BOOK REVIEWS

PHASE EQUILIBRIA AMONG OXIDES IN STEELMAKING, by ARNULF MUAN AND E. F. OSBORN. Addison-Wesley Publishing Company, Inc. Reading, Mass. 236 pp., 1965, $17.50.

Although this book is aimed toward practicing metallurgical and ceramic engineers interested in applying phase equilibrium data to steelmaking operations, there is much in it of interest and of value to the mineralogist and geochemist. The stated purpose of the book is to supply to the users of phase equilibrium diagrams the information necessary to extract from the diagrams all of the useful practical information which they contain. It is the opinion of this reviewer that the authors have succeeded very well in this task.

A geometrical approach is used in this book and therefore much space is occupied by presentation of diagrams of known oxide systems. In fact, about two thirds of the book is concerned with the diagrams themselves. First, the stabilities of individual oxides, then the systems of various complexity are discussed. The one-component systems, SiO_2 and Ca_2SiO_4, are reviewed in detail and a number of other one-component systems are discussed briefly. In the more complex two, three, and four component systems, a separation is made into those systems in which a gas phase plays an important role, and those in which the gas phase does not play an important role. In the very complex systems with more than four components, the liquidus relations in two different systems are selected for discussion.

The final third of the book is concerned with applications of phase equilibria data. The areas considered are slags, oxide inclusions, and refractories. Of these, the chapters on slags and refractories would be most likely to interest the geoscientist.

It would seem that the value of the book to experimental mineralogists and geochemists would be twofold: First, many of the individual diagrams and the accompanying discussions may be directly applicable; and second, the phase equilibria data which may have been neglected in the past could prove useful.

The book seems to have been well edited and is remarkably free from typographical errors. It has an extensive bibliography and is very well referenced. The only criticism of any consequence this reviewer would have is that the exact temperatures and compositions of the invarient points in the ternary diagrams should have been given where known. It is impossible to determine these values from the ternary diagrams in the book with any degree of exactness.

This book contains a wealth of information and should be available to anyone interested in phase equilibrium involving oxide systems at ordinary pressures.

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DIE OXYDISCHEN KRISTALLPHASEN DER ANORGANISCHEN INDUSTRIE-PRODUKTE, by FELIX TROJER. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, 1963, 428 pp.

This book is concerned only with compounds which have been synthesized in commercial applications, or are very closely related to them, and in particular with compounds of interest to the ceramic and refractories industries, since only descriptions of non-hydrous oxygen-containing compounds are included. The emphasis is on optical analysis, and thus there are very short introductory chapters dealing with specimen preparation and optical properties and on synthesis. Many excellent reproductions of thin and polished sections of typical examples are included both here and under the descriptions of individual phases. The bulk of the book is taken up with compilations of data on individual phases, arranged

in a chemical classification. Under each compound, data are included on composition, with a description of solid solution relations; crystal structure, but including little more than unit cell data; powder diffraction data, sometimes indexed; physical properties; optical characteristics in thin or polished section; etching properties; crystal chemistry; habit or appearance; associations; occurrence; references. Complete data are available, or are included, for relatively few compounds.

Although data similar to that presented here are available on minerals in various compilations, it is relatively inaccessible without a great deal of effort for the great bulk of synthetic materials. Data are included for about 250 minerals, but the value of this compilation lies in its emphasis on synthetic phases.

In many cases, particularly for phases which have been extensively studied, many references have been omitted. For example, with respect to both high and low eucryptite, references to significant work are not included. Care should therefore be used relative to the completeness of coverage, particularly with respect to minerals where references are kept to a minimum, since data are available in other compilations. Although this somewhat detracts from its usefulness, it is nevertheless true that this text is extremely useful in providing data in a convenient form on a large group of compounds related to minerals, and should prove to be a valuable reference book.

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STRUKTUR UND KRISTALLISATION DER GLÄSER, WERNER VOGEL. With an Appendix by WALTER SKATULLA, Elektronenmikroskpische Untersuchungsverfahren in der Glasforschung. VEB Deutscher Verlag für Grundstoffindustrie, Leipzig, 1965, ($8\frac{1}{2}'' \times 12''$) 242 pp., 245 fig. Price, cloth-bound, D.M. 85.00.

