

which have been observed<sup>14</sup> for other zero oxidation state iron compounds. These data suggest<sup>9</sup> essentially completely covalent bonding between the iron atom and the  $\pi$  electron distribution in the (COT) ring. Available n.m.r. and kinetic data for  $C_8H_8Fe(CO)_3$  suggest that bonding to the  $Fe(CO)_3$  group leads to strong electron delocalization in the ring. This delocalization is implied in the  $\pi$ - $\pi$  overlap integral calculations given by Dickens and Lipscomb<sup>4,5</sup>. The present results indicate that the charge density of the delocalized  $\pi$  electrons is essentially the same in the  $C_4$  residue of  $C_8H_8Fe(CO)_4$  as in the two  $C_4$  residues in  $C_8H_8Fe_2(CO)_8$  to which the iron atoms are bonded. This model is consistent with the *quasi*-octahedral

(14) L. M. Epstein, *J. Chem. Phys.*, in press, private communication.

configuration of the iron atom with respect to three CO groups and three of the eight carbon-carbon bonds suggested by Dickens and Lipscomb.<sup>4</sup>

A more detailed study of resonant gamma ray absorption studies in iron carbonyl compounds will be published elsewhere. We are greatly indebted to Prof. F. G. A. Stone and Dr. G. N. Schrauzer for generously supplying samples of these compounds and to D. N. E. Buchanan and Miss W. Robinson for assistance with the measurements. This work was supported in part by the U. S. Atomic Energy Commission.

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## BOOK REVIEWS

**The Parathyroids. Proceedings of a Symposium on Advances in Parathyroid Research**, held at the Rice Institute, now Rice University, Houston, Texas. Edited by ROY O. GREFF, Ph.D., Professor of Anatomy and Dean, Harvard School of Dental Medicine, and ROY V. TALMAGE, Ph.D., Professor of Biology and Chairman of the Department, Rice University. Charles C. Thomas, Publishers, 301-327 East Lawrence Avenue, Springfield, Illinois, 1961. xvii + 473 pp. 18 × 25.5 cm. Price, \$12.25.

As is apparent from the sub-title, this volume records the proceedings of a symposium on recent advances in parathyroid research held in February, 1960. The occasion was noteworthy in several respects and will be long remembered by the participants (including this reviewer) as a landmark in the field. First, the invited speakers were distinguished for their imaginative morphological, biochemical or physiological investigations of the parathyroid glands and their secretions. In addition, many of the men who pioneered the investigation of parathyroid physiology were present to comment on the new work which was presented. A unique feature of the program were several short formal tributes to these men in which the importance of their contributions as a basis for current studies was made clear for the younger workers present. Second, although the group was large—over 200 attended—extensive and spirited discussion followed the formal presentations in each session. The excellent physical arrangements made possible the recording of these comments which are included almost verbatim in the book.

The third and most noteworthy aspect of this symposium was that, in a sense, it underlined the emergence of a new era of parathyroid research. Several aspects contributed to this. For the first time the hormone itself seemed to be available in pure form in sufficient quantity to be characterized in terms of its chemical structure as well as its physiological effects. In addition, the first reports of the results of concerted efforts to examine *in vitro* the over-all metabolic patterns of bone cells at the biochemical level and the effects of hormones on these patterns were given. Perhaps most important, however, was that it was abundantly apparent that the two rather rigid "schools"—one believing the primary site of action of the hormone was kidney, the other bone—which had guided thinking in this field were replaced by a general acceptance of multiple sites of action for the hormone. Action at each of these sites, it appeared to be agreed, was such as to lead to an elevation of the serum calcium ion concentration. Thus the way seemed to be opened to examine the mode of action of the pure hormone at the cellular level in several organs and perhaps arrive at a better understanding of the mechanisms involved in controlling the calcium concentration of the blood.

Much of the excitement of the occasion is reflected in this publication of the proceedings both through the papers themselves and the records of the discussion which followed them. The editors have arranged these in six sections which follow, but not completely, the order of the symposium program. While the changes in order of presentation add to the development of the subjects discussed in the formal papers, they tend to detract from the value of the discussion. In these comments reference is made in several places to work already presented in the symposium but which appears later in the book. This also leads to some confusion of the reader perusing McLean's introduction to the body of the symposium in which he summarized the unsolved problems in parathyroid research and explained the program.

