

microwave spectroscopy and nuclear quadrupole resonance spectroscopy. All these fields have in common the fact that they involve the absorption of electromagnetic radiation in the radio-frequency or microwave regions. Their techniques are therefore quite different from those employed in the older branches of infrared, optical and ultraviolet spectroscopy.

The level of treatment is intended to be suitable for a non-specialized but professional scientific audience and the authors have succeeded admirably in presenting the material clearly and yet concisely. They have also provided excellent coverage of the important applications of the two magnetic resonance techniques and of quadrupole spectroscopy.

Since only about three pages are devoted to the applications of gas phase rotational microwave spectroscopy, this chapter is not even an adequate summary and cannot be recommended to those who wish to acquire an idea of what can be accomplished with this technique. Thus the reader would scarcely even suspect that this field has become the most effective available tool for the determination of the molecular structure of vapors, dipole moments and their components, quadrupole coupling constants, barriers to internal rotation, molecular magnetic moments, molecular electrical quadrupole moments, etc. There are also some errors in this chapter.

Another error worth pointing out occurs at the end of Chapter 2 where it is stated that quadrupole resonance is applicable to solids and liquids whereas it is correctly stated elsewhere that it can be applied only to solids.

In general only simple mathematical results are quoted, without derivation. Typical experimental arrangements are briefly described, for each field, and a number of illustrative results are described. Each chapter ends with a short bibliography including references to books and review articles, quite adequate to permit the interested reader to proceed to a more detailed study of the subject.

In summary, this book can be recommended, except for the reservation made above, to those who wish to be introduced in a simple, clear and yet adequate manner to these newer fields of spectroscopy which have provided such revolutionary new tools for chemists. The French in which the book is written is in general quite simple and straightforward.

DEPARTMENT OF CHEMISTRY
HARVARD UNIVERSITY
CAMBRIDGE 38, MASSACHUSETTS

E. BRIGHT WILSON, JR.

The Encyclopedia of Spectroscopy. Edited by GEORGE L. CLARK, Research Professor of Analytical Chemistry, Emeritus, University of Illinois, Urbana, Illinois. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. 1960. xvi + 787 pp. 18.5 × 26 cm. Price, \$25.00.

After some consideration, this reviewer has decided to define a spectroscopist as one who uses a spectroscope or spectrograph, or one who uses results obtained from these instruments, for scientific purposes. The breadth of this definition may be disappointing to those who restrict the purpose to the elucidation of atomic and molecular spectra. But if this definition of a spectroscopist is accepted, then the definition of spectroscopy can be made so general that an Encyclopedia of Spectroscopy may be justified.

The present encyclopedia includes thousands of minute technical details, many of which are of limited interest to specialists. Many details are of more general interest but it is very hard to find them, in the absence of any system of cross-indexing or collaboration between individual authors of the articles. This volume also contains articles which discuss problems of general interest, such as structure of atoms and molecules, description and theory of basic optical instruments and basic methods of spectrochemical analysis. While these discussions are generally good, they are (perhaps necessarily) superficial in comparison with standard textual treatments.

This brings us to the question of utility of this book. This reviewer has concluded that actually it will be of little use to the spectroscopist, who will have his own technical library and reference cards. It will be of almost no use to the general reader. It may be of some interest to the scientifically trained reader who has ample leisure for browsing.

Some of the bypaths and odd bits of information are indeed fascinating and may stimulate further reading.

A better Encyclopedia could have resulted from the fully coordinated efforts of fewer contributors. At least much of the repetition could have been avoided and the details could have been recorded in a more systematic way. Also, one does not like to see signed articles, for which the contributors are presumably responsible, mixed in with unsigned articles contributed by a Corporation and with one article taken from "an official news release."

The volume is attractively printed and bound as should be expected. It could have been reduced in size, and presumably in price, by reduction of excessive duplication.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF ROCHESTER
ROCHESTER, NEW YORK

A. B. F. DUNCAN

Annual Review of Nuclear Science. Volume 10. EMILIO SEGRE, Editor, University of California, GERHART FRIEDLANDER, Associate Editor, Brookhaven National Laboratory, and WALTER E. MEYERHOF, Associate Editor, Stanford University. Annual Reviews, Inc., Palo Alto, California. 1960. vii + 617 pp. 16.5 × 23 cm. Price, \$7.00 (U.S.A.), \$7.50 (elsewhere).

