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Book Reviews

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Book reviews

XIIIth International Colloquium of Group Theoretical Methods in Physics. Edited by W. W. ZACHARY. (Singapore: World Scientific and Chichester: John Wiley & Sons, 1984.) £80.60. ISBN 0 97196687 5.

This is a collection of the communications presented at Maryland in May 1984, and it is divided into four sections. The first one, on Plasma, Chaos and Nonlinear Dynamics, is particularly timely in reflecting the rapidly growing interest in and understanding of chaos and its related problems; it begins with a useful review by Ling-Lie Chau on methods for solving the Yang–Mills equations. The second section, on Mathematical and General Methods, starts with a very readable review on alternative space-times by I. E. Segal. The third section covers a wide range of problems, dealing with atomic, nuclear, chemical and condensed matter applications of group theory. Quantum Hall effect, band structures, space group representations, symmetry breaking and phase transitions are some of the subjects treated here. The last section, on Elementary Particles and Relativity, contains mainly contributions on gauge theory and supergravity. In an appendix, Professor Wigner discusses changes in the roles of the symmetry principles in his usual interesting and anecdotal style.

In a publication of this type one must expect, of course, that many of the communications report work in progress and thus that they will find a less ephemeral form in other publications. A few more wider review papers would probably have been very useful for the general reader and would have redressed the balance towards more permanent contributions.

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Symmetry and Structure. By S. F. A. KETTLE. (Wiley, 1985.) [Pp. 330.] £8.95 (paper), £22.00 (cloth). ISBN 0 471 90705 7.

This book is an introduction to group theory for chemistry students. In it the author adopts a deliberately non-mathematical, pictorial approach, using discussion of chemical bonding as a vehicle for group-theoretical concepts.

The first seven chapters take us through a series of molecules from H₂O to SF₆ serving as examples of increasingly complicated point groups. At each step the exposition is lucid and well illustrated; new material is tested in problems and worked examples. Chapters 8 to 10 treat descent in symmetry, molecular vibrations and selection rules. Chapter 11 deals with π -electron systems. All the mathematical details are relegated to a series of appendices which take up about a third of the book and in themselves constitute a concise summary of elementary formal group theory. The pace of the main text is much more gentle.

Most of the material that would be taught in an introductory course on group theory is presented in the early chapters, but sometimes in an unusual order. Thus, it is not until p. 164 that we are told how to assign a general molecule to its point group. In order to illustrate a group with complex characters, the author treats the π -bonding of cyclobutadiene not in D_{4h} but in the C₄ subgroup (Chapter 11). Optical activity of C₄ molecules is discussed in the same chapter, at the risk of some confusion.

To some extent the choice of topics for a general textbook must be subjective. This book includes a useful Appendix on reduction of representations in the linear groups. On the other hand, it leaves out symmetric and antisymmetric direct products. I would have liked to see some mention of Brester tables in the chapter on vibrations, and of the use of group theory to count independent force constants and other molecular properties.

There are a few misprints, mostly trivial. Perhaps the only one likely to cause difficulty is in the captions to the D_{2d} character table and figures A3.7/8 where a polyhedron variously described as a pentagonal dodecahedron or a pentagonal bipyramid is in fact the D_{2d} triangular dodecahedron.

In summary, this is a well written and well produced introductory text on the chemical applications of group theory that can be recommended to students first encountering this subject.

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