

BOOK REVIEWS

Plant Biomechanics: An Engineering Approach to Plant Form and Function. Karl J. Niklas. 1992. The University of Chicago Press, Chicago, IL. 607 p. \$75.00 cloth, \$29.95 paper.

This book examines the evolution of plant form and function under the constraints of the abiotic environment with emphasis on the physics and material science of plant structures. A basic theme that permeates this work is that a basic understanding of physical sciences can provide the plant biologist with insight into the evolution of plant morphology and anatomy.

Plant Biomechanics is written for plant biologists with interests in botany, ecology, systematics, and physiology. Indeed, Niklas does a superb job of integrating these topics into virtually every chapter of this book while at the same time presenting a continuum of mathematical models to explain the processes which influence the growth, development, and reproduction of plants.

Chapter 1 is a general discussion of the importance of plants, a comparison of aquatic versus terrestrial plants, multicellularity, and the process of convergence and adaptation. Chapters 2 and 3 cover engineering theories and principles relevant to the study of biomechanics. Niklas presents mathematical equations and models used by engineers to analyze such topics as stress/strain forces, viscous and viscoelastic materials, fracture mechanics, bending stress, and torsional buckling.

The following chapters are devoted to comprehensive examinations of plant-water relations, cell walls, mechanical behavior and attributes of plant tissues and organs, the plant body, and fluid mechanics. The final chapter is devoted to plant evolution. There is also a glossary of important botanical and engineering terms. Niklas has included an abundance of detailed figures to aid the reader in understanding how biomechanics can address interesting questions of plant biology.

I believe that this book is a "must read" for all plant biologists and should serve as a useful supplemental text in graduate programs, especially in plant physiology. The reading of this volume has certainly opened the eyes of this plant molecular biologist.

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The Hunterian Lectures in Comparative Anatomy, May and June 1837. Richard Owen. Edited and with an Introductory Essay and Commentary by Phillip Reid Sloan. 1992. The University of Chicago Press, Chicago, IL. 356 p. \$42.00 hardcover, \$16.95 paper.

Richard Owen is perhaps best remembered as the Victorian scientist who dared to oppose Charles Darwin's theory of evolution by natural selection. But Owen's opposition to animal evolution—or transformism—was not the simple knee-jerk reaction of an academic defending the fixity of species as the literal word of Scripture. Owen was a respected professional comparative

anatomist, who backed his conservative view on species transformism with his idea of the Vertebrate Archetype and his well-known distinction between analogous and homologous structures in animal morphology. Talented in both descriptive anatomy and theoretical speculation, Owen emerged as a leading comparative anatomist in the years preceding Darwin's *Origin of Species*. Yet unlike Darwin, whose life and work has been the subject of intense historical scrutiny, comparatively little has been written about Owen, especially about the intellectual influences that helped shape his early theoretical positions. The publication of these seven surviving Hunterian Lectures, which appear in the centenary of his death, begins to fill this gap.

The career paths of Owen and Darwin show a striking pattern of convergence and divergence. Both had studied medicine at the University of Edinburgh; but whereas Owen finished his medical training in London, becoming licensed by the elite Royal College of Surgeons, Darwin switched to theological studies at Cambridge, before embarking in 1831 on a five year circumglobal voyage as a naturalist aboard *H. M. S. Beagle*. While Darwin was busy collecting and studying firsthand the natural history of South America and other exotic places, Owen was made assistant curator of the Royal College of Surgeon's Hunterian Museum, and thus became immersed in the practical and intellectual challenges of arranging, describing, and cataloging one of the world's largest collections of anatomical specimens and natural curiosities.