This, the tenth volume of the "Annual Reviews of Nuclear Science," follows well in the path of its predecessors in the clarity and comprehensiveness of the various articles. There are fifteen separate articles, covering a wide spectrum of nuclear science from certain aspects of high energy particle physics down through several different areas of classical nuclear physics, cosmic radiation, chemical and geophysical applications, and certain aspects of biophysics. Almost without exception the contributions are very up to date, eminently readable, even to the uninitiated in the field, and quite authoritative in tone. In the order of their appearance they are: "Neutrino Interactions" by Frederick Reines; "Nuclear Interactions of Heavy Ions" by A. Zucker; "Cosmic Ray Showers" by Kenneth Greisen; "Bubble Chambers" by Hugh Bradner; "Optics of High Energy Beams" by Owen Chamberlain; "Nuclear Structure Effects in Internal Conversion" by E. L. Church and J. Weneser; "Recoil Techniques in Nuclear Reaction and Fission Studies" by B. G. Harvey; "Labeling of Organic Compounds by Recoil Methods" by Alfred P. Wolf; "Nucleon-Nucleon Scattering Experiments and Their Phenomenological Analysis"—"General Formalism" by H. P. Stapp, "Experimental Data" by M. H. MacGregor and "Phenomenological Analysis" by M. J. Moravcsik; "Theoretical Interpretation of the Energy Levels of Light Nuclei" by I. Talmi and I. Unna with an appendix by F. Ajzenberg-Selove and T. Lauritsen; "Nuclear Methods for Subsurface Prospecting" by J. G. Beckerley; "Experiments on Cosmic Rays and Related Subjects During the International Geophysical Year" by E. P. Ney; "Cellular Radiobiology" by Tikvah Alper; "Vertebrate Radiobiology: Metabolism of Internal Emitters" by Roy C. Thompson and "Vertebrate Radiobiology: Late Effects" by J. B. Storer and D. Grahm.

This reviewer was particularly impressed by Reines' article on Neutrino Interactions and Ney's article on Cosmic Radiation and the IGY. Both are extremely lucidly written, enormously informative and about as up to date in their respective fields as one could hope to attain in a finite space. Reines takes the reader quite carefully up to an understanding of the very latest ideas in the theory of weak interactions and in a short but elegant final section explores the new and fascinating field of neutrinos and cosmology. Ney's article is one of the most succinct presentations of the basic experimental facts that have emerged about our cosmic ray environment and the current thoughts that exist about their interpretation. In a more practical vein Chamberlain introduces the reader to the problems involved in beam transport with high energy machines and in wonderfully clear article gives sufficient theory and practice to enable a neophyte to do his own planning. Zucker's article on the interaction of heavy ions is an excellent introduction to this expanding field and Wolf's article on the Labeling of Organic Compounds is an excellent exposition of the wedding of nuclear techniques to chemical problems; it should be noted that the major emphasis in this article is on the use of carbon-14 and tritium.

Though the above-named articles have been singled out for special emphasis, it is not meant to imply they occupy a unique position in this volume. Rather, it is the reviewer's opinion that these particular articles seem to be especially topical in that they present a highly competent survey in a form, readily understandable by all, of a subject matter not elsewhere readily available. Of the many different review volumes now on the market, this particular one certainly should be high on the list of the reader who wants to keep informed of the broad aspects of nuclear science and the manifold directions in which it is developing and being applied.

DEPARTMENT OF PHYSICS & ASTRONOMY
UNIVERSITY OF ROCHESTER
ROCHESTER 20, NEW YORK

MORTON F. KAPLON

Crystal-Structure Analysis. By MARTIN J. BUERGER, Professor of Mineralogy and Crystallography, Massachusetts Institute of Technology. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1960. xvii + 668 pp. 16.5 × 23.5 cm. Price, \$18.50.

Professor Buerger has written four books (the others are "X-ray Crystallography," 1942; "Elementary Crystallography, 1956; and "Vector Space and its Application to Crystal Structure Investigation," 1959; John Wiley and Sons, Inc., New York) which deal with various aspects of crystallography. The purpose of this latest volume is to acquaint the student of crystallography with the different techniques of determining the positions of the atoms in the unit cells of crystals from the intensities of the X-ray diffraction maxima. The book fulfills the author's purpose in a most satisfactory manner. It can be read with profit by the student whose preparation in mathematics and physics is limited; a knowledge of elementary calculus, the algebra of complex numbers and vectors, and perhaps a year of college physics are the main prerequisites.

Chapter 1, a brief historical introduction, is followed by an elementary treatment of diffraction by periodic arrays and crystals in Chapters 2 and 3. The next few chapters are mainly concerned with the experimental measurement of diffraction intensities and the conversion of these data into the squares of the structure factors, which are the numerical quantities the crystallographer uses for structure determination. These chapters include extensive discussions of twinning, experimental measurement of intensities by film and counter methods, the Lorentz factor, and effects arising from extinction and absorption. The actual procedure of structure determination is first considered in Chapter 9, which is a discussion of special and general positions in the various space groups and the distribution of the atoms on these sites. The remainder of the book is devoted to descriptions of the various techniques of structure determination interspersed with chapters on important theoretical concepts, such as the structure factor, Fourier series and Fourier transform. The dependence on the space group of the form of these functions is discussed in considerable detail. Refinement of atomic positions and calculation of interatomic distances and angles are discussed in the last two chapters (22 and 23). The very important applications of Patterson synthesis and vector space to problems in structure determination are discussed only very briefly in this book, since Professor Buerger has devoted a separate volume to this subject (see above).

