have regarding the simplicity of insects. The authors even cite Gould (1982) in which he, according to the authors, "...believes that insects and other animals may even have sensory systems capable of detecting stimuli that humans will find difficult to imagine." (p. 187).

Insect ecology is adequately treated in the two chapters of Part 2, Insects and Their Environment. Basic ecological principles, from the effect of biotic and abiotic factors on populations to the effect of these factors on the organ systems and how the individual insect responds and adapts to these physiological stresses, are addressed. Numerous figures are used to depict populations through time under differing environmental regimes, and a separate chapter that treats the interaction of insects and plants in a rather classic fashion augmented through the usual, though necessary, pie charts, bar graphs, and line diagrams is included.

The first chapter of Part 3, Unity and Diversity, consists of a thorough discussion of the classification and evolution of insects; an overview of Insecta is presented in the subsequent two chapters. I particularly enjoyed the theories of wing development and found that the descriptions of orders and families emphasize life histories and importance to humans. Most texts with which I am familiar stress taxonomic characteristics at the family level to the exclusion of biological similarities and differences among groups. I think the treatment presented in this text lessens the tendency of teachers to simply list families and key characteristics for students to copy and memorize. From my perspective, the authors have taken a more integrated approach to the introduction of taxonomy, an approach students will find less intimidating and mundane. How-ever, because of this approach and the lack of keys, this book is not specifically designed for insect identification to the family level. I also think the descriptions of and explanations for the various professional viewpoints regarding systematics and classification at the beginning of each taxonom-ic group are enlightening.

Section 4, Applied Entomology, contains three chapters and emphasizes the importance of this science and the contributions made by entomologists. The first chapter of this capstone section showcases the beneficial aspects of insects and includes insect products, biological control, pollination, insects as food, and forensics. In addition, this chapter succinctly points out the harmful aspects of insects. The last two chapters address the overall concepts of integrated pest management in agroecosystems and present a balanced view of the control strategies available.

In conclusion, the authors have written a comprehensive entomology text that puts the right weight in the right places. They have hit a balance that will challenge a student's ability to stretch and will delight the amateur and naturalist for hours. It is written in an intelligent fashion that treats the reader with respect; however, it is not written so seriously that the authors, at times, cannot ask whimsical and rhetorical questions for effect. At a time when I feel my teaching is becoming a bit stale, I welcome a book that is invigorating and enables me to approach the teaching of entomology in a different way. But because the book contains such a wealth of up-to-date information, one must be sure that lower division students understand what is expected; otherwise, they could find the subject daunting. Does this book rival in format and eye appeal those used in general biology classes? Perhaps not quite, but it certainly does rival them with regard to text and the richness of information. No, it does not beckon students like a game, but it does educate. Finally, this book could promote the standing and understanding of entomology on college campuses more than anything I have seen lately.

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Hymenoptera of the World: An Identification Guide to Families
H. Goulet & J. T. Huber [eds.]
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668 pp., $63.35
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Over the past 15 years, there has been an increased interest in alternative biological methods of pest control. This, along with continued studies of pollination of horticultural crops, has brought about a concurrent need for knowledge about Hymenoptera, especially parasitic forms. In 1980, the USDA's Systematic Entomology Laboratory started an annual course on the identification of parasitic Hymenoptera; similar courses were started in 1985 in Canada and in 1989 in England and were expanded to include all groups of Hymenoptera. This manual is a result of the course given in Ottawa, Canada, with contributions from hymenopterists of the Biological Resources Division (formerly the Biosystematics Research Centre) and a few outside specialists.

Following a brief introduction, there are chapters on general information about Hymenoptera, morphology, use of keys, and a key to superfamilies. These introductory sections are followed by 11 chapters covering all major superfamilies of Hymenoptera. Each treatment includes general comments; illustrated keys to families and, in some cases, subfamilies; brief discussions of each family or subfamily (or both); and a list of primary references. A large habitus illustration of each family or subfamily (or both) completes each chapter.

