

gies for ESR studies in clinically important areas to which it may apply (cancer, aging, enzymatic oxidation-reduction systems in specific tissues); the relation of free radicals to unsolved problems of energy transport in biological systems.

The book under review is entitled "Free Radicals in Biological Systems" and contains 29 papers presented at a symposium of that title held at Stanford University in March, 1960. There were 59 participants in the symposium: 7 from abroad, 24 from California and the remainder from elsewhere in the U. S. According to its planner the symposium was designed to "review the progress that had been recently made and to assess the future." It is appropriate therefore that the volume be evaluated against the foregoing summary of the present accomplishments and problems in the field.

Over one-third of the papers deal with the effects of ionizing radiation on solid-state systems of biological interest. They vary considerably in length, experimental detail and depth of analysis. At one extreme is a highly informative treatment of ESR signals in oriented single irradiated crystals of glycine; at the other is a wholly empirical comparison of ESR signals from irradiated "mechanical" and "molecular" mixtures of 16 different amino acids with those due to irradiated cow tail hairs.

About one-fourth of the papers are on free radical components of oxidation-reduction enzyme systems. These, too, vary considerably in content. One paper is chiefly a report of failure to detect an ESR signal in a particular enzyme system and repetition (at a lower level of resolution) of other ESR observations previously reported by other investigators. Another paper derives, from purely optical data, a scheme involving a free radical intermediate, without reporting whether the critical ESR experiments have been done. Since a note to this paper, added in proof, withdraws the scheme, the critical experiment has apparently been carried out, but with negative results. In contrast, a detailed paper (35 pages) on certain flavoprotein enzymes discusses correlated optical and ESR data. This paper is also distinguished in that it represents the only effort reported in the symposium to describe quantitative changes in free radical concentration associated with enzyme activity. Despite the obvious importance of quantitative data in enzyme studies, they are difficult to achieve, and require, for example, careful control over the dielectric properties of the instrument cavity and over comparisons between samples and standard concentrations of free radicals. Unfortunately the quantitative data presented in this paper do not greatly advance our knowledge of this problem. The quantitative data are contained in two figures. In one of these, the ordinate which relates to ESR-determined free radical concentration, is marked "% semiquinone" but neither the legend nor the paper's text describes what experimental procedures and calculations were involved in the derivation of this term. The second figure is intended as a quantitative comparison of ESR and optical data from a butyryl dehydrogenase system as a function of time. Its value is rather limited by the lack of an ordinate which relates to ESR data.

The volume contains a single 4-page paper on ESR studies of photosynthetic systems. This paper contains some interesting conclusions regarding the quantum yield of photo-induced spins but, being so limited in scope, hardly reflects what is now known about ESR observations of photosynthetic systems. The only other papers on light-induced free radicals are two brief reports of essentially trivial observations of ESR signals in plant pigments.

Problems relating to ESR instrumentation are considered in three papers. One includes a useful discussion of principles involved in maximizing the applicability of ESR spectrometers for biological work. Another paper describes the construction of a flow apparatus for ESR spectrometers (elsewhere in the volume, results of the application of a similar apparatus to enzyme studies are given). The third paper describes a double cavity designed "for precision measurements of radical concentration" in ESR spectrometers. The usefulness of the paper to a reader interested in accomplishing this end is somewhat limited by the fact that no quantitative data are given, results being embodied in statements such as "Two samples of DPPH were compared and found very nearly equal in signal amplitude."

A comparison of the contents of this volume with the foregoing summary of the status of the problems suggests

that the symposium does not accurately reflect the experimental results, or the unsolved problems of current studies on free radicals in biological systems. Certain editorial inadequacies add to the difficulty which the reader will encounter in using this volume as a guide to the field. The chief of these is that in a number of instances observations which repeat, confirm or contradict earlier work previously published by others are put forward without any mention of the earlier observations.

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**Chemobiodynamics and Drug Design.** By F. W. SCHUELER, Ph.D., Professor and Chairman, Department of Pharmacology, Tulane University, School of Medicine, New Orleans, Louisiana, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N.Y. 1960. xiv + 638 pp. 16 × 23.5 cm. Price, \$19.50.

This pretentious book attempts to cover all the scientific and practical considerations which now (and in the future ideally could) enter into decisions as to what chemical compounds should be synthesized in order to achieve substances of desired physiological activity.

