

cation theory, structure of cold-worked metals, preferred orientations, anisotropy, and phase transformations. Many of these sections can be adapted for more advanced graduate student instruction.

Many revisions were made in this new edition, and the context of the first edition was increased by over 90 pages. The major changes were made on sections dealing with dislocations, imperfections, creep, structure of metals, textures and preferred orientations, precipitation hardening, and phase transformations—necessitated by the additional knowledge acquired in these fields since the publication of the first edition in 1943.

As it is now revised, Barrett's book is the most inclusive and up to date single reference that is available on the structure of metals.

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Chemistry and Biochemistry

Chemistry of Carbon Compounds: Aliphatic Compounds, Vol. I, Pt. B. E. H. Rodd, Ed. Amsterdam—Houston: Elsevier, 1952. 684 pp. \$17.50.

This book is a continuation of the excellent work which was published in 1951 (*SCIENCE*, 116, 181). The style is essentially the same as that used in the last half of Part A. The tremendous task of editing this treatise was made easier by the distinguished advisors: Sir Robert Robinson, J. W. Cook, R. D. Harworth, Sir Ian Heilbron, E. L. Hirst, and A. R. Todd.

There are 13 authors of the 12 chapters, several of whom have contributed to more than one chapter. The principal classes of aliphatic compounds covered are monocarboxylic acids and carbonic acid, dicarboxylic acids, polyhydric alcohols and their derivatives, complex carbohydrates, proteins, and enzymes. A particularly extensive treatment is given to polyhydric alcohols, covering 275 pages. Generally, methods of preparation and properties characteristic of the class of compounds are presented briefly at the outset of the chapter. This is followed by methods of preparation and properties of individual members of the class of compounds and derivatives.

This reference work will fall between such widely used treatises as Richter, Karrer, and Gilman, and the more extensive Beilstein and Elsevier in degree of treatment of the subject matter. The style of presentation by classes and compounds within classes is similar to Beilstein.

It appears that this will be an invaluable series of books for the organic chemist. The treatise is far too voluminous for a textbook; it will find its widest use as a reference book. The subject matter is up to date and is presented in a modern, comprehensive manner. It is strongly recommended for every qualified organic chemist.

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Metabolic Maps. Wayne W. Umbreit. Minneapolis: Burgess Pub., 1952. 439 pp. Illus. \$6.00.

From the introduction to the appendix, the author endeavors to present a summation of our present knowledge of the mechanisms of cellular metabolic functions. For the purposes of presentation, this objective is exceptionally well accomplished by dividing cellular biochemistry into logical subdivisions and, in workbook fashion, covering each individual reaction by means of a series of nicely executed charts, together with carefully selected references for each of the reactions diagrammed. The references include review articles, the historically important papers, and the most pertinent of the 1950–51 literature.

An excellent balance among the general fields of metabolism is achieved by allocating the first five chapters to the subject of carbohydrate oxidation and its related phosphate metabolism; Chapter 6 to oxygen transfer; Chapters 7 through 10 to nitrogen metabolism, including methylation (Chapter 9) and ring-containing amino acids (Chapter 10); Chapter 11 to nucleic acids and their derivatives, and Chapter 12 to the lipids, including the latest in the enzymatic synthesis of biologically important steroids.

The make-up of the book, with its inclusion of blank space for additions and changes as they appear in the literature, permits the reader to use it in accordance with the author's suggestion as "a device for the orderly assembling of useful contemporary information without employing extensive files."

The author has endeavored to help the reader keep abreast of the broader fields of cellular metabolism. An example of how he does this and, at the same time, gives the book practical value to readers unacquainted with a specific field, is the cryptic but clear section devoted to the nomenclature of steroids. Likewise, a few pages and references on the subjects of purine and pyrimidine antagonists will be found.

The subject index is complete and especially valuable in that many of the chemical substances involved as intermediates in the various metabolic pathways are listed.

It is the opinion of the reviewer that this book will be useful, not only to those active in the field of cellular metabolism, but also as a general source of information to all those interested in modern biology.

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Chemistry of the Metal Chelate Compounds. Arthur E. Martell and Melvin Calvin. New York: Prentice-Hall, 1952. 613 pp. Illus. \$10.00.

Recent years have witnessed a great resurgence of interest in inorganic chemistry, as is evidenced by the fact that the demand for inorganic chemists in industrial and academic institutions now far exceeds the rather modest supply. Although all areas of inorganic chemistry have enjoyed this rapid growth, the metal complexes have attracted particular attention, and

many groups of workers, both in America and abroad, are doing research in the field. Most of the current work involves physical chemical methods and measurements, but there is still great need for research on the preparative and descriptive side; some excellent work is being done in this area, however. The publication of this volume by Martell and Calvin is welcome—for more than 30 years has elapsed since the appearance of an authoritative book on complexes. Both authors have done excellent and extensive research on chelate compounds and are thoroughly familiar with the literature on complexes. They have surveyed it carefully and critically, and their book is well organized and clearly written. Since metal complexes are encountered in every branch of chemistry, this book should find wide use.

