Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (M. M. Woolfson, Physics Department, University of York, Heslington, York YO1 5DD, England). As far as practicable books will be reviewed in a country different from that of publication.

Theory of X-ray and thermal-neutron scattering by real crystals. By MIKHAIL A. KRIVOGLAZ. Pp.xix + 405. New York: Plenum Press, 1969. Price $25.

This book is divided into two parts. In the first the theory of the elastic diffraction of X-rays and neutrons in imperfect crystals is discussed in detail. The imperfections which are treated include solid solutions in which the atoms not only have different scattering factors but also are permitted to displace from their equilibrium positions and to be correlated with one another, the finite dimensions of the crystal, and severely distorted crystals containing many dislocations. In the second part of the book the inelastic scattering is described. This part discusses the scattering by phonons from harmonic crystals and then goes on to show how this scattering is modified by the anharmonicity and by the presence of defects in the crystal.

As will be seen from the list of contents the range of topics covered by the book is very large and they are all treated so as to bring the reader up to the last developments in the field by the time the book was written in 1967. Indeed in many places the book is even more up-to-date because it contains results which have only become common knowledge since that time. The book certainly contains a wealth of detailed results which are not readily available elsewhere.

The book suffers because it contains so much and little space is permitted to discuss the significance of the different results. Consequently it is very hard, unless the reader is very familiar with the field, to appreciate the significance of these results. Likewise the pace of development in the book is enormous. Unless the reader has a very sound background in solid state physics and familiarity with scattering theory he will find it difficult to follow. In short the work is a useful addition to the literature but could have been much more useful if more concessions had been made to the reader at the expense of not including as many detailed results.

The book is reasonably well produced and does not have too many misprints. The index could have been better.

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Wave mechanics of crystalline solids, BY R. A. SMITH London: Chapman & Hall, 1969. Pp.xx + 553. Price £6·30 U.K. only.

A second edition of R. A. Smith's successful introduction to the theory of the solid state has appeared. There is greater emphasis on presenting theory for three-dimensional situations than in the earlier edition, and a short chapter on many-body theory with applications to superconductivity has been added. While there have been criticisms, in some quarters, of omissions of some fundamental topics, and of excessive orientation towards semiconductors, the book is a very valuable bridge between descriptive treatments of the solid state and some more formal and formidable books on solid state theory that have appeared in the last few years.

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X-rays and their applications. By J. G. BROWN. Pp. 258. London: Iliffe, 1970. Price (soft back) £1·50, (hard back) £3·25.

The author justifies the publication of this book by claiming that there is no really suitable up-to-date textbook on X-rays for undergraduates; the last edition of Compton & Allison was published in 1935, and this is still a definitive work. X-ray tubes have changed a great deal since then. But one can see the difficulties facing anyone who wishes to bring the subject up-to-date; the basic theory has not changed, and the developments in X-ray tubes involve only technical improvements, so that descriptions of apparatus tend to be mere catalogues. The justification for the present book is therefore largely that it is a much smaller and therefore cheaper book than has existed up to now.

All the standard aspects of X-rays are dealt with – crystallography, diffraction, spectroscopy, health hazards, radiography and general applications. The writing is clear, but tends to be rather 'schoolmasterish'. The author reminds us that $\cos^2\theta + \sin^2\theta = 1$, that an X-ray tube presents hazards only when it is switched on, and that the anode has to be insulated from the cathode! The depth of some of the theoretical discussions is disappointing; often, when a crucial point is reached, the author refers the reader to another book. I believe that, for a textbook, treatments should be complete in themselves.

The section on crystallography is particularly disappointing; in an attempt to avoid excessive length, the treatment becomes misleading in parts. As examples, a well-formed crystal is said to have the form of a regular solid, and the centre of symmetry is said no longer to be used as a fundamental symmetry element (presumably because its symbol is that of a onefold inversion axis). The author makes use entirely of axes of symmetry, and thus the monoclinic system is said to be characterized by a twofold axis; the mirror plane is not included, again presumably because its symbol can be $\bar{2}$. The relationships between systems, classes and space groups are also not clearly set out.

The best parts of the book are those concerned with X-ray tubes and their operation, and the diffraction of X-rays; these are discussed in full detail. The Compton effect is also treated thoroughly. To my mind, it would have

been better to have treated to the same standard other theoretical subjects such as X-ray spectra and dispersion, and to have compensated these additions by the almost complete omission of the chapter on crystallography, since adequate textbooks on this subject are already available.

