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Book Review

Leschen, A. B., Beutel, R. G., Lawrence, J. F., Ślipiński, A. (eds.) 2010. Coleoptera, Beetles. **Volume 2 Morphology and Systematics (Elateroidea, Bostrichiformia, Cucujiformia partim)**. In Handbook of Zoology. Arthropoda: Insecta, Series Editors N. P. Kristensen and R. G. Beutel. De Gruyter, Berlin/New York, xiii + 786 pp. ISBN 978-3-11-019075-5. €248.00.

Despite their unrivalled species richness and an obvious popularity among lay people, beetles have not attracted from biologists an interest even remotely comparable to *Drosophila melanogaster* or *Caenorhabditis elegans*. This is, in part, because of the generally lengthy life cycle and to the lack of most of the peculiar qualities according to which a species is usually selected to become a new model organism. The only beetle species featuring regularly, at least in the journals devoted to developmental biology, is *Tribolium castaneum*, a small representative of the tenebrionid family that in the last decades has definitely put out of the game a different member of the same family, *Tenebrio molitor*, which previously seemed ready to become a favourite in the labs. Of recent, the horns of scarab beetles of the huge genus *Onthophagus* have become the focus of excellent work on the developmental background of an evolutionary novelty, but there is little else to add, for beetles, in the whole of developmental biology.

Substantially higher interest have obtained the beetles among evolutionary biologists, especially in respect to coevolution with host plants and geographical speciation, but a boundless range of wonderfully attractive topics have been still virtually untouched.

To stimulate further interest in the megadiverse lineage of beetles, to the benefit of both evolutionary and developmental biology, a lavish collection of colour pictures or a detailed taxonomic monograph of the traditional brand would hardly be of use. What is needed is a comprehensive account of the Coleoptera, rich in information about their metamorphoses, their reproduction, their multifarious adaptations, in addition to an obviously updated account on their comparative morphology, larval as well as adult.

These volumes of the *Handbook of Zoology* devoted to beetles are providing, at last, such a kind of monograph. This second volume (about the first volume, and the whole series currently expected to be published in four volumes, see my previous book review in this journal, 44:260–262, 2006) covers 112 families, plus a number of genera still awaiting a reasonable family assignment; this is the product of the collective efforts of 52 authors, among which the editors of the whole volume set on the Coleoptera.

My first exciting discovery, when browsing through the richly illustrated pages of this volume, has been the unexpectedly high number of genera, including many rare and exotic ones, of which the larvae are known, in addition to the adults. This has lead to several efforts to add larval characters to the matrices of morphological data used for phylogenetic reconstruction. Interestingly, larval vs. adult characters suggest different phylogenetic affinities of the Elateridae, thus opening the still unresolved question, whether it is the larvae, or the adults, which are most severely affected by homoplasy.

Beetle larvae and metamorphoses offer a number of research opportunities, but also of serious challenges, to the student of evolutionary developmental biology. On a possibly more elementary level, the larvae of some beetles (many examples, again, in the Elateridae) are likely of interest for the currently hotly debated issue of the origin and evolution of arthropod segmentation, in so far as these larvae show evidence of 'multiplication' of segments through a regular subdivision of the conventional thoracic and abdominal segments into higher-order units.

Some lampyrids, instead, may offer scope for investigation in the plasticity and evolvability of the postembryonic developmental schedules. In fact, these beetles deviate from the general condition in the Coleoptera, where the number of larval instars is fixed (not just at the species level, but also for entire clades with thousands of species) and very low: in the lampyrid *Pyractonema lucifera*, the number of larval instars may vary between four and nine, dependent on the photoperiod. Much more intriguing, however, are those beetles (some members of the Lycidae, Phengodidae, Rhagophthalmidae, and the *incertae sedis* genus *Stenocladius*) where the adult females are extremely similar to the mature female larvae, raising the question (to be possibly answered differently in the different genera) of what, if anything, is left here of a pupa, or of imaginal discs.

On a different vein, beetles offer amazing examples of parallelism, which often include whole large ('family' level) clades. For example, subsociality, with parental care occasionally offered by both parents to their offspring, is well known in the dung beetles (Scarabaeidae), but is also found in a few South African members of the Tenebrionidae; intriguingly, in either family this behaviour is 'troubled' by the presence of species which live as social parasites, scarabs on scarabs, tenebrionids on tenebrionids. Again, as the blister beetles split ecologically into two groups, one of which parasitizes solitary bees, while the other feeds in the larval condition on the eggs of celiferan Orthoptera, so do the members of the only remotely related genus *Trichodes* (Cleridae), among which there are larvae living on the same food items as those of the Meloidae.

For those interested in adaptation, beetles offer much more than the relatively popular association with host plants, although even this area would deserve to be complemented by new approaches, to enquire for example why mosses and ferns are so sparingly exploited by these (and other) insects.

Any open-eyed reader of this book will easily find here many additional items, each of which is the potential starting point for a project in evolutionary biology, or in developmental biology, or both.

To be sure, it is not by chance that beetles have contributed just one model species to modern experimental biology, but even in this respect there is a lesson to learn form this precious monograph. If the tiny members of the Sphindidae, which seem to feed strictly on myxomycetes, have a life cycle of only 20–30 days, it may be worth trying them in the lab. It may happen that sound traditional zoology as is the whole stuff of this precious *Handbook* volume will eventually turn out into an essential support for new adventures in experimental biology.

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