The metal chelate compounds differ from other complexes in containing ring structures which are formed by the union of the metal ion with two or more atoms of the same coordinating molecule. These rings give the complex peculiar stereochemical properties and greatly enhanced stability, so the chelates merit special attention. Although Martell and Calvin have been concerned primarily with the chelate complexes, they have of necessity surveyed the chemistry of all types of metallic complexes, particularly the stability constants, bond types, and structures. They perhaps overemphasize the distinction between chelates and other complexes, but in a book on chelate compounds this is excusable.

The last half of the volume deals primarily with applications of chelation, particularly in catalysis in biological systems, in analytical chemistry, in water softening, and in the dyeing of fabrics. Other authors would doubtless have emphasized other applications (e.g., electrochemistry, photography, and leather tanning), but the ones selected are representative and have received more attention than the others. The appearance of this monograph may well stimulate work along new lines and suggest new applications. The thoughtful reader will find that it answers many questions, but that it suggests far more than it answers.

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A Guide to Filter Paper and Cellulose Powder Chromatography. Tudor S. G. Jones, J. N. Balston, and B. E. Talbot. New York-London: H. Reeve Angel, 1952. 145 pp. Illus.

Paper Chromatography: A Laboratory Manual. Richard J. Block, Raymond LeStrange, and Gunter Zweig. New York: Academic Press, 1952. 195 pp. Illus. \$4.50.

In chemistry, as in doubtless all other areas of science, from time to time there come about fructifying new discoveries or inventions of technique that are followed by a seemingly explosive exploitation as each new tool is applied for the re-examination of current

concepts and for the investigation of new problems, now possible or facilitated.

Paper chromatography, although not without antecedent application, is essentially a development of the past decade, deriving from the work of Martin and Synge, winners of the Nobel prize in chemistry for 1952. The rapidity of development of this general technique and of its extension in so many directions is happily recognized by the appearance of the two books reviewed here.

The term chromatography, introduced for the separation of plant pigments by selective adsorption on columns, has come to refer also to the resolution of uncolored materials by the same or analogous procedures. Paper chromatography refers to the separation of mixtures of small amounts of substances placed on an originally restricted area on the paper, as a solvent or mixture of solvents is caused to flow past. A variety of appropriate methods is applied for the location of the individual constituents thus resolved. The ratio of the distances traveled by a substance and by the solvent front, the R_F value, is characteristic of the substance under the prevailing conditions, and is of aid in identifying an unknown constituent. If the R_F value is low, it is on occasion convenient to employ R_X , the ratio of the distances traveled by the substance and by some reference substance X .

The separation of mixtures on filter paper may involve selective adsorption, ion exchange, or partition between solvents, or—not uncommonly—a combination of these. Water, and presumably certain other solvents, by hydrogen-bonding with the cellulose, apparently form what is essentially a stationary quasi-liquid phase, between which and the flowing solvent mixture a partition equilibration occurs. Knowledge of factors affecting partition coefficients serves as a basis to explain or predict results in many instances. It has not been possible, however, to develop a rigorous mathematical treatment of the process or processes involved, although the theoretical discussions in papers by Martin and associates and others offer considerable guidance. The choice of conditions is still largely on an empirical basis, although work with new compounds may be guided by what is known of the action of related substances.

The book edited by Dr. Jones has been published by H. Reeve Angel and Co., Ltd., and W. & R. Balston, Ltd., distributors and manufacturers, respectively, of Whatman filter papers and cellulose powders. Part I, a general discussion of methods and materials, includes a brief outline of the processes involved in the conversion of cotton fiber to paper and relates the nature of the slightly altered cellulose molecules and of trace substances also present to the properties that may be of concern in paper chromatography. A description of pertinent characteristics of a number of their own papers is included.

The introduction to Part II on applications outlines the influence of the nature of the solute on separations, possible modifications of the paper for special

purposes, and methods for location, identification, and quantitation of materials on paper or cellulose powder columns. The remainder of the book is devoted to numerous classes of substances, such as amino acids, sugars, phosphoric esters, purines, pyrimidines and nucleosides, vitamins, antibiotics, alkaloids, steroids, radioactive tracers, proteins and enzymes, and various other organic and inorganic substances. There are also brief sections on the use of paper impregnated with alumina or silica, and of acetylated paper, and on reversed-phase paper chromatography and on electrophoresis on paper. The sections include much interesting information, generalizations, and critical comments, but essentially no detailed description of procedures, for which the reader is directed to the references included with each section. There are an author index and a classified list of recent articles. A short section of pictures and a two-dimensional "map" for amino acids and related substances are included.

