BOOK REVIEWS

COLLOIDAL CHEMISTRY OF THE SILICATE MINERALS, by C. EDMUND MARSHALL, Professor of Soils, University of Missouri, price, $5.80. This publication comprises Volume 1 of a series of monographs prepared under the auspices of the American Society of Agronomy.

The mode of approach used by Dr. Marshall in planning this volume may be illustrated by quotations from the preface. He says: "I have deliberately chosen to restrict this work in the main, to evidence obtained from the study of reasonably pure materials; well aware that by so doing, diverse and important applications have been relegated to the background. In the present state of our knowledge of the colloidal minerals it is in my opinion, more important to clarify the fundamentals than to describe technical details of application.

"In so far as I have been able to judge, this field has been free alike from competitive overeagerness and sterile controversy. Mineralogists, colloid chemists, soil scientists and ceramists have all contributed."

Thus the volume, although prepared under the direction of those interested in soils, has no narrow appeal, and should interest a wide circle of those concerned with the colloidal properties of minerals. Of course this interest centers largely around clay minerals, but this is because these are the typical colloidal minerals, and not because the author is interested in these alone. Throughout the paper he aims to present the basic science of the problems involved. This is the reason for confining the consideration largely to pure minerals, and to the reviewer this seems a sound approach.

Chapter 1 on "Historical Outline" should interest all mineralogists, not alone those interested in colloidal materials, for it shows what a fundamental role in the development of this complex problem has been played by mineralogists, and mineralogical techniques. Here the mineralogist will meet many old friends.

Chapters 2 to 6 discuss the structures of the various groups of silicate minerals. This section should appeal to all those who desire to become acquainted with the laws governing the atomic arrangements in crystals. Chapter 7 deals with "the sizes and shapes of clay particles," and presents the results of studies by means of the electron microscope. Chapter 8 deals with "the optical properties of clay aggregates and suspension." Chapters 9 to 14 turn to the more abstruse properties of colloidal materials, Chapter 9 on "Adsorption by the Clays and Its Consequences"; and Chapter 10 on "Clay Acids and Their Titration Curves." Chapter 11 deals with "Ionic Exchange Reactions of the Clays." This is a valuable treatment of this very widely important property of clay materials. Chapter 12 is on "Electrokinetic Properties of the Clays"; Chapter 13 on "The Mechanical Properties of Clay Suspensions, Soils and Pastes"; and 14 on "The Properties of Clay Aggregates and Films."

Each chapter is followed by a well selected list of references, ranging up to about 40 entries. In this synthesis comprising many lines of work Professor Marshall has been very modest in presenting his own important contributions. The writing is clear and concise; the book is well printed on good paper, and is a credit to the author and the publisher.

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X-RAY IDENTIFICATION AND CRYSTAL STRUCTURE OF CLAY MINERALS, edited by G. W. BRINDLEY. Published by Clay Minerals Group of the Mineralogical Society, London, 1951, 345 pages. $6.00. Copies in the U.S.A. from R. E. Grim, Geology Dept., Univ. Illinois, Urbana, Illinois.

Information, within the scope of the title, on clay minerals and several related or associated mineral groups is presented in fourteen articles prepared chiefly by English authors. G. W. Brindley, who has concerned himself much with the subject within recent years, is responsible for three of these dealing with experimental methods, diffraction from randomly displaced layers, and the kaolin minerals. The last two are treated very thoroughly as a central part of the general subject. The first is necessarily abbreviated and is probably included since it could not be logically omitted. Brindley is co-author on two other articles dealing with chlorites and the interpretation of diffraction patterns. A considerable amount of original work is presented for the first time in the treatment of chlorites which closely parallel the micas in their structural disorders. The weakness of this article as well as the one by R. E. Grim, W. F. Bradley, and G. Brown on "The Mica Clay Minerals" is that adequate information is lacking on variations in chemical composition, which, of course, is outside the province of the authors.

D. M. C. MacEwan, of the Rothamsted organization, prepared an article dealing with the montmorillonite minerals and was co-author with G. Brown of "*X*-ray diffraction by structures with random interstratification." Both articles are very thorough but the latter is of particular value for its many figures showing intensities of *x*-ray scattering from various averaged combinations of silicate layers as encountered in mixed layer minerals.

