potentialities of these various chemical and enzymatic tools in the elucidation of protein structure. This reviewer finds the discussions which follow the lectures as valuable as the lectures themselves, for here the various problems in the interpretation of the results are thrashed out—viewpoints it is difficult to find in more formal publications. The references at the end of each paper are remarkably comprehensive, and this book should be of great interest and value both to the general reader and to the worker in the field.

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Crystal Data. By J. D. H. DONNAY, The Johns Hopkins University, Baltimore, Md., and WERNER NOWACKI, University of Berne, Switzerland, with the collaboration of GABRIELLE DONNAY, U. S. Geological Survey, Washington, D. C., and many assistants. The Geological Society of America, 419 W. 117 Street, New York 27, N. Y. 1954. ix + 719 pp. 17.5 × 25.5 cm. Price, $5.00.

This book is really two separate, related works bound together in one volume. Part I, by Professor Nowacki, is entitled "Systematic Tables—Classification of Crystalline Substances by Space Groups"; Part II, by Professor Donnay, is entitled "Determinative Tables—Identification of Crystalline Substances from Cell Dimensions."

Part I presents the distribution of about 3800 crystalline substances among the 219 space groups that are distinguishable without a knowledge of the right or left handedness of the crystal structure. Under each space group, the substances are divided into seven categories, as follows: I, Elements and alloys; II, Sulfides and related bodies; III, Oxides and hydroxides; IV, Halides and oxyhalides; V, Salts of oxygen acids containing covalently bound oxygen; VI, Salts of other oxygen acids; VII, Organic compounds. Subsidiary tables set forth the numbers of substances in each category that belong to each space group, each crystal system, each crystal class, each space lattice, etc. In addition, the percentage distribution of substances in each of these ways is tabulated.

Even a casual perusal of the tables in Part I confronts one with some remarkable statistics. There are 41 space groups in which no substance is known to crystallize, according to the literature available to Prof. Nowacki in mid-1948, and there are 32 for which only one example is known; thus, there are only 146 space groups in which more than one substance crystallizes, *i.e.*, only two-thirds of the possible space groups are used by nature to an appreciable extent. Furthermore, almost half of all crystalline species belong to one or another of only ten space groups. Indeed, 9% of all substances (including 22% of all organic substances) crystallize in the monoclinic space group C_{2h}^5-$P2_1/c$. The tendency of molecules and ions to arrange themselves in certain selected symmetrical patterns, which is indicated by these figures, is certainly interesting and may become significant in the future. Of course, many more detailed correlations between chemical nature and symmetrical arrangement are presented, or can be discovered, in the tables of Part I; it is a painstaking and thorough piece of work, probably providing the data for many coming investigations.

Part II is of more immediate practical value than Part I. It presents the unit cell dimensions and, where possible, the space groups of about 5000 crystalline substances—all those for which data were available to Professor Donnay up to the end of 1951. These data are tabulated in order of increasing axial ratio a/b in the triclinic, monoclinic and orthorhombic crystal systems, axial ratio c/a in the tetragonal and hexagonal systems, and axial length a in the cubic system. (The rhombohedral system is included in the hexagonal.) A set of rules for choosing the proper unit cell and naming the axes correctly appears in the introduction to Part II; by the use of these rules each crystalline substance can be assigned an axial ratio which gives it a unique position in the tables. (A cubic crystal is uniquely placed by its axial length.) In addition to the main table, Part II is provided with two indexes in which each substance is listed alphabetically by formula or by name, with a reference to its position in the main table. Thus, from the data in Part II, the crystallographic constants of almost any known substance can be found, or, conversely, the chemical nature of almost any crystal.

The usual method for identifying unknown crystalline substances is by the use of the X-ray diffraction patterns of powdered specimens, because a library of powder patterns has existed for many years in the form of the well-known ASTM card file. This method, however, becomes extremely difficult to use on substances with large unit cells of low symmetry. Professor Donnay's tables in Part II of "Crystal Data" provide necessary means for making chemical analysis by X-ray diffraction a really efficient technique. All that is required is one tiny single crystal of an unknown substance and the ability to use a Weissenberg or Buerger Precession X-ray diffraction camera, or, even better, one of the new X-ray goniometers equipped with a Geiger–Müller counter; any of these devices allows rapid and accurate determinations of unit cell constants and space group from a single crystal which need not weigh even 100 micrograms. These data will allow a unique determination of the chemical nature of the unknown substance, provided they are listed in the table.

Part II also contains tables listing the criteria by which space groups can be determined by the use of systematic absences of "reflections" in X-ray diffraction patterns. These tables are arranged to allow space group deteminations (insofar as this is possible on the basis of absent reflections) no matter how the symmetry elements of the unit cell may turn out to be oriented, because of the formal orientation rules required by the main table. The inclusion of these tables makes Part II a complete handbook of single crystal data arranged for use in chemical analysis.

In the opinion of this reviewer, this book is one of the great additions to the reference literature of physical science. Not only crystallographers, but chemists, physicists and all others interested in useful data on chemical substances will soon find this work a necessity in the reference library. The scientific world is to be congratulated upon the existence of men like Professors Donnay and Nowacki who have been willing to spend years of painstaking, self-critical work, in order to provide us with this monumental book at no financial gain to themselves.

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Metallurgy of the Rarer Metals. No. 2. Zirconium. By G. L. MILLER, Ph.D., B.Sc., A.R.I.C., M.I.Chem.E. Academic Press, Inc., Publishers, 125 East 23rd Street, New York 10, N. Y. 1954. xviii + 382 pp. 15 × 22.5 cm. $7.50.

This book is the result of a comprehensive inspection of the literature on zirconium. The author states that he has "examined" the assembled information critically in the light of his own experience and "as a result of knowledge gained during several visits to the U.S.A."

The first fifty pages cover the occurrence and preparation of zirconium compounds. In the next fifty pages the preparative processes of Van Arkel (thermal dissociation of the iodide) and Kroll (reduction of the chloride with magnesium) are described in some detail. The central portion of the book is devoted to the properties of the metal and its alloys while the last one hundred pages describe melting processes (either in use or being studied), fabrication of the metal, powder preparation and metallography.

The author has included extensive bibliographies at the conclusion of each chapter to indicate where further information may be found. The notations referring to books are incomplete. As an example, the reference cited on page 230 and found in the bibliography at the end of Chapter 14, page 273, "Smith, D. C., Hydrogen in Metals, Chicago, 1948" should include the publisher's name. The same applies to reference 1, page 116, "Barrett, C. S., Structure of Metals, New York, 1943," as well as to the other book references. Also, it would seem that the well known A.C.S. monograph by Venable, F. P., Zirconium and its Compounds, The Chemical Catalog Co., Inc., 1 Madison Ave., New York, N. Y., 1922, should be cited in the references at the end of Chapter 3.

A spot check of references to scientific articles in technical journals, however, disclosed only one incorrect in forty. Reference 12, page 60, should read, Hunter, M. A., The Reduction of Metal Chlorides by Sodium, *Trans. Electrochem. Soc.*, **44**, 23 (1923).