In April 1836, Owen was appointed Hunterian Lecturer in comparative anatomy. A year later, he opened his lecture series with a comprehensive historical introduction to his subject, from the Greeks to John Hunter, the late 18th-century British surgeon and museum collector. Constrained by the necessity to make reference to the museum collection, Owen used the lectures to compare Hunter's views on comparative anatomy and physiology with those of major contemporary European biologists, as well as his own. For instance, the fourth lecture closes with an important section criticizing speculative transcendental anatomy, praising German embryology, and denying the doctrine of species transmutation. The lectures also reveal Owen's physiological explanation of the extinction of species, a biological problem made poignant by the fossils of extinct animals Darwin had recently brought back with him from South America.

Our understanding of the significance of these lectures is enhanced by Sloan's excellent 72-page introductory essay, "On the Edge of Evolution," which supplies the historical, conceptual, and sociological context of Owen's rise within the London scientific and biomedical elite and his important association with the Hunterian Museum. By examining Owen's theoretical biology, not in the context of academic natural history, but rather in the context of the squabbling metropolitan medical profession, Sloan's analysis widens the perspective from which British transformism can be viewed. To be sure, British historian Adrian Desmond has also shown the value of just this historical reorientation in his recent study, *The Politics of Evolution* (University of Chicago Press 1989).

Central to Sloan's account is his reinterpretation of the role played by surgeon Joseph Henry Green, who in his

Hunterian Lectures of 1827-1828, introduced Owen to an alternative vision of a philosophical biology. Sloan argues against seeing Green simply as a reactionary anti-Lamarckian and suggests that his theoretical framework for the study of nature actually combined Lamarck's radical view of a gradual, ascending and branching series of animal forms with Cuvier's conservative categorization of the animal kingdom into four static classes. Similarly, Sloan argues that Green's biological idealism was more complex than that of the German transcendental anatomists like Oken and Schelling, or that of the English Germanophiles like the Romantic Coleridge, because he had adopted a more genuinely Kantian position that distinguished between the descriptive, historical, and physiological approaches to the study of nature.

Stimulated by Green's sophisticated approach to biological problems, Owen had further opportunity to reflect upon important philosophical issues of biology during the early 1830s, when he avidly followed the bitter debates between French comparative anatomists Georges Cuvier and Etienne Geoffroy St. Hilaire over species transformism and unity-of-plan. Of course, during this time Owen was fighting his own scientific and political battles at home, as Desmond's book amply documents. But Sloan's account tries to show how the theoretical positions presented in the Lectures were also the consequences of Owen's daily preoccupation with cataloging and describing the museum collection, as well as his unique synthesis, worked out over several years, of diverse theoretical lines of inquiry in philosophical biology.

The lectures are meticulously edited and supplemented with a bibliography and index. The published texts are transcriptions of the final lecture copies. Although Owen's didactic prose lacks style, it is by no means unreadable. Sloan has helped by reproducing the text without distracting details such as interlineations and crossouts; instead, original alterations to the manuscripts are marked by small superscript numbers and given as footnotes. Useful explanatory notes and citations of works explicitly or implicitly referred to in the text are given as endnotes. Additional archival information, e.g., location, record number, size and type of paper, etc., for both Owen's original holograph manuscripts and the final lecture copies, is provided at the beginning of each lecture. The text of Green's 1827 Hunterian Lecture on the comparative anatomy of birds is also included as an appendix. Finally, the book is embellished with numerous illustrations, portraits, diagrams, and tables.

Darwin scholars, of course, will profit from the availability of yet another primary source on the problem of transformism, one which can be used to complement Desmond's study. Historians, biologists, and physicians interested in the history of comparative anatomy and physiology will also benefit from these lectures, especially from their discussions of the structural differences between plants, animals, and infusoria, and the microscopical observations of the constituents of blood, which were given on the eve of the introduction of the cell theory of life. Sloan's clearly written and thoroughly-researched introductory essay, with its succinct analysis of Kantian biology, will also be useful in both graduate and under-

graduate courses on Darwin or early nineteenth-century comparative anatomy, physiology, and embryology, where a fresh look at the role of the metropolitan biomedical community might put new life into an old subject.

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Butterflies and Skippers of Ohio. David C. Iftner, John A. Shuey, and John V. Calhoun. 1992. Ohio Biological Survey, Columbus, OH. 212 p. \$40 paper.