The structural constitution of glasses has rapidly developed since G. Tammann's classical definition of glasses as homogeneous, but undercooled melt phases, to modern atomistic aspects, in analogy with the evolution of our knowledge of the structure of crystalline phases of silicates, analogous oxides, sulfides, and other inorganic and even organic compounds. The theoretical aspects of W. H. Zachariasen on the framework structures of glasses, with a statistically completely disordered distribution of the atoms, and the diametrically opposed crystallite theory of micro-ordered glass structures, by A. A. Lepedev, stood for many years in the foreground of interest and discussion in glass research. Actually, there is a distinct and desirable tendency to find reconciling paths from one to the other extreme in the ideas on glass constitution. Nevertheless, it means a revolutionary new aspect of the problems here involved, when phenomena became increasingly known that glasses must be—in the majority of cases—understood as submicroscopically, micro-heterogeneous systems. This new experience was won by the rapidly increasing refinement of x-ray diffraction methods, chiefly by application of low-angle diffraction methods as used by E. A. Porai-Koshits a.o.a., but also more directly by advanced electron microscopy, used by A. F. Prebus and J. W. Michener (1954), V. I. Shelyubskiĭ (1955). The highly developed arts of glass sample preparation for high-resolution electron microscopy in the laboratories of the Jena Optical Works, chiefly in the hands of W. Skatulla, contributed in a high degree to further progress, to make the concepts of microheterogeneities in glass generally adopted. That these are really of highest importance for an understanding of the existence of "pre-crystalline" states in glass which determine the nucleation mechanism of crystalline phases, was made evident by many impressive investigations on the so-called Pyroceram process. Vogel reported in a series of articles in the not easily accessible periodical "Silikattechnik" during the last five years currently on his successful contributions to those problems.

It is a wonderful opportunity for the reader now to have this highly important material of observations in every experimental detail disclosed in the present, excellently illustrated book, in the first section which extends from pp. 13 to 141. The experimental data here presented are based not only on common silicate glasses, but first of all on the beryllofluorate "model glass systems," in V. M. Goldschmidt's definition. It is highly appreciated that Vogel and his coworkers give a detailed description of their successful and safe methods for the synthesis of beryllofluorate melts (pp. 24 f.), furthermore on their optical, density, molecular volume, and molecular refraction constants, as a function of systematically varied compositions. Rich tabulated data make evident the close analogies existing between those model glasses and those of corresponding silicate systems. Among the latter compositions, those with lithium, and borosilicate compositions are the most fascinating and important types for research on microheterogeneities, and crystallization tendencies, as a function of variation in their cation components. In this respect, a brief crystallochemical comparison of crystallized beryllofluorates with corresponding silicate phases is particularly fascinating (pp. 50 to 59).

The subjects of the second principal section of the book are specifically the nucleation phenomena from undercooled melts, starting from Tammann's classical investigations, now supplemented by modern aspects of crystal growth with structural defects and dislocations (analogous to the theories of W. Kossel, I. N. Stranki, and W. Kieber). A most fascinating study object for crystal habit changes as derived from glass composition proved to be aluminum metaphosphate, $Al(PO_3)_3$, obtained from an optical phosphate glass. It is really delightful to see the beautiful microphotographs of those crystals, which are accurately described in their evolution of definite crystal forms. The principal purpose, however, was for the author a well-based theory of nucleation and crystal growth from photosensitive glass products (Photocerams), and fully crystalline ceramics (Pyrocerams), by homogeneous or heterogeneous mechanisms, as a "catalyzed" crystallization, in combination with microheterogeneities, and evident unmixing phenomena from previously homogeneous, undercooled phases. The fascinating variability of synthetic methods used by the author is particularly well illustrated also here by numerous microphotographs and electron diffraction diagrams, or by application of gold-decoration methods (pp. 213 ff., 227 f.).

Controlled crystallization, which has contributed so much to the evolution of Pyroceram industrial products, is, as a matter of fact, by no means a recent discovery and achievement. It goes back in principle to the marvellous ideas of René Antoine Ferchault de Réaumur (1727), who was successful in making a fully crystalline "porcelain" from a common glass melt, only by adequate thermal treatment. However, exclusively by modern experimental possibilities of a refined adaptation of those treatment measures to the specificity of the nucleation and crystal growth characteristics of the given glass, Stookey and his group of coworkers in Corning Glass Works could achieve the accurate basis for the definite industrial success of Pyroceram production. Vogel and his research colleagues have an important merit in having developed with their facilities analogous possibilities in other branches of the same field of controlled crystallization. The present book is the fruit of their contributions to this wide and important field of investigation. Beyond the problems of the Pyroceram process, they present further aspects and new problems involved with possibilities of strengthening glass as a construction material, namely by reducing in a high degree its brittleness, also by controlled crystallization. This can be achieved, either by applying reinforcing crystallized surface layers on a given glass shape, or by the elimination of the Griffith flaws, and so-called "pockets" of glass brittleness cracks, by a controlled devitrification, using theoretical deductions developed by E. F. Poncelet (1944, 1948), beyond the Griffith theory of brittleness. As "Chemcor" process, analogous methods have been intro-

duced in the United States by Corning Glass Works, under the guidance of S. D. Stookey and J. S. Olcott (1962).

