In the whole of this part of the book, and also in the second part, the deeper, purely quantum mechanical calculations from fundamental constants of the cohesive and elastic properties (as given by Hylleraas, Landshoff and Löwdin for some simple ionic crystals) are, unfortunately, only briefly referred to. The corresponding calculation by Schmidt for diamond is not mentioned. Although these calculations refer to rather special cases they give useful insight into the nature of the forces in crystals and have also, as Lundquist has recently found, an important bearing on the theory of the infra-red vibrations considered in the book. The necessity of introducing an 'effective' ionic charge then follows without *ad hoc* assumptions like those used in the book, thus emphasizing the value of the quantum mechanical approach.

The second part of the book contains in its first chapter the investigations of the adiabatic approximation and of the optical theory of molecular systems, and includes also a general treatment of the statistical mechanics of such systems under external forces. An interesting new treatment of this problem is given by Born in an Appendix. The following chapter forms a central part of the book. The authors give here a general theory of crystal vibrations and deduce the elastic and piezoelectric properties as limiting cases for long wavelengths and small frequencies. The methods used are those laid down by Born and v. Karman in their original papers and by Born in his book *Dynamik der Kristallgitter* of 1915. These methods are supplemented by those introduced by Ewald for the field caused by vibrating dipoles, whereby ionic lattices with their long-range Coulomb forces are incorporated in a consistent way. As shown in the book, the theory of elastic and piezoelectric properties can then be based on the most general quadratic expression for the potential energy corresponding to the short-range forces if the macroscopic elastic and piezoelectric equations, including the symmetry properties of the elastic constants, are assumed to be valid.

The reliance on macroscopic equations should be avoided in a consistant microscopic theory. For this purpose a different approach to the problem would apparently be required.

After the next chapter, where the thermal properties are considered in detail on the basis of the theory of finite deformations, there follows the important final chapter where an exposition is given of crystal optics, including applications to infra-red absorption, the Raman effect and the thermal scattering of light. Here the theory has met with considerable success in the interpretation of the measurements on the Raman effect.

No mention is made in this chapter of the original work by Ewald in which the foundations of this theory were given. Important generalizations and simplifications of the theory have, however, been achieved in the book.

The second part of Born & Huang's book is not easy to read, particularly because the authors write their formulae in a form as general as possible. It is hard not to get lost in the jungle of formulae and notations, although the authors have been careful in choosing their symbols. The intention of the authors in this part of the book has evidently been to give the general methods rather than to apply them to definite problems. Even so, a number of special assumptions have, however, been unavoidable and, in order to test them, more complete comparisons with experiments would have been of great use. The book would certainly also have been more valuable if the references given had been more complete and appropriate. In spite of this, however, the book is of great value in giving a thorough exposition of a wealth of methods of fundamental importance in crystal theory.

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Dielectric Behavior and Structure. By C. P. SMYTH. Pp. 441. New York; Toronto; London; McGraw-Hill. 1955. Price $9·00; 64*s.* 6*d.*

This book has been published in a chemical series and has been written primarily for chemists. It deals with many aspects of dielectrics, but its principal subject is the relation between dielectric behaviour and molecular structure, in particular the elucidation of the structure of molecules with the help of dielectric measurements.

The two first chapters deal with the theory of dielectric constant and loss. These are very well written and give an excellent introduction to the theory. The author himself is not a theoretician, and in some parts of these chapters he follows other authors very closely, but this is to the advantage of the book, as the material has been judiciously selected. The theoretical physicist will find those passages of considerable interest where the validity of the various theories is tested by comparison with experiment.

Concerning the treatment of dielectric loss, one criticism can be made which, however, applies equally to many other treatises on this subject. The loss is treated on a purely macroscopic basis and the concepts used are those of macroscopic physics and electrical engineering. These concepts are well established and easy to use, and as they are often encountered in papers on dielectric theory it is essential that the student become familiar with them. Nevertheless, the chemist, or, in fact, any reader who is interested in atoms and molecules rather than in electric condensers, voltages and charging currents, will find that these concepts alone do not satisfy him. To him the statement that the loss is due to the charging current having a component in phase with the voltage will appear not an explanation of the loss but merely a formalism to describe it. I think that, in addition to the macroscopic theory, an atomistic explanation of the dielectric loss should also be given, at least in a qualitative way. Many readers would understand the nature of the dielectric loss much better if they were told something about the atomic and molecular processes which lead to the transfer of energy from the electric field to the random internal motion of the dielectric.

The two introductory chapters are followed by several chapters dealing with the dielectric properties of gases, liquids and solids, and by one discussing measuring techniques.