Two years ago, outgoing president of the Lepidopterists' Society, Julian Donahue lamented the fact that, despite long-standing interest by amateurs and professionals alike, few state and regional identification manuals for Lepidoptera were available. He contrasted this situation with that found in the botanical world, where such publications have been commonplace for quite some time. Part of the difficulty in duplicating the success of botanists in producing useful regional manuals is a surprising lack of distributional, phenological, behavioral, and other types of data available for most groups of Lepidoptera.

The Ohio Lepidopterists, by implementing The Ohio Lepidoptera Survey in conjunction with the Ohio Department of Natural Resources, have made tremendous strides in compiling and organizing the kind of data needed to fill the void referred to by Donahue. These groups were ambitious, yet realistic, about their goals. They set out, with the enthusiastic help of both amateurs and professionals, to catalogue and record the distribution of the Lepidoptera of Ohio. They started by focusing on the butterflies and skippers, and this volume is the culmination of this effort. If other publications resulting from the survey are of the same quality as this book, the effort can certainly be called a resounding success.

Following some introductory material, the authors have included chapters on history, education, and conservation, and on the ecological and geological divisions of Ohio and how these divisions influence butterfly distributions. The historical chapter adds completeness to the book and emphasizes that many individuals have worked over many years to accumulate the data compiled in this volume. Instead of being a compendium of methods on how to collect and kill insects, the education and conservation chapter refreshingly focuses on the value of studying butterflies and protecting their habitats to better understand how we can avoid destroying many populations. The next two chapters illustrate many factors that may influence butterfly distributions. They show the importance of having detailed distribution and habitat information for each species in order to understand the distributional correlation of some species with particular habitats or geological formations. These correlations are especially important if we are to predict how butterflies might respond to changes in their habitat, including those caused by habitat destruction and global climate change.

The methods section shows plainly the tremendous amount of work that went into this project. The list of

public and private collections surveyed is staggering, and the criteria used to record and evaluate information are clearly stated. The detailed distribution maps and flight season graphs accompanying each species account are a testament to this effort. Finally, a checklist of Ohio butterflies and skippers precedes the species accounts. I question the use of subspecific epithets for species when only the nominate subspecies occurs in the state, and I favor a taxonomy that is more inclusive at the family level, especially in the nymphaloid groups, but these criticisms are mostly a matter of personal preference.

The species accounts cover 144 species known to have been taken in Ohio, and they occupy most of the remainder of the text. This section starts with two figures summarizing the number of species recorded and known as resident in each Ohio county. Although the second figure uses wonderful graphics, I found it much more confusing than the first, and felt the county totals here could have been included in the first figure to make comparison easier. Each species account includes a distribution map and flight season graph as well as text covering the species' status in the state, distribution, habitat, host plants, adult energy resources, and flight period. Also included are notes on similar species, general comments about interesting aspects of the biology of the species, and any literature records of significance. I found that I concentrated entirely on the distribution maps and virtually ignored the written description of the distribution, especially since excellent comments on specific habitat associations were found under their own heading. I appreciated the careful distinction made between oviposition plants and larval hosts. These can often be quite different and careless reporting of "host plants" can cause much confusion. The information on adult energy resources is an interesting addition to the usual entries. This information is generally ignored, but should not be. Each species is illustrated using color photographs (often several per species) of spread specimens found after the text. The photos and text are cross-referenced for ease of use. These plates are of excellent quality, making identification of specimens easy for all but the trickiest species. The authors finish the text with chapters on species of possible occurrence, species erroneously reported, a glossary of terms used in the text, an extensive and useful bibliography, two appendices, and indices to host plants, common names of butterflies, and scientific names of the taxa.