The book of Block, LeStrange, and Zweig covers essentially the same territory but is intended as "a practical manual in which tried and proven procedures, employing relatively simple equipment and available reagents, are summarized."

A chapter on theory, with some mathematical treatment, and chapters well illustrated with diagrams and pictures on general and quantitative methods are included. The chapters dealing with various classes of materials include descriptions of many procedures, numerous pictures, diagrams, and tables of R_F values. A bibliography and author and subject indexes are provided. Well realized is the authors' hope "that sufficient detailed information is provided, in the majority of instances, so that the reader will be able to apply the technique of paper chromatography to his particular problem without recourse to an extensive search of the literature."

As the authors of these two books have made rather different approaches to the subject, a somewhat complementary relationship is observable. There is further reason to consult them both, since the eclectic bibliographies show numerous differences. For references after 1951 in this rapidly burgeoning field, other sources of information must be sought.

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Rocks for Chemists. S. James Shand. New York: Pitman, 1952. 146 pp. Illus. \$4.50.

The author has described this book as "An introduction to petrology for chemists and students of chemistry." This has been well achieved by careful arrangement and lucid explanation of the subject matter. Beginning with a brief historical introduction, he goes on to outline the characteristics of crystalline and sedimentary rocks as seen in the field and points out the differences in texture between plutonic and volcanic rocks. A list and explanation of the terms used to describe the texture of rocks are given.

A chemical system of rock classification is proposed,

based on the presence or absence of free SiO_2 (quartz, tridymite, or highly siliceous glass). A rock containing free SiO_2 plus minerals that can exist in equilibrium with free SiO_2 is termed "oversaturated." One that has no free SiO_2 but only minerals that can coexist in equilibrium with free SiO_2 is called "saturated." He terms "unsaturated" those rocks that contain no free SiO_2 but do contain minerals that could not coexist in equilibrium with SiO_2 , such as nepheline, sodalite, leucite, corundum, etc. Another method of chemical classification of rocks is described in which the molecular ratio of Al_2O_3 to $\text{Na}_2\text{O} + \text{K}_2\text{O} + \text{CaO}$ is the criterion. If the ratio is greater than 1:1 the rock is termed "peraluminous;" if the ratio is not greater than 1:1 but exceeds the ratio of Al_2O_3 to $\text{Na}_2\text{O} + \text{K}_2\text{O}$, the rock is called "metaluminous." Where all the Al_2O_3 is contained in feldspars, or feldspathoids, and a nonaluminous mineral such as olivine is present, the rock is designated "subaluminous." The steps in the calculation of the norm of a rock are briefly outlined.

The chapters on the systems plagioclase-pyroxene and olivine-pyroxene-plagioclase draw heavily on the published work of Bowen and Schairer, as does the chapter on feldspathoidal rocks. The chemical and mineralogical composition of sedimentary rocks is discussed. A comparison of alteration that is due to weathering with that due to hydrothermal action is made.

The physical and chemical processes of metamorphism are outlined in the last two chapters, and the importance of H_2O in metasomatic transformations is emphasized.

Preceding the index, under "Suggestions for Reading," a bibliography of geochemistry, containing 40 titles, is listed. Following the index are 32 excellent plates of photomicrographs of thin sections, photographs of polished sections, and views of geological formations.

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Gmelins Handbuch der anorganischen Chemie. 8th ed. Edited by Gmelin-Institut für anorganische Chemie und Grenzgebiete. *Sauerstoff*, System No. 3, Part 2: *Vorkommen-Technologie*, 1952. 218 pp. \$15.48. *Arsen*, No. 17, 1952. 475 pp. \$33.33. *Magnesium*, No. 27, Part A-4: *Legierungen von Magnesium mit Zink bis Rhenium; Oberflächenbehandlung*, 1952. 336 pp. \$23.81. *Titan*, No. 41, 1951. 481 pp. \$27.20. Verlag Chemie, GmbH, Weinheim/Bergstr., Germany. U. S. distrib.: Edwards Brothers, Ann Arbor, Mich.

