Book Reviews

Geochemistry: A Survey of the Chemistry of the Earth. Kalervo Rankama and Th. G. Sahama. Chicago: Univ. Chicago Press, 1950. 912 pp. $15.00.

This book is an important contribution to earth science by two eminent Finns, whose broad knowledge of geochemistry is matched by their deep interest in the subject, as shown by the thoroughness with which they have covered the field. An introductory section contains an illuminating discussion of the meaning and proper field of geochemistry. Following Goldschmidt, they believe that this science has for its three objectives the establishment of the abundance of elements and nuclides in the earth; accounting for the manner in which the elements are distributed in the minerals and rocks of the lithosphere and in natural products of whatever kind; and the discovery of the laws governing the relative abundance of the elements.

In discussing the interrelationships and overlapping of mineralogy, geology, chemistry, and geochemistry, the authors dispose of the matter of definition by the wise remark that the definition of geochemistry should not so much involve the subject matter but rather the viewpoint of the scientists attacking its problems. If, for example, the particular subject under consideration is the differentiation by crystallization of a magma, both the petrologist and the geochemist must ordinarily deal with the same basic factors. But the petrologist thinks first of the physical processes involved in differentiation, and the geochemist thinks first of the difference in chemical composition of the various products that are formed. For purposes of orderly treatment, the authors chose to divide the subject matter into two main parts. The first deals with the background and general laws that determine the occurrence and distribution of particular elements; the second treats in detail all the elements in the periodic system in relation to their occurrence.

Although by its name geochemistry has to do with the earth, the first chapter of the book treats of the composition and structure of meteorites, which are interesting in themselves because they supply information on interplanetary and interstellar masses. In addition, they bear directly on geochemistry because, according to general belief, these visitors from outer space represent fragments of a body similar in physical-chemical properties to the earth. The condensed account of the chemical and mineralogical constitution of meteorites, therefore, serves as a useful introduction to the remainder of the book.

Chapter 2 brings together in convenient form information on the abundance of elements and nuclides in the upper silicate layer of the earth (the lithosphere). Succeeding chapters deal with the geochemical structure of the earth, distribution of the elements among the geochemical spheres of the earth, geochemistry of the lithosphere, geochemistry of the hydrosphere, geochemistry of the atmosphere, and geochemistry of the biosphere. Part I concludes with a chapter on "Cosmochemistry and Geochemistry" and one entitled "Outline of the Geochemical Evolution of the Earth." In these sections, the authors bring together a great variety of facts and theories on cosmogony and the evolution of the earth. Naturally, in a subject such as this, many of the issues are befogged by controversy, but the authors deal fairly and rationally with the divergent views.

In Part II, consisting of 36 chapters, the known elements up to and including atomic number 96 are covered for each element or group of elements under the heads of abundance and geochemical character, the occurrence of the element in rocks, its biogeochemistry, its cycle during geologic processes, and such other heads as may be of importance for the particular element.

The value of this outstanding work is enhanced by a brief historical outline that mentions the milestones and great names in geochemistry, and by some appendices of convenient reference material, such as tables of the atomic and ionic radii of the elements and of the electronic structure of the elements. In addition to literature references and an author index, there is a subject index with over 3,000 listings. The book is clearly written, and the data are presented in convenient form. Typography is attractive, and the book shows evidence of careful preparation, editing, and proofreading. In their preface Rankama and Sahama modestly disclaim any intention to offer here a textbook of geochemistry or a complete account of all geochemical information. Rather, the volume represents an attempt to survey the broad field and to account for the present status of geochemical knowledge. In this purpose they have succeeded admirably, and students of earth science will find this an indispensable reference work.

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Physical Methods in Chemical Analysis, Vol. I. Walter G. Berl, Ed. New York: Academic Press, 1950. 664 pp. $12.00.

Fourteen competent specialists under the editorship of W. G. Berl contributed to this volume, which represents an impressive piece of work. It renders clear evidence of the continuously increasing importance of physical methods in chemical analysis during the past three decades. Accuracy, convenience, and speed are the characteristics of physical methods that qualify them to supersede older procedures. During the classical period of analytical chemistry, when gravimetric and volumetric methods played the main role, a few physical methods

already enriched the resources of the analyst, but usually many years elapsed between the original conception of a physical method and its introduction into the analytical laboratory. How rapidly nowadays physical methods find application by the analyst is shown by a glimpse at the contents of this volume, which contains all methods dealing with the interaction of radiation with matter.

