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.