Book Reviews

Biochemistry—Origins and Projections

Comprehensive Biochemistry. vol. 1, *Atomic and Molecular Structure* (265 pp. $11.50); vol. 2, *Organic and Physical Chemistry* (340 pp. $14.50); vol. 3, *Methods for the Study of Molecules* (340 pp. $14.50); vol. 4, *Separation Methods* (297 pp. $13). Marcel Florkin and Elmer H. Stotz, Eds. Elsevier, New York, 1962. Illus.

These four volumes comprise the first section of an advanced treatise on biochemistry which is intended to assemble pertinent material on the principal areas of the subject in a single set of books. Four more sections are scheduled to follow: Chemistry of Biological Compounds; Biochemical Reaction Mechanisms; Metabolism; and Chemical Biology. In this enterprise the able and courageous editors are assisted by a distinguished advisory panel of 14 members, and they will be supported by equally distinguished panels of contributors if the authorship of the chapters in the first four volumes is a gauge of merit.

In the general preface, the editors write: "Most evident to the modern biochemist, apart from the body of knowledge of the chemistry and metabolism of biological substances, is the extent to which he must draw from recent concepts of physical and organic chemistry, and in turn project into the vast field of biology. Thus in the organization of *Comprehensive Biochemistry*, the middle three sections . . . may be considered classical biochemistry, while the first and last sections provide selected material on the origins and projections of the subject." Nearly all biochemists wear a Joseph's coat; and many who read this may find themselves bemused by the attempt to define so neatly their particular biochemical origins and projections.

In the preface to the first section the editors make it clear that "the section is intended neither as a textbook of organic nor of physical chemistry, but rather as a collection of chapters which seem generally pertinent in the interpretation of biochemical techniques and in the understanding of the chemistry of biological compounds and reaction mechanisms. Certain areas of organic and physical chemistry have been reserved for later presentation in context with specific biochemical topics, but the material of section I seems to the authors to underlie all of modern biochemistry." In both prefaces the editors invite criticism and suggestions.

Volume 1, *Atomic and Molecular Structure*, contains four chapters: "Atomic structure" (W. Parker Alford); "Electronic theory of organic molecules" (H. H. Jaffé); "The structure of molecules" (J. D. Bernal); and "Stereoisomerism" (Kurt Mislow). Four vast, disparate fields, each a distinct field of inquiry but all strongly interrelated, are here treated in less than 300 pages. Chapter 1 presents concisely the foundations of what is known about atoms, from the point of view of quantum mechanics. Chapter 2 carries the subject further in developing the electronic theory of organic molecules. It is an excellent, compactly elegant summary of the subject, which introduces the reader to the symbolism and methods employed in the quantum mechanical treatment of molecular structure and outlines the general nature of the results obtained, without involvement in the detailed numerical aspects or results. The bibliography, however, does not refer to applications of the theory to problems of biological relevance and interest. Despite all of their excellence, we doubt that these two chapters will be useful to the great majority of biochemists. If one is young, and well brought up in chemistry, this is familiar ground; if one is middle-aged, these chapters are irresistible, but despite the attention they attract they will not lead one into insight. Chapter 3 is a brilliant discussion of the structure of molecules. It is clearly written, nicely ordered, faithfully relevant to biochemistry, and beautifully illustrated. It will frustrate some readers, for example, when they learn that, for the most part, problems of the conformation of molecules have been ignored in organic chemistry. It does not refer to, and is not connected with, chapters 1, 2, or 4. Is this fine chapter correctly placed in the whole work? Would it be more useful at the end of section 2? At that point the reader will have been introduced to the many types of simple and complex molecules and therefore will be ready to appreciate the full strength of this discussion of molecular structures. Chapter 4 (45 pages) contains a lean and forceful treatment of configurational and conformational steroisomerism, with many good applications to examples of biochemical interest, and an excellent bibliography. It can be instructive to any student, at any age.

Volume 2, *Organic and Physical Chemistry*, contains three chapters: "Mechanism of organic reactions" (M. L. Bender and R. Breslow); "Behavior of molecules in solution" (W. D. Stein); and "Diffusion and osmosis" (W. D. Stein). The first chapter is excellent. The authors have done a fine job of presenting, clearly and concisely, the principles of modern organic chemistry and of illustrating their application to important current problems. This chapter may not be taken up lightly by one who has a poor background in organic chemistry. It furnishes an excellent basis for a course in advanced organic chemistry in any graduate chemistry department. For the student with some background in physical chemistry, the two chapters by W. D. Stein provide an excellent introduction to the behavior of molecules in solution, from simple molecules to polymers. The treatment is from first principles, logical, orderly and, above all, clear and interesting. Close attention is paid to the interests of the biochemist; this is illustrated particularly well by the careful and explicit direction to references in which matters of particular biochemical interest are more fully developed. This volume earns full marks, for good writing and as a volume in which the editors achieved their aims.