More than sixty tables, many of them several pages in width, chiefly summarizing diffraction data are perhaps of greatest value since the original literature is spread so widely as to hinder ready reference. Here too, a considerable part of the data is original. There are many illustrations serving to describe the structures discussed and the points raised. The reader should not be lulled into placing too great value on the *x*-ray method for qualitative and quantitative work since neither ideal of a completely oriented nor disoriented specimen can be realized for powder diffraction work. The diffraction method fails with those finely divided materials in shales and soils that so often are mixtures of several clay minerals including mixed layer minerals. The tables of diffraction data, nevertheless, are a necessary guide.

As the reviewer and the dispassionate, I hope, originator of much that is described here I can perhaps best serve my reader by an excursion into the personal. Many obscure beauties of structural crystallography were first met in the clays to be described and seemingly lost again. The authors have found most of these and have treated them with insight not to be found in a dashed off book. I would quibble as to whether they fully appreciate the evidence for a few layer displacements in dickite, pyrophyllite, and talc; that kaolinite can be demonstrated by powder diffraction methods alone to have an ordered triclinic form; and with other points here and there, but these are minor. The subject is not closed and this summary should aid in the future development.

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EINFÜHRUNG IN DIE GESTEINSKUNDE, by H. LEITMEIER, Springer-Verlag, Vienna, 1950. viii+275 pages, 100 text figures, DM 18.50.

It has been more than 20 years since a general elementary textbook of petrology appeared in German, the last ones being the 1923 revision of Rosenbusch's *Elemente der Gesteinslehre* by Osann and Rinne's *Gesteinskunde* (1928). Leitmeier's *Einführung in die Gesteinskunde* was written to serve as an up-to-date substitute for the out-of-print *Elemente*. It was deliberately made much shorter (275 pages as against 779 pages for the 1923 edition of *Elemente der Gesteinslehre*) in part to produce a textbook that students can more readily afford and in part to appeal to a wider audience; it is intended for geographers, and all

other naturalists who are interested in knowing more of the building stones of the Earth's crust, as well as for petrologists, mineralogists, and geologists.

It is more the descriptive detail and numbers of examples that have been curtailed than the scope of the treatment. For example, there are approximately the same number of index entries (mostly rock names) in the book under review and the 1923 edition of the *Elemente,* but there are some 1550 chemical analyses of igneous rocks and minerals from igneous rocks given in the latter as against only 80 in the former.

In a general introductory section Leitmeier discusses briefly (6 pages) the methods of petrology, field methods, optical methods, and quantitative analysis (chemical and mineralogical). The second part of the introduction gives a 10 page tabular summary and discussion of the crystallographic and optical characteristics of the important groups of rock-forming minerals. Nine common accessory minerals are described briefly.

In the main part of the book 111 pages are devoted to igneous rocks, 49 pages to sedimentary rocks, and 84 pages to metamorphic rocks. Mylonites are discussed briefly in a separate section of 3 pages at the end of the text.

The section on igneous rocks leads off with a short discussion of the structure and composition of the earth. This is followed by a treatise on the formation of igneous rocks in which differentiation, assimilation, anatexis (palingenesis), and granitization are discussed. In the treatment of differentiation a very clear and concise description of the derivation and use of "Niggli-numbers" is given. Granitization is given more attention than the other topics because of the recent emphasis in the literature. Many recent books, papers and developments are cited. The author recognizes various degrees and types of granitization but describes them objectively and leaves to the reader the choice of what and how much he will accept. There is a 2 page outline of the relation of igneous rocks to orogenesis, followed by a 10 page discussion of order of crystallization and structures and textures of igneous rocks.

