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Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (R. O. Gould, Department of Chemistry, University of Edinburgh, West Mains Road, Edinburgh EH9 3JJ, Scotland). As far as practicable books will be reviewed in a country different from that of publication.

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Solid state science: past, present and predicted. Edited by D. L. WEAIRE & C. G. WINDSOR. Pp. xviii + 308. Bristol: Hilger, 1987. Price £35.00 (hardback), £15.00 (paperback).

This is an unusual and attractive book. It gives a readable and informative picture of ten distinct areas of present-day solid state physics, showing how these sciences got to where they are now. The selected areas are: diffraction; metallurgy; the Fermi surface; semiconductors; magnetism; superconductivity; critical phenomena; solid state optics; microelectronics; and solid state instruments. The chapter on diffraction is by Michael Woolfson. There is also a particularly interesting essay on the 'pre-history' of solid state physics. In a sense this is a book on the history of science; but it is written by physicists within these fields and its primary concern is the science itself. After outlining the technical and circumstantial details, it describes especially the drama and the human aspects of the development, as seen by the scientists who know the subject.

What is unusual is the division of the subject matter into these distinct subject areas, each of which is treated separately. Each of these chapters is thus a sort of cameo. Each starts with the state of knowledge in the early days of that subject, the theories at that time, and the personalities; then the advances, the crucial experiments, and the new theories are outlined, ending finally with the present-day outlook. The scientific coverage is necessarily somewhat sparse, but one learns a good deal and certainly finds a lot of interest in the essays in which one is not oneself a specialist. The book is very definitely recommended reading.

What is ironic is the manner in which the advances of science are so unpredictable, even by the best scientists. A book of this kind, venturing to point towards the future in each area, is almost inevitably going to miss something important happening directly after it comes into print. So, the essay on diffraction has missed 'maximum entropy', the latest development in direct methods; and, much more dramatic, the chapter on superconductivity has missed out on the recent explosive discovery of the 'high-temperature' superconducting ceramics. Embarrassing? Not really. This just illustrates, superbly, what an exciting thing science is.

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Quantum aspects of molecular motions in solids. Springer proceedings in physics, Vol. 17. **Proceedings of an ILL-IFF workshop, September 24–26, 1986.** Edited by A. HEIDEMANN, A. MAGERL, M. PRAGER, D. RICHTER and T. SPRINGER. Pp. xii + 221. Berlin: Springer-Verlag, 1987. Price DM 85.00.

This volume is a collection of papers on quantum motions in molecular crystals, metals and glasses. It has been divided into five sections, *viz Rotational tunneling* I - *Potentials and phonon interactions*; *Rotational tunneling* II - *Coupled systems*; *Rotational tunneling* III - *Surfaces*; *Isotope effect and matrix isolation*; *Translational tunneling and disordered systems.*

The first three sections largely comprise experimental papers. These papers show how inelastic neutron and Raman scattering, nuclear magnetic resonance, heat capacity and dielectric loss measurements can be used to deduce the potential experienced by the tunneling groups, their mutual coupling, and influence of phonons on their behaviour. They are intended to stimulate further theoretical and experimental work as they are generally open ended.

There are two reviews in the sections on rotational tunneling. The first covers the theory of rotational tunneling and

discusses the transition from quantum rotation at low temperatures to classical hopping behaviour. The theories predict how the energy levels of the tunneling states shift and broaden with temperature. Inelastic neutron scattering measurements on coupled groups are discussed in the second review which compares observations on frequencies and line widths of peaks with simple models.

A paper in §3 which will be of value to surface scientists shows how rotational tunneling spectra for molecules adsorbed on graphite can be used to determine the structure adopted by these molecules and the sites they occupy. Another paper shows how the study of methyl groups embedded in a matrix of argon, krypton or SF_6 can be used to reduce the influence of intermolecular interactions.

The fourth section covers the motion of hydrogen, muons and deuterium in metals. This topic is a major area in its own right and the papers here are of interest to specialists in that field. Many-body effects related to those observed in photoemission and X-ray absorption appear in the interaction of the proton or muon with the conduction electrons. Two review articles give a useful description of how the interplay between the influence of conduction electrons and phonons determines the temperature dependence of the diffusion coefficient. In particular, the second of these reviews contains a detailed comparison with experimental data. Neutron scattering, specific heats and sound velocities have been measured for hydrogen and deuterium in normal and superconducting metals and results are discussed in this part of the book. An unusual paper for this Workshop, on optical studies of proton tunneling in benzoic acid, shows how a combination of relaxation and tunneling can be used to understand the observations.

Lastly there is a section on tunneling states in disordered systems. There are only three papers here which discuss amorphous systems but they are of interest to physicists working on glasses as they discuss the well known two-level systems and look at the influence of sample preparation and treatment on parameters such as the transition temperature. This is in contrast to earlier work which emphasized the universality of the observed behaviour. There are also comparisons between different materials. The remaining papers are experimental measurements on quantum effects for H_2S in alkali halides and in solid hydrogen.

This book is a useful collection of state-of-the-art papers in a field which touches on many branches of condensed-matter physics. It is very much a research text and will largely be used by people working on tunneling phenomena as there is no broad overview of the subject and it focuses on the most recent developments in this area. However, the review articles on specific aspects of tunneling and some other articles such as that on adsorbed species will be helpful to those whose research covers these topics.

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