BOOK REVIEWS

FERROELECTRICITY IN CRYSTALS, by HELEN D. MEGAW. 220 pp. Methuen and Co. Ltd. (1957). 27s 6d.

The significant advances up to 1955 in this new field are assembled and reviewed in this book in a form which is readily assimilated and easily read. The emphasis here, in contrast to other treatments which stress the physical phenomena, is entirely on the matter of crystal structure and its influence on the electrical properties of this peculiar class of compounds. Such an approach, given to us by a veteran crystal chemist, is welcome for two reasons. First, it provides an easy and excellent introduction to the subject for those who are not primarily concerned with solid state physics. Second, it will provide the physicist a guide to the controlling factors of crystal chemistry and crystallography which are often not fully appreciated by workers in solid state physics.

Ferroelectricity was first discovered in Rochelle salt in 1921, but extensive study of the phenomenon was not begun until 1945 when the ferroelectric behavior of barium titanate was discovered. Since then, a diligent search for other crystals of this type has been carried on by many laboratories, yielding many new discoveries which are described in detail in Dr. Megaw's book. The one common feature of these structures is stressed, namely, that they are polar in symmetry, but have the special property of being only slight distortions of arrangements of higher symmetry. The measurement of these distortions is the most difficult task of the x-ray and neutron diffraction worker and the results which have been published are ably collected and evaluated. In spite of the advances that have been made, the collection of ferroelectric structures is a confusing picture of transition points, parallel and antiparallel displacements, hydrogen bonds, superlattices, and many other factors all of which, at one point or another, seem to play a key role in the development of ferroelectricity. The known examples of ferroelectric compounds grow in number at an increasing rate, but appear to defy any attempts to classify or systematize them. In fact, the study of ferroelectrics has served to reveal the inner complexity of many seemingly simple structures, which on closer examination have been found to exhibit a bewildering variety of first and second order transitions, by no means always associated with ferroelectricity.

The author has done her best to bring to bear the technique of crystal chemistry in combination with the current model theories for the physical properties of these crystals, but the failure of present-day theoretical methods is apparent. One reason why the discovery of ferroelectric barium titanate touched off such a storm of scientific investigation was that it was felt by workers in the solid state field that here was a structure basically so simple that it should be possible to evolve a unified theory relating the spontaneous polarization and other physical phenomena to the parameters of the structure directly. The investigations, especially in connection with the structure determinations, have proved to be far more difficult than had been anticipated, and the failure of a unified theory to emerge has been disappointing.

As Dr. Megaw points out, all of the model theories are based mainly on an analysis of the long-range electrostatic forces, and take no account of the short-range exchange forces involved in covalent bonding between the atoms. She stresses the need to take account of these latter forces in order to find the true source of ferroelectric behavior in crystals. Unfortunately, we are least well equipped to handle this part of the theoretical problem at the present time. Thus, we are brought directly to the fundamental problem of chemical bonding, and on this common ground solid state physicists, chemists, geochemists and mineralogists find each other standing side by side.

Dr. Megaw has enriched her book with cogent quotations from English literature at the

head of each chapter. The most appropriate is found before the introduction, from the "Testament of Beauty" by Bridges:

> "Wisdom will repudiate thee, if thou think to enquire WHY things are as they are, or whence they came: thy task is first to learn WHAT is."

This book makes it clear that in the field of ferroelectrics, we are still learning WHAT is.

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CHEMICAL ENGINEERING IN THE COAL INDUSTRY. Edited by FORBES W. SHARPLEY. 141 pp. Pergamon Press, London, 1957. Price, $8.50.

During a period when there is much discussion about atomic power and exotic solid fuels, it is interesting to read that the economy of Europe, including Russia, will be dependent for 20 to 30 years upon technical progress in the seemingly commonplace coal industry.

This short book contains seven technical papers presented at an international conference held in Cheltenham, England, in June, 1956. Subjects discussed cover briquetting, controlled oxidation, carbonization, and analysis and industrial use of low-temperature coal tar. Particular emphasis is placed upon the fact that, although coal is classified as a mineral substance, the extent of its heterogeneity is unknown in the ore-processing industries.

Information presented in the various papers summarizes recent developments in several European countries. Each paper is followed by an extensive discussion; in one instance a 6-page text is followed by 8 pages of comments. Data on engineering, scientific, and economic factors in the preparation and utilization of coal are presented in interesting fashion.

The book is attractive in its assembly, and the figures and microphotographs are excellent. Very few typographical errors were noted, but in future efforts of this type an attempt should be made to eliminate inconsistencies in units that arise during translation. Although expensive, the book is highly recommended as a source of information on recent European developments in the preparation of coal.

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EINFÜHRUNG IN DIE KRISTALLOGRAPHIE, by W. KLEBER. VEB Verlag Technic, Berlin, 1956, 312 pp., 316 figs., 44 tables. Price about $5.

The English philosopher Bertrand Russel stated in "The Analysis of Matter," p. 4, that "What were, in Peano's methods, primitive terms are . . . replaced by logical structures. . . ." The same process has taken place in many branches of geological science during the last five decades: The primitive terms, in our case unrelated observations on individual minerals, were replaced by logical structures; and we can understand the word structures even in a non-figurative way. Modern crystallography has provided a most remarkable, most valuable arsenal of logical concepts. In many ways it has thus counterbalanced the tremendous amount of new knowledge: by providing principles which reduce the number of unrelated data considerably.

Yet, in many schools mineralogy is still taught in the "old way" and the attitude is still alive that "what was good for many years will be good for many more," thus defying progress in science. Still a course in crystal structures is, in too many cases, pushed off into the graduate school, instead of forming an integral part of elementary crystallography.

Many attempts to condense the principles of crystallography exist in German, a few in English. However, a few only have been able to crystallize the most essential information into a course which is short and condensed enough to serve as a one semester textbook. Among these attempts KLEBER's new book appears to me to be the most successful one. On only 312 pages was he able to treat the subject of crystallography all the way from the symmetry principles and classes and the other aspects of morphological crystallography (p. 22–115), to crystal chemistry (p. 116–190), and to crystal physics, including excellent chapters on deformation, electrical and magnetic properties, optics and x-ray analyses (p. 191–299), followed by a ten-page index and a chart of the interference colors.

Again, one of the most outstanding features of the book is its clear and condensed style. The chapter on projections, e.g., takes up three and a half pages only, and yet the stereographic, the Schmidt, and the gnomonic projection are discussed in a well conceived way.

Building up on the tradition set by von Laue, W. H. and W. L. Bragg, Paul Niggli and V. M. Goldschmidt, this book is a masterpiece of teaching in the field of mineralogy.

The editors and printers have done a fine piece of clean organization and printing, and anyone interested in an excellent modern mineralogy textbook will want to add a copy of KLEBER's book to his library.

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