75.

THIS book is a revision and enlargement of the excellent previous edition by the same authors. A comparison of the two editions shows that the new publication has an increase of 53% in the number of pages of "text," 52% increase in pages of references, 57% in pages of index and 72% increase in the number of references (which now total 3747).

The authors have retained the style of the first edition—that of a review which is more than a review. Frequent added comments serve to evaluate, or at least to identify the sort of work mentioned in the references. In this connection the reviewer feels that the versatility of the technique of Irreverre and Martin makes it deserve more emphasis than a mere reference. The illustrations and, particularly, the tables will be of great value to the worker in the field. While the original works will need to be consulted by one who needs details of experimental procedure, this book will be extremely helpful in any such investigation.

In addition to the good but not exhaustive general background, the authors have presented ion exchange chromatography and partition chromatography. The latter includes column, paper and gas-liquid techniques. Both organic and inorganic substances are included.

Many of the 44 chapters are very short. Some are entirely new (Chap. 7, Adsorption Chromatography of Gases; Chap. 13, Ion Exchange Papers). New developments have brought added or expanded sections to many chapters. In some instances, as with Chapter 17 on Gas-Liquid Chromatography, a single paragraph from the first edition now becomes an entire chapter of four pages.

More than 90% of the references are in the nine-year span 1947–1956, with 86 published in 1956. Half of those 86 deal with gas-liquid chromatography.

The monograph is well printed and bound. In spite of the large amount of material it contains, the book is attractive and does not show crowding. Only two minor typographical errors were noted. The Lederer monograph should be immediately available to all who are interested in the principles and applications of chromatography.

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ADVANCES IN PROTEIN CHEMISTRY. VOLUMES 10 AND 11

Edited by *Mortimer L. Anson,* Cambridge, Massachusetts, *Kenneth Bailey,* University of Cambridge, Cambridge, England, and *John T. Edsall,* Professor of Biological Chemistry, Harvard University, Cambridge, Massachusetts. Academic Press Inc., New York. Vol. 10, 1955, viii + 425 pp. 105 figs. 36 tables. 16 × 23.5 cm. $9. Vol. 11, 1956, x + 665 pp. 112 figs. 72 tables. 16 × 23.5 cm. $12.

THESE volumes follow the usual pattern of this well-known series in consisting of several chapters, each devoted to a currently significant aspect of the chemistry or biology of proteins and written by one or more authorities in the special field. Most of the chapters constitute