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.

H. Lipson

Department of Physics
The University of Manchester
Institute of Science and Technology
P.O.Box No. 88
Sackville Street
*Manchester M*60 1*QD*
England

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the explanatory material would therefore seem to be redundant, since it cannot be understood on its own, and could have been replaced by extending the references.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 obtained in any other way. Second, would they change the three photographs which have been printed with white dots on a black background. The appearance of the precession photographs would put any student off the precession camera, which would be a pity, but in the back-reflexion Laue photograph, three of the annotating letters have got lost in the black background, which is a solid technical reason for having it the same as all the other excellent reproductions.

J. W. JEFFERY

Department of Crystallography
Birkbeck College
Malet Street
London W.C.L.
England

Festkörperphysik I & Festkörperphysik II. BY WOLFGANG LUDWIG. I:Pp. vi + 206; II:Pp. viii + 422. Frankfurt/Main: Akademische Verlagsgesellschaft. 1970. Prices not known.

Die vorliegenden Bändchen sind als Einführung in die Festkörperphysik gedacht. Es handelt sich dabei um einen Kurzgefassten Überblick mit mehr theoretisch-mathematischem Charakter.

Angesichts des geringen Umfanges wird ein sehr weites Gebiet behandelt, etwa entsprechend den beiden bekannten Werken C. Kittels. Daraus ergibt sich, dass Vieles zu knapp behandelt wird. Das gilt nicht nur für die experimentellen Aspekte, sondern oft auch für die physikalische Begründung der Theorie. Man findet z.B. kein Wort über die physikalische Natur der Austauschkräfte.

Vom Studenten wird einige Kenntnis der Quantenmechanik verlangt, gelegentlich auch etwas mehr. So werden etwa die Holstein-Primakoff'schen Transformationen, sowie auch die Onsagerschen Reziprositätsrelationen der Thermodynamik irreversibler Prozesse ohne Erläuterung verwendet.

In Band II, seite 223 wird die Knight-shift als zusätzliches Moment des untersuchten Kerns gedeutet, was zumindest als irreführend zu bezeichnen ist.

Die Bände werden, trotz dieser Mängel, neben einer ausführlichen Vorlesung brauchbar sein; gewissermassen als kommentierte Formelsammlung. Für das Selbststudium sind sie aus den oben angeführten Gründen nicht zu empfehlen.

H. BITTNER

Institut für Physikalische Chemie
Universität Wien
A-1090 *Wien*
Währingerstrasse 42
Österreich

Crystal acoustics. By M. J. P. MUSGRAVE. Pp. xv + 288. San Francisco: Holden-Day, 1970. Price: $24.00.

In recent years the elastic and inelastic properties of crystals, of ever increasing complexity, have been studied extensively with ultrasonic waves and neutron beams. This text by a well-known theorist provides an authoritative and up-to-date introduction to both the propagation of elastic waves in crystals and the dynamics of crystal lattices. It develops the mechanical and dynamical theory that is essential for an understanding of the anisotropy of crystalline solids. In many chapters experimental evidence for the validity of the calculations is provided, but this is a mathematical text and for a description of the experiments the reader is referred to recent papers and reviews. The result is a concise and logical treatment of the elastic properties of materials that will be welcomed by solid-state physicists, electronic engineers, crystallographers and geophysicists.

The first and major part of the book describes the mechanics of anisotropic continua and is divided into 16 chapters. The static and dynamic elasticity of crystals is developed from first principles for all crystal systems. The relations between the velocity, slowness (inverse velocity) and wave surfaces of elastic waves are derived for a general aeolotropic continuum and used to study the propagation of these waves in unbounded media of hexagonal, cubic, orthorhombic, tetragonal and trigonal symmetry. An introduction is given to some of the elastic properties of finite solids in chapters on reflexion and refraction, surface waves, vibrational modes of crystalline plates and rods and the elastic properties of structural materials (aggregates). In this part of the book the author has provided a concise statement of the tensor properties of crystals and shows clearly the relationships between the different conventions used in elasticity theory that have been so confusing to many students in the past.

The second part of the book is a brief introduction to lattice dynamics and is divided into 4 chapters. The dispersion relations for monatomic, diatomic and perturbed chains are derived and followed by the basic theory of the rigid-ion model of a crystal. This is subsequently illustrated by simple models of cubic crystals having metallic, covalent and ionic binding. Finally there are a few remarks on anharmonicity, phonons and phase transitions.

In such a good book there are only a few minor criticisms to be made. The rather pedantic distinction between the anisotropy of materials and the aeolotropy of crystal structures is not one universally accepted and hardly necessary. On the other hand it is a pity that the acoustical branch of the phonon dispersive curve is incorrectly called the acoustic branch, especially as the author is quite correct in his use of the adjectives dynamical and optical. There is a list of references and a useful bibliography at the end of each chapter, but the complex indexing of the references by chapter sections has led to some omissions and errors (*e.g.* 18.6.6, Fedorov is missing, while 18.9.1 is listed as 18.8.1, *etc.*). The usefulness of the five appendices listing the densities and elastic constants of many crystals, often to 4 significant figures, is severely limited, since it is not stated whether these are for the absolute zero, 0°C or room temperature.

These remarks should not discourage all those who study the crystalline properties of solids from reading this book. It is an excellent introduction to crystal acoustics, it is well written and amply illustrated with clear, precise figures. Unfortunately its exorbitant price means that it is likely to be found in institutional, rather than personal, libraries.

E. R. DOBBS

Department of Physics
University of Lancaster
Lancaster
England