

## BOOK REVIEWS

DAS POLARISATIONSMIKROSKOP (Eine Einführung in die mikroskopische Untersuchungsmethodik durchsichtiger kristalliner Stoffe für Mineralogen, Petrographen, Chemiker und Naturwissenschaftler im Allgemeinen) by CONRAD BURRI, Professor at the Eidgenössischen Technischen Hochschule in Zürich, Switzerland, 1950, pp. 308, 168 text figures and 4 Plates. Verlag Birkhäuser, Basel, Switzerland.

This excellent book by Burri is a worthy successor to the *Traité de Technique Minéralogique et Pétrologique* published in 1907 by Duparc and Pearce of the University of Geneva, Switzerland. However, their treatise is more detailed with emphasis on the derivation of equations and the theoretical aspects of each problem than is the recent book by Dr. Burri. This difference is natural because Duparc and Pearce were in a University, while Professor Burri teaches in an Institute of Technology which is adapted to the needs of the engineer whose primary interest is in the applications and significance of an equation rather than in its derivation; in fact, many equations important to engineers are purely empirical and set up primarily to represent data of observation.

This distinction in attitude toward the subject is important and fundamental. Burri's presentation wisely seeks to familiarize the student with the methods of direct application rather than to cover the entire field. Even with this restriction the book contains 286 pages of reading matter. His descriptions of the many useful methods are clear and show good judgment in their selection. Citations to the literature are copious and are intended to serve the serious student who may wish to enter more deeply into the theoretical aspects of a problem. In these references to the literature Professor Burri quite naturally emphasizes the contributions by Swiss and German authors and overlooks some important papers by investigators of other lands.

The book is separated into Divisions *A* to *J* respectively; each Division is in turn divided into sections. In Division *A* the fundamentals of crystal optics are discussed; section I treats of the nature of light; section II, of the optical indicatrix and its applications. Division *B* describes the polarization microscope; section I treats of image formation by use of lenses; section II, of construction details of the polarization microscope, including discussion of polarizing and analyzing devices; section III describes certain accessories; in section IV useful hints are given on work with the microscope and on its treatment; in section V methods for preparing materials for examination under the microscope are described. Division *C* considers investigations in natural light. Division *D* on orthoscopic methods includes section I on interference phenomena (theoretical) and section II on practical applications; section III is on the measurement of path differences, section IV, on extinction angles, and section V, on optically active crystals. In Division *E* the phenomena of absorbing crystals (pleochroism) and methods for the exact measurement of the absorption of transmitted light are described. Division *F* is on conoscopic methods; in section II the technique of conoscopic observations are considered; in section III the characteristics of interference figures are discussed at length; in section IV the dispersion of biaxial crystals is analyzed; in section V conoscopic measurements are treated in detail while in section VI the conoscopic relations of optically active crystals are discussed. In Division *G* methods are discussed for the determination of refringence by means of the Becke line and of the Schroeder van der Kolk phenomenon for comparing the refractive index of a crystal with that of an immersion liquid; section II is on the application of the immersion method to isotropic and to anisotropic crystals and crystal sections. In Division *H* on the Fedorow and later methods based on the use of the universal stage: section I presents a general statement on the usefulness of these methods and on the factors which affect the degree of accuracy of the results obtained therewith. In section II practical applications of the method

are described; in section III special methods for use with the universal stage are included; section IV contains descriptions of conoscopic methods which may yield good results with the stage. In Division *J* the computation of extinction angles for random section and zones of biaxial crystals is sketched. Illustrative cases, such as the series of plagioclase feldspars, of olivines, and of orthorhombic augites, are described for which data on extinction angles are useful.

The book is remarkably free from typographical errors; the text figures are well drawn and easily legible and the half tone illustrations are well reproduced. On page 67 an error appears in the demonstration that, in a uniaxial crystal, the direction of the extraordinary ray  $OS$  for a wave whose normal  $ON$  is given, can be represented by the reciprocal of  $p_1 Q_1$ , in which  $O p_1$  and  $OS$  are conjugate diameters, and that therefore the point  $Q_1$  may be considered to represent the direction of the ray  $OS$ , its plane of vibration, and its velocity. This conclusion was clearly stated by Fletcher in his pamphlet on the Optical Indicatrix published in 1892.

The book is so clearly and competently written and so well illustrated that it will interest and help students of the polarization microscope and of the methods of its application to problems in a wide variety of fields.

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THE NININGER COLLECTION OF METEORITES, H. H. NININGER AND ADDIE D. NININGER.