These four volumes represent a valuable addition to Gmelin and a satisfying advance toward completion of the eighth edition. With the continued growth of the chemical literature, the research chemist is becoming increasingly dependent upon reference works such as Gmelin and Beilstein. A literature search through the abstract journals upon any specific topic is becoming prohibitively costly in terms of require-

ments in time. Reference works such as these greatly facilitate such searches. Chemists everywhere would be profoundly grateful if a sharp reduction in the time lag between the appearance of a paper in the literature and its incorporation in the reference works were possible.

Sauerstoff treats the distribution of oxygen, ozone, and water. The geochemistry of the hydrosphere is reviewed. The technology of oxygen, ozone, and hydrogen peroxide manufacture is covered.

The volume on arsenic represents a complete treatment of the geology, chemistry, physics, and industrial utilization of arsenic and its compounds. As mentioned above, the regular appearance of such volumes covering the chemistry of each of the elements, with a delay of no more than five years, would tremendously simplify the time requirements for literature searches.

The magnesium volume deals with binary and ternary alloys of magnesium and is, therefore, of primary interest to metallurgists and engineers.

Titan is a comprehensive treatment of the chemistry of titanium and its compounds. The volume is particularly timely in view of the present active interest in titanium metal. It is of particular interest to American chemists to note that this volume is dedicated to Roger Adams for his assistance in the rehabilitation of the Gmelin Institute following World War II.

These volumes maintain the usual high standards of clarity, conciseness, and organization of previous volumes in the Gmelin series. They represent an essential part of the literature of inorganic chemistry and should be a required item in every library used by research chemists.

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The Biological Sciences

Evolution in the Genus Drosophila. J. T. Patterson and W. S. Stone. New York: Macmillan, 1952. 610 pp. Illus. \$8.50.

An appreciation of the importance of this book is best gained by a brief survey of its historical background. During the early decades of the twentieth century little interest was taken by biologists in the subject of evolution as a field for active study and research. However, the new science of genetics was rapidly advancing, particularly owing to the brilliant researches of the Morgan school on the genetics of *Drosophila*.

By 1927 H. J. Muller, then at the University of Texas, had demonstrated the artificial induction of mutations in *Drosophila* by x-rays. A few years later, in the same laboratory, T. S. Painter, ably assisted by W. S. Stone, had demonstrated the significance of the constant banded pattern of the giant salivary gland chromosomes of *Drosophila*—not merely an advance

in cytology, but rather an entirely new level of cytology. In the meantime A. H. Sturtevant had combined taxonomic and genetic studies of *Drosophila* species and demonstrated hybridization between two species of the genus. Genetic analysis of *Drosophila* populations by Sturtevant and Th. Dobzhansky, N. P. Dubinin and colleagues, and others had thoroughly disproved the old bromide of the irrelevance of "bottle mutations" in evolution studies.

About 1938 J. T. Patterson and his colleagues at the University of Texas, aided by a generous grant from the Rockefeller Foundation, turned their attention to the problems of speciation and evolution in the genus *Drosophila*. With a truck fully equipped for collecting and field studies, workers from this laboratory made many extensive collecting trips throughout the U. S. and Mexico, and brought back alive for taxonomic, genetic, and cytological study approximately 100 new species, and many previously described forms. A series of University of Texas bulletins, totaling over 1600 pages, many hundreds of tables, figures, and diagrams, with detailed figures of internal anatomy, colored plates of over 70 forms, and many salivary and metaphase chromosome plates, has been issued at intervals, reporting the progress of these researches on speciation and evolution in the genus.

This work, published and in progress, naturally forms much of the basic material for *Evolution in the Genus Drosophila*. The book, however, is a comprehensive review of the work on taxonomy, geographical distribution, hybridization, genetics, and cytology of the genus in many laboratories in this and other countries, with a synthesis and interpretation of this material as it bears on the subject of evolution. It is this reviewer's opinion that the authors have done an unusually thorough and unbiased job of evaluating the contributions of other laboratories, and of interpreting the findings of the many investigators in this field. In the bibliography of some 700 references, perhaps half the items have been published since 1938. The early literature has not been neglected, however, and those who have provided the background for the recent rapid advances have been given due credit.

A résumé of the taxonomy of the genus, with descriptions of 7 subgenera and 29 species groups to which 267 species are assigned, is followed by a section dealing with geographical distribution, possible phylogenetic relationships, and what is known of the ecology. In the chapter on chromosome evolution, figures of the metaphase chromosomes of over 120 species are shown, with illustrations and interpretations of many changes in chromosome configuration through translocations, fusions, and inversions.

Other sections deal with salivary chromosomes, gene variation, selection, and genic balance, and isolating mechanisms. Over 100 cases of hybridization, showing differing degrees of evolutionary divergence, are described. One chapter is devoted to the remarkable story of evolution in the *virilis* group, as revealed through a study of the geographical distribution, hybridization,