Volume 3, *Methods for the Study of Molecules*, contains nine chapters: "Crystallography" (G. J. Bullen); "X-ray diffraction" (G. J. Bullen); "Analysis by emission spectroscopy" (N. H. Nachtrieb); "Spectrophotometry in the

ultraviolet and visible regions" (R. A. Morton); "Infrared spectra of compounds of biological interest" (L. J. Bellamy); "Fluorescence" (A. Ehrenberg and H. Theorell); "Electronic paramagnetic resonance" (S. J. Weissman); "Nuclear magnetic resonance" (C. D. Jardetsky and O. Jardetsky); and "Determination of mass, form and dimensions of large particles in solution" (Ch. Sadron and M. Daune). The first two chapters are detailed introductions to their subjects—rather more detailed than necessary to show the biochemist when to consult the expert in crystallography or in x-ray diffraction analysis, yet without illustrating the application sufficiently to make it really clear what can, or what cannot, be learned by the application of these techniques to a given problem. The next four chapters are models of their kind. Each is concise, thorough, informative, relevant and operationally meaningful. Any advanced student, at any stage of learning, can read them with appreciation and gratitude. The authors of these chapters deserve congratulations for achieving effective pertinence in small compass. Unfortunately nothing like this can be said about the chapter on electron paramagnetic resonance or the one on nuclear magnetic resonance. The first, admirably succinct, is the voice of the pure expert, uncompromising, unbending, and impenetrable. The instruments required are not mentioned or described. There is one fleeting reference to a biochemical application. An effort of the imagination is required to see beyond this to the relevant biological or biochemical problems. In the chapter on nuclear magnetic resonance, a disproportionate amount of the limited space is given to a presentation of theory that has been presented elsewhere in a form more accessible to biochemists seeking orientation in this field. Nevertheless, the applications of the method are fairly extensively illustrated, and some are of biochemical interest. But this chapter will not attract the attention of a practising biochemist or impress the apprentice strongly enough to arouse his desire to make it a part of his armament. Despite this, we agree with the editors that a grasp of this powerful tool of analysis is indeed one of the elements that underlies modern biochemistry. The last chapter, on large particles in solution, is a very useful extension of W. D. Stein's discussion (in vol. 2) of macromolecules in solution. A great deal of fundamental information is packed into its 42 pages, and the authors have taken special pains to provide a series of guiding remarks that summarize their discussion, to furnish three useful appendixes, and to prepare a most useful and practical bibliography of working references for each of the general topics introduced so compactly.

Volume 4, *Separation Methods*, contains three chapters: "Countercurrent distribution" (L. C. Craig); "Chromatography" (E. Lederer and M. A. Lederer); and "Gas chromatography" (P. Chovin). In the monastic spareness of 30 pages, Craig, practised, skillful, and modest, presents the theory, practice, instruments, promise, limitations, and connections of the technique of countercurrent distribution. If the student hankers for more, a short but excellent and pertinent bibliography leads him on. The chapter on chromatography is, in its 166 pages, a masterpiece of concise information. It is possible to assess the meaning of this statement by saying that the combined references for parts A, B, and C of this chapter total 1195. This bespeaks the fantastic efflorescence of these techniques, and it underlines the constraints within which the authors have worked so gracefully. Although there are now a number of thorough and comprehensive works on this subject, the student who encounters this one will be rewarded, instructed, and led onward. The final chapter, on gas chromatography, is a splendid introduction to a relatively new technique now, as the authors say, at the height of its evolution, and exhibiting an amazing range of performance. It is supplemented by a bibliography of 268 references. Here too, one may readily agree, is one of the indispensable tools of the modern biochemist.

This first section of *Comprehensive Biochemistry* is interesting in its individual performances and for the selection of topics. As one would expect in an edited work with numerous contributors, it is unevenly executed. In making a general evaluation of the section we bear in mind the editors' remark that this is not a textbook but rather a collection of pertinent chapters. Without knowing what other work is reserved for presentation in other specific biochemical contexts, it is difficult to make broad judgments about the merit of this collection of chapters as they may be related to the whole work. But the editors also describe the whole work as an advanced treatise in biochemistry. In this light, the section reveals another kind of unevenness, one of extent and thoroughness. The nearly 1200 pages of these four volumes represent a mighty compression of a number of enormous domains. In some cases this cannot but lead to disappointment, even for those who are sufficiently prepared to enter the domain. The reader obtains full satisfaction in two circumstances: when the essence and pertinence of the matter are presented very briefly and the reader is led on to the significant literature, and when, by happy chance, the allotted space permits discussion that allows the reader to grasp the principles, the operations, *and* the relevance. To an increasing extent, those origins of modern biochemistry which properly lie in chemistry and physics are now, in the best schools, matters of advanced undergraduate instruction, and they are dealt with thoroughly. The editors may wish to consider whether, in dealing with some of these aspects of the origins of modern biochemistry, even more summary accounts of the topics, with apt illustrative histories of biochemical applications might not be more effective —for example, such an account of the x-ray crystallographic analysis of the structure of myoglobin. This suggestion is put forward with some diffidence, since no clue is provided about the body of readers for which these volumes are intended.