The Nininger Collection of Meteorites, by H. H. Nininger and Addie D. Nininger, published by the American Museum of Winslow, Arizona, in 1950, is a bound book of 144 pages and 38 plates. This is not only a catalog of meteorites, it contains a brief account of the methods the authors followed in making this collection. These meteorites were acquired the hard way, through fieldwork, lectures and writing countless letters, and does not represent the work of individuals who have had the prestige of a well-known institution with its resources behind them. To fully appreciate this, this book and the accomplishments it represents, one needs to have had similar experience and to have known the authors.

This collection of 587 different meteorites contains 133 that are unstudied. It includes the main masses of 140 different meteorites. In most collections there are small specimens that actually have no value other than to increase the total number of meteorites represented. This collection has some of these, about 50 of the 587 meteorites are represented by specimens of less than five grams. Percentagewise this is about 9 per cent. To appraise this, the reader should compare the Nininger Catalog with the Ward-Coonley Catalog, published in 1904. This privately owned collection consisted of 603 different meteorites, but contained 112 meteorites of less than five grams, or about 18 per cent.

The Nininger Catalog lists the essential information expected of such publications, but a general overall appraisal indicates it was hurriedly prepared and without the advantage of critical suggestions from others. These authors, could and should, have given some important information in the section "Field Notes." The bulk of these comments are uninteresting and of questionable value. When this work is reviewed in the light of the years of the authors' field activities, it seems unfortunate they did not take the opportunity to give some more important data.

Many very fine cuts are included but some of the meteorites illustrated are so small they add nothing of value to the catalog. Several photographs seem to have little bearing on the subject. If it is the aim of a reviewer to find mistakes, an opportunity is presented: the Bennett County, South Dakota, iron is listed as a coarse octahedrite, while Plate 12

shows it is a hexahédrite; Albin, Wyoming, is listed as a stone, it is a pallasite, but the listing of errors is not the sole aim of this reviewer.

This catalog will be useful to everyone interested in meteorites and even though some of the material in the sections Introduction and Field Notes are of questionable value, this reviewer recommends this volume.

E. P. HENDERSON,  
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BULLETIN 156, MINERAL COMMODITIES OF CALIFORNIA, with accompanying map. Published in 1950 by the California State Division of Mines, Ferry Building, San Francisco, California. Price \$2.00; cloth-bound, 443 pages.

Without so planning, Bulletin 156 serves as a closing salute to the termination of California's Centennial celebration. It records a significant era in the mineral development of the State, and is most timely in appearance, as this is a period of marked industrial expansion, accompanied by an increasing demand for various minerals essential to national defense. The publication presents the geological occurrence, economic development, and utilization of California's mineral resources and provides, in a single volume, information and data especially prepared by a large number of staff members of the Division of Mines. The book is especially well documented with reference data, contains a detailed index, and is a reliable source reference that has definite appeal to mineralogists, geologists, mining and technical engineers, economists, and to the staff members of industrial and manufacturing firms.

Recognizing the fact that California geology is constantly being amplified by field study and research, the discovery and development of new mineral deposits is frequently an economic resultant thereof. The opening chapter discusses the natural environment and the geological aspects that affect the occurrence of California's mineral resources. It is an excellent summary of California geology from an economic aspect, and it likewise presents in some detail an outline of the State's geomorphic provinces, and illustrates the wide diversity of both geologic structure and mineral occurrence within the State. An excellent large-size insert map of California accompanies this chapter, indicating in various colors the distribution of mineral deposits, with a smaller map showing the geology and major rock units, together with the larger fault lines, particularly the San Andreas and the Garlock.

Subsequent chapters present a summary of mineral production, followed by detailed descriptions of the various mineral occurrences. These discussions are quite comprehensive, embracing generally the historical background, geological setting, production, and economic utilization. Much extremely useful and interesting information is afforded; for example, in the description of lignite coal the fact is disclosed that the United States is now self-sufficient in a new raw material, namely Montan wax, formerly imported from Germany, but now recovered in a plant processing the Ione lignite beds. A further item of interest to the reviewer appears under the heading of platinum, it being recorded that blister copper from the Iron Mountain smelter has carried some platinum. Such occurrence affords an interesting geological implication, as thus far all California platinum mining has been confined to placer deposits. The section upon silver discusses the famous old Calico district, the rich ores being principally cerargyrite with some embolite occurring as near-surface or epithermal deposits. Likewise described under the caption of Tungsten are the Atolia scheelite occurrences, the steeply-dipping fissure veins containing high-grade scheelite, from which the erosional products created the noted scheelite placer deposit named the "Spud Patch."