Vogel presents in his book a most valuable and highly complete source of information, not least is a literature bibliography with 389 references. Among these, many have not been easily accessible and little known before. Particular emphasis is also given to Russian-written contributions and to the patent literature. The usefulness of the book is even raised by a most welcome Appendix written by W. Skatulla in which he presents to the reader interested in practical electron microscopy his rich specialist experience in handling samples for this purpose. Considerable refinements are noteworthy in details of preparation from glass fragments, the treatment of the structureless supporting film, shadow-casting of the sample reliefs by heavy metal vapors, deposition of carbon on the sample surface, and marking of the surface smoothness by sublimation of crystals of molybdenum trioxide onto the film. Direct transmission electron microphotography is preferred for highest resolving powers, in glass investigations, however, more often the replica techniques are used, for which different methods have been proved satisfactory. Skatulla's contributions in this Appendix are also supplemented by a separate literature bibliography (55 references from periodicals, and six book publications, mostly written in German).

Special appreciation may be given to the beautiful illustrations in the present book which are really of rare, clear-cut precision, as reproduced from the original photomicrographs, on smoothest paper. Details may be examined by the magnification lens, without too great distortion by raster effects. Also the printed text is of noteworthy beauty. In all, a most enjoyable book publication of high attractiveness.

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TERMODINAMIKA SILIKATOV (Thermodynamics of the Silicates), V. I. BABUSHKIN, G. M. MATVEEV AND O. P. MCHEDLOV-PETROSYAN, Gosudarstv. Izdat. Literat. po Stroitel'stvu, Arkhitekt. i Stroit. Materialov, Moscow, 1962. 266 pp., 91 text-figs. Cloth-bound, price Rbl 1, Kop. 7. German Translation by Armin Petzold, VEB Verlag für Bauwesen, Berlin, 1965. 336 pp. 107 text-figs. Cloth-bound.

The tremendous progress of modern construction methods in the U.S.S.R. and other countries, chiefly based on rational methods of production and scientifically controlled survey of raw materials and for the reactivity of hydraulic binders (in the first place, of Portland cement), made it urgent to revise on a thermodynamic basis the nature of silicates and aluminates of lime. This has been the principal reason for a thorough re-examination of the thermochemical literature, which is, however, not restricted to the theory of hydraulic binders, but responds to general needs of all fields of silicate technology, and includes also wide fields of mineralogy, petrology and geochemistry. Specific difficulties in treating this complex of tasks for investigation may become evident when we compare the scarce knowledge of "best values" of heats of formation, fusion, inversion and sublimation of silicates, with the abundant material of data available for metallurgical reactions, as collected in the standard works of F. R. Bichowsky and F. D. Rossini, "Thermochemistry of the Chemical Substances", Reinhold Publishg. Corp., New York, 1936, and F. D. Rossini, D. D. Wagman, W. H. Evans, S. Levine and I. Jaffe, "Selected Values of Chemical Thermodynamic Properties", Circular No. 500, Nation. Bur. of Standards, Washington, 1952. Even much scarcer is literature on the thermochemistry of rock-forming minerals (*cf.* W. Eitel, "Thermochemical Methods in Silicate Investigation", New Brunswick, N. J. 1952, Rutgers University Press).

