

sally regarded as the epitome of representation'. Locke in the eighteenth century argued that human understanding can no more block out physical sensations than can a mirror refuse to reproduce the objects set before it. From this, Miller explores a possible philosophical parallel between a perception and a reflection, but is keen to not overlook their fundamental differences. Unlike a reflection, which I can compare with the object that is its source, I cannot compare a perception – for example of houses on the other side of the street – with its *unperceived* appearance. I have to take their representational character on trust. Reflections, then, Miller concludes, are not everything. But surely here he misses a trick, despite setting out the relevant elements at the beginning of the book? For what we see of the houses opposite is only a 'reflection' of part of the illumination that fell on the houses. So all our visual perceptions surely *are* only through (usually imperfect) reflections?

The book is enjoyable, interesting and stimulating. I have a nagging feeling – reinforced in discussions with others who have independently come to a similar conclusion – that Miller has tried to build up too much superstructure on the reflection concept (in some cases, his arguments hold equally for non-reflected images), but you can take what you want from what is offered. The surface texture of the pages is such as to show a little too much reflected gleam when read in a strong light, but perhaps that was designed in purposely to demonstrate a point? I came away with a strong message that what works in a picture depends as much on the viewer as on the artist, though I believe that Miller underestimates the technical skill that an artist puts into representing something as a reflection in favour of arguing that the context is more important. For a scientist who deals with the details of reflection, rotation and coordinate transformations all the time, some of the tricks which Miller argues are used to draw us to conclude something about an image may not be totally successful. But our perception is no less valid for that. The artist can't always get it right for everyone. Miller's view from his perspective is valid for himself, as is mine for me. And the perceptions of each of us are influenced by what we understand and know – or don't understand and don't know. How I look at a picture, how I decode the clues the artist has left, depend upon my own conceptual baggage, which is not necessarily the same as someone else's. There is danger in overgeneralizing to imply that we all look at things in the same way, and can be 'misled' by clues in the same way. That we can respond differently makes artistic perception all the richer.

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*Acta Cryst.* (1999). A55, 972–973

**Physical properties of quasicrystals.** Edited by E. M. STADNIK. Pp. xvi + 438. Berlin and New York: Springer Verlag GmbH, 1999. Price DM 198, US \$134. ISBN 3-540-65188-8.

Quasicrystals were discovered in the 1980's. They are basically made of metals but exhibit a well ordered nonperiodic arrangement of atoms with long-range rotational symmetries. This unique structure has attracted considerable attention and its detailed determination has been the subject of many studies. The peculiarity of quasicrystals extends also to properties such as heat conduction, diffusion constants, phase transition, electron transport phenomena and mechanical behaviour. Since the beginning, quasicrystals have been objects of considerable cross disciplinary interest and a score of books (in English or French) has been published on different aspects of the subject, ranging from mathematical treatments to materials science.

The Editor's stated objective was to produce a comprehensive research-level monograph on the physical properties of quasicrystals. The book is 'intended for researchers in the field of the physics of quasicrystals, solid-state physicists, materials scientists, crystallographers, as well as for graduate students working in the area of new materials'.

The book is a collective work, involving about 20 scientists well recognized in the field of quasicrystals. The chapters have been written independently on various aspects of the material of interest. Using a panel of competent authors is certainly the best way to produce a monograph with the desired breadth and depth of coverage in all chapters. However, the possible drawbacks of this approach, in the absence of rigorous overall editing, are repetitions or, worse, contradictions and a lack of proper introductory material. These drawbacks have not been completely avoided here, as will be illustrated in our detailed analysis of the book.

After a short general introduction by the Editor, the book starts with Chapter 2 on the metallurgy of quasicrystals by An Pang Tsai, the man at the origin of the discovery and preparation of most of the stable quasicrystals. The chapter describes the several routes that may lead to quasicrystals, proposes classifications and introduces the field of phase transformation. The weak point may be the section devoted to phase diagrams where the most spectacular results published so far (notably on AlCuFe and AlPdMn) are not included.

Next come two chapters basically devoted to structure, by Walter Steurer & Torsten Haibach (Chapter 3) and Michel Boudard & Marc de Boissieu (Chapter 4). Chapter 3 is certainly one of the very good chapters in the book and crystallographers will find it interesting and well presented. Both chapters deliberately treat quasicrystals as perfect quasiperiodic structures with recovery of periodicity in a higher-dimensional space. This leaves out of the book consideration of three-dimensional approaches, such as varieties of random tiling and cluster models.

