Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (M. M. Woolfson, Physics Department, University of York, Heslington, York YO1 5DD, England). As far as practicable books will be reviewed in a country different from that of publication.

Amphiboles (crystal chemistry, phase relations and occurrence). By W. G. ERNST. Pp. x + 125. New York: Springer-Verlag, 1968. Price DM 27,20. US $ 6.80.

This book is the first to be published in a series of monographs entitled *Minerals, Rocks and Inorganic Materials*, and it is one of the sub-series *Experimental Mineralogy*. These volumes are intended to provide a medium for the publication of extensive reviews of selected topics, of a kind which are not catered for by the standard journals (and not normally by review journals), nor by textbooks or advanced works of reference. The sub-series is intended to give for particular mineral groups a critical presentation of the results and implications of phase equilibrium studies.

The amphibole minerals have a basically simple chain-like crystal structure, determined by Warren in 1929. Two varieties, crocidolite and amosite, are important industrially since they are the raw materials of many asbestos products, and many other amphiboles are of widespread geological occurrence in igneous and metamorphic rocks. Although the structure is simple it incorporates sites for large, medium and small sized atoms of varying valencies so that there is considerable chemical complexity. This perhaps explains the relative lack of detailed study on the crystal chemistry and phase equilibria of amphiboles hitherto, but improved techniques have led to a great increase in this kind of work in recent years.

The present volume deals in separate chapters with experimentally and theoretically derived phase relationships of the main amphibole sub-groups, and puts these in an appropriate setting by discussing in earlier chapters the crystal structures and chemical variability of amphiboles, and also by giving, for each sub-group, an account of the natural modes of occurrence of the minerals, the kinds of rock in which they occur, and the common mineral associations.

The crystal structures of the amphibole minerals are very effectively summarized, but perhaps undue weight is given to conclusions from single projection structure determinations as compared with more recently completed full three-dimensional solutions. Unfortunately, a number of the latter are known to have been completed within the last few years but have so far only been published as abstracts of conference proceedings. Discussion of the ordering of cations (Fe, Mg, Al) in nearly equivalent sites is not as clear or as detailed as it might be. It is given in terms of ionic sizes only, and important crystal field effects are not mentioned at all.

The treatment of phase equilibrium relationships is extremely helpful to the reader. A good deal of the experimental work on amphiboles has in fact been done by Ernst and his co-workers within the last decade. Ernst discusses the way in which experimental results bear relation to natural occurrences of amphiboles in terms of temperature, pressure, oxidation potential, ranges of solid solution, and abundances of elements in different geological environments. He is perhaps unduly gloomy therefore in stating in the last paragraph of the book that 'because of the complex and subtle relationships between bulk compositions of the host rocks and amphibole compositions, very little can be said regarding amphibole parageneses in igneous and metamorphic rocks, in spite of painstaking studies by numerous investigators.'

This book and others in the series will undoubtedly be useful, as intended, to students and research workers who are interested in rocks and minerals, but the intention stated in the foreword '.....to publish, at reasonable prices.....', must be said to have been forgotten, ignored or revised. It is not uncommon for reviewers to feel that prices of books are high, but this one is unusually so. The price is not explained by an exceptionally lavish production; many of the figures, for example, are direct copies of varying quality from papers in journals.

A feature of this volume, which may not be typical of the series, is that in spite of a long reference list (comprehensive until early 1967), a rather high proportion of its content is available in a relatively small number of recently published papers.

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Chemical bonds in semiconductors and thermodynamics. Edited by Academician N. N. SIROTA. Pp. xi + 255 New York: Consultants Bureau, 1968. Price $27.50.

This book represents the substance of 47 papers read at 'The Third All-Union Congress on Problems of the Chemical Bond in Semiconductors, Minsk 1965'. The average length of each report is about 5 pages, so that most of them are effectively rather longish abstracts of the full papers read at the conference.

The papers are gathered into groups: General questions (6 papers), X-ray studies (12 papers), Thermochemistry (8 papers), Dynamics of crystal lattices (4 papers), and Physical properties of semi-conducting bonds (16 papers); the volume concludes with a somewhat strange article by Academician Sirota inspired by the centenary of the Second Law of Thermodynamics, and bearing chiefly on the relation between stars and galaxies and the uniform (or non-uniform) increase (or decrease) of entropy in different parts of a very large system.

Inevitably, in a collection of this sort, there is a certain scrappiness in treatment of the material; and a certain lack of cohesion. But in recent years the Russians have been very interested in chemical ideas as applied to semi-conductors, and it is very good to have, in this volume, a survey of much of their work, together with lots of references to other published work along the same lines. The outlook is – naturally – very much Russian, and the cov-

erage of other European and American work is by no means complete. In places further progress has been made than is allowed for in the reports. Thus the account of electron density work in silicon does not properly interpret the differences between the [111] and the [110] directions, although if this had been done it would have thrown some more light on what is meant by the chemical bond in a semi-conductor.