The acid test for books of this type should be how much interest and new work they inspire, and *Butterflies and Skippers of Ohio* will serve this purpose in at least two significant ways. First, identification of any Ohio butterfly species (and most in neighboring states) will be significantly easier with this book. I know from experience that, for beginning lepidopterists, being able to identify specimens with certainty is an important step in retaining interest in the subject. This book will promote new generations of talented lepidopterists. Second, because of the complete coverage and extensive research put into the work, it is immediately obvious to anyone using the book what is *not* known about a species in Ohio. This is a strength, not a weakness of the book. It should spur

others to try to fill these gaps in our knowledge.

This volume is an excellent example of collaborative work that illustrates the often neglected expertise of "amateurs." Although not employed as entomologists, all the authors have a professional knowledge of their subject and have produced an admirable work that will serve as the standard for such efforts in the future.

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The Owlet Moths of Ohio Order Lepidoptera Family Noctuidae. Roy W. Rings, Eric H. Metzler, Fred J. Arnold, and David H. Harris. 1992. Ohio Biological Survey, Columbus, OH. 219 p. \$20.00 paper.

Little is known of the natural histories of the majority of Lepidoptera, despite their popularity among collectors and the fact that caterpillars are the dominant herbivores in virtually all terrestrial ecosystems. Until we know more about the distributions, habitat requirements, developmental stages, food sources, and phenologies of these organisms, terrestrial ecologists will lack basic data on the relationship between producers and primary consumers, and wildlife managers and conservation biologists will be unable to account for potential impacts on non-target species. But there are thousands of Lepidopteran species—the latest checklist contains over 11,000 in North America (Hodges et al. 1983)—and to effectively accumulate natural history information, we need identification guides suitable for non-specialists.

The Owlet Moths of Ohio is a step towards this end. It is a checklist of species in the family Noctuidae, one of the largest Lepidopteran families, annotated with up-to-date summaries of natural history information. The primary database is derived from label data and literature records of specimens from throughout the state, many collected by the authors over the last 15 years. It contains color plates of species which are difficult to identify, with comments to aid identification. It is particularly strong in the Herminiinae, Hypeninae, and Nolinae, subfamilies usually underrepresented in such guides, and in the difficult genus *Zale* of the Catocalinae, but omits noctuid subfamilies often grouped as the family Arctiidae. Species discussions contain whatever information is available on habitats and host plants, and subjective estimates of relative abundance on local and regional scales. Each discussion is accompanied with a dot map of known distribution at the county level, and a graphical representation of adult phenology taken from capture records. There are sections on principles of classification, moth developmental stages, collection and preservation methods for all life stages, identification, lists of known host plants, Ohio biogeography including notable habitats, conservation, and species anticipated upon further collecting.

The book is extensively cross-referenced, permitting searches for information from several different perspectives. For pinned specimens, it is organized by the most recent checklist (Hodges et al. 1983), and includes the numbers from the previous checklist (McDunnough

1938) for use in institutional collections which have yet to be updated. Host plant information is with each species, but is also included in a separate list organized by plant species, so the identity of a (noctuid) caterpillar found on a known plant can be quickly narrowed to a few possibilities, a handy reference for plant and community ecologists. This must be used cautiously since the hosts of few species are known completely and many are altogether unknown. Endangered, threatened, or otherwise notable species are also listed in a separate section for easy reference during environmental impact studies. Species endemic to notable Ohio habitats are listed by habitat. All these additional lists are cross-referenced to the original. Cross-referencing is the most impressive and useful aspect of the book, especially for non-specialists, and with the advent of computerized databases, it ought to become a widespread feature in guides of this type.