The present Russian-written book of three well-known specialists was excellently

translated into German by A. Petzold. It means a very important advance in the thermochemistry of silicates. It is not written as a textbook as one would, perhaps, conclude from the general introduction into the basic laws of thermodynamics. The mathematical requirements are deliberately kept on a moderate level to make the text also easily understandable for civil engineers interested in silicate materials and their properties. The important aim for the authors was to demonstrate the advantages, but also the limits, for the application of classical thermodynamics to the problems of solid-phase reactions, fusion equilibria, polymorphism and particularly to reactions of silicate hydration. Great emphasis is also given to methods of experimental determination and of calculation of heat capacities, up to high temperatures, as shown for the "dry" systems CaO-SiO_2, CaO-Al_2O_3, MgO-SiO_2, Al_2O_3-SiO_2, then extended to reactions with participation of gases and volatiles, as illustrated by the typical "glass-batch" and cement "raw mix" reactions, e.g. Na_2CO_3-SiO_2, $CaCO_3$-SiO_2, $BaCO_3$-BaO-SiO_2, and $CaSO_4$-SiO_2. Although metallurgical gas reactions of similar character are not treated *in extenso*, the fundamental significance of reactions taking place in systems as a function of the partial pressure of oxygen is equally discussed, finally the phenomena of devitrification in their importance for glass products and slags. As a very interesting specificity of the book may be mentioned the calculation methods for heat capacities of crystalline inorganic compounds at high temperatures, based on the entropy method of N. A. Landiya, from the original publication by the Academy of Science of the Gruzinian S.S.R., Tiflis, 1962, which may be warmly recommended for use in thermochemical calculations because of its simplicity and universal applicability. The text of the Gruzinian source is sufficiently presented in a very clear tabulation in the Russian book, and in the German translation, for direct practical application.

In the introduction is explained why the most extensive field of application of silicate thermodynamics is in the theory of hydration processes, chiefly those of hydraulic binders which are the subject of the second section of the book. The system CaO-$Ca(OH)_2$-SiO_2-H_2O is also for the mineralogist fascinating not only by a direct application to the equilibria of the formation of calcium zeolites in nature, and similar problems of postmagmatic mineralization, but it is an excellent paradigma for systematic thermochemical investigations of the partial systems: CaO-H_2O, and in parallel with this MgO-H_2O (brucite crystallization), the fundamental systems SiO_2-H_2O, and the hydraulic systems $2CaO \cdot SiO_2$-H_2O, and $3CaO \cdot SiO_2$-SiO_2, with hydration products of the tobermorite group. Great emphasis is stressed on a thorough thermochemical treatment of the mono- and polysilicic acids, based on calculations of heats of formation, derived from average energies of bonding (cf. T. L. Cottrell, "Strength of Chemical Bonds", London, Butterworth Scient. Publishg. 1954), and structural aspects of hydrated silicates as developed by N. V. Belov and Kh.S. Mamedov (*Zapiski Vsesoyuzn. Mineral. Obshch.* **85**, 1956 (1) 13; Doklady Akad. Nauk S.S.S.R. **104**, 1955 (4), 615; **121**, 1958 (4), 720; (5) 901; **123**, 1958 (1), 163, (4)). Calculations are extended to the typically hydrothermal calcium silicate hydrates minerals like hillebrandite, foshagite, xonotlite, riversideite, tobermorite, plombierite, gyrolite and okenite, with a very impressive collection of diagrams showing the free energies, ΔG, as a function of temperature. In these diagrams it becomes particularly evident how sensitive the formation reactions of calcium zeolites respond to the ratios of the components, CaO, SiO_2 and H_2O, in the initial mixes. One is able to conclude on the stabilities of the single crystal phases, and to predict their changes with temperature. Such deductions are in a remarkably good agreement with the experimental facts for the different silicate hydrate compositions, although one must always consider how prone they are to form unstable, non-equilibrium, and intermediate phases. As a heuristically used orientation help, those diagrams are in every case of high value.

It is furthermore interesting to learn that the analogy of silicate with aluminate systems

is evident by parallelisms existing in the development of calculation methods for the system CaO-Al_2O_3-H_2O, with the very important subsystem Al_2O_3-H_2O. These are able to make understood the hydraulic reactivity of basic calcium aluminates in fused cements. Beyond that, the facinating problems of ettringite crystallization in the system CaO-Al_2O_3-$CaSO_4$-H_2O are convincingly solved by elegant thermochemical methods. In the second section of the book it is quite natural that the center of interest is seen in the application of thermochemistry for the theory of setting and hardening reactions of hydraulic binders, although a more detailed discussion of this technological field must here be omitted. But in the third section, the authors make an excursion into the fields of genetic mineralogy, geology and geochemistry. Applications of a thermodynamical treatment are presented for problems of silicate mineral stability under varying conditions of temperature and pressure, either in the "dry" systems as in the presence of water, the magmatic fusion and crystallization phenomena, and as a simple paradigma of metamorphic reactions the system MgO-H_2O, for the hydration of periclase, and the dehydration of brucite or the thermal decomposition of silicate hydrates with particular emphasis to the clay mineral decomposition with formation of meta-phases. In the system Al_2O_3-SiO_2, the polymorphism of Al_2SiO_5 and the theory of weathering are discussed, making ample use of the results in the studies of R. M. Garrels (*Am. Mineral.* **42**, 1957, No. 11/12).

