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BOOK REVIEWS

GEMS MADE BY MAN. By Kurt Nassau. Chilton Book Company, Radnor, Pennsylvania. xviii + 364 pages, 34 color and 214 other illustrations, 38 tables. $28.50.

This is by far the most important survey of the science and art of growing synthetic gem materials yet to appear. It happily combines careful choice of information with a writing style that makes the text readily understandable and interesting even to those without much background in mineralogy or the scientific aspects of crystal growing. Especially valuable are its historical introductions to many chapters which provide perspective and lay the basis for the appreciation of modern technological achievements. It is well and pertinently illustrated by photographs, drawings, charts and diagrams, and its statements are supported by sources from the literature given at the end of each chapter.

The first section of two chapters discusses the beginnings of mineral gemstone synthesis, especially under the stimulus of possible profit in their sale, with remarks on how such synthetics were marketed and the development of improved gem-testing techniques made necessary by their appearance. The second section begins with Verneuil's classic experiments which ultimately resulted in a successful and economically feasible method for growing corundums and spinels via the flame-fusion process. Other attempts, less successful, are also described, as well as modern flame-fusion techniques and the development of methods for melting corundum and withdrawing very large single-crystals.

Section three turns to hydrothermal syntheses beginning with early attempts to grow quartz crystals and the modern development of autoclaves capable of growing large, flawless, piezoelectric-quality single crystals. The recently synthesized smoky, greenish-yellow, citrine, and amethyst varieties are also described, with remarks on probable coloring agents used in them. Section four, treats the synthesis of emerald, which now is very important commercially, describing early attempts at synthesis by hydrothermal and flux-melt means, and the short-lived success of the Linde hydrothermal emerald crystals grown over substrates of beryl. The early and sustained success of Chatham, and the somewhat later production of Gilson of France of flux-melt emerald crystals are given much space in the text but without neglecting other workers in the field of emerald synthesis as Nacken and Espig.

Section five is devoted to diamond synthesis, again preceded by a history of previous failures and doubtful successes, up to the time that the principles of modern high-pressure technology could be applied to the consistent production of diamond in the United States, Sweden, and in other countries. Other methods successfully used to produce diamond are also described, as the shock-wave method, now used by Dupont, and the low-pressure vapor growth technique, which remains a laboratory curiosity.

Section six is a potpourri of numerous gem materials that were created deliberately or only incidentally to imitate diamond, as corundum, spinel, strontium titanate, rutile, several garnets, and lately, cubic zirconia, grown in the unique skull-melting process. The seventh section is similar in scope, gathering up information on colored synthetics of various types, as alexandrite, rare earth garnets, and the odd but highly successful synthetic opal, also turquoise, lapis lazuli, and even the cultured pearl, although the last is treated only briefly as it should be. This section also discusses alteration of color and treatments of gemstones designed to enhance their attractiveness.

The eighth and last section of two chapters provides a summary of synthesis problems and their solutions, and a particularly valuable chapter on origins of color in gemstones, in both fields of which the author has been active for many years and has published many papers.

In sum, Nassau's book provides an authoritative, comprehensive, and easily understood survey of gemstone synthesis, suitably illustrated, and enlivened by historical anecdotes which make the text interesting and instructive. It should be regarded as the standard authority and is strongly recommended for inclusion in the library of every mineralogist, gemologist, jeweler, and gem collector.

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OPTICAL MINERALOGY: THE NONOPAQUE MINERALS. By W. R. Phillips and D. T. Griffen, W. H. Freeman and Co., San Francisco, 1980. xi + 677 pages. $39.95 hardbound.