How easy is the book to use? I live in the Oak Openings region in Lucas County, OH, and wondered if any of the endemics might show up at my light. I consulted the Oak Openings list of 17 endemics (3 narrow endemics), and easily found the discussions in the main list. But only five were figured in the plates, and I needed other references to identify the remaining 12 moths. Indeed, of the 708 described species in the book, only 33% are figured, and no keys are provided. At minimum, one must consult Covell (1984) for an additional 52%; most of the remainder can be found in Holland (1968) and in Rockburne and Lafontaine (1976). It is to the book's credit that each species discussion contains cross-references to figures in other publications. Nevertheless, fully eight of the 16 plates are devoted to eggs and larvae of selected species. Caterpillars vary considerably in pattern within and among populations and with developmental stage (unaddressed in the species discussions). The level of resolution of these figures is too low to identify characters for phylogenetic analysis, so the value of these figures is limited at best. Any study of this magnitude must make compromises, but this book would be considerably more useful if the adults of all species had been figured.

What of the natural history information? Distributional and phenological conclusions in studies of this type are necessarily biased by collecting intensity, collector interest, and prevailing collecting methods. Natural history data from the literature are often biased by inaccurate identifications of moths and plants, and by confounding information about what larvae will eat in captivity with what they normally eat in the field. Confirmation data are hard to obtain—larvae must be collected and reared to maturity from natural hosts. And even when accurate, most data are anecdotal, so that geographic variability and host range information are usually confounded. The authors wisely pass the buck and provide references to the primary literature to accompany the host plant data of others, and document their methods when presenting data of their own. Their conclusions are among the more reliable and up-to-date of the genre, but despite the 15 years of work that went into this book, a reasonably complete natural history study is well beyond the scope of this book.

The authors make several recommendations regarding conservation issues, notably habitat deterioration and the potential susceptibility of uncommon forest species to spraying programs being implemented to control the gypsy moth. It is unfortunate that they don't cite the conservation literature to support their positions. I concur that the gypsy moth is beyond control using indiscriminate spraying programs and, to the extent that plant communities are regulated by herbivory, widespread use of insecticides will have unanticipated effects on plant and invertebrate species diversity. But I have difficulty with their advice for maintaining habitat quality in the face of encroachment and fire suppression. We really know little about historical species composition and community structure excepting the largest plant and vertebrate species, and from what we can surmise from physiognomy. We don't know enough about the natural histories of the endemic species to make anything but guesses about effective habitat management strategies. It is the classic conundrum of conservation: should we concentrate efforts on understanding the biology of the endangered species, which would lead to more effective management, or just go out and do *anything* to combat habitat deterioration before it's too late? On secured land, I believe local biologists should be encouraged to concentrate on the natural histories of endemic and rare species before advocating particular habitat preservation methods—the last colony of the Large Blue in Britain was extirpated by the good intentions of uninformed habitat management (Pyle et al. 1981).

I expect this book to be consulted relatively often by ecologists interested in habitat conservation and management in the midwestern states, and by Lepidopterists interested in natural history and identification. It will be used more rarely by people studying basic ecological questions. Its main problem is the requirement of several outside references for effective use in species identification (and even in distinguishing an owlet moth from several superficially similar moth families). If similar volumes on other large moth families are being contemplated, this problem should be addressed. As stand-alone references for non-specialists, books such as this could find their way into high school and university science classrooms.

LITERATURE CITED

- Covell, C. V. 1984 A Field Guide to the Moths of Eastern North America. Peterson Field Guide Series No. 30, Houghton Mifflin, Boston, MA.
- Hodges, R. W., T. Dominick, D. R. Davis, D. C. Ferguson, J. G. Franclemont, E. G. Munroe, and J. A. Powell 1983 Check List of the Lepidoptera of America North of Mexico. E. W. Classey, Ltd., London.
- Holland, W. J. 1968 The Moth Book. Dover, New York, NY.
- McDunnough, J. H. 1938 Check list of the Lepidoptera of Canada and the United States of America. Part I. Macrolepidoptera. Mem. Southern Calif. Acad. Sci. 1: 1-275.
- Pyle, R., M. Bentzein, and P. A. Opler 1981 Insect conservation. Ann. Rev. Entomology 26: 233-258.
- Rockburne, E. W., and J. D. Lafontaine 1976 The Cutworm Moths of Ontario and Quebec. Canada Dept. Agric. Res. Branch Pub. 1593.

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