There follows a treatment of scalars, vectors and tensors that concentrates particularly on their relationships with the point groups.

A chapter on the symmetry of space and time includes a brief account of the symmetry theory of elementary particles as well as a discussion of the relative motions of galaxies in terms of space-like and time-like intervals. These highly theoretical topics of modern physics may seem out of place in a book bearing such a title as this one, but they serve to underline the thesis that all phenomena determined by conditions of symmetry are dependent on invariance with respect to the inversion of time. The stability of elementary particles is further discussed in an Appendix.

The book goes on to consider phase transitions in crystals. The symmetry relations that determine these are discussed in detail, as are the phenomena of pyroelectricity and piezoelectricity. Finally, some aspects of the optical properties of crystals form the subject of a separate section.

Throughout the book, the treatment is very theoretical and relies greatly upon fundamental considerations. The point is made strongly that natural phenomena can occur only if symmetry relationships permit them, but that not all changes so allowed will necessarily happen in practice. The exposition is clear, and the book should be useful to those wishing to gain an insight into this fascinating subject.

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Quasicrystals, networks and molecules of fivefold symmetry. Edited by I. HARGITTAI. Pp. xiii+314. New York, Weinheim, Cambridge: VCH Publishers, 1990. Price £55.00. ISBN 0-89573-723-X.

This expensive but attractive book is a collection of 19 short specialist essays, connected by the single theme of fivefold symmetry.

Fivefold symmetry will always have a certain fascination for crystallographers. It is the symmetry governing two of the five regular polyhedra of Plato and it is a symmetry extremely common in biology, yet it is the first 'forbidden' symmetry for crystals. Only in the past ten or so years has this situation rather suddenly changed, for we now know that fivefold symmetry *can* fill space, only not periodically.

This change began quietly enough around the 1950s, on the far periphery of crystallography, in the mathematics of tiling (two-dimensional space filling), and advanced most notably when Penrose's paper of 1974 on 'The role of aesthetics in mathematical research' (a discussion with no apparent relevance to crystals) produced the paradigm 'Penrose tiling'. All this was abstract mathematics, even when Mackay, in 1981, generalized this nonperiodic tiling into three dimensions. But when Schectman and his colleagues in the US Bureau of Standards published electron diffraction pictures of fivefold symmetry obtained from micrometre-size grains of an aluminium alloy, crystallographers had to take notice. That was in 1984. Since then, about a thousand research papers have followed 'directly from the stimulus of that discovery' (Mackay's comment).

Not everything has changed, of course. The great majority of solids remain periodic, but the incidence of fivefold symmetry in certain special cases, forming 'regular' if not periodic solids, able to give high-quality diffraction, is important. These solids are now properly called quasicrystals. Hence the title of this book. This development has enormously spurred theoretical work on the mathematics of lattices in general - for 5-, 7-, 9- and 12-fold symmetries, in N-dimensional spaces, and so on - during the past decade. It is clear that good-quality quasicrystals are not easy to produce. They require quite special shapes of the packing polyhedra, they come only from certain special alloys, they require long annealing to be more than micrometre sized and they come with compositions such as $Al_{63.5}Cu_{24}Fe_{12.5}$. These restrictions and isolated cases of apparent fivefold symmetry observed since the earliest days of crystallography have led some researchers, notably and most recently Pauling, to argue that they could be explained by specific types of twinning associated with an unusually large cubic unit cell. Pauling's explanation has been very carefully tested by Dunlap and his collaborators at Dalhousie University and their findings (reported in detail in Chapter 6 of this book) show that it is definitely inferior to analyses based on true quasicrystallinity. We may take it that quasicrystals are real; they are also exciting, especially to theorists.

For crystallographers who wish to get up to date with these developments, Professor Hargittai of Budapest has provided this album of specialist essays. Hargittai himself has contributed only the six-sentence Preface; but he has assembled no fewer than 37 distinguished authors (from 9 countries) who have supplied 19 separate articles to cover as much as possible of this exotic field.

The first 12 essays focus on quasiperiodicity: tilings of all sorts, with fivefold and other symmetries; whereas the next 6 are concerned with fivefold symmetry in isolated molecules, principally the new icosahedral molecule C_{60} (which is the subject of four essays on its history, energy levels and vibrational modes). The final chapter is a short essay on the fusion of five-membered carbon rings - essentially an essay in organic chemistry and somewhat removed in tone from the rest of the book.