The most valuable section of this manual is chapter 3, which deals with structure and morphology. A good discussion is provided for all the important morphological features of Hymenoptera. Each feature is illustrated by large, clear drawings. Of special importance is the structure and naming of wing venation. Hymenopterists have been notorious for using different systems of nomenclature for each group studied. Although the systems presented in this manual do not solve all the problems, this manual is a first step in the standardization of wing venation terminology. The most valuable part of this chapter is, however, the glossary of morphological terms. Each character is defined and illustrated. This chapter will be of extreme use for nonspecialists trying to identify their specimens using these and other published keys to genera and species. However a few inconsistencies were found. For example, the wing cell terms marginal, submarginal, etc., are used in the Apoidea keys but not in the glossary or morphology section.

The keys presented in this manual are not conventional dichotomous keys and may require some study. The first half of each couplet lists the essential attributes with single letters (a, b, etc.), and the second half uses corresponding double letters (aa, bb, etc.). Most of the characters are illustrated, with the sample drawing noted by the same letter as the couplet character. I had difficulty using the keys at first, but, perhaps, this will only be a problem to a taxonomist who uses "normal" keys daily. Nontaxonomists who rarely need to use keys may find these convenient. I did not study or test all the keys, but one of my colleagues, in a quick perusal of the Nyssonidae, found an error in the couplet on page 302. In the figures associated with the couplet, those of the dorsal view of the mesoscutum should be labeled b and bb; those of the lateral view of the mesopleuron should be c and cc.

In addition, the keys present another difficulty. The scope of this manual, as the
title states, is worldwide. Thus, the editors and authors have attempted to include every exception and minor group of Hymenoptera. The result is long and cumbersome, with some keys, with some groups keying out several times. This, of course, makes it great for world coverage and for use in identifying museum backlogs of Hymenoptera. But its use in a course that tries to cover the entire order in a limited time becomes laborious. Most courses undoubtedly will use this manual as a basic text but each instructor may need to supply shortened keys and text that covers the major groups and eliminates the various exceptions or rare taxa.

The habitus illustrations for each family or subfamily (or both) are mostly simple line drawings that give a good idea of the general form of the group. However, they are not of consistent quality because some were taken from other publications, as mentioned in the acknowledgements. However, the illustrations for the Ichneumonidae look suspiciously like those from other papers but are not acknowledged as such.

Although this is not a taxonomic treatise on the Hymenoptera, the manual does present some of the latest ideas of family and subfamily arrangements. For instance, the recognition of one superfamily, Apoidea, for sphecid wasps and bees follows contemporary thinking. However, elevation of sphecid subfamilies to families seems unnecessary, especially since the author states that none of the current higher category systems for Sphecidae s.l. is likely to be correct.

The one major flaw I found in this manual was the tremendous amount of wasted space. Each of the 210 habitus drawings is on a separate page. Furthermore, pages with keys often are only half-filled. I assume this was done to avoid splitting a couplet between pages. The large page size (8.5 x 11 inches) of this manual makes it possible for the habitus drawings to have been reduced considerably without losing any quality and for possibly allowing additional figures on a page. The same can be said for the keys, by reducing the size of the illustrations or moving them closer together, many more pages could have been saved.

I suspect that the 668 pages of this manual could have been reduced to 400 or less with a little more thought. This certainly would reduce the cost of publication. Perhaps the editors felt that, because this is a manual to be used in a class or laboratory, the extra space could be used for notes.

The binding of this manual is adequate for such a large book. It does lie flat when open, which is useful when using at a microscope. I would have preferred a spiral binding, which makes it easy to open flat on a desk. Spiral binding for such a thick book may be difficult to prepare, but this is another reason to reduce the number of pages and the consequent thickness of the manual.

This is a much needed and well-prepared identification aid for this important group of insects. I suspect it will become the standard text for future courses on Hymenoptera, and I would strongly recommend it for any biological control laboratory or museum curator. The non-taxonomists will find it a necessary tool in their quests for knowledge of the Hymenoptera.

I wish to thank my colleagues in the Systematic Entomology Laboratory, Arnold Menke, David Smith, and Mike Schauff, for their useful comments that have been incorporated into this review.

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