This book is a modern compendium on the optical properties of minerals. It is intended to provide determinative tables in conjunction with Phillips' earlier book *Mineral Optics* but can easily be used with other optical mineralogy texts. It is divided into two parts, the first containing fairly detailed descriptions of some 160 of the commoner mineral species and groups, and the second providing tables of optical properties for more than 1500 minerals. One person's list of common minerals may include another's rare species, but this reviewer's list would not have included amblygonite, apophyllite, chrysoberyl, cryolite, dumortierite, hemimorphite, lithiophyllite, ludwigite, mullite, petalite, triphylite, vonsenite, and wavellite. Relegation of paragonite and phlogopite to virtual varieties of muscovite and biotite is also unfortunate. Most of the minerals of part I are illustrated as three-dimensional drawings with optical and crystallographic planes and axes, along with an illustrated cross-section parallel to the optic plane for biaxial minerals. Such drawings are most useful yet are not given in most books on optics of minerals.

Part I is a systematic discussion of the common mineral groups emphasizing optical properties with some treatment of the effects of solid solution. This section is a definite improvement over the now classic texts of Berman, Dana, and the Winchells. Some specific usages of the authors are not those which would be chosen by this reviewer: use of terms like inosilicate and tektosilicate instead of chain silicate and framework silicate; discussion of zeolites and clays without emphasizing powder X-ray diffraction as the best

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technique of identification; continued use of n_ω, n_ε, n_α, n_β, n_γ rather than the much simpler ω, ε, α, β, γ; promulgation of outmoded names in parantheses such as anatase (octahedrite), fluorite (fluorspar), gibbsite (hydroargillite), sphalerite (zincblende), or sphene (titanite). In this way lies madness: diopside (malacolite, coccolite, etc.), glaucophane (gastaldite), or melilite (fuggerite). Surely we should let redundant names die quietly for otherwise generations to come will still be cursed with them. At the same time not to give vesuvianite equal status with idocrase is absurd. Some specific errors are also noted. The authors have assumed that septechlorites are a subdivision of chlorites somehow distinct from serpentines, listing the antigorite–amesite series under the chlorite group when both amesite and antigorite are serpentines (= septechlorites). Microclines are reported to have ubiquitous grid-twinning when in fact most microclines from low-grade metamorphites (zeolite, prehnite–pumpellyite, greenschist and blueschist facies) show *no* twinning and can be difficult to distinguish from albite or quartz. Extinction angles for pyroxenes (p. 184) and amphiboles (p. 218) are given as maximum angles when they should be specified as maximum angles in a prismatic direction. Some of these are stylistic criticisms but some are errors which may mislead the student on specific minerals. However, the overall quality of the text on optical mineralogy is generally quite good.

Part II of this book contains tables of minerals sorted by increasing refractive index as to isotropic, uniaxial positive and negative, biaxial positive and negative minerals. This is a standard approach but may obscure wide ranges of refractive indices often encountered in solid solutions. Minerals which should appear in more than one category are generally only listed in one. Anyone with uniaxial positive vesuvianite, biaxial negative staurolite or biaxial calcite may spend some time with these tables before correctly identifying the mineral. Additional useful data given in part II also include cleavage, twinning, color, occurrence, and a reference. This reviewer would also recommend additional tables compiled by characteristic properties such as polysynthetic twinning, anomalous interference colors, forming and causing pleochroic haloes, distinctive colors. Such information quickly located is often useful in identification of unknowns.

The exhaustive compilation of mineral species will be useful to the research mineralogist but may be frustrating for the undergraduate. How many times will the student encounter duftite, marokite, metahewettite, salesite, xanthoconite, *etc., etc.* and how will he be able to select rockformers out of the incredibly detailed list? At the very least the writers should have placed the more common minerals (these also in part I?) in boldfaced type. They also could consider sorting those species known from only a few localities in the entire world into a second table of rare minerals. Still, researchers will be glad to have an updated text to replace the excellent but outdated books by Berman, Dana, and the Winchells. The writers are to be congratulated for extraordinary persistence in this compilation. Despite the somewhat critical comments of this reviewer, he is pleased to have this book on his shelves.

ERIC J. ESSENE
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KLOCKMANNS LEHRBUCH DER MINERALOGIE, By Paul Ramdohr and Hugo Strunz. Ferdinand Enke Verlag, Stuttgart, 1978 with 1980 supplement. 876 + 56 pages, 631 figures. Price not given.

