at C-2 or C-4. While we are attempting to distinguish rigorously between the two possibilities for B, we consider the α,α'-dipyrrylmethene III, formed from A + B, to accommodate the properties of prodigiosin better than the α,β'-alternative II.

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CONTRIBUTION NO. 1590
DEPARTMENT OF CHEMISTRY
YALE UNIVERSITY
NEW HAVEN, CONNECTICUT

HARRY H. WASSERMAN
JAMES E. MCKEON
LEWIS SMITH
PETER FORGIONE

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BOOK REVIEWS

Elasticity, Plasticity and Structure of Matter. Second Edition. By R. HOUWINK. Dover Publications, Inc., 920 Broadway, New York 10, N. Y. 1958. xviii + 368 pp. 13.5 × 20.5 cm. Price, $2.45.

This book, which had been received with acclaim when first published in 1937, may now be considered a classic. It represented a rather successful attempt to present a physical outlook on diverse chemical and rheological observations of such systems as clays and doughs, synthetic and natural polymers and crystals.

Although the theories advanced two decades ago may appear inadequate today to describe "structure," the work provides a good survey of the phenomena of elasticity and plasticity. The revisions incorporated into the second edition (1952) still kept the point of view of 1937, although a section on the statistical theory of rubber elasticity was added.

In spite of its age, the book presents the field of rheology in a manner worth reading today. A reissue is thus amply justified. This economical, paperbound reproduction of the second edition should find itself in the libraries of rheologists who will find in it valuable history and of others who will discover a readable account of an important field.

RESEARCH SERVICE DEPARTMENT
AMERICAN CYANAMID COMPANY
STAMFORD, CONNECTICUT

DONALD L. SWANSON

Organic Sequestering Agents. A Discussion of the Chemical Behavior and Applications of Metal Chelate Compounds in Aqueous Systems. By STANLEY CHABEREK, The Dow Chemical Co., and ARTHUR E. MARTELL, Clark University. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1959. xv + 616 pp. 16 × 23.5 cm. Price, $25.00.

In this book the authors have accomplished their stated aim admirably, namely, "to employ the principles required for an understanding of the behavior of aqueous metal chelates as a basis for understanding the varied functions and uses of chelating agents and metal chelate compounds." The book is definitely not a mere revision of "The Chemistry of the Metal Compounds" by Martell and Calvin.

The first third of the book, Chapters 1–4, may be considered as a presentation of fundamental principles involved in the stoichiometry, structure and stability of metal chelates and the methods used in determining these properties. There is no discussion of the theories of the coordinate bond, this subject being considered by the authors as beyond the scope of the book. There are excellent discussions of hydrolysis of metal chelates.

Chapter 5 is a good treatment of "metal buffer" systems, in which chelating agents regulate metal ion concentrations.

The remaining three chapters, comprising over half of the text, is devoted to the role of chelating agents in analytical chemistry, in industry, and in biological systems. The subject is discussed from both theoretical and practical points of view.

In the appendix the authors have tabulated about 2000 reported stability constants.

The book is profusely documented, although the reviewer found no satisfaction in being referred on page 39 to "unpublished results" for the demonstration of the olated cyclic trimer, $(Cr(tren)(OH))_3$.

Every book contains some unavoidable errors, but a few in this book leave the reviewer puzzled. For instance, on page 34 a structural formula is given for a (biscitratodioxouranate(VI))$^{-6}$ ion, although there is long-standing evidence in the literature that citrate does not chelate the uranyl ion in greater than a 1:1 citrate/uranium ratio even in eight-fold excess citrate. Also, on page 308 the weaker chelation tendency of tartrate ion relative to that of the citrate ion is explained on the basis of tridentate chelation by two alcoholic OH groups and one carboxyl group in the case of the tartrate ion in preference to chelation by one ethanolic group and two carboxyl groups as depicted for the citrate ion. There is no evidence in the literature for the type of tridentate chelation attributed to the tartrate ion. On the contrary, the literature shows that tridentate chelation by tartrate is similar in type to that by malate and citrate, *i.e.*, involving two carboxyls and one alcoholic hydroxyl, as is shown on page 448 for ferric citrate. In fact, the authors abandon their own arguments of page 308 in citing on page 448, as a possible structure for the magnesium citrate chelate, formula IX.