The first section entitled "Keynotes in Parathyroid Research" includes besides McLean's excellent introduction and summation, a description by Gaillard of his classic observations of the effects of parathyroid hormone on the histology of bone in tissue culture. Each of these is preceded by the introduction of the speaker by an old friend—a touch which adds warmth and human interest to the book. This section is followed by sections dealing with the cytology of the gland and the chemistry of the hormone, certain selected topics in parathyroid physiology, the relationship of the parathyroids to bone, to citric acid, and to the kidney, and finally a group of papers on parathyroid dysfunction in man. In each of the formal papers outline the problems in need of solution, the current state of thinking in the particular area under discussion, and present many previously unpublished observations. In addition, several new working hypotheses concerning the mechanisms by which parathyroid hormone exerts its actions are proposed. Disagreement was not uncommon and this, together with the degree to which these presentations stimulated the participants, is well brought out in the published discussion. These comments include, as well, new and often highly intriguing observations pertinent to the topic under consideration. A unique feature is the inclusion at the end of several of the sections of the formal tribute to the man whose pioneering work was especially concerned with the area under discussion.

Here is a book, then, which includes in a single volume a description of the means of isolation and major chemical features of parathyroid hormone and indicates through selected papers and discussion by workers actively engaged in the field the present status of investigation of its physiological action together with the directions being taken in further studies of unsolved problems. The inclusion of discussion and the tributes, formal and informal, add to the readability and interest of the book as well as reviewing for the newcomer some of the background of the work and the

personalities concerned in its execution. Finally, the physical aspects of the volume are attractive. The print is clear and the reproduction of photographic material unusual in its clarity. All in all, the organizers of the symposium and the editors of these proceedings are to be congratulated for producing a remarkable meeting and a book which is both readable and of equal use to the neophyte and the dedicated worker in this field.

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GEORGE NICHOLS, JR.

**Radical Polymerization.** By J. C. BEVINGTON, Department of Chemistry, University of Birmingham, England. Academic Press Inc., (London) Ltd., 17 Old Queen Street, London, S. W. 1, England. 1961. viii + 188 pp. 16 × 23.5 cm. Price, \$6.00.

Polymerization by free-radical mechanisms is an intensively cultivated field, not only for its great practical importance, but because it is one of the best ways to study the principles governing free radical behavior. Reviews, monographs and books on this subject have not been lacking, but there is recurrent need to put the continuing effort into perspective. Dr. Bevington has made many research contributions to the field about which he writes. He has succeeded in providing an up-to-date, critical account which is both well organized and inviting reading. As can be inferred from the small size of the book, it does not discuss cases in detail, but it includes about 350 selected references to the original and review literature, including recent books to which he defers for their treatment of special topics.

Workers in the fields of free radicals and polymerization will enjoy this mature discussion. Those seeking an introduction to the field cannot do better than to use this monograph as a starting point.

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PAUL D. BARTLETT

**Physical Chemistry of Macromolecules.** By CHARLES TANFORD, Professor of Physical Biochemistry, Duke University. John Wiley and Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 1961. xiv + 710 pp. Price, \$18.00.

This book represents an attempt to treat in a unified manner the physical chemistry of macromolecules of diverse origins. These include the simpler polymers as well as the more complex macromolecules of biological interest such as the proteins and nucleic acids. In order to assess the success of this endeavor, which is the reviewer's obligation, it is important to clearly understand the audience to whom it is addressed and the necessary prerequisite set forth to its understanding. According to the author the only prerequisite is "a good undergraduate course in physical chemistry." Consequently, the book is primarily addressed to the graduate student commencing research in this field and in particular to those engaged in the physical chemistry of proteins.

With these self-imposed limitations it was found necessary to introduce a somewhat extensive though understandably incomplete discussion of certain basic disciplinary subjects which are germane to the understanding of macromolecular behavior. These include methods of determining molecular structure such as the principles of X-ray diffraction, infrared and ultraviolet spectroscopy, the general fundamentals of thermodynamics, electrostatics and flow processes in viscous fluids including the thermodynamics of irreversible processes. Thus, a significant portion of the book is devoted to developing the necessary background.

In regard to the principal subject matter, there is extensive discussion of the properties and structure of the individual molecules and their transport and thermodynamic behavior in dilute solution. The various methods of determining molecular weight are discussed in great detail. There is a rather elegant discussion of multiple equilibria, while the section devoted to polymerization kinetics and mechanisms is extremely brief commensurate

with the extreme importance of the subject. Notable by its absence is any discussion of the thermodynamics and statistical mechanics of rubber elasticity, a subject which has achieved a high level of development and can be said to be one of the cornerstones of polymer science. Also missing is any consideration of crosslinking and network formation, while only two pages are devoted to the crystalliquid transformation in polymers.

The subject matter concerned with macromolecules that is presented is given an exhaustive treatment from the point of view of fundamentals and first principles. It is to the author's credit that those subjects which might be termed controversial are treated in an objective manner. The limitations of existing theory and liberties that have been taken with theory in the interpretation of experiments are clearly brought out. Within the concept that is adopted as to what constitutes the physical chemistry of macromolecules and with the understanding that the book is directed to the beginning research student the author's objectives can be said to be accomplished and the volume should serve a useful purpose.