This book is the German equivalent of Dana's *Textbook of Mineralogy, i.e.,* a one-volume textbook approximately equally divided into sections covering the principles of crystallography and mineralogy and a systematic part in which all minerals currently recognized are described, albeit briefly for the less common species. Dana's Textbook first appeared in 1877, with revised editions in 1898, 1921, and 1932. Klockmanns Lehrbuch first appeared in 1891 and has been revised at frequent intervals; Professor Ramdohr authored the 11th (1936) and subsequent editions, being joined by Professor Stunz as coauthor in the 15th edition (1967).

The present edition is divided into two parts, Kristallkunde (340 pages) and Mineralkunde (502 pages). Kristallkunde comprises sections on Kristallgeometrie, Kristallchemie, and Kristallphysik. Mineralkunde comprises Geochemie, Mineralgenese, Lagerstättenbildung; Systematische Mineralogie; and Mineralnutzing. Two indexes are provided, one to Kristallkunde and one to Mineralkunde. The supplement (reprinted with the original pagination from *Aufschluss*, v. 31, p. 317–372, 1980) described 115 new minerals published (up to January 1, 1980) after the completion of the manuscript of the present edition.

The book is thoroughly up-to-date, comprehensive, and authoritative, as one might expect from these authors. Were my mineralogic library to be limited to a single book, this would be it. I recommend it both to the professional mineralogist and to the serious amateur. It should certainly be available in the library of any institution where mineralogy is studied. One may hope that a corresponding edition of Dana's Textbook may soon be available for non-German readers.

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CRYSTAL STRUCTURES OF CLAY MINERALS AND THEIR X- RAY IDENTIFICATION. Edited by G. W. Brindley and G. Brown. Mineralogical Society, London, 1980, 495 pages. $52.50 (members), $70.00 (non-members).

This book is the long-awaited third version of volumes previously titled *The X-ray Identification and Crystal Structures of Clay Minerals.* The editors of the two earlier editions (published in1951 and 1961) combined their talents in this endeavor and have produced a first-class sequel. The stated objectives of this edition are to provide an authoritative account of the fundamentals of clay structures and to be a laboratory handbook. The book fulfills the two purposes admirably.

The title change reflects a shift in format which places crystal structure first from (Chapters 1–4) and X-ray identification second (Chapters 5–7 and Appendix). The format change emphasizes the large amount of structural information that has been gathered in the past two decades and diminishes repetition of topics. Useful interpretations are scattered liberally throughout the book as are previously unpublished diagrams and data. An important feature is the willingness of the authors to give their judgments and opinions and not merely to tabulate data.

Chapter 1 (Structures of Layer Silicates by S. W. Bailey) covers one fourth of the book. (The references for this chapter alone total nearly 9 pages!) The classification of layer silicates and the ideal geometry of the sheets that comprise layer silicates are discussed in

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a brief introduction followed by a treatment of each clay mineral species.

Chapter 2 (Order–Disorder in Clay Mineral Structures by G. W. Brindley) covers 70 pages. Disorder in layer stacking, disorder due to curvature of layers, and diffraction by small crystals are some of the topics. Indeed, order–disorder in clay minerals is a pervasive theme throughout much of the book.

Chapter 3 (Interlayer and Intercalation Complexes by D. M. C. MacEwan and M. J. Wilson) runs about 50 pages. Topics covered include aqueous and organic complexes with 2:1 clay minerals, complexes with 1:1 minerals, and dehydration-rehydration.

Chapter 4 (Interstratified Clay Minerals by R. C. Reynolds) is about 50 pages long. Various methods for analyzing interstratified structures are examined. Reynolds' treatment of the one-dimensional diffraction profile is considered in some detail complete with a helpful sample calculation. Many previously unpublished computed profiles are given.