The book of Babushkin, Matveev and Mchedlov-Petrosyan is in its entirety a tremendous source of information and of great practical usefulness. Particularly valuable are the excellent collections of numerical data tabulated with standard enthalpies, free enthalpies, entropies, and binomial equations of heat capacity with temperature for fundamental elements, ions and chemical compounds (483 substances are listed). In addition, there is a detailed literature bibliography of 291 references and another list of 55 references for literature of thermochemical data in the Appendix. The German translation also contains Author and Subject Indexes which, unfortunately are lacking in the Russian original.

For a future new edition it may be suggested to present more recent information on the effects of water association when bound in hydraulic compounds, and the introduction of the heat of association into the thermochemical calculation, as indicated by recent investigations of nuclear magnetic resonance effects (*cf.* Watanabe and Sasaki, IVth Internation. Symp. Chem. of Cements, Washington, 1960 (1962 publ.), Section IV, Suppl. Paper **3**.).

The mineralogist will be able to find by the study of this book encouragement to apply methods of thermochemistry for mineral genesis and metamorphic reactions. The advancement of high-pressure investigation may give impetus also in this direction, e.g. by an application of A. F. Kapustinskii's $(v \rightarrow 0) \lim S = 0$ relation (so-called fourth law of thermodynamics). The authors themselves, emphasize repeatedly how the majority of silicate reactions in nature should not be only treated by applying the laws of classical thermodynamics for *reversible* equilibria when one must be fully aware that in reality non-equilibria and *irreversible* reactions prevail by far. However, the expectation may be justified in the future that advanced methods of a thermodynamics of irreversible processes may be applied for problems in geochemical research, particularly for the theory of metamorphism.

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MICROSCOPIC IDENTIFICATION OF MINERALS, by E. WM. HEINRICH, McGraw-Hill Book Company, New York, 1965, 414+xiii pp., $10.50.

This textbook provides the basic information required for the identification of the most important rock-forming and rock-accessory minerals by means of the petrographic microscope. Whereas, other textbooks of optical mineralogy concentrate on the properties of minerals in thin sections; this book emphasizes their characteristics as immersed micro-

fragments. The importance of the immersion technique as a prime method for the rapid identification of a large number of rock forming minerals and for estimating their compositions from their optical properties has long been recognized. Thus, it is gratifying to see a textbook that emphasizes this technique. The book will be particularly useful in helping the student to advance from the study of principles of optical crystallography to the application of optical microscopy in petrographic and mineralogic research.

The book is divided into three parts: Part one, General Information (44 pages); Part two, Descriptions of Minerals (326 pages) and Part three, Identification Tables (28 pages).

Part One consists of five chapters: Introduction, Microscopic Methods of Study of Minerals, Mineral Composition and Optical Properties, and Identification Technique. After a brief history and statement of the importance of the immersion technique in mineralogical and chemical analysis, the author describes the mechanics of the method in detail and provides information on immersion media, technique for preparing mounts, and variation in appearance of species. He also discusses the thin section method, compares it with the immersion technique, and provides a concise summary of staining techniques. Students will find the chapter on the Optical Properties of Minerals very helpful, especially the section which describes the mechanics for determining the optical orientation of mineral grains as immersed fragments or in thin sections. It is hoped that in any future edition that this section on optical orientation will be expanded to include illustrations. The concept of isomorphism and its relationship to optical properties is covered in 5 pages. The chapter on identification techniques (7 pages) presents a generalized outline of procedure and rules to be employed in identifying minerals in immersion mounts.

Part Two (Descriptions of Minerals) is the major portion of the book. Included are descriptions of 157 mineral species that are of importance as essential or accessory constituents of rocks. In addition, minerals of lesser significance are referred to briefly under species to which they are related. The minerals are presented in order of increasing optical complexity; *i.e.*, opaque, isotropic, uniaxial and biaxial. Within each optic group, they are arranged by chemical groups, following the new Dana classification. For each mineral, a general optical description is given, and specific information is listed on its appearance in thin section, as a crushed fragment, and as a detrital grain. For opaque and isotropic minerals, the subheadings of the description are Properties, Occurrence, and Diagnostic Features. For the more optically complex species, the following subheadings have been employed: General (i.e., information relating to a mineral group), Composition, Indices, Color, Form, Orientation, Occurrence, and Diagnostic Features.

