BOOK REVIEWS

PHYSICAL PROPERTIES OF DIAMOND. Edited by R. BERMAN. Oxford University Press, New York, New York, 1965. $12.00. 443+xii pages.

Physical Properties of Diamond, edited by R. Berman of Oxford University, is a most attractively presented series of review papers by highly qualified specialists, all of whom have made major contributions to an understanding of the nature of what would seem should be one of the simplest of minerals, diamond.

Fifteen chapters cover many properties of diamond. The coverage reflects strongly the fruits of the recent extensive research which has been stimulated by the interests and material encouragement of the late Sir Ernest Oppenheimer, and at present by his son, H. F. Oppenheimer, and Industrial Distributors (1946) Ltd. Many fine illustrations are incorporated with the text. Twelve pages of selected bibliography are included.

The results of x-ray diffraction studies of natural and synthetic diamond are given. The effects of irradiation are considered. Special methods of study, x-ray topography, electron microscopy, and surface-feature examination are well covered. Paramagnetic resonance, optical absorption and fluorescence, and thermal properties are the subjects of other chapters.

A rather speculative consideration of the origin of meteoritic diamonds by shock synthesis is given. No space is devoted to the origin of terrestrial diamonds. The thermal properties of diamond that are related to the diamond-graphite transition are well covered. The remarkable thermal conductivity of diamond is discussed from the experimental point of view. The fact that a type IIa diamond has been found to have a thermal conductivity at room temperature five times that of copper will no doubt surprise some readers.

As is inevitable in a work of this sort, there are some duplication, some unevenness of treatment, and some things omitted which the reviewer would like to have seen included; *i.e.*, index of refraction and dispersion as well as the stress-optical behavior and the elastic properties of diamond. Nonetheless, the book is very well done, and it will no doubt become a standard and oft-quoted reference. It is a "must" for all persons doing research—applied or basic—on diamond and related substances.

The reviewer hopes that as new material on the subject of diamond research becomes available, either revised editions of the present work or supplementary volumes, will be published.

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QUANTITATIVE ELECTRON MICROPROBE ANALYSIS, by ROGER THEISEN. Springer-Verlag New York Inc. 1965. 174 pp., 7 figs.; $6.00.

This book is a welcome addition to the rapidly expanding field of electron microprobe analysis. Its chief value is that it brings together in one small volume (174 pages) some of the latest computed data which is necessary for making corrections in this type of analysis.

The book is divided into two parts. The first deals with 1) general features of electron probe microanalysis, 2) fundamentals of quantitative electron microprobe analysis, 3) procedures for correction calculation and 4) detection limit, detection threshold and microprobe trace analysis. The section, as the author points out, is designed "for the more directly interested critical reader." In this section, the various formulae used for corrections of electron penetration, primary x-ray emission efficiency, mass absorption and backscattered electrons are derived, and the terms explained. Alternate methods for making these

corrections are discussed. The number of spelling errors in this section unfortunately are too numerous to be attributed solely to errors in typing.

The author could have made this section more easily comprehensible to the average microprobe user who is more interested in applying the correction procedures to obtain quantitative data than in deriving formulae by giving an actual example of the application of the correction formula and use of the tables rather than describing, without example, how it is done. However, the correction method does work and does give good results even for multicomponent systems such as minerals. The chief weakness in this portion of the book as far as mineralogists are concerned, is the inadequate treatment of fluorescence corrections. The author advises that these corrections either be made by previously described methods which he does not discuss but does reference, or be avoided by making thin films of the materials and the standards being analyzed. Previously described methods were designed for two component alloys and not complex minerals and the making of thin films is not feasible for most minerals. Thus the mineralogist still does not have an adequate means of making fluorescence corrections on a complex mineral in which more than one element may be causing fluorescence and more than one element may be fluorescing.

The second part of the book consists of the following tables A) Characteristic Wavelength and Excitation Potentials for K, L, M Series, B) Determination of Effective Leonard Coefficients, C) Table of Electron Penetration Factor, D) *X*-ray Mass Absorption Coefficients, E) Variation of Effective Electron Current (backscattering factor) and F) Determination of the Efficiency Function $1/f(\chi)$. The table of mass absorption coefficients is particularly useful because the values given are probably the first ones to be tabulated which incorporate values obtained from microprobe determinations.

