

It must be unusual to find a physics book appraised by this standard, but it is an unusually well-illustrated book. Sequences of photographs are used to follow the progress of demonstration experiments; these contain in themselves material for detailed study and some interesting work with pencil and paper. Only one sequence fails to deliver its message; plate 54 shows a series of cinematograph frames of progressive waves, numbered at irregular intervals, and when the key to the arrangement has been found it appears that the period of the waves is twice that stated in the captions.

The general excellence of the book was commended in these columns when it first appeared, and the upper limit of its possible usefulness to university students in Great Britain was then considered. The present reviewer, thinking of its adaptability for use in schools, finds that some two-thirds of the work covers the ground of the usual advanced courses in secondary schools, and that the remainder, while beyond this standard, is presented so clearly that a good pupil interested in reading beyond the limits of his syllabus could readily follow it. Some parts of the 'syllabus' work are done in less detail than is customary in Britain, but this is amply compensated by the full and careful treatment of experimental dynamics, physical optics, and wave motion. It can be recommended as a valuable addition to the school science library, and the paper and binding are such as to stand up to the constant hard use it would sustain in this capacity.

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PIEZOELECTRICITY

Piezoelectricity

An Introduction to the Theory and Applications of Electromechanical Phenomena in Crystals. By Prof. Walter Guyton Cady. (International Series in Pure and Applied Physics.) Pp. xxiii+806. (New York and London: McGraw-Hill Book Co., Inc., 1946.) 9 dollars.

THE production of electric charges on certain crystals by the application of pressure was discovered by the brothers Curie in 1880. Until the First World War the phenomena were of scientific interest only, but with the researches of Langevin and Rutherford the use of ultrasonic waves became important in warfare at sea. Between the two Wars piezoelectricity became of great importance to radio in the control of frequency. During the Second World War millions of piezoelectric crystals were made for use in communications both by radio and by telephone. Corresponding to this intense industrial activity there has been a great development of the theoretical aspects of the subject.

The present volume has appeared at the end of one of the periods of most rapid development of the subject of piezoelectricity, and it is written by one who has contributed personally in large measure to that development. In its 806 pages it gives a comprehensive, detailed and reliable account of the subject, and it is at the same time a reference work and a text-book. It is mainly theoretical in treatment; few descriptions of apparatus occur, and the practical details of measurement are scanty. A few electrical circuits are given, but in general only the main features of these are mentioned.

The first seven chapters are concerned with fundamental theory of crystal elasticity, including vibra-

tions in crystals, and the dielectric properties of crystals. One important feature of these chapters is the explicit formulation of the various elastic and dielectric properties for plates and bars of any arbitrary orientation. For those who have occasion to work in this field, these detailed tables will be of great help. Chapters 8-12 deal with fundamental piezoelectric theory. This is one of the most valuable parts of the book, for it compares in a most lucid manner the various theories which have been advanced. Coming, as it does, just after the recent intensive study of the Rochelle salt group of crystals, this section of the book is most welcome, as it puts into proper perspective the relation between the piezoelectric properties of the Seignette-electric and the quartz-like groups of crystals. Chapters 13-18 discuss piezoelectric resonators—the theory, an outline of the methods of manufacture, the influences of air-gaps, electrodes and special cuts both for quartz and other crystals. Chapter 19 is devoted to the piezoelectric oscillator. The next 140 pages, Chapters 20-27, are concerned with the Seignette-electric crystals. The properties of Rochelle salt are exhaustively described on the basis of a critical survey of the literature. This is a most involved subject, largely because so much of the original work was done without a full appreciation of all the factors which affect the results, and the new reader will be grateful for this clear analysis. The last five chapters deal with certain applications of the phenomena of piezoelectricity, pyroelectricity, certain optical effects in crystals, a sketch of the atomic theory of piezoelectricity and a brief account of ferromagnetism designed to show its relation to the properties of the Seignette-electric crystals.

In the introductory chapter on crystallography there are a few points which might have been better expressed. On p. 15 a polar axis is defined as one "having at its two ends faces of different forms, with different numerical indices". This unqualified definition would not be accepted by crystallographers. Similarly, the statement "such vectorial effects as pyro- and piezoelectricity are found only with crystals having polar axes" is scarcely consistent with the piezoelectric character of class (222). It is also unfortunate that although the Hermann-Mauguin notation is mentioned in the introduction, it is not used in the text. Giving numbers to the crystal classes instead of the now accepted international symbols is a retrograde step. On p. 16 the statement "Two opposite vertices of a rhombohedron lie on the trigonal axis, thus forming a three-sided pyramid at each end of the crystal" will be confusing to the student who has been taught to distinguish between rhombohedra and pyramids as separate forms. On p. 34 the definition of a stereographic projection appears to exclude the possibility of points occurring outside the primitive circle. Crystallographers will also be surprised to learn on p. 36, "If the stereographic projection is desired for a face belonging to a hexagonal or trigonal crystal, for which the indices are given according to the Miller or the Bravais system, it is necessary first to calculate the relative intercepts of the face on the three orthogonal axes".

These relatively trivial criticisms would be inappropriate in reviewing such a great work were it not that a second edition will almost certainly be called for soon. In conclusion, it would be fair to say that this book does for the subject of piezoelectricity what Voigt's "Lehrbuch" did for the whole subject of crystal physics.

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