The written descriptions of the minerals are enhanced by the varied type. In addition, the excellent photomicrographs of various minerals in thin section and the line drawings of their appearance as crushed fragments or detrital particles all contribute to aiding identification. The orientation diagrams for the optically complex minerals are useful, but the reviewer prefers the type used by Tröger in his "Tabellen zur optischen Bestimmung der gesteinbildenden Minerale." The author has presented the best available charts (73) that relate the variation of optical properties in a series or a group to compositional variation. This compilation of charts will have special appeal to the researcher. With the student in mind, the author has included detailed procedures in using the charts. For example, in his discussion of the Plagioclase Series, he gives detailed instructions for the following determination techniques:

Michel-Lévy statistical method
Combined Carlsbad-albite twin method
Fougué method
Microlite method
Schuster method

Tsuboi method
Rhombic section method

Part Three consists of four tables:

I. Species arranged by (1) optical groups and (2) refractive indices.
II. Colored species arranged by (1) color and (2) optical groups.
III. Anisotropic minerals arranged by (1) increasing birefringence and (2) optical group. This table includes an outstanding interference color chart with a discussion of the chart and its use.
IV. Minerals that commonly show twinning grouped by (1) types of twins and (2) optical group.

The entries in Tables I and II provide page references to the descriptions in Part II.

A reference list (76 entries) provides a good source to much of the significant literature in optical mineralogy ranging from Maschke (1872) and Michel-Lévy (1877) to Deer, Howie and Zussman (1963) and Wilcox (1964). The usefulness of the index is enhanced because the mineral species described in detail are set in boldface type as are the pages covering the detailed description. Mineral species partly described are set in italics.

In a text such as the one under review, it is practically impossible to avoid all errors, misstatements and omission. A few are here noted. In the general description of detrital grains, bottom of Page 25 and top of Page 26, a portion of the sentence has been omitted. The index does not contain the terms euhedral, anhedral or subhedral, although the author defines these terms on page 21. Also, the term trichite is referred only to page 229, but an excellent photomicrograph of trichites appears on page 22. Descriptions of volcanic glass and palagonite will be missed by petrographers studying volcanic rocks or volcanic derived sediments. One feature of the book which may prove irritating to some users is the comparison in the sections on diagnostic features of various species to less important species not described in the book. For example, gmelinite is stated to have lower refractive indices than chabazite, but the reader will need to refer to another source in order to obtain information as to actual value of the refractive indices of gmelinite.

Aside from these minor criticisms, the book is a concisely stated, well-organized introduction to optical microscopy in practice and will serve as an excellent companion volume to any of the several modern text books that deal in the theory of optical crystallography. It is well worth the moderate price.

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CRYSTALLOGRAPHIC BOOK LIST, edited by Helen D. Megaw, for the International Union of Crystallography Commission on Crystallographic Teaching, 1965.

This book list has been prepared by Helen D. Megaw assisted by H. Curien, E. G. Steward, M. M. Umanskij and J. Zemann for the Commission on Crystallographic Teaching and has been distributed to all subscribers to *Acta Crystallographica*. It contains a list of books and reference works on all phases of crystallography as very broadly defined. Material is presented under the headings Main List, Conferences and Serial Publications, and there is a cross reference list by subject. The author, title, publisher and data are given for each reference. The book is available through N.V.A. Oosthoek's Uitgevers Mij, Domstraat 11–13, Utrecht, The Netherlands (U. S. $3.00).

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MINERALY, SPRAVOCHNIK. Tom II, vyp. 2 Simple oxides: Izdatel'stvo "Nauka", Moscow, 1965, 341 pp. (in Russian) 181 fig., 2 rubles, 29 kopecks ($4.50 in U.S.A.)

This is the third section published of this comprehensive reference work on mineralogy (see *Am. Mineral.* **49,** 1781–82, 1964). Seventeen authors are listed.

The material is presented as in the first two volumes. The coverage is that of *Dana's System of Mineralogy*, 7th Ed., v. I, 490–622 (1944), except that the forms of silica are included (136–243), corresponding to *Dana's System*, 7th Ed., v. III, 335 pp. (1962). The literature has been covered very thoroughly; there are a number of references to papers published in 1963 and some to papers published in 1964.

A highly recommended reference work.

MICHAEL FLEISCHER