The foregoing in no degree exhausts the wealth of information, but rather, in the terms of the miner, be regarded as a grab sample. The bulletin is so fundamentally important that it should not be overlooked by those interested in any degree in California mineralogy and

geology, and by those who either utilize or are searching for natural mineral products to meet their commercial needs. A final word as to the term mineral commodities as included in the title, such expression being employed by the writers to define, without specific restriction, the useful constituents of the earth as are found within the State. This includes mineral fuels, industrial minerals, metals, quartz crystals, and virtually all else that is so vital to our economic and social life.

An important concluding section is a listing of mineral producers, dealers, and commercial laboratories. An exceptionally fine series of photographs accompany the text, which is further supplemented by a series of economic graphs, from which future trends might be predicted. Bulletin 156 will long serve as a reliable reference for California minerals, which, at the close of a century, are still being discovered.

J. B. NICHOLS,  
*Sacramento, California.*

CONSERVATION OF NATURAL RESOURCES, edited by GUY-HAROLD SMITH. Published by John Wiley and Sons, Inc., New York, 1950, 552 pp., \$6.00.

This is a noteworthy symposium on problems and methods of conserving our national resources—public land, soil, forests and treecrops, grass, water, waterways and waterpower, wildlife and fish, minerals and mineral fuels, recreational facilities and manpower. There are 20 different contributors for the 23 chapters, including the editor, Guy-Harold Smith, of Ohio State University, who also presents a short preface. In the introductory chapter, The development of conservation in America, by Alfred J. Wright, also of Ohio State University, laudatory tribute is paid to, among others, C. R. Van Hise for his 1910 book, *The Conservation of Natural Resources in the United States*, which had an outstanding influence on the early conservation movement. Other well known geologic figures mentioned as having contributed importantly to the growth of conservation efforts are Major J. W. Powell, N. S. Shaler and Herbert Hoover.

Of interest to students of the earth sciences group are chapter 3 on soil groups, by L. A. Wolfgang of Michigan State College; chapter 4 on soil conservation by W. A. Rockie of the Soil Conservation Service; chapter 12 on water supply by J. H. Garland of Illinois University; chapter 16 on mineral conservation by the late W. M. Meyers of Pennsylvania State College; and chapter 17 on the mineral fuels by E. W. Miller, also of Pennsylvania State College.

The chapter on mineral conservation sketches the history of the mineral industries and discusses the nature of mineral resources and the factors influencing their estimation. Some recent estimates of United States mineral reserves are summarized. Possibilities for reduction of waste in extraction, in processing and in use, recovery of secondary minerals and use of substitutes also are explored. The chapter concludes with a section on national and international mineral policies.

The chapter on mineral fuels opens with a comparison of the relative importance of energy sources between 1800 and 1946. Coal is discussed under origin, rank, reserves, districts, production, uses and its conservation in mining, processing, consumption and conversion to heat energy. Next follows a review of the nature, occurrence, products, distribution and reserves of petroleum. Petroleum conservation hinges on developments in each of the industry's technical branches—exploration, drilling, production and refining. Natural gas and atomic energy also receive short sections in this chapter.

For a panoramic survey of conservation, its problems and practice, this work deserves recommendation even to those whose chief interests brush only lightly the more specialized aspects of this field.

E. WM. HEINRICH,  
*University of Michigan.*

GEOCHEMISTRY by KALERVO RANKAMA and TH. G. SAHAMA. 912 pages, 54 figures, 211 tables. University of Chicago Press, 1950. \$15.00.

The first major book in any particular field must generally bear sharper scrutiny than its successors, and often can be expected to undergo more careful criticism. *Geochemistry*, by Rankama and Sahama, attempts in its own words "... to survey the broad field of geochemistry and to account for the present stage of geochemical knowledge. . . ." If, throughout the course of his examination, the reader continues to recall that the authors intend the volume "... neither to serve as a textbook of geochemistry nor to give a complete account of all geochemical information," then he may well consider that the work achieves unqualified success in hitting its somewhat shotgun target.