The lion's share of the book is devoted to electronic properties (Chapters 5–8, although Chapter 7 also includes other elementary excitations such as atomic vibrations). Two chapters focus on experimental results – mainly transport properties and spectroscopy – while the other two present models for electrons and phonons in quasicrystals. These four chapters overlap heavily and contain much repetition. Some contradictions may also confuse the average reader; for instance, Fujiwara in Chapter 6 emphasizes the importance of atomic clusters to explain narrow peaks in the density-of-states (DOS) and power-law dependence, while Hafner *et al.* in Chapter 7 repeatedly claim that eigenstates cannot be on clusters. This part of the book is, however, well documented and will be of

interest to experts in the field, even if it proves a more difficult read for the novice.

Chapter 9, by Kazuaki Fukamichi, is a report on the magnetic properties of quasicrystals. The chapter unfortunately has a basic weakness in that it fails to differentiate between effects that may arise from second-phase inclusions or other imperfections and what is intrinsic in the observed magnetic behaviour. Instead, the chapter opens with a lengthy relation of the magnetism of some Al-based alloys, which, according to their composition, cannot be well characterized quasicrystals. It would have been more appropriate to have devoted more attention to diamagnetism in AlCuFe or AlPdMn and to possible magnetic ordering in MgZnRE (RE = rare earth).

Chapter 10, on the surface science of quasicrystals, by Patricia Thiel *et al.*, is an excellent piece of work on a very difficult subject. Everything is clearly presented within the limits of our understanding of the pending problems: surface structure, oxidation, surface energies, surface preparations and composition, surface reactivity and frictional behaviour. All scientists, from beginners to experts, will find reading this chapter useful.

Chapter 11, on the mechanical properties of quasicrystals, is written, appropriately, by Knut Urban's group. This is one of the best chapters, reporting on up-to-date experimental results and realistic models in which the role of atomic rigid clusters is clearly demonstrated. The curious fact that quasicrystalline alloys behave mechanically as if they had directed atomic bonds of a highly covalent nature is also underlined. Both points are certainly at variance with any approach to the electronic structure in terms of atomic pair potentials and metal-like DOS.

The last chapter is intended to present industrial applications of quasicrystals. This is a self-sufficient chapter in which about 20 pages contain a pleasant summary of most of the properties analysed in the preceding chapters. Applications *per se* do not occupy more than five pages. It may be the actual, somewhat disappointing, state of the art?

To conclude, the book may be useful, but not for as large an audience as claimed by the *Introduction*. Those already engaged in research on quasicrystals will certainly benefit from having it available, but outsiders may be confused by some of the chapters, even though others provide clear-cut presentations. All in all, the book has the merit of reflecting faithfully the state of the art in its various subjects, with a mixture of different levels of understanding of the various aspects of quasicrystal science, a science that perhaps needs a little more time to pass before it reaches the formal universality of that of periodic crystals.

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*Acta Cryst.* (1999). **A55**, 973

### Books Received

*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.*

**Crystallography across the sciences.** Edited by H. SCHENK. Chester: International Union of Crystallography; Copenhagen: Munksgaard, 1998. Pp. iii + 269. Price US \$25.00. ISBN 87-16-16327-3. This volume is a hardback reprint of the special commemorative issue of *Acta Crystallographica* [Vol. A54, (1998), Part 6, Number 1]. The reviews celebrate 50 years of the journal and the IUCr. Additional details on contributors and topics covered may be found in the advertisement on the outside back cover of the March 1999 issue of the journal.

**Ultrafast dynamics of quantum systems. Physical processes and spectroscopic techniques.** NATO ASI Series B: Physics, Vol. 372. Edited by BALDASSARE DI BARTOLO. New York: Plenum Press, 1998. Pp. xii + 725. Price US \$140.00. ISBN 0-306-45929-9. The book presents the Proceedings of the course of the same name, organized by the International School of Atomic and Molecular Spectroscopy of the 'Ettore Majorana' Centre for Scientific Culture, and held in Erice, Italy, from 15 to 30 June 1997. Topics covered include 'the study of ultrafast phenomena, such as nonequilibrium phonon effects, evolution of excitations at surfaces, dynamics of electrons in semiconductors and metals, rapid conformational changes in molecules and optical control of the quantum states of molecules and solids'.

**Crystallography.** By D. SCHWARZENBACH. Pp. ix + 241. Chichester: John Wiley & Sons Ltd, 1996. Price £65. ISBN 0-471-95598-1. This is a translation into English, by Professor Alan Pinkerton, of the author's French language *Cristallographie*, published in 1993 and reviewed in this journal by Professor François Brisse [*Acta Cryst.* (1994), **A50**, 652].

**Einfuehrung in die kristallographie**, 18th edition. By W. KLEBER† with H.-J. BAUTSCH and J. BOHM. Berlin: Verlag Technik, 1998. Pp. 416. Price not given. ISBN 3-341-01205-2. Despite the 'stark bearbeitete Auflage' attached to this edition, the differences between it and the 17th edition of this stalwart text are quite minor, with only a few new figures and paragraphs.