Although written with great enthusiasm and imagination the text is stuffed with quasi-philosophical absurdities typified by "Scientific investigation is a form of *living growth* in the truest sense of the words and everything which stifles [*sic*] the pulse of life becomes dead—QED!" (p. 587), and is marred by numerous gross misconceptions, careless errors and haphazard documentation.

All things considered it is the belief of the reviewer that this book could seriously misguide a normally unsophisticated student and would prove an unbearable burden to any normally sophisticated teacher who attempted to use it as a text or reference work.

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**Treatise on Analytical Chemistry. Part II. Analytical Chemistry of the Elements. Volume I.** Edited by I. M. KOLTHOFF, School of Chemistry, University of Minnesota, and PHILIP J. ELVING, Department of Chemistry, University of Michigan, with the assistance of ERNEST B. SANDELL, School of Chemistry, University of Minnesota. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1961. xxi + 471 pp. 16.5 × 24 cm. Price, \$16.00; subscription price, \$14.00.

The volume under review is the first of a series of volumes of Part II of this Treatise. It is devoted to the analytical chemistry of hydrogen; water; the gases of Group 0 of the periodic system, and to the alkali metals. Six different authors have contributed to the volume, but the style has been made as uniform as possible by editorial policy.

In addition to analytical methods, there is a thorough introduction (32 pp.) to inorganic nomenclature by W. C. Fernelius, and a chapter (9 pp.) on the general concepts of the underlying philosophy of analytical chemistry by James I. Hoffmann. The various chapters on the elements contain much information on chemical and physical properties, like that normally included in books on general chemistry.

The chapter on hydrogen (23 pp.) by H. F. Beeghly also summarizes information on deuterium and tritium as well, but it is chiefly concerned with the estimation of hydrogen in metals and alloys, either by combustion, vacuum fusion, or by heating *in vacuo*. The determination of hydrogen in organic substances is covered elsewhere in the treatise.

The chapter on water (137 pp.) by J. Mitchell, Jr., follows the general lines of the book on "Aquametry" of which he is co-author. The method of Karl Fischer properly receives main emphasis among the chemical methods for water. There is, however, a thorough review of other chemical methods as well as a brief outline of physical techniques. The uses of infrared measurements, nuclear magnetic resonance spectroscopy, mass spectrometry, neutron scattering and radiometric methods are reviewed, together with numerous conventional applications of physical meas-

urements to the determination. The estimation of deuterium and tritium is also covered. A bibliography of 356 citations is included.

The inert gases of Group 0 are fully considered in a 92-page chapter by Gerhard A. Cook. Much attention is given to sampling and methods of separation. The major portion of the chapter deals with methods of estimation of which mass spectrometry and gas chromatography are of major importance. Spectral measurements, radioactive measurements and numerous other techniques are described in detail. The laboratory procedures cover practical methods and the determination of the usual impurities in each of the gases. An adequate bibliography is included.

The chapter on the alkali metals is the most lengthy (159 pp.) and includes a bibliography of 471 references. Some 27 pages are devoted to the physical and chemical properties of the elements. The various methods of separation and determination are given in detail.

The various chapters in the volume differ considerably in the amount of analytical detail that is given. The volume is a good source of information on both the commonplace and the newer and less studied methods for the determination of the elements and compounds that are included. A Subject Index is provided.

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#### An Introduction to the Analysis of Spin-Spin Splitting in High-Resolution Nuclear Magnetic Resonance Spectra.

By JOHN D. ROBERTS, California Institute of Technology. W. A. Benjamin, Inc., 2465 Broadway, New York 25, N. Y. 1961. vii + 116 pp. 16 × 23.5 cm. Price, \$4.95.

Professor Roberts' book (his second in this field) should be of considerable help to organic chemists who have occasion to interpret high-resolution n.m.r. spectra. The book does not pretend to be a rigorous, sophisticated analysis of n.m.r. spectra. However, it succeeds quite well in giving the beginner a feeling for what is going on in spin systems, and in giving plausible, correct and readily applied recipes for calculating the necessary matrix elements, energy levels and transition probabilities. The utility of the book is greatly augmented by the spectra of un-named compounds given for the reader to interpret and by the numerous problems which are distributed throughout the book.

The excellent figures and diagrams are also most helpful. A beginner, having worked his way through this book, should be able to handle Pople, Schneider and Bernstein or the review article by Corio without undue difficulty.

