Atoms and molecules

W. Graham Richards

Physics of Atoms and Molecules.

By B.H. Bransden and C. Joachain.

Longman: 1982. Pp.690.

£12.50, \$26.

The Shape and Structure of Molecules, 2nd Edn.

By C.A. Coulson.

Oxford University Press: 1982. Pp.94.

Hbk £10.95, \$19.95; pbk £4.95, \$8.95.

Computational Chemistry: An Introduction to Numerical Methods.

By A.C. Norris.

Wiley: 1982. Pp.452. Hbk £21.75,

\$50.60; pbk £9.65, \$21.45.

AN OLD classic does not used to tease younger colleagues by demanding an explanation of the difference between chemical physics and physical chemistry. One possible response was to say that the physicists were more interested in atoms while the chemists concentrated on molecules.

Certainly, in *Physics of Atoms and Molecules* Bransden and Joachain devote all but two of their 14 chapters to atoms. The early parts of the book summarize relevant quantum mechanics and give a good undergraduate account of atomic structure. Later chapters cover atomic and electron-atom collisions, and the final section describes some of the important applications of atomic physics. The level is suitable for second- and third-year undergraduates reading physics at a British university and for chemists taking options in chemical physics. The book would not be suitable as a background text of molecular structure for chemistry undergraduates. In the United States it might fall between stools, being too comprehensive for a typical undergraduate course but not sufficiently deep for graduate students.

McWeeny's update of the late Professor Coulson's undergraduate text on molecular structure is, by contrast, very much meat for an undergraduate chemist. Atoms are treated in the briefest possible way whereas molecules are allowed to contain several atoms, even those from the transition series.

The first edition provided a clear if somewhat terse introduction for the first-year undergraduate to the question of why molecules of a given atomic constitution adopt a particular shape. In this second edition some of the introductory material has been amplified and the coverage has been extended to incorporate transition-metal compounds and to make the student aware of the impact of quantitative theoretical calculations. The treatment is intentionally pictorial and qualitative, and none the worse for that. Just occasionally one feels, however, that giving half the story does create the possibility of confusion or misunderstanding. The nature of hybridization is not really understandable without

going into the determinantal nature of orbital wavefunctions: it is seen as an effect rather than a description. On the other hand the combined authority of Coulson and McWeeny is such that the simplified story comes over well enough to enable the student to understand a lot about molecules for a very small investment of effort, and to go on to other chemical problems before returning to make a more detailed and possibly quantitative investigation of molecular structure.

Quantitative studies of molecular structure using molecular orbital techniques have, thanks to developments in computing power, grown into the new sub-discipline of computational chemistry. At the research level this is frequently done using freely available standard packages. Prior to Norris's *Computational Chemistry*, however, there has been very little available for undergraduates and graduate students who have the need or desire to delve into the workings of the programs. It

is increasingly important for chemists to have some basic knowledge of the theory as well as the practice of numerical computation, and this is exactly what the book provides, including an introduction to the Numerical Algorithms library. After basics the areas covered are non-linear equations, simultaneous linear equations, numerical integration, differential equations and approximations. Ideally a course based on this book would follow one on FORTRAN.

Any student who combined the knowledge of all these three books would be in a powerful position — that of understanding the principles, being aware of good problems and being equipped to solve some of them. □

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Subject without seam

Colin Upstill

Similarities in Physics.

By John N. Shive and Robert L. Weber.

Adam Hilger/Wiley: 1982. Pp.276.

£9.95, \$27.95.

STUDENTS of physics are almost invariably taught in a structured way, their lectures grouped into courses, each with (ostensibly) a common theme or thread. But more often than not there seems little connection between courses, other than that all are part of "physics" — or "mathematics", or whatever. It is only long after graduation — if ever — that students begin to appreciate how similar many bits of physics are, how often the same equations describe different phenomena — disguised in different notations, and with different variables, even different values for constants, but essentially the same.

It is rare to find a teacher who attempts to show his students how their fragments of knowledge are related, and even rarer to find a book which seeks to demonstrate explicitly the ubiquity, utility, and power of similarities and analogies in physics. All credit to Shive and Weber for writing a book which does just this, and moreover at a level comprehensible to first-year undergraduates, by whom such insights are so sorely needed.

Like most books, it is not uniformly good; in places the authors lose their grip on the "similarities" theme, and for the occasional chapter the book metamorphoses into a fairly standard, albeit rather descriptive, physics text. But such lapses are instantly forgiven when one learns the connection between a dentist's rubber dam and an electron microscope, or between

webbed feet and bloomed lenses. How differently one appreciates exponential decay when encountered in the context of determining the time of death of a body, rather than in the usual analysis of some idealized system.

It is a great pity that our teaching system is so structured that a book like this is unlikely to be recommended as a course text; I can only hope that many students will be directed to it as collateral reading for the disjoint collection of courses from which they learn physics. □

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Showing the flag

Maurice Rigby

Introduction to Physical Chemistry.

By Arthur M. Lesk.

Prentice-Hall: 1982. Pp.746.

\$30.95, £27.85.

AT LEAST eight general textbooks of physical chemistry are currently competing for students' attention (and cash) in well-stocked university bookshops. Comparisons between them suggest that there is a remarkable general agreement on the basic material which must be covered, and on looking back at older texts it is clear that this has changed relatively little over the past 20 years or so.

There is perhaps now more general emphasis on the central role of quantum mechanics, but coverage of the classic foundation of thermodynamics and the properties of matter remains largely unaltered, and these topics are normally considered in detail. Some changes, however, are discernible. Newer experi-