Chapter 5 (X-ray Diffraction Procedures for Clay Mineral Identification by G. Brown and G. W. Brindley) is 55 pages. Topics discussed include clay preparation of X-ray diffraction techniques, and identification of mineral species. The useful checklist of d-spacings that appeared in the first edition but was omitted from the second edition has been resurrected here. The d-spacings of aluminum metal are included for those who irradiate their specimen holders. The user is cautioned that the list is not all-inclusive, *e.g.*, some reflections for calcite are omitted which are equally as intense as those given. The relative merits of copper and cobalt radiation are compared as well as the reasons for changing divergence slits, particularly at low 2θ values. Not generally appreciated, however, is the fact that not all divergence slits (particularly the finer ones) center the X-ray beam at exactly the same position resulting in misalignment. The recently-available theta-compensating slit may preclude this problem.

Chapter 6 (by G. B.) covers Associated Minerals and is about 50 pages long. Chapter 7 (by G. W. B.) covers about 35 pages and deals with Quantitative Analysis. An Appendix (by G. B.) gives tables of d-spacings for $°2\theta$ for the Kα and Kβ radiations of copper, cobalt, and iron.

A few minor negative points can be noted. Some of the tables and figures reduced for printing are quite light in my copy. The book contains a minimum number of typographical errors; however, the country in which the book was published is mispelled on the page facing the title page. Also, the equality at the top of page 255 contains two identical quantities the last of which should probably be $P_{IIM.M}$. The octahedral charge of chernykhite appears to be *excessive* rather than *deficient* as stated on page 70. Very few papers appear to have been overlooked. One notable omission is the paper by K. K. Bissada, W. D. Johns and F. S. Cheng (1967), Cation-diple interactions in clay organic complexes. *Clay Minerals, 7,* 155–166. The editors regret that a chapter on the geology of clays could not be finished in time for publication and I must concur. An attempt to correlate the vast amount of structural and chemical data of clays in a geological context is desirable. My personal feeling is that the Appendix could have been omitted. Finally, the antecedent of the pronoun *their* in the title seems ambiguous. Nevertheless, this definitive update on the crystal structures and X-ray identification of clay minerals is essential for anyone with a serious interest in the subject.

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NOTICES

MSA Short Course on Amphiboles and Other Hydrous Pyriboles
October 29 to November 1, 1981

The Mineralogical Society of America will sponsor a Short Course on Amphiboles and Other Hydrous Pyriboles before the 1981 MSA/GSA Annual Meeting in Cincinnati, Ohio. The Short Course will be held at a conference center near Erlanger, Kentucky, from October 29 (evening) to November 1 (noon). It will include an intensive review of the crystal chemistry, spectroscopy, phase equilibria, igneous and metamorphic petrology, and subsolidus behavior of amphiboles, as well as discussions of the mineralogy and geology of amphibole asbestos and wide-chain pyriboles. The outstanding lecturers who have been selected for this course will also participate in the preparation of Volume 8 of the MSA Reviews in Mineralogy series. For further information, write to Amphibole Short Course, Mineralogical Society of America, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

First International Symposium on Crystal Growth Processes in Sedimentary Environments

The first International Symposium on Crystal Growth Processes in Sedimentary Environments will be held in Madrid, Spain from April 13–16, 1982, under the auspices of the International Mineralogical Association, the IMA Commission on Crystal Growth of Minerals, the International Organization for Crystal Growth, the Spanish Council for Scientific Research, the Spanish Mineralogical Society and the Instituto Geológico y Minero de España.

The Symposium is aimed to provide a forum mediating between the science of crystal growth and the science of sedimentation and sedimentary petrology, as well as for reporting and discussing recent studies on crystal growth processes in sedimentary environments. The symposium is organized in view of the increasing importance of the knowledge of crystal growth mechanisms in understanding the formation of sedimentary rocks and diagenetic processes.

The symposium will consist of lectures by invited speakers (about ten speakers are expected), Round-Table discussions led by invited speakers and contributed papers presented by the assistants in the form of posters. Those who are interested in this symposium may obtain further information from: Dr. R. Rodríguez Clemente, Instituto de Geología, Consejo Superior de Investigaciones Científicas, c/ José Gutiérrez Abascal, 2. MADRID -6. SPAIN.

The registration fee is fixed at 100 US $, and the deadline for submission of abstracts of contributed papers is December 20 1981.

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