initio methods for interpreting nuclear magnetic resonance spectra of transition metal complexes, Tripathi and Smith compare experimental and theoretical results for the cross sections for x-ray and high-energy electron scattering from molecules, and Monkhorst discusses the utility of the geminal method for going beyond the standard one-electron basis sets used in most quantum chemistry approaches.

The papers in this book illustrate the wide range of problems that can be tackled with modern electronic structure methods. They should be useful to physical chemists and others working in the areas of molecular spectroscopy, structure, and reactivity. The book should be particularly valuable as a source of supplemental readings in graduate-level quantum chemistry courses.

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Interstellar Matter

Molecular Astrophysics. State of the Art and Future Directions. G. H. F. DIERCKSEN, W. F. HUEBNER, and P. W. LANGHOFF, Eds. Reidel, Dordrecht, 1985 (U.S. distributor, Kluwer, Hingham, MA). xxiv, 744 pp., illus. $89. NATO Advanced Science Institutes Series C, vol. 157. From a workshop, Bad Windsheim, West Germany, July 1984.

In 1937 Dunham and Adams detected three absorption lines toward a star at optical wavelengths that were later identified as belonging to the CH radical and that provided the first evidence of an interstellar molecule. By 1940 two other molecules were identified optically, CH^+ and CN. Despite numerous suggestions concerning other potential molecules in interstellar space, it was not until 1963 that another molecule, OH, was reported with the discovery of absorption at centimeter radio wavelengths. Within five years ammonia, water, and formaldehyde had been detected with radio techniques at centimeter wavelengths. Millimeter-wave radio astronomy developed about 1970 and led to the rapid discovery of many molecules in the interstellar medium, and today over 60 have been discovered.

The importance of these molecules goes way beyond the novelty of their detection or the curiosity of their existence in the hostile environment of interstellar space. They are unique, and often the only, probes of the physical and chemical conditions in a wide variety of astronomical objects. The objects and processes they have been used to study include interstellar clouds in our Galaxy and in external galaxies, galactic structure, nucleosynthetic evolution in the Galaxy, protostars, circumstellar shells, star formation, stellar jets, comets, and astrophysical masers. Finally, through their absorption and emission of radiation, they can influence the thermal and ionization properties and the dynamical evolution of the objects in which they are found.

The study of astronomical objects through observations of molecules, or the modeling of the effects of the molecules on their environment, requires a detailed understanding of a wide variety of physical and chemical processes involving the reactions of molecules with radiation, atoms, and other molecules. In the low-temperature environment in which most molecules are found, optical studies have primarily been limited to absorption features. Such studies have therefore been restricted to those positions which happen to lie along a line of sight to a background star. The development of radio millimeter and submillimeter molecular astronomy has enormously expanded the studies of molecular clouds, galactic structure, and star formation because the molecules emit at radio wavelengths even at low temperatures. The radio telescopes can be used to map out the emission of the molecules and thus the structure of the entire object under study. Molecular processes and the observations of molecules in space are the subject of *Molecular Astrophysics: State of the Art and Future Directions*.

The book is divided into three parts, Astrophysical Observations and Models, Theoretical and Experimental Laboratory Studies, and Contributed Papers. The first two parts, which make up the bulk of the text, are a series of lectures by various investigators in different research areas. The first part could be used as an introduction to molecular processes in interstellar environments and the nature of molecular observations. It will be of particular value to graduate students and newcomers to the field. The longest lecture, by Rydbeck and Hjalmarson on radio observations, is one of the more interesting of its kind that I have read on this topic. The authors not only cover the history of the subject but explain many of the basic properties of molecules, molecular spectra, and their observational interpretation.

The second part of the book is much less general and requires a more specialized background on the part of the reader. It deals with laboratory and theoretical work on molecular spectra, ion-molecule reactions, photoprocesses, and collisional excitation. Here again, the general reader can learn much, although more effort is required. I found useful the lecture by Winnewisser *et al.* on spectroscopy and the discussion by Buck of rotational excitation in molecular beam experiments.

It is in the last section that the reader encounters examples of the state of the art in laboratory work. The highlight of this section is a pair of papers, by Rowe *et al.* and Böhringer and Arnold, discussing measurements of ion-molecule reactions at temperatures down to 8 K and 18 K, respectively. This development is crucial to understanding and modeling the chemistry of interstellar clouds, whose temperatures typically lie in the range 6 to 20 K. The authors found a number of reactions to have a temperature dependence in this range considerably different from that indicated by measurements above 80 K. For example, the reaction of the ammonia ion with molecular hydrogen is much larger at 8 K than at 100 K, which may be important for understanding the production of ammonia in interstellar clouds.

There are only a few contributions that do not live up to the high standards of the work as a whole, and even these contain useful discussions. A minor detraction from the volume is a small section on contributed oral papers consisting only of abstracts. I did not find these at all informative.

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Books Received

Alternatives to Animal Use in Research, Testing, and Education. Office of Technology Assessment, Washington, DC, 1986 (available from the Superintendent of Documents, Washington, DC). viii, 441 pp., illus. Paper, $16.

Beatrice (Hill) Tinsley, 1941–1981, Astronomer. A Tribute in Memory of an Outstanding Physicist. Scott Whineray, Ed. Massey University and New Zealand Institute of Physics Education Committee, Palmerston North, 1985. 97 pp., illus. Paper, $5.

Between Pacific Tides. Edward F. Ricketts, Jack Calvin, and Joel W. Hedgpeth. Revised by David W. Phillips. 5th ed. Stanford University Press, Stanford, CA, 1985. xviii, 652 pp., illus. $29.50.

Beyond Analytic Philosophy. Doing Justice to What We Know. Hao Wang. MIT Press, Cambridge, MA, 1986. xii, 275 pp. $17.50. A Bradford Book.

Biological Oxidation of Nitrogen in Organic Molecules. Chemistry, Toxicology and Pharmacology. John W. Gorrod and L. A. Damani, Eds. VCH, Deerfield Beach, FL, and Ellis Horwood, Chichester, England, 1985. 445 pp. illus. $58. Ellis Horwood Health Science Series.

The Body. Anthony Smith. 3rd ed. Viking, New York, 1985. xii, 548 pp. $25.

Chemotherapy of Parasitic Diseases. William C. Campbell and Robert S. Rew, Eds. Plenum, New York, 1986. xxviii, 655 pp., illus. $79.50.

Chromatography and Separation Chemistry. Advances and Developments. Satinder Ahuja, Ed. American Chemical Society, Washington, DC, 1986. viii, 304 pp., illus. $54.95. ACS Symposium Series, 297. Based on a symposium, Philadelphia, Aug. 1984.

(Continued on page 1562)