Notes and News

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Kathleen Lonsdale Lectures

As a result of a suggestion from the Bragg Lecture Fund committee, the Kathleen Lonsdale Lectures have been established by the British Crystallographic Association to commemorate her achievements. These lectures are intended to educate the public in the science of crystallography and will be given at the annual meetings of the British Association. The first one will be at 2 pm on 27 August 1987 at the British Association meeting in Belfast, Northern Ireland, and will be open to the public. The lecture will be given by Professor David Blow and the title of the lecture is 'Protein Crystallography Applied to Medicine and Industry'.

Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (J. H. Robertson, School of Chemistry, University of Leeds, Leeds LS2 9JT, England). As far as practicable books will be reviewed in a country different from that of publication.

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Physikalische Kristallographie. By PETER PAUFLER. Pp. xi+325 (in German). Berlin: Akademie-Verlag, 1986. Price 42.00 M; and Weinheim: VCH Verlagsgesellschaft, 1986. Price DM 118.00.

The title of this book immediately recalls the classic work by J. F. Nye, *Physical Properties of Crystals*, published in 1957 by Oxford University Press.

Paufler's book describes the physical properties of crystals in the homogeneous anisotropic continuum approximation. The crystal symmetry is then reduced to that of the point group. The physical phenomena considered are those linear ones which can be expressed by means of tensors, and they are classified according to the rank of the tensor (up to four). The subject is thus essentially the same as in Nye's book, but Paufler includes sections which give a short clear discussion of the basic physics underlying the different phenomena he treats. He uses a coordinate-free notation for the tensors, not really that which a mathematician would adopt but a dyadic one, but I do not think this should cause any difficulty.

The strength of the book lies in the way the physical phenomena are approached. First, a clear and synthetic exposition of the experimental observations is given. A phenomenological description, making use of Maxwell's equations and/or thermodynamics, is then presented in terms of tensors and taking symmetry into account. Following this the author goes deeper into the analysis of the physical phenomena by considering microscopic models based on classical and/or quantum mechanics. Finally applications are discussed and, where relevant, also the inverse effects.

Symmetry appears on two different levels: an external or geometrical one connected with the crystal structure, and an internal or permutational one depending on the physical phenomenon. The geometrical symmetry is given by the point group and acts on the components of the tensor. The internal symmetry acts on the indices of the tensor components and characterizes their transformation properties with respect to permutation of indices. For example, in the case of the dielectric constant described by a second-rank tensor, the thermodynamics of a polarizable medium in an external electric field implies that the tensor is symmetric, *i.e.* invariant with respect to two-indices permutation. The point-group symmetry then admits a classification into isotropic, axial and biaxial systems. In these cases the internal symmetry can be described in terms of tensor surfaces (of second order), which have to be invariant with respect to the point-group transformations. The nature of the surfaces is a geometrical expression of both the external and the internal symmetry. Such a pictorial method is, however, restricted to the symmetric tensor case.

The result of this effort in understanding the phenomena at various levels of description is a book which goes beyond an exposition of tensorial properties of crystals in the macroscopic approximation and represents a kind of solid-state compendium. Despite the fact that the crystal lattice translational symmetry (and the space group) lies beyond the range of the book, one finds an elementary exposition of electrical conductivity in terms of one-electron Bloch states and electronic energy bands. Even the phenomenon of superconductivity is discussed, but of course very briefly.

The content of the book is rich. It is remarkable how many physical phenomena the author is able to present in an understandable way in about 300 pages. Typical is also the fact that the author does not neglect the zero-rank tensors (scalar properties), which can be considered trivial from the point of view of symmetry, but not from that of physics.

Without trying to be complete, I shall give a list of the physical phenomena discussed in the book:

Rank-zero tensors: density, heat capacity, optical giratory power.

Rank-one tensors: pyroelectricity, pyromagnetism, electro- and magnetocaloric effects.

Rank-two tensors: stress and strain, thermal expansion, thermoelasticity, dielectric constant and crystal optics, birefringence, electron and ionic conductivity, superconductivity, thermal conductivity, thermoelectricity, Seeback, Peltier, Thomson and Bridgman effects, diffusion.

Rank-three tensors: piezoelectricity and piezomagnetism.
Rank-four tensors: elastic modulus and elastic constants.

