able attributes are often introduced to make images more striking. This is perhaps as it should be (in the spirit of artistic freedom), and dinosaur art of the variety presented in *Dinosaur Imagery* usually represents the best estimate at a particular moment in time. Yet all these images remain and find their way into the cultural mainstream to influence future generations of scientists.

My intent is not to suggest that there is anything insidious going on, but rather to highlight the major role that works of art can play in shaping scientific discourse. Although it is unlikely that *Dinosaur Imagery* will have the impact on science of a film like *Jurassic Park*, it seems a safe bet that movie producers are more likely to pick up *Dinosaur Imagery* for inspiration than *Science* or the *Journal of Vertebrate Paleontology*.

BOOKS: ENTOMOLOGY

A Framework for Melittology

David W. Roubik

Bees are the pollinators of most flowering plants, the spore dispersers for many fungi, winged invaders of continents due to human manipulation, and understated butterflies to the naturalists who inspect and explore their beauty. The 20,000 to 30,000 extant species are descended from solitary wasps that largely abandoned feeding on insects and spiders in favor of pollen as a protein source. They share an extensive evolutionary history with ants and wasps, and like those groups they are the subject of a voluminous literature. Charles Michener, a professor emeritus of entomology and of ecology and evolutionary biology at the University of Kansas, has made many substantial contributions to that literature since publishing his first paper in 1935. *The Bees of the World* marks the completion of a pursuit that traces from his 1944 doctoral thesis. Offering readers a sense of the taxonomic, morphological, and behavioral diversity of bees, the book is designed to provide the systematic framework required for the continuing study of bees as biological entities.

Throughout the volume, Michener pursues the phylogenetic and taxonomic underpinnings of bee biology with particular alacrity. He discusses how groups of bees are related to one another, why he recognizes these relationships, and what they imply. Bolstered by the research of a legion of collaborators and students, Michener's extensive consideration and modest speculation regarding bee diversity will appeal to scientific curiosity, as systematics is supposed to. His clear presentation also serves as a guide to the extensive literature on bee biology; the 2500 references cover a wide range of the field.

To facilitate identification, Michener provides valuable keys to all families, subfamilies, tribes, genera, and subgenera. These are accompanied by figures and text commentary, but there are only a few phylogenetic diagrams to illustrate the underlying relationships. Michener's judgments are evidently offered not as edicts, but as invitations to work out further details. Few will resist received wisdom in this form.

The bees, Apiformes, are part of the more inclusive superfamily Apoidea, which also includes the sphecoid wasps. In many earlier studies of Hymenoptera, bees consist of the single family Apidae. Although this classification may conveniently avoid further complications in an already paraphyletic group of wasps, Michener points out that it does not coincide with the evolutionary relationships among higher taxa of bees. Holding in one's hands an iridescent, furry, long-tongued euglossine "orchid bee" with a 4-cm-long tongue and a smooth, small brown nocturnal halictid (sweat bee) with abbreviated mouthparts, there is little doubt they belong in different families. This impression is reinforced by the wide range of data on bee biology that Michener summarizes. In the author's classification, bees comprise seven families. Five are short-tongued bees. One of these, the Melittidae, is probably the paraphyletic source of the long-tongued bees. The latter, in the families Apidae and Megachilidae, are known to all from painful experiences with their sting or ineluctably pleasant experiences with honey or the fruits of applied pollination science.

The Bees of the World
by Charles D. Michener
Johns Hopkins University Press, Baltimore, MD, 2000. 929 pp. $135, £93. ISBN 0-8018-6133-0.

One hundred years ago, the concept of a bee was grounded on honey making. Most species were fit into a few, rather large genera such as *Apis*, *Bombus*, *Xylocopa*, and *Megachile*. These are still known by their vernacular names (a good indication of relevance to humans): honey bees, bumble bees, large carpenter bees, and leaf-cutter bees (a misnomer). But the overwhelming majority of the 425 genera Michener recognizes, and their many thousands of species, do not make honey and have no colonies. Perhaps 15% are parasites of other bees, usurping their provisions and nests. Still, the hidden complexity and gaps in knowledge are astounding. The number of accepted species of honey bees has nearly tripled in the last decade. There are also over 200 species of *Bombus*, some 400 *Xylocopa*, and over 1000 *Megachile*; and field work is far from complete. Euglossini, restricted to the Neotropics, were thought to consist of some 100 species; intensive recent investigations have doubled the number of known species in the tribe. Except for some highly social forms, bees are relatively scarce (both as individuals and species) in tropical areas. Instead, the highest diversity of species, and, probably, largest numbers of genera and subgenera are found in xeric, warm-temperate regions. But, as Michener notes, it is difficult to document diversity and abundance patterns because of the different levels of sampling and knowledge in different areas.

Blue bee. This *Thyreus* species from the Congo lays its eggs in the nests of anthophorine hosts.

Michener's coverage encompasses fossil bees, stingless bees, the silent majority of solitary bees, as well as colonial species, and the highy eusocial bees. (The last, with their perennial colonies of a queen and her many daughter workers, are the best known, although only two tribes consist of such bees.) The author supplements the comparative microscopic study of morphology with behavior and ecology, but he gives museum research the central place. The diversity of the group is also portrayed in sublime color photographs of bees in nature (E. S. Ross and P. Westrich), which will stimulate readers.

I found the continuity and cohesiveness of *The Bees of the World* very pleasing. Such a well-produced classification provides a rigorous organizational framework. No extravagant claims or puzzling omissions appear; there are only conclusions drawn from nature and systematic study. To know a diverse and abundant group of organisms so well that they can be reasonably reorganized into meaningful and correctly identified biological units is vanishingly rare. Michener has produced what is properly labeled a magnum opus. Ambrosia.

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