This book should be of greatest value to the beginner in the field of metal chelates and to those primarily interested in applications. Even the tyro should find it to be smooth reading and easily understandable, although he may in a few cases have difficulty in distinguishing between proven explanations and unsupported speculations.

The book is quite free of typographical errors. The quality of the binding and paper is good, but the price of the book seems inflationary.

DEPARTMENT OF RADIATION BIOLOGY
SCHOOL OF MEDICINE AND DENTISTRY
UNIVERSITY OF ROCHESTER
ROCHESTER, NEW YORK

ISAAC FELDMAN

Anleitungen für die Chemische Laboratoriumspraxis. Band X. Gaschromatographie. By ERNST BAYER, Privatdozent an der Technischen Hochschule Karlsruhe, Institut für Organische Chemie. Edited by H. Mayer-Kaupp. Springer-Verlag, Heildelberger Platz 3, Berlin-Wilmersdorf, Germany. 1959. viii + 163 pp. 16 × 23.5 cm. Price, DM 39.60.

This little monograph describes the correlation of an obviously extensive literature survey. It is divided into four chapters and two lengthy appendices.

The book is designed to deal with the practical aspects of the analytical applications of gas chromatography. This point is exemplified by the length, 12 pages, of the chapters devoted to introductory material and to the theoretical foundations of the technique. The principles of linear, ideal chromatography are clearly enunciated and equations given for the calculation of the number of theoretical plates, etc. Linear, non-ideal chromatography receives passing mention by quoting the van Deemter equation. Although the implications of this equation are not discussed in detail, a copious selection of references to the bibliography is given. An interesting anecdote is the revelation, page 6, that a form of gas chromatography was reported in the year 1512.

The second chapter on columns and the third on general apparatus together occupy 35 pages. Since many important statements are justified throughout the book simply by references to the bibliography rather than by detailed argument in the text, the reviewer was left with the feeling that many less consequential details are discussed too fully in these chapters. For example, almost three pages of text are devoted to an outline of the types of thermostats which have been used. A detailed description of column packing materials is left to the final chapter and of detector construction to an appendix.

The fourth, and longest (55 pages), chapter gives examples of applications of the technique to specific analytical problems. The number of examples is large and quite complete, recipe-type instructions are given for column packings and other experimental conditions for many of the separations. All such material appears to be taken directly from the references.

Appendix I comprises 25 pages of tabulated values of relative retention volumes and selectivity coefficients (see below) for various column liquids and sample components. For the more common combinations relative retention volumes are given at two temperatures. A more extensive tabulation of the effect of temperature would be useful. A second appendix, of 20 pages, gives detailed instructions for the construction of filament type katharometers and less complete outlines of the construction and operation of other detectors.

The selectivity coefficient referred to above seeks to give a quantitative measure of the selectivity of a given column in the separation of a pair of substances of differing chemical structure. It is a property of the nature of the stationary phase only (and its temperature, see below) for a given pair of substances. This coefficient, σ, is defined as the ratio of the retention volume (absolute or relative to some standard substance) of some member of a homologous series on a given column liquid to that (referred to the same standard if relative values are used) of some, usually hypothetical, member of some other series which has an identical boiling point; σ is usually evaluated graphically (page 21). Rather useful conclusions are reached on this basis. For example, a non-polar stationary phase sometimes effects a better separation of a sample containing two polar substances of different types than does a polar column liquid.

To this reviewer, the definition of σ appears to be ambiguously stated both in the book and in reference 21 ("in press" at the time the book was printed; presumably *Angew. Chem.*, 71, 299 (1959)). The column temperature at which retention volumes are taken for the calculation of σ are not specified (in fact it is not specified that the column temperature should be constant for all values required in the calculation). Hence it is not clear whether the "temperature dependence" of σ is a function of the "identical boiling point" chosen for its definition (as it must be for the data shown in figure 8b) or of the column temperature used to obtain the data for its estimation. The concept seems worthy of a more precise treatment; certainly the tabulated values appear to be useful.