It is worth mentioning the presence of a list of some 350 references for the reader who wishes to go beyond the treatment presented. In summary, the book gives a clear and easily comprehensible view of tensor properties in crystals supplemented with informative discusssions of the physical background. It would be suitable as a text book in a course at graduate level. For working scientists it can be used as a very good first reference book to be consulted before going further into the subject. It would certainly be worthwhile to consider an English edition.

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X-ray instrumentation for the Photon Factory: dynamic analyses of micro structures in matter. Edited by S. HOSOYA, Y. IITAKA and H. HASHIZUME. Pp. xiv+357. Tokyo: KTK Scientific Publishers; and Dordrecht: D. Reidel Publishing Company, 1986. Price Dfl 228.00, US $94.50, £66.50.

In the late 1970s, Japanese crystallographers initiated a program, supported by grants-in-aid from the Ministry of Education, Science and Culture, to promote the development of new experimental techniques and instrumentation for all aspects of structure analysis. The particular intention was to ensure that these techniques should be available as soon as possible after the commissioning of the 'Photon Factory', the dedicated Japanese synchrotron radiation facility. The main emphasis was on X-ray optics, high-count-rate position-sensitive detectors, new diffractometers and X-ray cameras and on the provision of high- and low-temperature and high-pressure environments for the specimen. The program was highly successful and visitors to the Photon Factory have been impressed by the beautiful engineering and the finished appearance of the instruments there.

The stated intention of the present monograph is to help overseas readers to improve their understanding of the techniques in the various fields which have been developed in Japan. Individual chapters devoted to the fields mentioned above contain separate articles by different authors. These accounts are well written and the excellent quality of the drawings of instruments, in particular, enables the reader to study details of construction. Japanese workers have been particularly active in the field of real-time topography and in the application of energy-resolving solid-state detectors. There are full descriptions of the 5 μm resolution X-ray-sensitive TV camera tube developed for X-ray topographical work at the NHK Laboratories and also of a versatile topography camera embodying a more orthodox video camera with an external phosphor. The use of position-sensitive solid-state detectors is discussed in several articles. Other Japanese specialities described in the monograph are the integrating multi-wire detectors of Hasegawa, Mochiki and Sekiguchi, the multi-layer-line-screen Weissenberg camera of Sakabe and his co-workers and the use of toroidal X-ray imaging mirrors by Sakayanagi. Even where closely comparable work is being done in other countries the specialist will find much to interest him in such diverse accounts as those of the construction of a diffractometer designed to operate with single-crystal samples in magnetic fields up to 20 kOe (1590 A m^{-1}) at temperatures below 1 K, the use of flexure hinges in the design of high-resolution goniometers or the layout of a fibre-diffraction scattering bench.

The monograph presents the state of the art as it was at the Photon Factory in about 1982 and so contains little which has not found its way into the literature in other publications. Indeed, there are some omissions, such as the recent development of image plates which have been utilized in the Sakabe Weissenberg camera and in the muscle diffractometer, both of which are described here in earlier forms. The advantage of the present collection, however, is that the diverse topics are discussed here in a readily accessible form which enables one to gain a general impression of the Japanese effort in the field. The impression is one of very sound rather than very innovative engineering, coupled with very elegant design. It must be a pleasure to use some of the instruments described here.

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Crystal growth processes. By J. C. BRICE. Pp. x+298. Glasgow, London: Blackie; New York: Halsted Press, 1986. Price £29.00.

This book is devoted to the scientific and practical problems of large-scale crystal growth. It is intended for research workers for whom the formation of crystals is not their major speciality. As acknowledged by the author, the book gives an introduction to what is known about crystal growth and the methods of growth which are in commercial use.

The first part of the book (chapters 1 and 2) discusses the basic modern concepts of the fundamental phenomena of crystal growth. The author begins with a brief exposition of the history of the subject, then describes some of the current uses of single crystals and gives a classification of growth methods. Chapter 2 looks systematically at those aspects of the theory which have wide application, starting with some crystallographic concepts. The formation of defects in crystals is considered in detail in this chapter, with the introduction of some thermodynamic ideas; also, phase relations and growth kinetics - the driving force for crystallization and transport processes - are described here. The choice of literature sources for these chapters testifies to a good knowledge of the subject.

More specialized theory is given, as appropriate, in chapters 3-11, which discuss methods of growth which are