This is followed by a very detailed discussion of the connexion between dipole moment, molecular structure and electronic configuration in the molecule, and by a number of chapters illustrating the conclusions concerning molecular structure which can be drawn from dielectric

measurements. As already mentioned, the treatment of this subject is excellent and very detailed. This is the subject in which the author is particularly interested; he is a great authority on it and he and his collaborators made many important contributions in this field. There is also a very large collection of experimental material, no doubt the largest available.

Many other aspects of dielectrics are also treated in the book, but they do not receive such detailed attention as the questions relating to molecular structure. It so happens that most of those subjects in which the crystallographer or the solid-state physicist is interested are treated very briefly. The treatment of ionic crystals is very sketchy, but there is a good summary of the behaviour of ferroelectrics which many readers may find of interest. As far as solids are concerned, the most interesting parts are those which deal with the order–disorder transitions above which dipolar molecules can change their directions in the crystalline state. In this respect much experimental material is presented, an important part coming from the author's laboratory.

In addition to the more or less free orientation of dipolar molecules in the disordered solid state, there is also another type of orientational polarization, much smaller than the former, but it persists at temperatures below the order–disorder transition. This is sometimes called librational polarization; in contrast to the usual orientational polarization, this type of polarization is not a relaxation phenomenon but is connected with a proper frequency of the crystal, namely with the frequency of the rotational oscillations of the molecules. This polarization is not mentioned in the book. So far there are hardly any experimental data available about it, but there is no doubt that it must exist. Its frequency is in a very awkward region experimentally, but its measurement would be of considerable interest because it would provide important clues concerning the intermolecular forces in solids.

In conclusion it can be said that the book treats many aspects of dielectric materials. It is written mainly from the point of view of the chemist, and in this respect it is very good indeed and undoubtedly the most important book available.

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Small-Angle Scattering of X-rays. By A. GUINIER and G. FOURNET. Translated from the French by C. B. WALKER. Pp. xi+268 with 78 figs. New York: Wiley; London: Chapman and Hall. 1955. Price $7·50; 60*s*.

The diffraction of X-rays at small angles is a relatively new subject which has already attracted a great deal of attention and has produced an imposing list of publications. The time is certainly ripe for a comprehensive review of the subject and this purpose is more than adequately served by the present book.

There are six chapters. The first is a short introduction of a few pages; the second is a comprehensive summary of fundamental theory; the third provides descriptions of experimental equipment; the fourth is concerned with methods of interpretation of experimental data; the fifth is concerned with the comparison of results with those obtained by other methods; and finally there are examples of actual applications. There is a 40-page bibliography compiled by K. L. Yudowitch.

To most X-ray crystallographers the subject will appear rather unusual. The reason is, of course, that while X-ray crystallography is mainly concerned with complete diffraction patterns, small-angle scattering is concerned with one order of diffraction only—the zero order. This is chosen partly because it is so strong and partly because it has the property that all the waves that produce it are in the same phase; that is, the paths do not differ by whole numbers of wavelengths. From the broadening of the zero-order diffraction one can obtain information about crystal imperfections that is not easily obtained by any other method.

The information is, however, extracted only with difficulty. The experimental conditions must be precisely controlled, and the results obtained must be accurately analysed. There is little doubt that there has been some over-optimistic work in the past, and the book serves a welcome purpose in describing in great detail the essential experimental requirements and the steps necessary in carrying out the theoretical analysis.

The chapter on general theory is long and rather daunting; it seems to cover every conceivable circumstance that can produce small-angle scattering and gives full details of the associated mathematics. The chapter on experimental methods is of the same high quality. In contrast, the final chapter is somewhat disappointing; a large range of subjects, from proteins to metals, is covered, but most of the conclusions are rather tentative and make sadly little use of the elaborate theoretical edifice created in the second and fourth chapters. Nevertheless, for the general reader, this final chapter will probably be the most useful, since it describes a variety of types of problem to which small-angle scattering can be applied.

To sum up, the book must be considered only as introductory. It lays a very solid foundation, but it demonstrates clearly that considerably more experience must be gained before quantitatively reliable results can be obtained from small-angle scattering.

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Bibliography of Hardness and Hardness Testing. Pp. ii+118. London: Industrial Diamond Information Bureau. 1955–1956. Price 5*s*.6*d*.

This is an extremely comprehensive bibliography of books, national standards and original articles on all aspects of hardness testing which should be invaluable to workers in this field. The bibliography includes not only work specially devoted to hardness testing, but also work in which hardness testing was used only as one of the methods of investigation. The period covered is from 1937 to 1955, the former year having been chosen for the beginning of the bibliography as it marks approximately the date when microhardness testing methods were first introduced. The majority of the entries give only author,