
Book Review

Introduction to Ecological Biochemistry, Third Edition. J.B. Harborne. London, Academic Press, 1988, 356 pp.

Breadth and brevity are the hallmarks of this wonderful little book. Each chapter is an engaging, skillfully crafted, self-contained discussion of a major area of contemporary research in chemical ecology. The titles of the 10 chapters are "The Plant and Its Biochemical Adaptation to the Environment," "Biochemistry of Plant Pollination," "Plant Toxins and Their Effects on Animals," "Hormonal Interactions Between Plants and Animals," "Insect Feeding Preferences," "Feeding Preferences of Vertebrates, Including Man," "The Co-evolutionary Arms Race: Plant Defense and Animal Response," "Animal Pheromones and Defense Substances," "Biochemical Interactions Between Higher Plants," and "Higher Plant-Lower Plant Interactions: Phytoalexins and Phytotoxins."

In working through this volume the reader will be treated to interesting and authoritative discussions of topics as diverse as the ecological significance of Crassulacean acid metabolism (CAM), the evolution of flower color, the chemistry and ecology of cyanogenesis, food selection by wild gorillas, the chemistry of sweetness, mammalian pheromones, allelopathy, and phytoalexins. In presenting this tremendous diversity of material, the author shifts easily between fairly detailed accounts of individual case histories, passing references to isolated but interesting facts, and lucid informative summaries of topics that have extensive bodies of literature associated with them. The chapters on pollination, pheromones, and phytoalexins are outstanding reviews of very complex subjects.

Every reader of this book will be able to think of a few topics that he or she feels ought to have been included or discussed in greater depth. For example, my list would have included a discussion of foraging energetics of bumblebees as a final section of the chapter on pollination. An account of various approaches to assess the costs of producing or detoxifying defensive chemicals would have been useful in the chapter on plant toxins. A discussion of recent work on the induction of detoxifying enzymes in insects by naturally occurring plant chemicals would have rounded out the section on the fate of plant toxins in animals. A discussion of the importance of the composition of foliage volatiles in the attraction of the Colorado potato beetle to host plants would have

added to the discussion of the role of alkaloids as feeding deterrents for this insect. A chapter on the role of microorganisms in plant-herbivore interactions would have been a good companion to the one on higher plant-lower plant interactions. I would have preferred that more space be allocated to discussions of recent work on the chemical ecology of beetle-willow interactions, pharmacophagy in Danaine and Ithomiine butterflies, iridoid glycosides and insect herbivores, and the mode of growth inhibition in insects by tannins, even if the coverage of these topics had been at the expense of space dedicated to some of the studies that so influenced this field during the 1970s.

These, however, are minor quibbles about content. The author has, in fact, exercised masterful judgment in his selection of topics. By his choice of subject matter, Prof. Harborne illustrates the broad range of questions addressed by the field of chemical ecology, introduces studies that have influenced the development of ideas in a significant way, and communicates the current excitement that pervades the field.

I am able to point to only a single topic in which the discussion has been weakened by the omission of pertinent material. In discussing possible explanations for the distribution, abundance, and diversity of plant secondary chemicals, the apparency hypothesis is presented, but there is no mention of the resource-availability hypothesis. There is also no discussion of the nutrient-balance hypothesis, of the responses of plant secondary metabolism to nutrient and light stress, or of genetically based within-species variation in secondary chemicals. As a consequence, the chapter on coevolution of plants and their herbivores is weak. It is essentially a restatement of the Ehrlich and Raven model of pairwise coevolution interpreted within the framework of the apparency hypothesis.

The value of the book as a reference work would be greatly enhanced by a better subject index, which is largely an alphabetical list of chemical names. Latin binomials for plant and animal species are separately indexed. The subject index includes very few common names of organisms and very few entries that identify processes or phenomena. For example, none of the following words or phrases are indexed: apparency, birch, deterrent, generalist, host-parasite, host selection, induced defense, induction, inhibition, inhibitor, mimicry, monarch, mutualism, parasitism, pharmacophagy, predictability, sequestration, slug, snowshoe hare, specialist, swallowtail, symbiosis, three-trophic-level interaction, trichome, variability, variation. The reader has no way of determining whether sequestration is discussed in the chapters on plant toxins, animal defenses, coevolution, or all of the above. There are no entries in the index that would direct a reader interested in the role of trichomes in plant defense to the chapters on feeding preferences and coevolution where this topic is discussed.

This deficiency in the subject index is amplified by somewhat arbitrary

placement of some topics in chapters where they do not quite seem to belong. For example, the excellent account of pheromonal interactions in pine bark beetle biology has been placed in the chapter on hormonal interactions between plants and animals rather than the one on pheromones. Since this discussion is not referenced under "pheromone" in the index, and there are no entries for "aggregation," "attraction," or "bark beetle," the only way a reader can find it is by looking up "myrcene," "pinene," or "verbenone," or by reading the entire book and remembering where it is. Other examples of questionable organization include reference to the toxic effects of many plant chemicals in the chapter on feeding attractants and deterrents, the placement of the discussion of induced plant defense in the chapter on coevolution, and a discussion of the synthesis of cardenolides by some insects in a section on pyrrolizidine alkaloids, which immediately follows a section on cardiac glycosides.

The first edition of this book was published in 1977. It had nine chapters and 243 pages. In the preface to the first edition, the author noted that the book was "based on a course taught over a number of years" and that it was "intended as an introduction to...new developments in biochemistry that have...expanded our knowledge of plant and animal ecology." A second edition appeared in 1982. The third edition has expanded to 10 chapters and 356 pages. Despite the publication of many excellent books in the area of chemical ecology during the past decade, *Introduction to Ecological Biochemistry* remains a one of a kind. It is still the only comprehensive single-author book that attempts to summarize the whole field of chemical ecology. Because of its uniqueness in this regard, it has become much more than the "simple introduction to new subject matter," it was originally designed to be. Some of us are beginning to look upon it as the book that defines what chemical ecology is. Perhaps this third edition is not yet quite chemical ecology's equivalent to Wigglesworth's *The Principles of Insect Physiology*, but at least it is close enough to suggest the analogy. Let us hope that Prof. Harborne will continue to accept the challenge of providing us with an up-to-date, expanded, and improved edition of this singularly important book every five years. In the meantime, I would encourage anybody with an interest in chemical ecology or ecological chemistry, both students who are new to the field and researchers who have been active in it for years, to buy a copy of the third edition of *Introduction to Ecological Biochemistry* and to read it from cover to cover.

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