The tables are useful only for elements with atomic number 11-92 (Na—U) and the fact that they do not extend down to include elements with atomic number 4-10 is unfortunate because it is just at this time that microprobe analysis of these elements has become a reality. Ignoring the errors in the headings of the first two columns of Table B on Leonard coefficients which should read $V-V_C$ and $(V-V_C)^2$, both this table and Table F (Determination of the Efficiency Function $1/f(\chi)$) would have been more useful if it were not necessary to interpolate for values greater than $V-V_C=20$. Except for the deficiencies listed above, these tables comprise the most valuable part of the book.

The book should be of great interest and help to those who do have to concern themselves with fluorescence corrections or analysis of elements lighter than Na. The price, the compact size, and the well presented tables should earn this book a place in the library of all microprobe laboratories.

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THE EFFECTS OF ULTRASOUND ON THE KINETICS OF CRYSTALLIZATION. A. P. KAPUSTIN. Authorized translation from the Russian. Consultants Bureau Enterprises, Inc., New York, 1963. $12.50. 65 pages. Paper bound.

One of the important research methods in recent years involves the use of ultrasonics during crystallization. Ultrasonics has become quite extensively used in many branches of science and technology. Studies in physics, crystallography, and chemistry, particularly, have provided means of discovering new effects. Crystal growth is a very important technical problem in many fields, on account of the increasing uses of crystals; studies on nucleation, growth, and dissolution, especially as regards the effects on various agents on the kinetics of the phase transition, are thus of considerable importance. One such agent is ultrasound. The importance of ultrasound in recent scientific experiments involving controlled crystallization and dissolution is presented in the introduction.

The text consists of five chapters, each an essential aspect of the effects of ultrasound on the kinetics of crystallization. In Chapter I, the methods and apparatus for studying crystallization and dissolution in ultrasonic fields are explained with two photographs and four drawings to show the details of the design of the apparatus used. The second chapter gives a review of the work on the interaction of ultrasonic energy with crystallizing or dissolving material. Most of the results presented were obtained at the Institute of Crystallography in Moscow prior to tbe original publication of this work in Russian in 1962. Zinc and lead are two of the materials used in the experimentation. Among the illustrations in the chapter are photomicrographs showing the structure of these metals, unirradiated and irradiated, which are useful additions to the text. Ultrasound affects solids as well as solutions and melts. Tests were done with transparent crystals which were observed in polarized light while exposed to the ultrasound. The experimentation on single crystals is described briefly.

Chapter III on "Crystallization Processes of Organic Compounds" is a longer chapter, including a discussion of thin films, crystallization in bulk material, structure of castings and mechanical properties, and the effects of ultrasonic frequency on crystallization. The last three sections of the chapter mention briefly crystallization of eutectic mixtures, production of zoned structures, and effects of vibration on the walls of the vessel. Chapter IV consists of two pages devoted to the effects of various agents on nucleation in an ultrasonic field.

A more detailed description of the results of ultrasonic experimentation is found in the last sixteen pages of the text. The author discusses, with ample illustrations, the growth and dissolution of single crystals, particularly alum and zinc. He shows that ultrasonic vibration can be used to stimulate the production of etch pits which reveal the distribution of dislocations.

As is often the case with translations, the reading is not so smooth as one should like nor is the organization quite so compact as when a work is read in the original language in which it was composed. Nevertheless, this translation of Kapustin's study of the effects of ultrasound, one of the newer research methods, is an important reference to any one concerned with crystal growth.

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STRUCTURAL AND TECTONIC PRINCIPLES. Peter C. Badgley, xvii+521 p., 439 figs., 16 tables, Harper & Row, New York, 1965. $13.95.

A much-needed addition to the literature in structural geology, this book ranges in content from definitions of basic structural terms (concordant pluton, embayment, footwall, plunge, etc.) to a synthesis of mountain building and world-wide orogeny. This spread in treatment of subject matter is effectively integrated and well developed. Emphasis on definitions and terminology is considerably less than in the majority of basic structural texts,—an asset in this reviewer's opinion. Extra flavor is added by the author's willingness to discuss controversial subjects such as polar wandering, continental drift, and the like, for which the final verdicts have not been cast.

Structural and Tectonic Principles is an attractive book with a large (7″×10″) page size and abundant illustrations. The numerous sharp photographs and well chosen maps, cross sections, and line drawings are an important addition. Illustrations are well referenced, although this reviewer found the especially bold type of the citation volume numbers distracting, particularly because the printer was inconsistent in its use.

Following a brief introduction (Chapter 1), the subject is first examined from a mechanics standpoint (Chapter 2). This section contains reasonably complete treatments of the modes of rock failure, mechanics of deformation, and the behavior ot rock materials under controlled experimentation. Discussion of the Mohr envelope is marred by poor editing:

equation (1) on page 23 is incorrect and should read $\sigma_1 \, ds \cos \alpha - \sigma \, ds \cos \alpha - \tau \, ds \sin \alpha = 0$; W is omitted from Fig. 2–21 which may perplex the reader of page 25 where repeated reference to angles including point W is made. Fortunately, the book is relatively free from errors despite the examples cited here.

