Notes and News

Announcements and other items of crystallographic interest will be published under this heading at the discretion of the Editorial Board. The notes (in duplicate) should be sent to the Executive Secretary of the International Union of Crystallography (J. N. King, International Union of Crystallography, 13 White Friars, Chester CH1 1NZ, England).

Index of French laboratories producing mineral crystals

The Montpellier Documentation Centre has just issued a new index of French industrial and university laboratories which produce mineral crystals. This index supersedes the index prepared in 1967.

This index may be obtained by sending the sum of three francs (postage stamps) or four international reply coupons to Professor Vergnoux, Centre de Documentation sur les Synthèses Cristallines, Université des Sciences et Techniques du Languedoc, Place Eugène Bataillon, F-34060 Montpellier Cedex, France.

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.

The physics of phonons. By J. A. REISSLAND. Pp.xi+319, Figs. 70, Tables 29. New York: John Wiley, 1973. Price £7·00.

The range of this book is narrower than its title suggests. The author has deliberately limited his task by examining 'the physics of phonons' only in the ideal, nonmetallic crystal in which lattice dynamics is manifested in a pure form, without the complications encountered in a real crystal by structural defects and in a metal by the electron gas. Such limitation of the range of material is quite justified and the author has fulfilled his objective with great skill and brilliance. Reissland's book is characterized by the logic of his treatment and the strict selection of his material and the reader is thus acquainted in the most efficient way with modern methods, theory and applications of lattice dynamics. The book gives clear physical interpretations of the material with which it deals even in those chapters dealing with the mathematical formalism (as, for instance, chapter 6 devoted to Green's functions). An as example of this we may note the author's attitude to the chief topic of his book – the phonon. On page 9 the author draws a distinction between the quantization of electromagnetic fields and of the fields of sound waves in solids, which are really quite different in spite of the mathematical similarity in the description of the two types of waves. The author emphasizes that the consideration of the mechanical vibrations of the lattice as a gas of Bose particles is possible only at the transition to Fourier space. Every phonon represents one of the quantized normal modes of the crystal, the totality of which is represented by the nodes of reciprocal space. The contents of the book show the usefulness of the concept 'phonon', but the author stresses once more that it is convenient (but not obligatory) to describe vibrational lattice states as particles.

The logical progression of the book is shown by the sequence of its chapters (1. Phonon. 2. Dispersion. 3. Vibrational states of a crystal. 4. Phonon statistics. 5. Phonon–phonon interactions. 6. The Green's functions formulation. 7. Lattice Dynamics as applied to ..... 8. Interaction of phonons with other 'ons'). The titles of the two last chapters need some explanation. In Chapter 7 the author examines from the viewpoint of lattice dynamics the energies and the life-times of phonons, the thermodynamics of equilibrium processes and the different physical properties of a crystal in the harmonic and anharmonic approximations – figuratively speaking about 'bare' and 'dressed' phonons. A broad range of physical properties of a solid is discussed in the same chapter: thermal expansion, elastic constants for crystals with and without a centre of symmetry, their temperature dependence, the attenuation of ultrasound, thermal conductivity, dielectric properties, piezoelectricity and ferroelectricity. In Chapter 8 there is considered the interaction of phonons with other 'ons', such as infrared phonons, photons of the three ranges of energy (optical, X- and γ-rays), neutrons, electrons, with generalized excitations (the so-called generalons), excitons, magnons and finally with the excitations caused by the imperfections of a crystal. This recapitulation of the contents of the two last chapters illustrates the range and interest of the crystal-physics topics treated by the author on the basis of lattice dynamics, the equations of which are written in the coordinate space of an object and on the base of the phonon set in the space of the impulses. The content of these chapters fully justify the title of the book. Some additional topics connected with the calculus of finite differences and with different models are given in a number of appendices. Every chapter includes a number of references – mostly papers and reviews that have appeared in the last few years. These references are the 'Ariadne threads' handed by the author to a reader in order to find his way through the voluminous labyrinth of the relevant scientific literature.