The book suffers to a certain extent in being too short. Such a book, written for the beginner, might well have included a section introducing the reader to the art of resolving secular determinants larger than  $2 \times 2$ ; a description of the Jacobi method might have been appropriate here. Anderson and McConnell's use of spectral moments is just mentioned, although it often readily yields chemically valuable information. The utility of group theory in simplifying n.m.r. spectral calculations was most elegantly shown by E. B. Wilson; this utility is hinted at here, but might have been developed fully to good advantage, since the technique can drastically decrease the amount of work necessary in spectral analysis. This book includes several good charts and correlation diagrams of n.m.r. spectral variation with the relative magnitudes of the parameters. It does not approach the detailed numerical coverage given in Corio's review article, however, and explicit mention of the existence of these tables would have been appropriate.

In some places an unwary reader might be confused as to the meaning of  $I_2$ ; is it being used as a quantum number or as an operator? The physical interpretation of the orthogonality of the spin functions  $\alpha$  and  $\beta$  could cause confusion when mixed states of several nuclei are considered later on.

All in all, however, the strong points of this book heavily outweigh the weak ones, and Professor Roberts' book will probably serve organic (and physical) chemists for some time as the most readable, easily followed introduction to spin-spin coupling in n.m.r. spectra available.

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**Organo-Metallic Compounds.** By G. E. COATES, M.A., D.Sc., F.R.I.C., Professor of Chemistry in the University of Durham. John Wiley and Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 1961. xiii + 366 pp. 14 × 20.5 cm. Price, \$7.50.

In keeping with the conventions adopted in the earlier edition Professor Coates has again limited his consideration to compounds containing carbon-metal bonds, a restriction which eliminates any detailed discussion of metal alkoxides and other interesting compounds where the metal atoms are bonded to carbon-containing entities *via* oxygen, nitrogen, etc. The very extensive organic chemistry of silicon, phosphorus and arsenic has also again been omitted. In addition, certain voluminous fields in synthetic organic chemistry, such as use of the Grignard reagent, are necessarily treated rather briefly. In the main, the chemistry of transition metal carbonyls and cyanide complexes has not been included, except where these substances are used in the preparation of other compounds, such as the mixed cyclopentadienyl and arene carbonyls.

The new edition has been increased in size by approximately a factor of two. Most of the new material is concerned with recent developments in the chemistry of the alkali metals, boron, tin and the transition metals. In incorporating this material the author has rewritten a considerable portion of the text dealing with these elements. The most striking change is perhaps that made in the section dealing with the transition metals, where the earlier rather short chapter has been expanded to well over one hundred pages. In the other chapters not mentioned above, new material also has been introduced, but in many instances the over-all change in content is not very extensive. An attempt has been made to include the major developments which were published up to the autumn of 1959, and a few references to the 1960 literature have been added in proof. Some idea of the scope of the author's over-all efforts may be gained by noting that the book contains approximately nine hundred references to the original literature.

The major emphasis has again been placed on the preparative and descriptive aspects of the subject. This is reflected both in the selection of the material and in the method of presentation, the latter being based almost exclusively on the framework provided by the groups of the periodic table. In addition to the purely descriptive material, the book contains a discussion of the nature of various types of carbon-metal bonds, including an especially detailed summary of the conclusions which may be drawn from the molecular orbital viewpoint about the bonding in the cyclopentadienyl and arene complexes of the transition metals. When the results of physical-chemical studies such as molecular weight, dipole moment, magnetic susceptibility and infrared, n.m.r. and e.p.r. spectra were available, this information has usually been summarized at the point where the properties of the individual compound are considered.

In the reviewer's opinion Professor Coates has been remarkably successful in summarizing a large amount of fascinating material in a book of relatively modest size and price. The over-all treatment of the subject is not intended to be comprehensive, but even an expert in the field will find that the book provides a useful summary of information and a ready source of key references. For the non-specialists the book should serve as a most perceptive and readily comprehended introduction to an important and rapidly expanding field of research.

In the reviewer's opinion, certain minor defects are inevitable in a book of this sort. The condensation of so much material in so little space has necessitated the use of a rather terse and not particularly readable style of writing. The organization of the material in terms of the groups of the periodic table provides an efficient presentation of descriptive material; unfortunately, this classification does not readily lend itself to an emphasis either of over-all generalities or of the physical-chemical aspects of the subject. For example, when structural information based on X-ray analysis is available for a given compound, this is clearly presented in diagrammatic form at the point in the book where the compound is considered. However, a summary of such structural information and generalities to be deduced from it can only be obtained by a page to page perusal of the entire book, unaided even by a listing of the appropriate information in the subject index. The