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**Analyse der Metalle. Zweiter Band. Betriebsanalysen.** Zweite neubearbeitete Auflage. Erster Teil. Aluminium bis Schwefel. Zweiter Teil. Selen bis Zirkonium. Edited by CHEMIKERAUSSCHUSS DER GESELLSCHAFT DEUTSCHER METALLHÜTTEN- und Bergleute e. V. Springer-Verlag, Heidelberger Platz, 3, Berlin-Wilmersdorf, Germany. xvi + 1568 pp. 17.5 × 25 cm. Price DM. 158.

This new and enlarged edition is a cooperative effort of some seventy individuals and organizations to present the most recent analytical practice in the laboratories of various German metal producing organizations, foundries, mining organizations and metals research institutes. The first volume and roughly one-third of the second deals with the occurrence, detection and quantitative determination of the principal metal and the accompanying elements in ores, process intermediates and various finished grades of metals, alloys and compounds.

The metals, other than iron, are treated in alphabetical order with a separate chapter for each metal with the exception of gold and silver; cerium and the cerite metals; niobium and tantalum and the Platinum Metals, which are treated in four chapters as groups. The non-metals boron, silicon and sulfur are included. The extent of the coverage in the various chapters reflects German practice in the production and the utilization of the non-ferrous metals. The chapter on uranium is much more scanty than many other chapters. Other metals for which there is little production or utilization in Germany are also treated briefly.

In addition to conventional gravimetric and titrimetric methods, there are numerous procedures that utilize photometric, electrolytic, polarographic measurement, as well as considerable utilization of potentiometry and various special methods. Liberal use is made of E.D.T.A. compleximetric procedures.

The accuracy to be expected by various methods is stated. For example, accuracy 1 means a procedure that is adequate for impure analyses. Accuracy 2 indicates a type of method that is suitable for process control, whereas 3 designates one that is suitable only for approximate estimations. Time requirements are also indicated.

In general, the chapters on the elements give a selection of workable procedures that are in more or less standard practice for each element, its ores, intermediates and the chief alloys, salts or other major commercial products. A total of 45 chapters is devoted to the non-ferrous metals and to B, S and Si.

The next eight chapters (46-53) deal with related analyses that are important in connection with the production of metals and alloys. They are: Metallic and Non-metallic Inorganic Coatings for Metals; Determination of Oxygen in Metals; Solid Fuels; Testing Fuel Oils; Industrial and Natural Gases; Testing Water for Boiler Operation; Pickling Effluents. The most extensive of these chapters are those on Coatings (59 pp.) and Solid Fuels (50 pp.). This whole section occupies roughly one-third of the second volume (264 pp.)

Photometric, spectrographic and certain electrical methods are treated in Chapters 54-59. The chapter headings are: Photometry (14 pp.), Polarography (10 pp.), Potentiometry (12 pp.), Conductometry (9 pp.), High Frequency Titrations (21 pp.), Spectrochemical Analysis (84 pp.). In each case useful bibliographies are given. Those for High Frequency Methods and Spectrochemical Analysis are extensive.

The three final chapters deal, respectively, with Solutions, Buffers and Compositions of Metals and Alloys.

Under Solutions are given concentrations of concentrated and dilute acids and bases. Procedures are given for the preparation and standardization of acids, bases, oxidants, reductants, precipitants and complexing agents; also for acid-base, oxidation-reduction and other indicator solutions. Directions are given for preparing special reagents, e.g., the Zimmermann-Reinhardt reagent, etc. The solubilities for various important reagents at 20° are tabulated, as well as density-composition tables for solutions of many acids, bases and salts.

The chapter on Buffer Solutions is thorough with respect to buffer compositions and references on their use.

The final chapter gives the German standard compositions for various commercial grades of metals and for the principal types of non-ferrous alloys.

A Table of Atomic Weights (1955) is on p. xvi of the first volume, and a Table of Physical Properties of the Metals, including at. wts., density sp. heat, thermal conductance specific resistance, melting point and boiling point is to be found on pp. 1518-1519.

Author and Subject Indices make up pp. 1520-1568.

This treatise can be recommended to all who are interested in the determination of the non-ferrous metals in their ores, production intermediates and finished products, together with methods for the chief accompanying elements. Accessory materials such as refractories, fuels, coke and coating materials are also covered thoroughly. The treatment and the selection of methods is up-to-date and capable of giving good service in the general analysis of non-ferrous metals and the closely related materials.

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April 10, 1962-May 10, 1962

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