subjects of reduced cells and the Delauney reduction are dealt with in chapters 11 and 12 respectively.

Later sections of the book are devoted to identification, sources of error in measured spacings, and the problem of attaining high accuracy in lattice parameter determination. The chapter on errors is short but covers most of the important points clearly. A fair appraisement of ultimate limits of accuracy is given, and well-balanced advice is offered on the choice between analytical and extrapolation procedures in lattice parameter determination.

There is a final chapter on the appearance of powder photographs. The discussion is a most useful one because it is not until the various effects that are obtained by accident or design can be certainly recognized and explained by a practician that he will realize the full potentiality of the powder method. In this chapter air scattering, fluorescence scattering, general radiation scattering, causes of line doubling, maladjustment of the camera, misalignment of the track and so on are considered. Line broadening, preferred orientation, and crystal texture are briefly referred to but obviously not in sufficient detail to provide any basis for serious work on these topics. Not the least helpful items in this chapter are the four reproductions of sets of patterns illustrating several of the effects and faults mentioned in the text.

Lists of literature references are included at the ends of chapters. Though not by any means complete these show the reader where to turn for further information on the different subjects. Three appendices comprise quadratic forms for cubic, tetragonal, and hexagonal crystals, tables for conversion of d to $1/d^2$ (a useful innovation), and tables of extrapolation functions respectively. The combined subject and author index is adequate. The printing and binding of the volume are excellent and maintain the usual high standard set by most United States publishing houses.

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Ferroelectricity in Crystals. By H. D. MEGAW. Pp. xi+220 with many figs. and tables. London: Methuen. 1957. Price 27*s.* 6*d.*

Ferroelectricity is a fairly young subject that has so far led a rather sheltered existence. This situation is understandable for as yet it has not proved necessary to invoke it as a process basic to the interpretation of physical phenomena occurring outside a fairly restricted set of substances. Furthermore, in spite of obvious possibilities, it appears that no ferroelectric devices are yet in production, partly on account of their unreliability. However, ferroelectric crystals provide an interesting field for basic research and a mass of literature on the subject has steadily accumulated over the past two decades. The recent appearance of several books and review articles on the subject can be taken as a sign of its coming of age.

Dr Megaws' book is intended to cover certain aspects of the various ferroelectrics that had been discovered by mid-1955. Since that time many more ferroelectrics have been discovered (and, presumably, will continue to be discovered) and this leads to a possible criticism of the book—its usefulness may decline quite rapidly. On the other hand, at some time in the growth of a subject it is highly desirable to have a book available to serve both as a reference work and as a discerning review of early work.

Dr Megaw, who is primarily a crystallographer, believes that the key to the understanding of ferroelectrics lies in a knowledge of their structure, and this viewpoint is much in evidence throughout the book. Nevertheless, she has succeeded in making the book readable for those not trained in crystallography while making it, at the same time, a useful compilation of facts concerning those crystal structures discussed.

After an introductory chapter concerned, chiefly, with the very basic dielectric properties of ferroelectrics and anti-ferroelectrics, the author devotes separate chapters to Rochelle salt, the tetragonal phosphates, and barium titanate. In these chapters, the effect of temperature on the crystal structure and the dielectric properties, the nature of the phase transitions, and the mechanisms believed responsible for the ferroelectricity are discussed. Then follow two chapters in which structural considerations of the family of perovskite-type crystals are treated in some detail and Dr Megaw's approach to ferroelectricity becomes apparent. This section of the book is rounded off with a chapter on miscellaneous structures, the most recently discovered ferroelectric that is discussed being guanidine aluminium sulphate hexahydrate. These chapters provide a very good account of the crystal structures covered and are particularly informative in their discussions of the ferroelectric mechanisms. On the other hand, there are large omissions concerning the electrical properties of ferroelectrics—permittivity and polarization measurement as a function of temperature find a place in the book because of their obvious close connection with structure studies and theory, but, for example, the variation of the permittivity and dielectric loss with field strength or frequency, and relaxational (fatigue) effects are not mentioned. Such topics as well as other electrical properties have been well covered in a recent book on ferroelectrics by Sachse, and, in this sense, the two books can be regarded as complementary. Domain structures in barium titanate are described briefly and there is only an inadequate report of experiments on domain wall motion. Surprisingly, no mention is made of the energetics of domain formation and the sequence by which a crystal reverses its direction of polarization, subjects of vital interest to those concerned with the switching properties. Dr Megaw justifies omitting such topics as the piezoelectric effect and optical properties on the gounds that the former has been adequately treated elsewhere and that the latter has not yet been studied sufficiently.