Both the general preface and the preface to this section are very brief. In a comprehensive work such as this, the general preface might be the place for a thoughtful editorial essay on the history, range, and scope of biochemistry and for a definition of the modern biochemist. This neglected opportunity may be related to the rather one-sided definition of the origins of biochemistry. Biochemistry does not stand upon one leg; it does not merely "project into the vast field of biology," it also stands in that field. There are many interested chemists and physicists, already fluent in the fundamentals treated in this section, who would be grateful for an introduction to the principles of biology that also underlie all of modern biochemistry. In the organization of the entire work, an early presentation of these principles might perform a parallel service to that intended for the first section.

These books are attractively bound,

adequately indexed, and typographically very clean. Their aggregate price in the series is $43. There is no royal road to learning, but the roadside stands, like those along more common highways, extract a King's ransom from the eager traveler.

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Crystallography

Crystal Data. Determinative tables. J. D. J. Donnay and Gabrielle Donnay, Eds. American Crystallographic Association, 1963 (order from Polycrystal Book Service, Brooklyn, N.Y.). x + 1302 pp. $20.

The first edition of this book, published by the Geological Society of America in 1954, carried the subtitle "Classification of substances by space groups and their identification from cell dimensions." Part 1 of that volume, on the classification by space groups, which was prepared by Werner Nowacki, is omitted from the present volume, but we are promised a second edition of it. The tables for the determination of crystalline materials from cell dimensions have been greatly expanded. "The number of entries, which was about 6,000 in the first edition, is now estimated at about 13,000." However, there are many multiple entries. Parts of the colossal task of compilation were carried out in Leeds, London, Paris, and elsewhere, with subeditors for inorganic compounds, organic compounds, and proteins, but the final assembly was carried out in Baltimore.

The work consists of a short preface and introduction, followed by tables (pages 19 to 1019), indexes (by formula and by name), and two appendixes. The tables are similar in form to those in the first edition. There is a section for each crystal system, in which substances are listed in the order of numerical values of certain axial ratios. For each substance the following information is given: cell dimensions, space group, cell content, structure type, measured and calculated specific gravity, name or formula, and literature reference. For many substances there are editorial comments, generally referring to auxiliary information, pseudocells, conflicting data, or related matters, with references to other entries.

The introduction is much briefer than the one in the first edition. The true *reduced cell* rather than the *De-Launay cell* is now chosen to define the lattice. This change, which should affect only triclinic (now called "anorthic") materials, is referred to only in a footnote. The concordance of space group notations is copied without change from the first edition. Appendix 1, by M. V. King, is devoted to protein crystal data. Appendix 2, tables of space group criteria, is slightly modified from that in the first edition.

The general editor concludes the preface with this statement, "With due humility I repeat a former warning to the reader to beware of misprints and above all not to quote from this book second-hand numerical data." The number of misprints and other errors in the book is certainly very small. I noted one faulty reference in the name index. Other apparent errors probably can be attributed to conflicts in editorial policy and to the inclusion of material from the earlier edition without needed modifications. For example, incorrect data and the extended comments on schairerite (H-2.742) are repeated unchanged from the first edition, though correct data appear in standard reference works. The statement, in the introduction, that "the space group may not be known until the crystal structure is fully worked out" implies that, when the structure is fully worked out, the space group is known. Nevertheless, alternative space groups are listed for a number of materials for which the structure is "fully worked out."

Under the heading Structure, there are indications of the state of knowledge with respect to the crystal structure of the substance for which the lattice is recorded. This might be most helpful. Unfortunately there are many blanks; I sampled 15 pages throughout the book, and the result suggests that structural information is lacking for about 40 percent of the materials for which the lattice is known. However, such a conclusion would be unduly pessimistic. In many cases the blanks probably mean only that there was no structural information in the source cited, although a full structure determination may have been reported elsewhere. Strangely, blanks also appear in some instances when a full structure determination was reported in the source of the data cited.

This work, nominally a set of determinative tables for the identification of crystalline materials by axial ratios based on cell dimensions, is also by far the most comprehensive guide to the sources of crystal data. It is appropriate to repeat some remarks that I made in a review of the first edition, which apply equally to the present one. "This reviewer has spent pleasant hours just browsing through the tables enjoying the bits of intriguing information. But the volume can be put to much more solid uses and not only in the identification of crystalline substances. In its pages can be found suggestions for many problems in crystal chemistry and the solutions of others. This book is highly recommended to all mineralogists and crystallographers (chemists, metallurgists and many others) and it is hoped that it may lead some to realize the advantages of single crystal x-ray examination for purposes of identification" [*Am. Mineralogist* **40**, 784 (1955)].

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Science and Society

Heredity and Human Life. Hampton L. Carson. Columbia University Press, New York, 1963. xviii + 218 pp. Illus. $5.

The well-read and well-educated person who wants an introduction to human genetics will find it in this book. The first half of the book clearly and concisely describes the processes of genetics as they apply to man. The discussion includes the current findings in chromosomal genetics and a bit about the chemistry of heredity, but correctly stops short of the intricacies of these subjects. Gene and chromosome mutations are discussed as natural and as artificially caused phenomena. This section creates some false impressions, particularly in that it stresses the effects of strontium-90, which is not important gentically, but neglects almost all of the other elements which, though mostly transient, contribute high doses of radioactivity to the gonads.

The mood and tone of the book