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A Review of: "Molecular Physics: Theoretical Principles and Experimental Methods, by Wolfgang Demtröder"

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Book Review

Molecular Physics: Theoretical Principles and Experimental Methods, by Wolfgang Demtröder, Wiley-VCH, 2005; xiv + 470 pages; 69 Euro, paperback.

This volume is more than a translation of Demtröder's 2003 book on this subject. The current work is a revised text with a few "Germanisms," that is, word uses or terminology distinct from what is customarily found in works by native English writers and speakers. None of these should confuse readers, regardless of the level of their education. The book is described as a textbook rather than a monograph. That there are no exercises may appear to be an omission but truly for the advanced and serious students, there is no need for external evaluation of what thus have or have not learned. The price alone reflects the desire for a wide readership, that is, that students will use this book, not only their professors and others already advanced in their profession.

The reader is explicitly told "this advanced textbook comprehensively explains important principles of diatomic and polyatomic molecules and their spectra in two separate, distinct parts. The first part concentrates on the theoretical aspects . . . whereas the second part of the book covers experimental techniques." This book is narrower in scope than what the title tells us: perhaps it was naïve of the reviewer to imagine all of molecular physics condensed to a single readable volume, giving as much attention to detail as the author gives in his numerous derivations and explanations. The first part presents the spectroscopy almost exclusively for diatomic and other small molecules. This is understandable in terms of the author's research interests. Areas such as vibrational, rotational, and electronic spectroscopy are treated carefully and extensively, and here the reviewer strongly appreciates the author's efforts. Many a concept that the reviewer had only casually heard of before, for example, centrifugal distortion, the Dunham expansion and associated coefficients, line profiles, and the RKR procedure, now have mathematical realization, physical meaning, and chemical significance for him. In addition, the last chapter and second part (75 pages), entitled "Experimental Techniques in Molecular

Physics," is highly detailed and includes careful drawings of setups for numerous and diverse methods. This helps bridge the gap between the theoretical and experimental scientific communities. Indeed, this is the first time I have paid so much attention to the methodology and apparatus of my experimentalist kin and how they obtain the data that I so contentedly use as a theorist.

The pages devoted to orbital aspects and the electronic states of polyatomic species, and to more contemporary quantum chemical techniques (both semi-empirical and *ab initio*), are simultaneously too few and too many. They are incomplete and often misleading, if not incorrect. They come through as a failed promise, especially because the book cover is of the σ framework of benzene. Important topics, often ignored elsewhere, such as Walsh diagrams, Hartree–Fock theory, and configuration interaction, are included but almost in a tangential, rather than tantalizing, sort of way. Had only Demtröder titled his book *Molecular Spectroscopy: Theoretical Principles and Experimental Methods* the reviewer, admittedly a bonding theorist, would have been so much more pleased!

The book is accompanied by a 20-page reference citation section with each study cited accompanied by its title as well as authors, journal, and pagination. Many of the references are recent. Not surprisingly, Demtröder's work appears quite prominently—this is an author's oft-taken privilege to document his own interests and expertise as well as of students at his university. Errors of commission are rare; those of omission (see the preceding paragraph) are also rare. (Interestingly, and perhaps perversely, Walsh's original paper is miscited.)

Do I recommend this book to the reader? Within the complaints, constraints, and caveats given previously, the answer is yes. As a practitioner of the orbital aspects of chemistry and not a spectroscopist of any ilk, there is much that I learned about many other areas of contemporary molecular physics. For that, I thank the author and so suggest this volume.

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