The book was originally published in 1966, and the new issue is a limp-back edition apparently without any change. The author has therefore been saved the worse features involved in having to adapt himself to the use of S.I. units!

To summarize, the idea of this book is good, and it is useful to have around. But it should be considerably changed if it is to have the impact that it deserves.

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Laboratory experiments in X-ray crystallography. By LEONID V. AZAROFF and RAYMOND J. DONAHUE. Pp. vii + 135. London: McGraw-Hill, 1969. Price £2·85

The object of this book as stated in the Introduction is to provide a set of self-contained experiments which can be carried out by students who, for lack of time or adequate equipment, cannot be given a meaningful laboratory course.

Photographs are presented full size together with chart recordings, and the student carries on from that point. A description of the laboratory work is given which can also act as a check list for those who do have access to X-ray diffraction equipment.

The book has been designed as a supplement to standard textbooks which have to be consulted for every 'experiment'. Some of the explanatory material would therefore seem to be redundant, since it cannot be understood on its own, and could have been replaced by extending the references.

The 21 different aspects of X-ray crystallography included are: cut-out models for symmetry determination and indexing; stereographic projection; X-ray emission and absorption spectra; fluorescence analysis; Laue method (back reflexion); rotating crystal method; Weissenberg method; precession method; space group determination; structure analysis; powder diagram indexing (cubic, tetragonal and general); accurate parameter determination; identification; quantitative analysis; wire texture; sheet texture; crystallite size and residual stress analysis.

The treatment of many of these is excellent, but one wonders whether the 2½ pages devoted to the structure determination of the cubic mineral cuprite, which reduces to looking up the only two possible fixed special positions, really gives a student an insight into the problems of modern structure analysis.

One can sympathize both with the desire to be all-inclusive and to start the student off on simple problems, but there are dangers in this approach of giving a greatly oversimplified view of the subject. All the single-crystal 'experiments' are carried out with cuprite and, in fact, the 'rotating-crystal method' consists only of the interpretation of a rotation photograph of this crystal. There is not even a reference to an oscillation photograph. The rotation photograph was taken on a Weissenberg camera, and the authors apparently had no access to a standard rotation camera. This presumably explains the two statements, one in § 7 that 'the rotating crystal method is not well suited for crystal orientation' and in § 9 that 'it is a relatively simple matter to orient a single crystal on the precession camera'.

The method actually described on the precession camera is pure hit and miss. You take photographs at 10° intervals until you can recognize something (if you're lucky!). On the other hand, from a single oscillation on a properly constructed rotation camera, one can identify $K\alpha$ reflexions using the θ chart, measure the spherical coordinates of the reciprocal lattice vectors with the ϱ,φ chart and plot these on a stereogram to determine the orientation of the crystal and the corrections required. This is possible because of the much greater simplicity of the motion of rotation compared with precession and the consequent possibility of producing such charts.

One has the impression that the many desirable features of a precession camera have blinded some crystallographers, especially in North America, to its limitations and to the complementary desirable features of a simple rotation camera. At any rate, nothing of this appears among the experiments in this book.

It is in § 7 also that the description of the alignment of a camera against a tube occurs. Since this is claimed to be a 'procedural guide' as well as a description of an imaginary experiment it cannot go without criticism. With the tube shutter open and a fluorescent screen in front of the collimator, the beam 'is observed first by sliding the camera gently back and forth' and later while adjusting the legs. This is a very hazardous procedure and should be replaced by a system of optical alignment. It is true that as an afterthought the student is warned that care should be exercised to enclose the beam between the X-ray tube and first collimator slit because the 'X-rays can't be seen but can scatter, in full force, round 90° corners!'. Fortunately it is not as bad as that or our labyrinths would not be very effective. One suspects the author of this paragraph has had his photographs taken by his research students for a good long time! However that may be, it should be altered in the next edition.

I say this without qualification, because I am sure there will be a next edition. It is a pioneering work and pioneers not only produce something new, but inevitably make the initial mistakes. I hope that my criticism has been, in the main, constructive and that it will not overshadow my earlier judgement that at least three-quarters of the 'experiments' are excellent and the rest useful. I shall certainly use it in my own teaching and look forward to a second edition which will repair some of the sins of omission and the very few of commission.

I hope the authors will forgive me two final requests. One, that in their next edition they will refrain from claiming that, 'by providing all the material that is necessary to carry out each experiment, the student is relieved of much non-instructive drudgery even when extensive laboratory facilities and ample time are available'. If laboratory work is not possible, this book will be better than nothing, but its most important function will be as a supplement to laboratory work, which provides the insights that cannot be