One of the almost inevitable results of a compilation of this sort is that some of the central notions are never fully defined. It would have been very instructive, for example, to have had a definition of what the various authors meant by the phrase 'a chemical bond' in a semi-conductor. If this had been provided it would have helped to clear up some of the confusion between talking about band structures and, at the same time (or nearly the same time), about atomic hybridization. Nevertheless much of the work reported is still very topical; and there is no doubt but that a lot of progress will be made in the near future when we combine together (i) information such as that reported here dealing with the dependence of K and L X-ray levels, and absorption edges, on the chemical environment of the atom studied, and (ii) even more recent studies of electron spectroscopy and ionization potentials. This collection, therefore, may be welcomed as one part of the great movement of the last few years towards an understanding of what an atom looks like when it becomes part of a molecule or a solid.

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Oxidation numbers and oxidation states. By CHR. K. JØRGENSEN. Pp. 291. Berlin, Heidelberg, New York: Springer-Verlag. 1969. Price $12.00.

The concept of the oxidation state of an element in a coordination complex is beloved by most inorganic chemists but there is no doubt that it is often used without precision, particularly in organometallic molecules. A carefully written treatise on oxidation numbers and oxidation states would therefore be very welcome but, regrettably, Jørgensen's book does not fulfil this requirement.

Without doubt, a good deal of useful data have been compiled but the style of presentation is poor, if not downright irritating at times; even more important, the data have not been compiled critically.

After some definitions of formal oxidation numbers, we are led on to a discussion of configurations in atomic spectroscopy; there is little new here although it is probably the best section of the book. Characteristics of transition group ions and internal transitions in partly filled shells are then dealt with but together with the chapters on electron transfer spectra and inter-shell transitions, an impression of *déja-vu* is left with the reader. 'Oxidation states in metals and semi-conductors' is a useful summary but the two chapters on closed-shell systems, hydrides and back bonding and homopolar bonds and catenation are better dealt with in other books. The chapters on quanticule oxidation states and taxological quantum chemistry are such that I believe the book would have benefited from their omission.

Looking at the bibliography, one might guess that the coverage is much more up to date than it really is. By way of example, complexes such as $[(NH_3)_5CoO_2Co(NH_3)_5]^{5+}$ are discussed and we are left with the view that the Vlček–Vannerberg views of the geometry of these systems are basically correct – no mention is made of the definitive structural work of R.E.Marsh and his colleagues. Other points, picked largely at random, are that the formula on p. 125 is misleading; on p. 159 the formula is incorrectly drawn while no mention of mass spectroscopic evidence for $NHC_6H_4S^{2-}$ is given.

This book should only be used as a source of references which may have been overlooked.

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Fundamentals of inorganic crystal chemistry. By H. KREBS, translated by P. H. L. WALTER, Pp. xv+ 405. London: McGraw-Hill, 1968. Price £5.

The spectacular increase in the number of published crystal structure determinations which has resulted from the application of automatic diffractometry and high speed computing to crystallographic problems has underlined forcefully the need for continued classification and reclassification of the known facts of crystal chemistry on the basis of a minimum number of fundamental principles. In this book Professor Krebs continues in the tradition of Bragg, Pauling, Belov and Wells in bringing some order into the apparent chaos of inorganic crystal chemistry. The properties and structures of selected groups of crystals are interpreted in terms of the electronic structures of atoms and the bonds between atoms. Emphasis is placed throughout on theories of the chemical bond derived from quantum mechanical considerations. In his discussions of the chemical bond the author, for the most part, avoids any reliance on traditional notions of 'ionic' and 'partial ionic' character, concepts which probably serve more to confuse than to enlighten.

The first part of the book is devoted to a sketchy introduction to the formalism of quantum mechanics. Mathematical complexities are largely avoided. Brief discussions of crystal and ligand field theories then follow, providing a logical transition from fundamental theory to the experimental data of crystal chemistry.

The groundwork having been prepared, we are then treated to four pages devoted to 'The Seven Crystal Systems' in which the reader is introduced, perhaps for the first time, to concepts of classical crystallography. It is unfortunate that the treatment in the section is so brief; it is certainly too concise for the beginner.

The remaining two-thirds of the volume are devoted to crystal chemistry proper. The structure of the elements and a variety of AB, AB_2 and A_2B_3 phases are described in detail with emphasis always on unifying structure concepts and on the interpretation of the crystal structures in terms of the electronic structures of the atoms. Molecular structures are almost totally ignored but fruitful discussions of silicates, borates, alloys and glasses are included.