To the uninitiated this book gives a more direct route, in German, to a working knowledge of an extremely useful analytical technique than could be obtained by reading the 302 references. The tabulated data in the appendix are sufficiently extensive to suggest that this book also has a place on the shelf of those well acquainted with gas chromatography.

DIVISION OF PURE CHEMISTRY
NATIONAL RESEARCH COUNCIL K. O. KUTSCHKE
OTTAWA, CANADA

Researches in Geochemistry. Edited by PHILIP HAUGE ABELSON, Director, Geophysical Laboratory, Carnegie Institution of Washington. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1959. x + 511 pp. 15.5 × 23.5 cm. Price, $11.00.

Professor Robert M. Garrels in his contribution to this book suggests that "The major aim of geology is to recreate the environments of the past." Although such a statement may appear quite restrictive, it nevertheless defines the role of the chemist in earth science studies. The geochemist seeks a description of the conditions, whether equilibrium or not, under which the solids, liquids and gases of the earth have interacted, as well as a balance sheet of the distribution of the elements and their isotopes among the various earth's components.

This book resulted from a seminar series in geochemistry held at the Geophysical Laboratory of the Carnegie Institution of Washington and at the Johns Hopkins University during 1957–1958. Twenty-three contributions emphasize the broad spectrum of geochemical investigations, a spectrum that closely parallels that of chemistry. The applications of such a wide range of chemical disciplines, including solid state, isotopic, organic, inorganic, thermodynamic and kinetic, to natural processes does not permit an adequate review by a single person. At least, however, the directions in which geochemistry is making significant advances can be pointed out from this book, which in a way is a status report.

The accomplishments of geochronologies based upon the decay of natural radioactive species in nature are reviewed in a general article by Tilton and Davis and in more specific coverages of C^{14} by de Vries and H^3 by Libby. The three articles elaborate upon the limitations inherent in the methods as well as promising extensions into geologic domains at present devoid of measurable time parameters.

Invigorating sections of the volume are concerned with the chemistry of the solid state, especially those heterogeneous and homogeneous equilibrium relations among minerals. The carbonate (Goldsmith) and sulfide (Kullerud) phase relationships of the laboratory are extended to interpret the equilibrium (or non-equilibrium) conditions in nature, as functions of temperature. The equations of state of minerals (Clark) subjected to the high pressures encountered beneath the earth's crust, approached either from thermodynamic or statistical mechanical models, provide a point of entry into the structure of the earth's interior. Coupling such information to studies of meteorite composition has led MacDonald, in his section, to propose the earth may have a composition similar to that of chondritic meteorites. The more sophisticated problems of order–disorder relations in crystals provide both an irritation and a stimulation to petrological investigations (Chayes), but the very existence of inhomogeneities may well solve as many old problems as the new ones introduced.

The processes causing the fractionation of the stable isotopes of oxygen and sulfur are treated by Epstein and Ault, respectively. The tremendous power of isotopic variations in unraveling both biochemical and inorganic chemistries in nature is considered thoughtfully with an abundance of examples in igneous and metamorphic petrology, hydrology, paleontology, vulcanology and sedimentation.

A fair portion of the book is centered about sedimentation processes; two articles in particular are impressive. Arrhenius utilizes the minerals accumulating on the ocean floor in studying both global and regional events during the geological history of the earth. Milton and Eugster direct their attention to the general geological conditions during the Eocene in the Green River basin where a large and unique group of mineral assemblages were laid down. Phase rule considerations quite adequately interpret the sediment types and associations.

The ever increasing number of domains into which the geochemists penetrate can be readily established by briefly noting some of the remaining chapters: low temperature and pressure kinetics (Garrels); organic geochemistry (Abelson); petroleum genesis (Hanson); equilibrium compositions of magmatic gas phases (Krauskopf); ore deposition (Barton); hydrothermal investigations of amphiboles (Boyd); and reduction and oxidation processes in metamorphism (Eugster).

Careful editing has given a strong coherence to the widely ranging chapters. The book lacks an index, which is sorely needed. It is difficult to conceive of a geochemist who would not find several of the chapters pertinent to his activities, for the mainstream of geochemical research has been well recorded by the book's distinguished authors.

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UNIVERSITY OF CALIFORNIA EDWARD D. GOLDBERG
LA JOLLA, CALIFORNIA