The book concludes with three chapters on theories of ferroelectricity. In these a distinction is made between phenomenological theories (exemplified by Devonshire's, which is based on general thermodynamic principles) and model theories. The latter are based on the postulation of some mechanism in the crystal structure as being responsible for its ferroelectric properties, and other properties are then deduced. As a result, there are nearly as many model theories as there are types of ferroelectrics. The basic assumptions of, and the objections to, the various theories are stressed. The author concludes by again expounding her belief that the best road

to an understanding of ferroelectrics is by a knowledge of their structure, though she points out that this approach can be made quantitative only when considerably more is known about the nature of covalent bonds.

In short, this book will be found useful for its good coverage of the structural properties and the various theories of ferroelectrics but it does not contain, and its author did not intend it to contain, a comprehensive record of the electrical properties.

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Dislocations and Mechanical Properties of Crystals. By J. C. FISHER, W. G. JOHNSTON, R. THOMSON and T. VREELAND, Jr. Pp. xiv+634 with many figs. New York: Wiley; London: Chapman and Hall. 1957. Price £6.

This book consists of a series of papers (with discussion) presented at a small International Conference on Dislocations and Mechanical Properties of Crystals held at Lake Placid, on September 6th–8th, 1956. The conference was attended by 41 experts in this field, and by limiting the attendance to such a small number, it was possible to have useful stimulating discussions. There is little doubt that small conferences of this type are ideal for interchange of information and ideas between experts. The value of the conference is, however, enhanced enormously by recording the proceedings, and so enabling other research workers to become acquainted with the most recent developments. The editors of this report are to be congratulated on the very fine book which they have produced, which will be of great value to every research worker in this field.

The report is divided into eight parts corresponding to different subjects discussed at the conference. The first part deals with methods of direct observations of dislocations; studies are described in which dislocations are observed by 'decoration', etching, or transmission electron microscopy. These techniques of observation of individual dislocations have helped to put dislocation theory on a firm foundation. Many predictions of dislocation theory have been confirmed.

The second part consists of papers on the deformation of single crystals including a remarkable paper by Blewitt and his colleagues on twinning and low temperature deformation in copper. The next part, on work-hardening and recovery, contains a comprehensive review by Seeger (85 pages) on glide and work-hardening in f.c.c. and h.c.p. metals. On reading this paper one feels that whereas the properties of isolated dislocations are understood and have been confirmed in some detail, much remains to be done theoretically in relating the bulk mechanical properties to the behaviour of assemblies of dislocations, and experimentally in testing those theories which have been suggested. The paper by Boas on stored energy, resistivity, and density measurements on cold-worked metals underlines again the discrepancy between the observed resistivity and that calculated for unextended dislocations. Seeger attributes the discrepancy to stacking faults, but a full theoretical treatment is still required on this point.

A section on alloys includes a theoretical paper by H. Susuki on the yield strength of binary alloys as well as a number of experimental papers, in particular one on the deformation of alloy single crystals by Garstone and Honeycombe. It appears that more studies of this type are needed to elucidate the nature of hardening mechanisms in alloys.

The next part includes a review of internal friction phenomena due to dislocations (Lücke and Granato); this technique is extremely sensitive to the presence of dislocations and promises to be a powerful tool in the study of dislocations. Two papers on fatigue underline our lack of understanding of this phenomenon.

The short section on dislocation theory includes an important paper by Leibfried on thermal motion of dislocation lines, which has applications to the problems of thermal activation of dislocations at obstacles.

A few papers on whiskers are followed by a section on radiation damage, including papers by the Urbana and Oak Ridge Schools on annealing. The detailed interpretation of the complicated annealing characteristics and the precise nature of the damage are far from clear.

The nature of the papers presented at this conference is characteristic of the present trends in this subject. The theory of many of the basic properties of dislocations has been worked out, and it is clear that 'Dislocation Physics' is becoming an 'experimental' subject. It is now up to the experimentalists to test directly the predictions of theory and to suggest new directions in which the theory might be developed. On the other hand there is plenty of scope for the theorist in the study of the properties of assemblies of dislocations and of bulk properties of metals, as well as in the field of radiation damage.

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Splitting of Terms in Crystals. By HANS A. BETHE. Pp. 69. New York: Consultants Bureau, Inc. New York 11. 1958. Price $3·00.

It is a testimony for the solid and informative work published in this 1929 paper by H. Bethe that there is now sufficient demand for an English translation to be made. In fact, in re-reading the paper after a long period, one is all the more impressed by the author's sovereign application of group theory to the problem of the splitting of atomic levels caused by placing an atom in the electrical field of crystallographic symmetry which is created by the charges of the surrounding atoms. This predictable effect prepares the way for the discussion of further changes of the energy level scheme by electron exchange between neighbours. The main advance made recently beyond Bethe's treatment is the inclusion of spin interaction in the group theoretical treatment by Fiek (*Zs. f. Phys.* **147**, 1957, p. 307).

The translation is clear and adequate, and the price moderate.

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