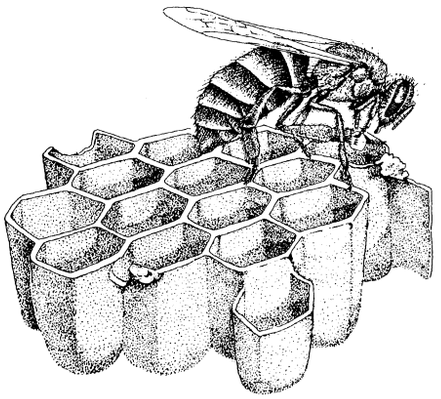

Wax manipulation and cell construction by a honey bee worker. [From *The Biology of the Honey Bee*]

needing to be done, and indeed how it sorts out and decides among the various stimuli impinging on its sense organs. Thus, we do not really understand how a worker honey bee knows when a particular larva needs feeding or how much food to give it, why some workers respond to their queen's proximity and others do not, or why some workers leave the hive to forage for themselves while others wait to be directed by dancing companions.

Everybody associates honey bees with swarming, so it is perhaps surprising that the factors that induce a colony to swarm have not been determined for certain, although Winston provides us with a comprehensive account of the circumstances that contribute to it. With swarming, as with other aspects of honey bee biology, it remains extremely difficult for us to understand how the individual workers measure, appreciate, and communicate so many varied pieces of information available to them and act in collaboration as a result.

The spread of Africanized honey bees in South and Central America has aroused much interest in the characteristics of African races of bees, especially in how their behavior differs from that of European races. These differences are mentioned at appropriate places though the book; for example, evidence has recently accumulated indicating a surprisingly low rate of survival of swarms in cold temperature climates relative to that in tropical conditions. A final chapter is exclusively concerned with comparing the biology of temperate and tropical honey bees and with the extent to which the differences in their aggression, reproduction, absconding, and colony foraging behavior have been selected by differences in predator pressure and resource abundance in the habitats in which they have evolved.

The text is written clearly, concisely, and with apt and refreshingly different metaphors and descriptions: prehistoric cave paintings of bees are regarded as "forerunners of the thousands of articles written" on bees; the uses of honeybee comb are said to range from "larval nursery to pantry to message center"; larvae themselves are described as "feeding mechanisms designed for rapid growth" and pheromones as "part of the social glue" that holds the honey bee colony together.

Where appropriate, techniques and methods used in particular studies are succinctly described, and where the available evidence is conflicting Winston suggests possible reasons and often provides a satisfying conclusion of his own. The book is illustrated with clear diagrams, tables, and figures. A glossary could usefully have been incorporated.

As a result of the vast increase in the literature on bees Winston has needed to be more selective than Ribbands in his choice of references. He manages in general to be unbiased, although there is a tendency to favor more recent North American work. Of the 853 papers cited in the references, 32 percent were published in the decade 1976 to 1985 and 21 percent in each of the two preceding decades. Because the dynamic growth of the subject is likely to continue I hope Winston will have the opportunity to provide us with a revised edition of his book before too long.

Without hesitation I recommend this book to a wide range of potential readers: to beekeepers because up-to-date knowledge of the underlying biology of the honey bee will enable them to increase their efficiency; to general biology students because the honey bee is surely the most fascinating of all insects and recent research on it exemplifies many new biological concepts; and to specialist students of honey bees and other social insects because it embraces much new research and many new ideas.

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Animal Relations

Kin Recognition in Animals. DAVID J. C. FLETCHER and CHARLES D. MICHENER, Eds. Wiley-Interscience, New York, 1987. x, 465 pp., illus. $77.95.

"Rarely in the history of biology has a domain of empirical knowledge followed so closely and fruitfully upon an abstract theoretical idea" as in the case of kin selection, writes E. O. Wilson in an introduction to this volume. Much of the scattered empirical literature on kin recognition has now been condensed, organized, and integrated in *Kin Recognition in Animals*, a book that examines kin recognition in invertebrates and vertebrates, including humans.

Specialists in kin recognition will notice that many of the most active researchers in kin recognition are absent from the list of contributors to the book. The editors acknowledge that they sometimes intentionally "bypassed eminent researchers who seemed to have had their say in favor of persons whose fresh ideas [might] be appreciated." Kin recognition has rapidly become a specialty, however, and several of the weakest chapters in the book are those written by behavioral biologists whose primary research area is not kin recognition. One cannot help believing that contributions from such researchers as Beecher, Getz, Holmes, Sherman, and Waldman would have improved the book.

In general, the chapters discussing kin recognition in specific taxa are reasonably accurate and comprehensive distillations of the published literature. The authors of the two chapters on social insects, who were faced with the difficult task of reviewing the voluminous literature on sweat bees, honey bees, social wasps, and ants, successfully uncovered both differences and broad patterns among the recognition mechanisms of the various groups.

There are several chapters that are especially absorbing. By far the longest (88 pages) chapter is by K. E. Linsenmair on the kin recognition system of a desert isopod. Although much of the chapter is based on unpublished work enough details of the methods and data analyses are included to permit one to judge that the experimental results justify the conclusions. By asking excellent questions and using numerous ingenious experimental designs, Linsenmair has teased apart various aspects of the mechanism of recognition in *Hemilepistus reaumuri*. As a result of his extensive studies over a period of 15 years, desert isopods almost certainly have one of the best-understood kin recognition mechanisms of any animal.

A stimulating chapter by E. B. Spiess brings the findings of research on mate discrimination in *Drosophila* to the attention of sociobiologists studying kin recognition. One may wonder how mate discrimination in a solitary fly is related to kin recognition in social animals, but the same mechanism may underlie both systems. In fact, several contributors, including Crozier, Michener, and Wells, have suggested that mate recognition on the basis of relatedness (or incest avoidance) likely served as an ancestral preadaptation leading to kin recognition.

One has to be impressed with the restraint displayed by J. R. Walters and P. A. Wells in

their careful discussions of the limited evidence for kin recognition ability and its mechanism in nonhuman primates and in humans. Although research on kin recognition in primates is still in its infancy, the preliminary evidence is intriguing. Wells, for example, discusses evidence that humans can discriminate among conspecifics by using odors but may be unable to discriminate between twins. Equally fascinating is the evidence that identical twins appear to display greater cooperation and willingness to work for the benefit of each other than fraternal twins.

The final chapter by W. D. Hamilton, "Discriminating nepotism: expectable, common, overlooked," is interesting and thought-provoking. Hamilton argues that we should have long ago suspected that animals can recognize kin but that the investigation of kin recognition was hampered because nepotism has become an embarassment in civilized cultures. (You will have to read the chapter to learn why.) One of the most tantalizing ideas in the chapter is that kin recognition could have evolved in a series of small steps: (i) an animal's odor, perhaps metabolic byproducts, provides it with a chemical signature (expression component); (ii) an animal habituates to the familiar odors (perception component); and (iii) an animal develops behavior that is conditional on the degree of familiarity between the learned and the perceived odor. Such an evolutionary scenario is intriguing because it suggests that the perception and expression components of recognition may have already been present in primitive ancestors and that the evolution of kin recognition ability required only the development of an appropriate behavioral response, the "action component"—in a phrase coined by H. K. Reeve—of recognition.

In sum, *Kin Recognition in Animals* is a valuable contribution to sociobiology. There is no other single source that contains so great an amount and diversity of information on kin recognition in animals.

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