As a general observation let us look at the treatment in Section 4.8 of the thermodynamical heterogeneous process – melting – as a homogeneous process. On page 132, according to F. Lindemann, as the melting temperature is reached the amplitudes of the thermal oscillations are so large that the particles are no longer held in an equilibrium position by intermolecular forces and so the lattice is destroyed. Such a treatment may be applied to sublimation, when a sublimated particle looses its bonds with the other particles of a crystal, but it should not be applied to melting,

when only a fraction of the bonds are broken (about 10–15%, as is well known). On page 136 it is assumed, according to M. Born, that melting occurs at the temperature when the rigidity modulus, G, equals zero. The loss of elastic stability corresponds to the breaking of the condition of homogeneous stability, which happens at a temperature not reached by experiment since the condition of heterogeneous equilibrium is disturbed at lower temperatures, which corresponds to the equality of the free energies of the two phases: crystal–liquid. It has to be mentioned that thermodynamically incorrect treatments of melting as a homogeneous process can be found in the papers and books of some other authors. It should be said, by the way, that in Table 4.10 incorrect values of the interatomic distances are given for the diamond-type structures (for diamond and silicon the lattice parameters are given with a misprint for the latter values).

In conclusion one may say that Reissland's book is an interestingly planned and useful monograph giving an account of the contemporary state of one of the most important parts of the physics of solids – the physics of phonons. The language of the book is simple and clear. Every chapter has a brief formulation of the basic theory and an account of obtained results and the book is illustrated by a number of well chosen figures. All this facilitates the use of the book. This book will undoubtedly find a wide circle of readers, from youngsters only beginning to study the principles of solid-state physics right up to the specialists working in this field who must take account of the influence of temperature and the thermal motion of atoms on the structure and properties of solids. The study of Reissland's book presupposes a knowledge of the general basics of the physics of solids and of quantum mechanics. The book should be useful not only to theoreticians, but also to experimentalists.

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X-ray diffraction by polymers. By M. KAKUDO and N. KASAI. Pp.xii + 464. Figs. 238, Tables 44. Amsterdam: Elsevier, Tokyo: Kodansha, 1972. Price *f* 125.00 (about U.S $48.10).

In writing this book on X-ray diffraction by polymers the authors' stated purpose was to provide 'an intermediate textbook bridging the gap between primers and specialist works', and on the whole they have been very successful in achieving this. The book is divided into three sections: Fundamental (seven chapters, 148 pages), Experimental (one chapter, 66 pages), and Analytical (six chapters, 216 pages); there is also an appendix, mostly of numerical tables, of 17 pages. The amount of space allocated to experimental techniques is perhaps disproportionately small: much is mentioned, but little is treated in detail. The gaps are partially remedied in the numerous applications to particular substances and particular problems in the analytical section, but this supplementary material on experimental methods is not systematically indexed or cross-referenced.

The fundamental section is thorough, beginning with the properties of X-rays, and proceeding through the theory of scattering by assemblages of atoms of varying degrees of order, to a brief but clear discussion of crystal symmetry and crystal structure. As would be expected, the Hosemann 'paracrystal' gets a good deal of attention. The section ends with a brief chapter summarizing the relationship between structure (including texture) and the X-ray diffraction intensity, and a slightly longer one putting forward models for the structure (texture) of high polymers.

It is perhaps worth while to list the chapters in the long analytical section, in order to give an adequate picture of its scope. They are: Identification of crystals by X-ray diffraction; Analysis of crystallite orientation; Crystal-structure analysis of high polymers; Analysis of the breadth and shape of diffraction patterns; Analysis using the total diffraction intensity distribution curves of high polymers; and Analysis of small-angle X-ray scattering. It is this part of the book that the reviewer found most impressive, with its numerous fully described practical illustrations. There are points about which one could quibble: the 'ASTM file' has been the 'JCPDS file' for many years now, and the Scherrer constant perhaps deserves a fuller treatment; but it is from this section that the beginner in the study of high polymers will begin to get a feeling of what has been achieved and what can be achieved.

The translation, by a London translation service, reads smoothly. The translator's name is not given. Very few misprints were noted, most of them in the six-page subject index. There is no author index.

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Multivariate error analysis. By A. A. CLIFFORD, Pp. ix+112, Figs. 8, Tables 4. London: Applied Science, 1973. Price £4.00.

Crystallography is not the only branch of science in which one becomes involved in determining a number of parameters from a much larger number of observable quantities. The parameters can be determined by least-squares techniques but in order to determine correctly the probable errors one must resort to multivariate analysis, which takes account of the covariance of the parameters.

This book deals with the theory of multivariate analysis in a clear and concise way which does not assume too much initial expertise on the part of the reader. The work is well printed and is in an attractive format with important equations boldly delineated.

The main part of the book occupies 82 pages, the remaining 30 being devoted to bibliography (one page), computer programs in Algol and Fortran and an index (two pages). The small size of the book is in disappointing contrast to its price.

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