of the award committee, K. N. Trueblood, Department of Chemistry and Biochemistry, University of California, Los Angeles, CA 90024, USA (BITNET address: TRUEBLOOD@UCLACH), or to any of the other members of the committee: Dr Helen Berman, Dr Philip Coppens, and Dr Michael James.

The deadline for receipt of nominations is 1 December 1989.

## 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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**Solids and surfaces: a chemist's view of bonding in extended surfaces.** By ROALD HOFFMANN. Pp. x + 142. Weinheim and New York: VCH Verlag, 1988. Price DM 48.00, £16.25.

This book is a timely addition to the literature of two related and vigorously developing fields of chemical research: solid-state chemistry and the chemistry of well defined solid surfaces. The book focuses on the chemist's view of bonding in extended periodic structures, developing the relationship between geometric structure and electronic structure and asking the question 'where are the bonds in these systems?'

Chemists have contributed a great deal to the advance of our knowledge of both the solid state and the behaviour of molecules at surfaces. They have provided new methods of synthesis of materials, discovered new and fascinating structures and attempted to tailor make materials with desirable physical and chemical properties. The chemist's understanding of bonding in the solid state, and the bonding of molecules at surfaces, is based on concepts developed from investigations of discrete small molecules. This has tended to emphasize the importance of local coordination geometry and localized bonding pictures, which provide qualitative rationalizations of some of the observed properties of solids.

The physics community, with its elegant use of mathematical models, has meanwhile provided a sound framework for understanding some of the quantitative aspects of the properties of solids. The languages that these two communities use to describe the same materials and to explain the same phenomena often appear profoundly different at first sight. This is particularly so when bonding in extended structures is being discussed. How can the chemists, who like to think in terms of localized bonds in the real solid structure or at a solid surface, relate their insights to those of the physicists who are happy with band-structure calculations and diagrams of energy dispersion relations plotted in reciprocal space? Perhaps a guide book is needed which takes the reader on a tour of some of the main attractions of both terrains and provides a dictionary which enables the language of one tribe to be translated into that of the other. Hoffmann's book provides such a guide which specifically sets out to show how the physicist's band picture can be related to the chemist's bond picture.

Hoffmann's book is derived from a number of his papers which have already appeared in the literature and which cover much of the same material. The book is an extended enthusiastic essay presenting a non-mathematical, interesting and elegant summary of his view of the bonding in solids and on surfaces. The book is profusely illustrated with at least one diagram per page, all of which help to clarify the argument in the text and make the finished book visually appealing.

The approach adopted views the solid as a giant molecule and constructs one-electron 'molecular orbitals' using the linear combination of atomic orbitals familiar to all chemists. Bloch functions, wavevectors and energy bands are introduced in simple one-dimensional examples. Band folding, together with the Peierls distortion and its relationship to the more familiar Jahn–Teller effect, are explained. The complications which arise in two-dimensional and three-dimensional periodic structures are described. Various examples of band structures of one-, two- and three-dimensional solids, calculated using the extended Hückel approach, are included in the discussion and related to band structures that would be predicted by the sort of qualitative reasoning familiar to chemists. The chemist's familiar local bond picture is retrieved from the band structures by the introduction of density-of-states diagrams and crystal-orbital-overlap populations. These are clearly explained, and interesting examples of their use are scattered throughout the book. The approach developed in the text is used to examine a number of two- and three-dimensional structures and to rationalize variations which occur among compounds with related structures, such as the $AB_2X_2$ compounds with $A$ = rare earth, $B$ = transition metal and $X$ = group 15, 14 or 13.

The bonding of ordered overlayers of CO and various hydrocarbon species on metal surfaces is discussed. The observed trends in chemisorption experiments on well defined surfaces are rationalized in terms of the bonding models developed. A brief investigation of bond-breaking and bond-making processes involved in surface reactions is included, and references to further theoretical work in this area are given.

The book has a useful annotated reference section which directs the reader to many related papers and original contributions which add to our understanding of bonding at surfaces and in the solid state.

This book will appeal to any chemist studying solid-state or surface chemistry who wishes to be able to interpret the band-structure diagrams so often encountered in the literature and who wishes to develop new ways of thinking about bonding in extended structures. The discussions could be understood easily by third-year undergraduates as well as beginning graduate students. The text will be

useful for courses on solid-state or surface chemistry at this level.

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**Patterson and Pattersons. Fifty years of the Patterson function. (IUCr crystallographic symposia,** Vol. 1.) Edited by JENNY P. GLUSKER, BETTY K. PATTERSON and MIRIAM ROSSI. Pp. xx+727. Oxford University Press, 1987. Price £35.00.

This book looks back to the giant step made by A. L. Patterson in 1934 in recognising that given only the amplitudes of the structure factors it was still possible to obtain useful and in many cases total information about a crystal structure. A symposium was held in 1984 in the Fox Chase Cancer Center, Philadelphia, to celebrate the 50th anniversary of Patterson's paper on the $|F|^2$ synthesis and the proceedings of this meeting form the central part of this volume.

The text is divided into four parts. Part 1 is an historical introduction and underlines the contribution that David Harker made in the interpretation of the sections of the Patterson function which bear his name. Part 2, the record of the symposium, emphasized the impact of X-ray crystallography, and the contribution of the Patterson function, to the determination of structures of biological and biomedical importance. Dorothy Hodgkin's contribution here shows the value of the Patterson function in the interpretation of the structures of large biological molecules. Part 3, a set of contributed papers, looks at the development of rotation and translation searches for a known model or the detection of non-crystallographic symmetry and their application to biological structures. In addtion, a section looks at the question of homometric structures, and the expert, the late Martin J. Buerger, gives a clear introduction to the subject. Part 4 consists of biographical anecdotes from leading members of the crystallographic fraternity. It is of considerable interest to those who knew Lindo Patterson or have been affected by his work.

My own experience confirms all that is said. He always humbly referred to what we all know as the Patterson function as the $F^2$ synthesis. And he was always willing to listen keenly and attentively to young research workers in the field.

The book is rather long, partly because of the inclusion of material rather removed from the topic and partly by the repetitiveness of some of the anecdotal material. However, I can thoroughly recommend it to all crystallographers and perhaps especially to a new generation who may feel that direct methods are the answer to all problems.

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**Symmetries in physics.** By W. LUDWIG and C. FALTER. (**Springer series in solid state physics,** Vol. 64.) Pp. xi+461. Berlin and Heidelberg: Springer-Verlag, 1987. DM 98.

There are so many books available on group theory that it is hard to see why there should be yet another one. Nevertheless, this book does achieve some notable success in breaking new territory by the immense range of applicability that is discussed. The topics covered include the usual solid-state symmetries, molecular vibrations and electronic states, as well as molecular and crystal spectra, all well treated in many other group theory texts. In this book, however, the authors include the application of group theory to Lie algebras and to gauge theories, with particular reference to particle physics. It is therefore very complete and is highly to be recommended for those who wish to have the full story of group theory rather than the more piecemeal approach adopted in most books. Throughout, the text is cleanly printed with equations set out clearly; a joy to follow in what must rank as a difficult book for most people. For once, although the authors are not themselves crystallographers, they do not use terms that offend crystallographers' sensibilities, apart from some references to the now discarded term 'lattice structure', whose use in this book may mean crystal structure or simply 'lattice'; I do not know which. It is a pity that they do not use the International notation when discussing crystals, but prefer the Schoenflies symbols. But these are mere quibbles, as the book is well worth including on your bookshelf.

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