Chapters 3 through 9 treat fundamental topics of structural geology—folds, joints, faults (3 chapters), metamorphic structures, and igneous tectonics. Each topic begins with basic definitions and then the reader is led through a discussion of classifications (descriptive and genetic) to a treatment of well-referenced field examples. Up-to-date literature is cited in the analysis of the mechanics involved. Discussions are enhanced by relating the structures to the exploration and development of natural resources—an aspect too often overlooked and one in which Badgley is especially capable.

The last two chapters (125 pp.) are an analysis of structures on a world-wide scale, as indicated by their titles: "Factual Data Bearing on World-Wide Orogeny" and "Tectonic Patterns and Tectonic Classification." Arm-waving is here at a minimum and the author should be praised for his succinct appraisal of the vast amount of pertinent literature.

In this prodigious work, Badgley has demonstrated familiarity with a wide spectrum of geologic literature and has utilized this knowledge effectively. Carefully selected literature citations are abundant with a bibliography compiled at the end of each chapter. In addition the book contains a table of contents with helpful subheadings and indexes to both authors and subjects. Unfortunately, the subject index is highly selective and inconsistent, and the resulting incompleteness will be an inconvenience to many readers. For example "conical fold," "cap range," "marginal triple faults," and "micelles" are alphabetically listed as is "fault" with 15 subtitles; in contrast the terms "fold," "Mohr circle," "orogeny," "pluton," "syncline," and "tectonics" are not included.

The wealth of information and the excellent organization of the material far outweigh the book's relatively minor deficiencies. Badgley can be proud of a product which will find much use as an advanced undergraduate- and graduate-level textbook as well as a resource book that will be of value to a wide spectrum of geologists.

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PRINCIPLES OF STRUCTURAL GLACIOLOGY, by P. A. SHUMSKII, translated by David Kraus, Dover, N. Y. 497 pp. 124 fig. $3.00.

To those who believe that *glaciology* refers only to the study of glaciers, *Principles of Structural Glaciology* will be a revelation. The author, a noted Russian geologist, explains his understanding of the term glaciology on page two of David Kraus' translation: ". . . *glaciology is the science of natural ice in all its diversity.*" On page four he explains structural glaciology as " . . . primarily the *petrology of ice*, i.e., *the science of ice rocks and the laws of their formation.*" What follows in some 400 pages of text is a well organized treatise that leads to a genetic classification of ice types and a discourse on the geographical zonation of the ice forming processes.

In part I of his treatise on the Mineralogy and Crystallography of Ice, Shumskii presents five chapters that deal with various aspects of single ice crystals. They include a description of the minerals of the ice group, the structure and symmetry of ordinary ice crystals, basic physical properties of ordinary ice, ice crystal nucleation, and the growth and form of ice crystals.

Part II is entitled The Petrology of Ice and first directs attention to general questions of ice petrology in three chapters: ice as a rock formation, impurities in ice, and methods of petrographic ice study. Mineralogists and petrographers will find many familiar techniques that have been adapted to the study of ice masses. The remaining three sections of part II

deal with the three categories of ice: congelation ice, sedimentary ice, and metamorphic ice. The appendix to part II, the genetic classification of ice rocks, is a particularly useful section because it brings together in a single table the many diverse types of ice masses. The three basic groups of ice rocks, congelation ice (analogues of igneous rocks), sedimentary ice (snow), and metamorphic ice (glacier ice) are subdivided into ten subgroups containing twenty-eight distinctive types of ice rock. For each of these the table contains a brief statement of the processes and physical conditions of formation, mode of occurrence, texture and structure, predominant orientation of the main crystallographic axes, composition, and characteristic air inclusions.

Part III of this book is entitled The Geography of Ice and deals with the geographic distribution of ice rocks on the earth's surface. The term *cryosphere* as introduced by Dobrowolski[1] (1923, p. 11) is further elaborated upon by Shumskii. The cryosphere is an earth envelope bounded above by the high temperature zone of the upper stratosphere and ionosphere and below by the high temperature zone of the earth's crust. It contains part of the earth's surface, a fairly thick layer of the earth's crust, and the lower part of the atmosphere. The cryosphere thus ranges in thickness from 8–12 km. Schematic latitudinal and meridional cross sections of the cryosphere are given in Figures 123 and 124 in order to show the influence of continental, oceanic, and latitudinal effects on its thickness.

