BOOK REVIEWS

THEORY OF *X*-RAY DIFFRACTION IN CRYSTALS by WILLIAM H. ZACHARIASEN, New York, John Wiley & Sons, (**1945**), V & 255 pages, 30 figures. Price $4.00.

This excellent book, written by one of the leading workers in the field, contains a complete mathematical treatment of the phenomena encountered in *x*-ray diffraction in crystals.

Chapter I starts with the macroscopic concept of a crystal and of crystal faces, introduces the lattice concept, the reciprocal lattice, and Fourier development of crystal properties.

Chapter II contains an excellent and concise discussion of the symmetry properties of crystals. Throughout the chapter dyadic algebra is used rather than geometric considerations. The properties of dyadics required, as well as the group theory needed, are derived in Appendix A and B. The possible symmetry operations in crystals are discussed. The properties of the 32 point groups are derived and discussed. All possible space groups are listed, and their complete derivation is treated.

Chapter III deals with *x*-ray diffraction in ideal crystals. The Laue and Bragg equations are deduced, and the construction of the diffracted vector discussed. The main part of the chapter is devoted to the calculation, from the atomic scattering power, of the intensity distribution in the interference maxima. Formulae are developed for the percent reflection, integrated scattering power, and half width in a number of cases. The cases treated are those of small crystals, thin, thick, and intermediate crystal plates, with and without absorption.

The agreement of these formulae with experiment is in general poor. The theory predicts smaller integrated intensity and narrower intensity distribution than those found experimentally at the Laue-Bragg spots. The reason for the difference is to be found in the crystal imperfections.

These imperfections are taken up in Chapter IV, where the discrepancy between experiment and theory is resolved. The mosaic structure of crystals is shown to be able to account for the broader and more intense interference maxima which are observed. Another important disorder is the heat motion. The normal coordinates of the lattice are introduced, and their thermal vibrations are shown to give rise to diffuse scattering and a decrease of intensity of the interference maxima. Temperature motion taken alone, without the imperfections due to mosaic structure, would increase the disagreement between theory and experiment. The last section discusses some common disorders found in real crystals.

The book is clearly and concisely written throughout. All the material in it is completely and logically derived from the fundamental concepts. The numerous formulae for intensity and half width ought to be very useful for a worker in the field. A considerable amount of the material of the book consists in original work of the author and cannot be found in any publication. This is especially true of the treatment of mosaic structure in Chapter IV.

The book is extensively mathematical. Dr. Zachariasen ends his introduction with the sentence: "The modest size of this book is not a fair measure of the time I have spent on it." This is indeed to be believed. The reader trying to master the material of this book may find the same statement to apply to himself.

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PYRITES DEPOSITS OF MISSOURI by OLIVER R. GRAWE has recently been issued as volume 30 of the *Missouri Geological Survey and Water Resources*. This report of 482 pages describes the location, history, geologic conditions and production of 91 mines and prospects. Spectrographic analyses of the pyrites and its oxidation products have shown the presence of 23 elements, most of which are present in amounts less than 0.05%. The report also includes *x*-ray analyses, studies of polished sections and a description of 36 minerals that have been reported as occurring in the pyrites and iron ore bearing sink structures of the northern Ozark plateau.

REPORT OF INVESTIGATIONS NO. 50 OF THE SOUTH DAKOTA GEOLOGICAL SURVEY embraces a "PRELIMINARY REPORT ON THE MINERALOGY OF SOME PEGMATITES NEAR CUSTER" by D. Jerome Fisher. The main object is to suggest an economical plan for the recovery of the valuable minerals in the pegmatites of the area. This report covers the history, geology, detailed mineralogy and paragenesis of five pegmatites designated by the following Lodes: Buster, Earl, Custer Mountain, Old Mike and Ross. Descriptions of the geology of three of the pegmatites of the Custer District appear in Report of Investigations No. 44 of the South Dakota Geological Survey.

PHILADELPHIA MINERALOGICAL SOCIETY

Academy of Natural Sciences of Philadelphia, May 5, 1945

Dr. W. Hersey Thomas presided, with 59 present. Dr. Hugh E. McKinstry of the Foreign Economic Administration addressed the society on "Collecting minerals for the war." Sources of mica, beryl, iceland-spar, vanadium and tungsten were described.

Meeting of June 7, 1945

Dr. Thomas was in the chair, with 54 present. Dr. William J. Kirkpatrick addressed the members on "Growth of Crystals." The historical introduction to the growth of euhedral crystals included Robert Boyle's (1669) observation that the rate of growth influences crystal habit, Romé Delisle's (1783) observation that sodium chloride crystallizes in octahedra from urine, and Le Blanc's (1808) observation that alum is octahedral when grown in weak alkali solutions. Beudant (1818) published a paper of 100 pages on the causes that determine the variations of crystalline forms.

Some factors that influence crystal habit are *p*H of a solution, presence of cosolutes, colloids or dispersing agents, rate of growth, temperature, pressure, and degree of agitation. A law of crystal growth may be stated: "If all of the faces grow at the same rate, the faces will disappear in the order of their distance from the center, $d=1/\sqrt{h^2+k^2+l^2}$, where h, k, and l are the Miller indices.

Sodium chloride usually crystallizes in cubes; the presence of urea and other alkalies in the solution cause it to crystallize in striated octahedra, although no record could be found of anyone having obtained good reflections on the goniometer from octahedral faces.

Some practical applications of crystal habit control were given: the dodecahedral face is the most effective plane in nickel for catalyzing hydrogenation reactions. Because they dissolve at a predetermined rate, many commercial chemicals such as photographer's hypo and sodium chromate are supplied in uniform equidimensional crystals. The habit of cupric chloride is influenced by the presence of certain tissue extracts: a fact made use of in pathology.

J. S. FRANKENFIELD, *Secretary.*