The book may be considered to consist of five main sections: An introductory section; Part I. General Geochemistry; Part II. Manner of Occurrence of the Elements; seven appendixes; and a bibliography containing 735 entries. In their introductory remarks the authors attempt to define geochemistry and choose to follow the example of Goldschmidt who set the geochemical goals of not only establishing the terrestrial abundance relationships and distribution of elements but also of defining the laws governing these two factors. Thus the writers justify their complete omission of any petrological phase diagrams by inferring that the goal of the geochemist lies beyond, in the more fundamental task of delineating "... the properties of the elements or of their ions which are responsible for the enrichment phenomena observed." In this introductory part there is also a brief but interesting historical outline of geochemical study.

In Part I, which consists of 406 pages, are found chapters on meteorites; abundance of elements; terrestrial geochemical structure; distribution of elements among the geochemical subdivisions of the earth; a chapter each on the geochemistry of the lithosphere, hydrosphere, atmosphere, and biosphere; a comparison of geochemistry with cosmochemistry; and a chemical history of the earth. Chapter 5, the largest chapter of 170 pages, describes the geochemistry of the lithosphere and is the backbone of the book. Topics considered in this chapter are crystal chemistry, composition and chemical differentiation of magmas, formation of sediments and the exogenic cycle, and metamorphism.

Part II contains 36 short chapters, each describing an element or group of elements in terms of its manner of occurrence, its geochemical character, its minerals, its behaviour during magmatic differentiation and in the exogenic cycle, and its abundance. The appendixes are (1) the periodic system, (2) atomic weights (1948), (3) atomic and ionic radii, (4) electronic structure of elements, (5) geodetic and terrestrial data, (6) gravimetric conversion factors, and (7) ways of expressing concentration.

The overall plan and organization of the book are excellent, and particularly useful are the many tables and diagrams into which much critically evaluated material has been compressed. The type style is large and easy to read, and the literary style is clear and generally concise. Relatively few typographical errors were observed; e.g., p. 181 chrysober for chrysoberyl, p. 734 kylindrite for cylindrite, and Daly is listed in the bibliography under both Reginald Aldworth and Reginald A.

Some of the general defects of the work have already received comment by other reviewers: namely, the rather haphazard organization of the subject index and the lack of many important references not in English, French, or German. Papers in languages beyond these three may not be "... addressed to the international reader," but a survey worthy of its name cannot afford to disregard them. The writers follow what appears to be a widespread continental fondness for specialized and superfluous nomenclature, not only in general terms such as diadochic, reuzates, sedimentogenic, agpaite, resistates, and magmagenic for which better known terms are in more widespread use, but also in mineralogical names under which appear such obscurities as oyamalite, mallardite, asbolan, nagatalite, manganomelane, and szmikite. In spite of a continuing emphasis on the quantitative distribution of elements, the authors allow themselves to become preoccupied with the enumeration of minutiae of their occurrence, often listing very rare species of hardly quali-

tative significance, whereas others of greater geochemical importance receive no mention, e.g., ludwigite under the boron minerals and the occurrence of V in aegirine.

The pegmatites and veins deserve less cavalier handling. No mention is made of the large body of information on pegmatite structures, which are of considerable value in deciphering the relations of the magmatic and hydrothermal stages in differentiation. The treatment of ore deposits includes assumptions of many minerals as pneumatolytic and omits any mention of the works of Lindgren, Emmons, or Graton on ore fluids, zoning, or classification of ore deposits. This section is regrettably provincial in emphasizing its European viewpoint. The discussion of diagenesis is elementary. On the other hand, the section on granitization, although favorable, is notably restrained in its treatment.

Occasionally a statement of obscure phraseology or dubious validity crops up, as on p. 342, "There is conclusive evidence that living bacteria may occur and be active in certain sediments and sedimentary rocks of considerable geological age, as high as Permian." Again on p. 462 one reads ". . . minerals of the garnet group are not found in igneous rocks with the exception of the pyrope-rich garnet of the eclogites." This assumes that all eclogites are igneous rocks, a doubtful case, and ignores melanite in feldspathoidal syenites, pyrope in peridotites, and spessartite in pegmatites. Moreover the statement is contradicted on p. 644 by the puzzler, "Spessartite occurs in aplitic granite pegmatites."

The number of these minor criticisms in no way detracts from the broad value of the work as a summary of geochemical processes and data. The book is characterized by an extraordinary usefulness that cannot be diminished by minor defects in its usability. It is an essential volume for all geologists and mineralogists who can afford it.

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#### INTRODUCTION TO THEORETICAL IGNEOUS PETROLOGY by ERNEST E.

WAHLSTROM. John Wiley and Sons, Inc. New York. 1950. 365 pp., 138 figures, 31 tables. Price \$6.00.