The extensive bibliography contains 400 references which include papers in the Russian, German, French, English, and Polish languages. The wealth of material drawn on by Shumskii is not only a tribute to his knowledge of the literature but also reveals that a fairly sizable literature on this subject was already extant prior to the International Geophysical Year of 1957–58. Only a handful of the references in Shumskii's bibliography postdate the year 1950.

David Kraus has done an excellent job in his translation and Dover did a commendable job in reproducing the halftones presumably made by photographing the figures in the original Russian book. In some cases the Dover halftones are better than the ones in the original Russian, due possibly to the higher grade of paper used in the Dover publication. In the original, figures 37 and 38 are colored reproductions of microphotographs under crossed polars, whereas in the Kraus translation the same figures appear as black and white halftones. Line drawings from the original have been altered with English language equivalents of Russian words, a commendable practice that is not always followed by other translators.

Although this book appeals mainly to students of glaciers and workers in permafrost, it also provides a basic reference book for mineralogists and petrologists who would like to know more about one of earth's most ubiquitous minerals and monominerallic rocks, ice.

[1] Dobrowolski, A. B. (1923) *Historja naturalna lodu* (Natural history of ice), Warsaw, 940 pp.

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ANALYSIS INSTRUMENTATION—1963. Edited by L. J. FOWLER, R. D. EANES, AND T. J. KEHOE. Plenum Press, New York, 1963. 261 pages. $12.50.

The significant technical papers presented at the Ninth Annual Analysis Instrumentation Division Symposium of the Instrument Society of America are printed in the attractive lithoprinted volume under review.

The keynote session consists of four papers on the present status of analysis instrumentation from the points of view of the manufacturer, of the user, of the user-developer, and of the manufacturer involved in foreign operations. The topics of discussion in other

sessions are on the dynamics of analysis instruments, problems of analyzer applications, laboratory instrumentation, electrochemical and chemical methods, and radiation methods of analysis. Some thirty papers, presented at the Analysis Instrumentation Symposium, are included in the published proceedings.

It is interesting to note that the types of instrumentation analysis considered are extremely diverse in application. For example, there are general considerations of dynamic process control and monitoring instruments, gas chromatographs, polarigraphs, and infrared gas analyzers. Two papers may be of interest to persons working in the field of "earth and planetary sciences," namely, "The Lunar Gas Chromatograph" by Wilhite and Burnell, and "Neutron Methods for Lunar and Planetary Compositional Studies" by Trombka and Metzger.

The drawings, charts, graphs, and photographs add appreciably to the interest and understanding of the reader. It would seem to the reviewer that the book should be of value to persons concerned with industrial instrumentation design. Selected papers will be useful references to persons concerned with specific instrumentation problems.

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SHORT REVIEWS

CATALOG OF THE COLLECTION OF METEORITES IN CHICAGO NATURAL HISTORY MUSEUM, by Henry Horback and Edward J. Olson: Fieldeana: Geology 15, (3), pp. 175–319, 1965 Chicago Natural History Museum. $3.00, paperbound.

ADVANCES IN EARTH SCIENCE. Contributions to the International Conference on the Earth Sciences, M.I.T., Sept. 1964. Ed. by P. M. Hurley. The M.I.T. Press, 50 Ames St., Cambridge, Mass. 502 pp., 1966. $20.00. In five parts: 1. The Earth's Environment; 2. Atmospheric motions; 3. Dynamics of the Oceans; 4. The Solid Earth I· 5. The Solid Earth II, each with from three to four papers by different authors (a total of 16 papers in all). Of particular interest to mineralogists—petrologists are: "The chemical composition and origin of the earth and mineralogy of the mantle by A. E. Ringwood; Geochronology, and isotopic data bearing on development of the continental crust by G. J. Wasserburg; and Thermal structure of the upper mantle and convection by W. M. Elsasser.

PHYSICS AND CHEMISTRY OF THE EARTH, Vol. VI. Editors: L. H. Ahrens, Frank Press, S. K. Runcorn, H. C. Urey. Pergamon Press Inc. 44-01, 21st St., Long Island City, N. Y. 510 pp., 1965. $20.00. Seven papers and author and subject indexes. The first three contributions are of interest to petrologists: 1. Recent evidence concerning the structure and composition of the earth's mantle by D. L. Anderson; 2. The application of trace element data to problems in petrology by S. R. Taylor; 3. Factors in the distribution of the trace elements during the crystallization of magmas by L. V. Tauson.

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