The classification used for igneous rocks is essentially that of Rosenbusch, but the order of treatment is different. Instead of discussing all plutonic rocks, then dike rocks, then extrusive rocks, as Rosenbusch does, Leitmeier describes together all of the rocks with the same chemical characteristics. For example, trachyte, syenite and syenitic dike rocks are treated in that order instead of being widely separated in the text. The classical order of treatment followed by most textbooks of petrology is from silica-rich to silica-poor, i.e., granite, syenite, diorite, gabbro, peridotite. Leitmeier departs from this sequence by discussing basalt and related rocks first because "basaltic" magma is supposed to be the material from which all other igneous rocks are derived directly by differentiation or indirectly by assimilation and subsequent differentiation, weathering and eventual granitization, etc. These relations are shown in detail in a diagram on page 40, modified after Cloos and Rittmann. After the section devoted to basalt, gabbro and related rocks the following groups are treated in the order listed: pyroxenite, hornblendite, periodotite, anorthosite, alkalic basic rocks, diorite, monzonite, nepheline syenite, syenite, quartz diorite, and granite, each with the equivalent hypabyssal and extrusive rocks where known.

The sections on sedimentary and metamorphic rocks follow Rosenbusch in general in classification and manner of presentation, but both sections have been brought up to date and take into account modern workers and their ideas. For example, Sander's ideas concerning development and interpretation of *s*-planes and related preferred orientation of mineral grains in rocks play an important part in the section on metamorphic rocks.

It appears to the reviewer that the author has done an excellent job of what he set out to do. The book is nicely illustrated with photomicrographs of thin sections and well chosen pictures of hand specimens and field occurrences of the various types of rocks. There are no diagrams of artificial systems and no systematic discussion of the physical chemistry of igneous rocks, but these things are hardly to be expected in an elementary

textbook of this nature. The style is pleasing and the German easy to read. The book should be very good for students in non-German countries to learn German and petrology simultaneously, as well as appealing to a wide audience among German-speaking students and scientists.

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DIE SILICATISCHEN TONMINERALE, by K. JASMUND. Monograph #60 "Angewandte Chemie" and "Chemie—Ingenieur-Technik." Published by Chemie, Bergstrasse, Weinheim, Germany, 1951. 142 pages, 40 figures and 67 tables, price 15.80 DM.

This small monograph is an excellent treatise of what is known about the silicates which make up most of the clays. The author has made a thorough search of the literature on the subject as is attested by the 298 references which even include many as late as 1950. The work is in two parts. The first deals with the following general subjects: mineralogical composition, occurrence and separation of the minerals, methods of investigation, structures of the layer silicates, syntheses of some, swelling, plasticity and viscosity, base exchange and thixotropy. The second part takes up the minerals by special groups. One hundred pages are filled with a wealth of information in which very little has been overlooked. While great stress has been put on the properties depending on structures, optical properties are also given in detail. It is highly satisfying that the author has been able to integrate the great many facts and ideas. He has succeeded in giving each investigator due credit for his contributions. In doing so he seems to avoid bringing forth ideas of his own on the subject, which is to be regretted.

Ion exchange (base exchange) is discussed in greater detail than in the usual mineralogical treatises as the author has made use of numerous references of soil chemists. Those referring to the exchange of phosphate ions were new to the reviewer. The author does not favor the new nomenclature for halloysite (endellite) and metahalloysite (halloysite), and retains the original meanings. While glauconite and vermiculite are not strictly clay minerals, they are discussed in detail. On the other hand, chlorites are only mentioned in connection with hydromicas.

Very few typographical errors were seen. On page 99 in the formula of sauconite Mg should read Zn. The arrangement and printing are a credit to the publishers. The paper stock is of fair quality. The monograph should be very useful to mineralogists and soil chemists.

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OPTICAL CRYSTALLOGRAPHY, by ERNEST E. WAHLSTROM. Second edition (1951), John Wiley and Sons, Inc., vii+247 pp.

The addition of several new three-dimensional drawings in this edition has raised even higher the standard of textbook illustration set by the first edition. This excellence alone makes the book a valuable contribution. It goes beyond the basic requirements of students of crystal optics by emphasizing several of the light surfaces which are only of historical significance and by devoting considerable space to such topics as conical refraction. On the other hand, it falls short of giving a complete and accurate presentation of optical theory.

The discussion of crossed axial dispersion in brookite and especially the addition of Fig. 4 makes the treatment of this subject less adequate than that in the first edition. A brief chapter on the universal stage added to this edition will suffice to introduce the basic concept of the utility of this instrument to the student.

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