

HEMING, BRUCE S. 2003. *Insect Development and Evolution*. Cornell University Press, Sage House, 512 E. State St., Ithaca, NY. xv + 444 pp. Cloth Hardback. ISBN 0-8014-3933-7.

Insect Development and Evolution is an excellent resource and reference book for insect biologists and others conducting research with insects. Many scientists using insects as models in genetics and biological development do not have a formal background in entomology, and this book will be an invaluable source of fundamental information. The book is oversize, and the 400+ pages contain a vast amount of information. It grew out of the author's more than 30 years teaching of insect development.

The book comprises 13 chapters, as follows: The Male Reproductive System and Spermatogenesis; The Female Reproductive System and Oogenesis; Sperm Transfer, Allocation, and Use; Sex Determination; Parthenogenesis; Early Embryogenesis; Specification of the Body Plan in Insect Embryos; Organogenesis; Postembryonic Development and Life History; Molting and Metamorphosis; Specification of the Adult Plan; Hormones, Molting, and Metamorphosis; and Ontogeny and Hexapod Evolution.

There are many fascinating topics one could mention in this book, but I choose two that particularly interest me. The first has to do with the pupal stage in insects. The insect pupal stage is unique. Pupation has many of the characteristics of a second embryonic stage in midlife of the insect. The embryo in the egg develops into a larva that hatches, feeds, grows, and molts as it gets larger. Sometimes after only a few days of larval life, sometimes after weeks, it enters the (mostly) quiescent pupal stage during which larval tissues are nearly completely broken down and an adult body plan is fashioned. The adult usually looks quite different from the larval form, and has a different life history. How did the same organism evolve these two strange and wonderful lives? What forces acted during ancient insect evolution to create a complete metamorphosis through egg, larva, pupa, and adult life forms? Starting on Page 248 the author devotes 9 (oversize) pages to an evaluation and discussion of the many models that have been proposed to explain the evolution of complete metamorphosis.

I found Chapter 12 entitled Hormones, Molting, and Metamorphosis a very interesting chapter. Some might think that insects are too simple to have much in the way of hormonal controls. In

truth, virtually every aspect of insect biology, including behavior, digestion, metabolism, excretion, reproduction, pheromone synthesis and secretion, and development is under some form of hormonal control. This chapter deals mainly with developmental aspects of hormones. The chapter, comprising 32 pages, is an intense lesson in insect development as influenced by hormones. The author starts with a delightful summary of work in the early decades of the 20th century that established hormonal control of molting and metamorphosis, leading to isolation and identification of a complex of hormones involved in molting and metamorphosis. As the author concludes near the end of the chapter, the story is already complex, but not yet complete. The ecdysteroids are known to act at the gene level, controlling transcription, but the mechanism of action of juvenile hormone in regulating the type of molt, for example, is still unknown. Although juvenile hormone seems to be unique to insects, many of the other hormones, including the ecdysteroids, belong to families of hormones known to be functional in vertebrates. Hormonal control of development and physiological function is clearly fundamental, evolved early, and much conserved throughout evolution.

There are many line drawings in the book, one or more on nearly every page. The drawings are detailed, sometimes complex, and sometimes a little small, requiring careful study to get the full meaning.

The book contains nearly 60 pages of references to the literature of insect biology and development, providing a guide into the primary literature. The book will be useful to teachers of insect development, and as Heming has done, can be used as a textbook for a one- or two-semester course in insect development. As scientific and textbooks go today, the price is very modest and should enable many graduate students to purchase the book as a resource book even if not used as a textbook. Overall, I think this is a very useful book for any scientist working with insects.

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