Bee Societies

The Social Behavior of the Bees. A Comparative Study. CHARLES D. MICHENER. Belknap Press of Harvard University Press, Cambridge, Mass., 1974. xii, 402 pp., illus. $25.

This book is, as the author writes, "concerned with the distinctively social attributes of the bees." It has three main parts. The first (Melittological Background, four chapters) presents some basic information and concepts and defines terms, aiming at giving the reader, lay or initiated, a common language. In this section one can see that the author has made some changes in his dendrogram (figure showing the phylogenetic relationships among tribes, subfamilies, and families of bees) since his 1944 paper; in this book the Apoidea are divided into nine families (the earlier dendrogram had seven) and 50 tribes and subfamilies (previously there were 48). The second part (16 chapters) is on comparative social behavior (caste determination, sex ratio, reproduction, communication) and its evolution. Chapter 5 presents the author's ideas on the evolution of social organization. Michener recognizes seven levels of socialization: solitary, subsocial, communal, quasisocial, semisocial, primitively social, highly social (the last two are also called eusocial). Part 3 (ten chapters) consists of an interpretative description of nests, life cycle, and many other aspects of behavior for five groups of social bees.

The evolutionary approach permeates the book, which presents many beautiful interpretations. An example is Michener's explanation for the parallel between the gradual diminution of caste intermediates and the gradual evolution of society in bees: "The more different the castes the less useful will a caste intermediate be—she is likely to be neither an effective forager and nurse bee (worker) nor an efficient egg layer (queen). Therefore switch mechanisms arise which assure that nearly every female develops either as a typical worker or as typical queen" (p. 107).

In the course of the book Michener, in addition to giving his own contributions and summarizing his ideas, reviews 700 papers, many times reinterpreting the data they contain. As in E. O. Wilson's *The Insect Societies*, the Brazilian school is well represented: 13 percent of Michener's references are to work done by this group, reflecting, in addition to the importance of the new school, the good command Michener has of the Portuguese language.

Michener's book and the other recent books on social insects by Wilson, von Frisch, and Lindauer apparently have a great region of overlap. However, new books in this field are not redundant, for the field is in a dynamic state, with new groups of researchers entering it, many changes taking place in the ideas of the old schools, and new discoveries being made. For 18 months ago, Michener's chapter on sex and caste determination was perfectly done. If he were writing it today he would have to cite 10 to 15 new papers that have advanced the subject considerably. The same is true of the account of swarming.

For every researcher, professor, or graduate student concerned with any species of social Apoidea this book is indispensable. I have been using it in my graduate course Genetics of Hymenoptera with excellent results, specially for giving to the students that kind of general knowledge, of common language, of intelligent look that every professor likes to find in his students.

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Motion at the Molecular Level

Internal Rotation in Molecules. W. J. ORVILLE-THOMAS, Ed. Wiley-Interscience, New York, 1974. xviii, 606 pp., illus. $39.95. Wiley Monographs in Chemical Physics.

Molecules are not internally at rest. With little expenditure of energy, rotation may occur about single bonds within a molecule. The result of this process is a reorientation between groups at either end of the bond. With additional energy (usually more than is thermally available at room temperature), rotation may occur about partial or even full double bonds. The amount of energy required to effect rotation depends on the identity and hybridization of the atoms that form the bond in question and on the substituents on these atoms. The field of conformational analysis has been concerned with studying the arrangements of atoms in space obtained by rotations about single bonds, the energetics of interconversion of these "conformations," and the influence of conformational interconversions on the reactivity of molecules in chemical processes. Conformational analysis has its experimental roots in the work of Pitzer and Hassel in the 1930's, although its theoretical foundations were laid much earlier. It became a major field as a result of the insight of Barton into the chemical consequences of conformations, and because of the development of instrumental methods for the characterization of conformations.

The title of this volume might suggest that the contents go beyond the field of conformational analysis to include data on rotational processes of partial and full double bonds. The scope of the book is in fact not so broad. The introductory chapter by the editor is concerned exclusively with the rotational properties of single bonds. Rotation about double bonds is referred to only in the chapter on theoretical methods, although studies of intermediate bonding situations (amides, α,β-unsaturated carbonyl compounds, and so forth) are treated quite fully in several chapters. This inconsistency in coverage may reflect the lack of general agreement among chemists about whether arrangements that result from rotation about partial double bonds should be called conformational or geometrical isomers. Conformational influences on chemical reactivity are not included within the scope of the book.

The approach of this book to conformational analysis is quite different from that taken in the older works on the subject by Eliel *et al.* and by Hanack. The present volume surveys experimental and theoretical methods rather than molecular systems. It is organized in a logical fashion, with each of the major methods covered by an expert in the field: chemical equilibration, dipole moments, vibrational spectra, nuclear magnetic resonance (NMR) and electron spin resonance, microwave spectroscopy, acoustic methods, electron diffraction, and ab initio calculations. In addition, there are two systems-oriented chapters, one on 1,3-dioxanes and cyclic sulfites, the other on medium effects. Both are excellent reviews of their subjects, but the subjects do not fit in with the organization of the remainder of the book.

Each chapter (or set of chapters) that deals with a particular experimental technique contains coverage of both the