In solving a crystal structure, from collecting the original data to the final refinement of atomic positions, there is no uniquely correct method. Thus, different "schools" of crystallography tend to follow rather different procedures. Although in places Professor Buerger's preferences are apparent, he has generally succeeded in being comprehensive. I believe that most crystallographers who are faced with the problem of teaching graduate students the art and science of crystal structure determination will be grateful to Professor Buerger for writing this book. Most of the mathematical formulas and techniques (such as finding the proper form for the Fourier series for a given space group) which are commonly encountered in crystal structure determination are explained in considerable detail. The important methods of structure determination are illustrated by examples from the literature, and the logic of the solution is explained with the aid of a large number of excellent drawings. Several topics in the book—for example, the section

dealing with the effects of twinning on the observed intensities and the discussion of high absorption and surface reflection—are not discussed in other books and will be of interest to many experienced crystallographers.

The workmanship of the book, particularly the illustrations, is outstanding. The book contains approximately 900 references to the literature. These are listed, often under topic headings, at the ends of the chapters and are chosen to illustrate the corresponding discussion. Although the references to the periodical literature are generally more than adequate, there is no reference to several important books.

The book has been proof-read by several experienced crystallographers, and there are few errors. However, the statement concerning the inequality at the top of p. 561 is incorrect, and the description of a "structure seminvariant" at the bottom of p. 573 is wrong. Also, it seems to me that the characterization of the visual method of measuring intensities as a "peak intensity" method does not do justice to this important technique. In fact, the general discussion of the visual method is inadequate compared to the extensive discussions of the photometric methods.

SCHOOL OF CHEMISTRY
RUTGERS, THE STATE UNIVERSITY
NEW BRUNSWICK, NEW JERSEY

PHILIP A. VAUGHAN

Comparative Biochemistry. A Comprehensive Treatise. Volume II. Free Energy and Biological Function. Edited by MARCEL FLORKIN, Department of Biochemistry, University of Liège, Liège, Belgium, and HOWARD S. MASON, University of Oregon Medical School, Portland, Oregon. Academic Press Inc., 111 Fifth Avenue, New York 3, N. Y., 1960. xix + 685 pp. 16 × 23.5 cm. Price, \$18.00 (Subscription price); \$20.00 (Non-subscription price).

This book contains articles on the thermodynamics of organic phosphates by M. R. Atkinson and R. K. Morton; on the reactions of saccharide biosynthesis by L. F. Leloir, C. E. Cardini and E. Cabib; on some reactions of protein synthesis by H. Chantrenne; on ammonia metabolism and urea biosynthesis by P. P. Cohen and G. W. Brown, Jr.; on contractility by S. V. Perry and also by H. Hoffmann-Berling; on active transport by B. Andersen and H. H. Ussing; on material balance by F. Brown and W. D. Stein; on osmoregulation by J. Shaw; on nerve action by M. Gerebtzoff and E. Schoffeniels; and on bioluminescence by E. N. Harvey.

Although they are greatly outweighed by its virtues, this book has certain faults, and for some of these faults the editors and the publishers—not the authors—must accept responsibility. Perhaps the most serious is that due to intentional (to preserve order) delays in publication the authors were unable to consider adequately the most recent developments; in reviewing swiftly-moving fields, *e.g.*, protein synthesis, such delays were damaging. Another fault common to compendia of reviews and evident here is lack of uniformity. The book begins with an excellent thermodynamics chapter (Atkinson and Morton); it would have been well to ask subsequent authors to conform with the framework developed in this beginning; instead, the usual untidiness in regard to standard and actual states, influence of *pH*, efficiency, and so on, was subsequently allowed to creep in. Persons looking for an exposition of the truly "comparative" point of view in the sense of, say, tracing biochemical evolution, will often be disappointed with mere cataloguing of phenomena in diverse species (the articles by Cohen and Brown, by Hoffmann-Berling, and by Shaw are shining exceptions to this criticism). However, this was not a disappointment shared by this reviewer, who is quite content to regard the book as a collection of excellent articles on "interesting topics in cell biochemistry and physiology." Finally, if taken too literally, the sub-title, "Free Energy and Biological Function," will seem a little ambitious, for in dealing with some processes, say secretion or nerve conduction, there is insufficient information even to warrant the formulation of the free energy efficiency.

Perusal of the author list will show that the editors, M. Florkin and H. S. Mason, were singularly successful in recruiting famous writers to their cause. This reviewer found all the articles to be of high quality, and, within bounds of delay, all the articles were accompanied by useful bibliog-