Three chapters deal with x-rays: "Absorption Phenomena of X-rays and γ-rays," by G. L. Clark; "X-ray Diffraction Methods as Applied to Powders and Metals," by W. L. Davidson; and "X-ray Diffraction as Applied to Fibres," by J. A. Howsmon. These are followed by an article by L. O. Brockway on electron diffraction. "Spectrophotometry and Colorimetry" are presented by W. R. Brode. Three sections are concerned with spectroscopic topics: "Emission Spectrography," J. Sherman; "Infrared Spectroscopy," H. H. Nielsen and R. A. Oetjen; and "Raman Spectra," J. H. Hibben. Polarimetric methods are discussed by C. D. West and "Refractive Index Measurements" by L. W. Tilton and J. K. Taylor. The treatment of "Electron Microscopy" by R. D. Heidenreich emphasizes application to metals. The last article in the volume, written by H. W. Washburn, deals with mass spectroscopy.

All these are excellent monographs about physical methods which are already acknowledged as indispensable means in quantitative analytical work, or will undoubtedly become of steadily increasing importance. Each paper covers the fundamental principles of each field, detailed treatments of methods, clear descriptions of instruments, critical discussions of the various fields of application, and includes a list of references to specialized texts and original research papers. Since all contributors are experts in their special fields, one finds many valuable discussions of a practical nature that could originate only from continuous laboratory experience. There is no doubt that every analyst will greatly appreciate these valuable contributions and will profit from them.

Credit is due to the publishers for the excellent production of this volume.

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The Autobiography of Robert A. Millikan. New York: Prentice-Hall, 1950. 311 pp. $4.50.

Every physicist who has come into contact with Professor Millikan—and who is there of us who has not?—to say nothing of all the countless others in so many fields of practical affairs, will want to read this book in order to discover, if he can, what it is that makes this extraordinary man go. And I believe that he will succeed in finding the answer to a much greater extent than he has a right to expect. It is seldom that a man is so successful in getting his personality into his own writing about himself; here the man we have known speaks to us from every page. Here will be found, for example, an answer to the question which so puzzled or even dismayed the physicists of a generation ago: how was it possible that a man comparatively unheard-of and with no recognized achievement in research should suddenly blossom out at the age of 45 into a physicist of the first magnitude? Although the book does not supply the complete answer, it shows that it was at least no accident. The exuberant energy, and the vision that knew how to concentrate on the essential and the significant, were there all the time, waiting only the inevitable eventual removal of the inhibiting effect of irrelevant and unusual circumstances in his early career.

The book is much more than a record of the life of one man, however; it is a history of the physics of his time, and as such will find its place among the other histories of the most memorable decades that physics has yet experienced.

Not the least interesting part of the book to one who passed through some of the same experiences is the detailed account of Millikan's activities during the first world war. Surely none of the tales of the fabulous activities of physicists during the second war can surpass this tale of its forerunner. But the younger generation should read these war experiences for another reason—as an antidote to the cynicism which became so fashionable in the years immediately after the war. Most of the unselfish men who threw their lives into that war, as did Professor Millikan, were actuated by a sense of high idealism, as were also a large part of the other decent people in this country. This has too easily been forgotten.

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Heterocyclic Compounds: Three-, Four-, Five-, and Six-Membered Monocyclic Compounds Containing One O, N, and S Atom, Vol. 1. Robert C. Elderfield, Ed. New York: Wiley; London: Chapman & Hall, 1950. 703 pp. $11.00.

The Chemistry of Heterocyclic Compounds: The Heterocyclic Derivatives of Phosphorus, Arsenic, Antimony, Bismuth, and Silicon. Frederick George Mann. New York-London: Interscience, 1950. 180 pp. $5.25.

This introductory volume on heterocyclic chemistry proclaims that the series is to be "a general treatment with primary emphasis on the principles involved." This treatise is long overdue, and if the subsequent volumes live up to the high promise of the first volume a long-felt need will be fulfilled. There have been numerous books on heterocyclic chemistry, but the subject is too complex and diverse for one author or one volume. The compendia which tabulate in great detail all available literature on a subject lack critical evaluation of the chemical principles disclosed. The present effort gives promise of fulfilling the need for a chemistry of heterocyclic compounds.

The first volume covers ethylene oxides, trimethylene oxides, ethylenimines, azetes, furans, thiophenes, pyrroles and derivatives, pyrans, pyrones, thiapyrans, thiapyrones, pyridines, partially hydrogenated pyridines, and piperi-