This, the third of the recent books by Ernest E. Wahlstrom (*Optical Crystallography and Igneous Minerals and Rocks*), probably is the best of the group and is a worthwhile addition to the growing group of modern petrological textbooks. For it is a textbook, making no claim toward presentation of new data or original hypotheses. It is, however, a concise, well balanced and equitable digest of current viewpoints on magmas and their descendants.

The book is divided into two parts. Part I (102 pp.) includes four chapters: (1) Introduction, (2) Heterogeneous Equilibrium and the Phase Rule, (3) Equilibrium in Silicate Systems, and (4) Igneous Minerals. Chapters 2 and 3 form an excellent introduction for the beginning student to the comprehension of the phase rule and multiple component systems as related to igneous petrology. Chapter 4 presents brief and somewhat abrupt statements on the origins and petrogenetic significance of the plagioclases, potash-soda feldspars including perthites, feldspathoids, silica minerals, pyroxenes, amphiboles, olivines and micas.

In Part II are found the following chapters: (5) The Crust and Interior of the Earth, (6) Magmas—Source and Nature, (7) The Ascent and Emplacement of Magmas, (8) Crystallization of Magmas, (9) Igneous Differentiation, (10) Assimilation and Syntexis, (11) Granitization, (12) Late Magmatic and Postmagmatic Processes, (13) Origin of Rock Types, and (14) Classification of Igneous Rocks. The work concludes with an appendix, Physical-Chemical Concepts Useful to Petrologists, which is a poor man's short course in physical chemistry, and finds place in the book because the author believes that ". . . most American students of geology and mineralogy never advance beyond the introductory levels in mathematics, chemistry, and physics . . ." a doleful observation, whether fact or opinion.

The arrangement of the book presents some irregularities in the over-all concept. Chap-

ter 12 on deuteric and post magmatic processes could best follow as a consequence of igneous differentiation (Chapter 9). The final chapter on igneous rock classification is a dull millstone of questionable usefulness to the book and concludes with a puzzling section on the metamorphic facies concept. In Chapter 8, Crystallization of Magmas, the significance of many of the phase diagrams, whose mechanics are explained in detail in Chapter 3, might well have been employed.

In the introduction the author implies that magma and lava are identical or synonymous. It is regrettable that he does not list among the references at the end of the chapter on silicate systems the useful compendium by Hall and Insley (*Jour. Amer. Ceram. Soc.*, **16**(10), 1933).

One is impressed throughout the book by the valiant attempt to present the several sides to controversial subjects, yet this effort has, in some instances, led to noncritical summaries and will result in some confusion in the minds of average beginners who thus cannot distinguish among old historical chestnuts, untried neophytic notions, and tested concepts with sound factual and theoretical bases. An evaluation as critical as the coverage is complete would increase the value of the book.

The line drawings are well chosen and excellent throughout. The photographs vary in quality. Some are very good (Fig. 10, Chap. 12; Fig. 2, Chap. 4); others are poor (Fig. 1, Chap. 4; Fig. 3B and C, Chap. 11). None is worthy of being repeated: Fig. 5, Chap. 4 and Fig. 11, Chap. 12 are identical. The index is sufficiently complete.

The book fulfills its title adequately, for it will undoubtedly serve ably to introduce a multitude of geological students to the elements of petrogenetic theory. As such it belongs on the bookshelves of all teachers of petrology and recommends itself as a more than useful textbook in this field:

E. WM. HEINRICH,  
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## ANNUAL MEETING

The thirty-second annual meeting of the Mineralogical Society of America will be held in Detroit, Michigan, on November 8-10, 1951, with headquarters at the Hotel Statler.

Abstracts of papers to be presented at the annual meeting must be received by the Secretary on or before *July 16, 1951*. Abstract blanks may be obtained from the Secretary.

C. S. HURLBUT, JR., *Secretary*

The spring meeting of the Society for Experimental Stress Analysis will be held at The National Bureau of Standards and The Wardman Park Hotel, Washington, D. C., May 16, 17, 18, 1951. All inquiries should be addressed to Dr. Edward Wenk, Jr., c/o The David Taylor Model Basin, Washington 7, D. C.

The 14th meeting of the Meteoritical Society will be held with the Pacific Division of the American Association for the Advancement of Science on Monday, Tuesday and Wednesday, June 18-20, 1951, at the University of Southern California. Titles and abstracts of papers to be presented at the meeting should be sent to John A. Russell, Secretary, Department of Astronomy, University of Southern California, Los Angeles 7, California.

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