Each one of these essays is quite brief. There is little unity among them other than that they are all involved with fivefold symmetry of one sort or another; their order in the book does follow their subject orientation. A great variety of tilings and elaborate theoretical discussion are much in evidence, both in the text and in the numerous diagrams. A highlight is the essay by E. J. W. Whittaker and his coauthor R. M. Whittaker on fivefold symmetry in higher-dimensional spaces, for which there are six colour plates showing, stereoscopically, stick models that are three-dimensional projections of various four-dimensional structures. The principal highlight for this reviewer is the chapter exhibiting real quasicrystal specimens. This is a 14 page article by Denoyer, Heger & Lambert, of Université de Paris-Sud and CEN-Saclay. It shows a visibly pentagonal dodecahedral quasicrystal of a few tenths of a millimetre in diameter and another of triacontahedral symmetry, glued to a glass fibre, plus superb pictures of precession-type X-ray diffraction by these same specimens.

The delightful essay by Mackay, of Birkbeck College, University of London, is well worth reading in its own right and, considering the role that he has played in the development of this subject, it is fitting that he should have the honour of writing the introductory chapter. With broad coverage and innumerable scholarly asides, Mackay succeeds in mentioning magic, determinism, chaos, religion, the date of Easter, Olber's paradox and the legal profession, as well as the Babylonians and the Greeks. His article also contains a charming example of the absence of cohesion between the contributors, characteristic of this kind of book: Mackay refers to the synthesis of the 'Platonic' molecule $(CH)_{20}$, as an 'Everest of alicyclic chemistry', hoping (p. 15) that it could be crystallized and its structure determined; Kuck, of Universität Bielefeld, in his article at the end of the book (p. 290), casually mentions this same molecule as 'of course ... well established ...', giving the reference to its structure determination, which was published in 1986!

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Introductory solid state physics. By H. P. MYERS. Pp xi + 546. London: Taylor and Francis, 1990. Price (paper) £18.00. ISBN 0-85066-761-5.

This is an undergraduate textbook aimed at the second/third-year level. The author's stated objectives are to limit theoretical demands, use simple models, provide reasonable coverage and include some present-day research. These aims have been beautifully fulfilled in an eminently readable fashion. Several good points make this book better than average. There is a splendid introduction that explains the subject matter of solid-state physics and that impresses upon the reader the rewards of studying this subject. Chapter 1 is an unusual opening; it gives the reader a feeling for the magnitude of experimental fields, the phenomena found in the subject - such as superconductivity - and a tour around the Periodic Table. The next four chapters deal with properties other than electronic ones, including X-ray characterization, defects in solids, and phonons. There follow three chapters on the basics of electrons in materials, including free-electron theory, periodic potentials and cohesion. The origin of band gaps - a difficult concept - is dealt with cogently in Chapter 7, beginning with a simple Bragg reflected and transmitted plane wave. The author then explains Brillouin zones and other lattice effects before attempting a full solution for the nearly free electron model. The remainder of the chapter introduces band structure and the density of states in different materials. This is an important point since *pictures* of the density of states convey much insight. Metals, semiconductors, magnetic properties and dielectric properties each have a chapter. This forms the author's notion of a basic coverage. The specialist topics are: superconductivity, surface physics and the nucleus in solid-state physics - particularly NMR.

Modern topics appear frequently throughout the book: the quantum Hall effect, organic semiconductors, high-T_c superconductors and magnetic bubbles - to name a few. The subject matter is nicely dealt with, featuring many experimental results and lucid diagrams. Asides are put into special boxes and complicated mathematics are relegated to Appendices - in fact BCS theory is explained without equations! Each chapter has a list of references and most have problems. Some problems are not numerical, but are questions requiring a descriptive answer; only the numerical problems have answers at the back. I recommend this book and, as an additional endorsement, add that it is the textbook used at Leeds for our third-year solid-state physics course.

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Books Received

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The following books have been received by the Editor. Brief and generally uncritical notices are given of works of marginal crystallographic interest; occasionally, a book of fundamental interest is included under this heading because of difficulty in finding a suitable reviewer without great delay.

Salt effects in organic and organometallic chemistry. By A. LOUPY and B. TCHOUBAR. Pp. xiv + 322. Weinheim and New York: VCH Publishers, 1992. Price DM 164.00. ISBN 3-527-28025-1. A translation of the 1988 French edition, the book sets out to show the importance of the part played by salts in the development of chemical reactions in solution.