

Following a discussion of amber and resin, the origin of Baltic amber and the fauna and flora of the amber territory, the remaining two-thirds of the book is devoted to insects. To emphasize ecological aspects the material is arranged in chapters headed 'Plant-sucking Insects', 'Leaf- and Seed-Consumers', 'Gall Producers', 'Nectar Seekers', 'Insects Trapped while Resting', 'The Fauna of Moss and Bark', and 'The Hidden Fauna of Tree-Trunks'. In a final 'Review' conditions in the amber forest as envisaged by the author are summarized. A list of the amber material in the Zoological Museum, Copenhagen, and an index conclude the book. Extensive references are given at the end of each of the 4 main sections of the text. The book is illustrated by 12 good quality halftone plates of original photographs of amber inclusions, mostly insects. Almost all of the 62 text-figures are redrawn from the literature; some of them are crude and the purpose of their inclusion is not always clear.

Baltic amber is a fossil resin of Eocene-Oligocene age, characterized by a high content of succinic acid, and is believed to have originated from the extinct amber tree, *Pinites succinifer* (Pinaceae). The massive resin production of that tree is no longer considered the result of disease but is now accepted as natural, analogous to the resin production of present-day kauri pines. The amber forest was subtropical and is considered to have been a continuous territory of considerable East-West extension where conifers were well represented with over 30 species. The faunal composition in the Baltic amber suggests that the humidity in the amber forest was high and that there was plenty of running and standing water. There is ample evidence of aquatic insects (Plecoptera, Ephemeroptera, Trichoptera, and Diptera).

No longer can one scientist be expected to have expert knowledge of all orders of insects, consequently Larsson's single-handed treatment of the entire Baltic amber fauna suffers from a number of weaknesses. The specialist literature is neither fully covered nor critically evaluated, and published taxonomic information is invariably accepted as correct. Although the Baltic amber forest has been recognized for a long time as having been subtropical, taxonomic and ecological conclusions are frequently based on comparisons with the insects and environment of the northern temperate zone. The ecological conditions are interpreted and described in a generalized and oversimplified way. To give one example (p. 123): 'The recent Oecophoridae do not fly far and in fact keep to the lowest part of the tree-trunks. Their larvae live mainly in rotten wood or under dead bark . . . That so relatively many Oecophoridae have been found in amber is therefore quite natural, since they have had excellent conditions for breeding in the *Sciara* zone of the forest, with all the fallen and rotting trunks of many different trees, as one may assume has undoubtedly been the case.' In fact many, if not most, recent Oecophoridae are neither forest dwellers nor do their larvae live in decaying wood.

Larsson notes that Danish amber has yielded a number of insect taxa which are not represented in the vastly richer Samland material and interprets this as evidence of faunistic differences in separate parts of the amber forests. Considering the duration of the amber age, such discrepancies could equally reflect changes in the faunal composition of an area over a period of time.

The division of the book into 'ecological' chapters makes it difficult to find certain information; many subjects are discussed in more than one place and not always where one would expect them. The text is in places clum-

sily written and would have benefited from thorough linguistic editing.

Although the book contains little worthwhile original material and lacks a critical evaluation of the previous literature, it is of some value to the entomologist as an introduction to the study of the Baltic amber fauna.

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BIOCHEMICAL ASPECTS OF PLANT AND ANIMAL COEVOLUTION, J. B. Harbone, ed. Academic Press, London. \$50.90.

This fluently readable book is an enticing mix of factual review material interlarded with flights of speculation ranging from the cautiously tentative to the fanciful. Its title perhaps emphasizes the speculative aspects, i.e., coevolution; but those who have followed in recent years the proliferating literature of phagostimulants/antifeedants/digestion inhibitors/allelochemicals and what-have-you will know that plant-animal coevolutionary biochemistry signifies an astonishing efflorescence in the identification of both plant and animal chemical oddities, much of which information is here synopsisized insofar as it may be pressed into the service of coevolutionary hypotheses. In another respect, the title calls for some interpretation: though subsuming animals in general as its domain, in actuality the contents are largely entomological. There is substantial reference to the literature of birds and mammals, primarily where this information is essential to support in breadth a speculative ecological structure. Indeed, one chapter is framed about an experimental program which dealt jointly with the foraging of both vertebrates and insects. But other groups of animals receive no more than passing asides, although 2 chapters deal entirely with plant-plant relations. This lopsidedness doubtless reflects the fact that more of the detailed chemical information now mandatory for effective work on plant-animal interrelations is available for insects and the plants they chew on than for other animals. Nevertheless, one may guess that the real reason for entomological emphasis is to be found in the historical background and genesis of the book.

This volume comprises review papers based on contributions to a symposium held in 1977 at Reading, England, under the auspices of the Phytochemical Society of Europe. I would surmise that the meeting was organized primarily around the interests of entomologists concerned with the dietetics, feeding behavior, and alimentary physiology of phytophagous insects, supported by some essential contributions from the real natural products chemists upon which this line of enquiry now depends so heavily. Of the 14 chapters, 4 are mainly descriptive and classificatory of the many categories of plant "secondary chemicals" (a term held by some to be outdated, of which more later) and their distribution within and across plant taxa. The largest group of 8 chapters deals entirely or primarily with the ways in which the chemistry of plants or plant parts may affect the behavior, growth and distribution of insects which might eat or otherwise molest the plants. It is among these contributions, together with an introductory account of comparative plant and animal palaeontology, that coevolutionary speculations most abundantly adorn a greater or lesser substructure of chemical, behavioral and physiological fact. Within this entomological core,

there is a preponderance of emphasis on the role of secondary substances in mediating plant-insect relationships, which on casual skimming might leave the impression that they alone regulate feeding. However, this is balanced by 2 chapters mainly devoted to emphasizing the delicate influences on feeding of the nutrient components of plants. Though several of these chapters invoke studies on foraging by mammals and birds to flesh out the broader ecological structures to which the activities and population dynamics of insects contribute but a part, it is apparent that the subject of this book is basically in the direct line of descent of those now legion studies on the quirks and quiddities of insect food selection.

It is of interest to contemplate how, during the past 5 decades, the ruling paradigms with respect to insect-plant dietetic relations have changed—some might say have coevolved—with increasingly sophisticated chemical, behavioral, and ecological techniques and knowledge. Since wood-eaters, wool-eaters, fastidious phytophages, etc., were first noticed among insects, explanations have been proffered for such dietetic singularities as compared to ourselves and the other more obvious animals. Before rigorous nutritional studies revealed that insects and vertebrates differ only marginally in their qualitative requirements, extreme dietary specialization was viewed as most likely an indication of digestive and nutritional assistance from microorganisms, as in wood-eaters, or, especially among fastidious phytophages, was ascribed to unusual nutritional needs requiring the postulation of “unknown growth factors” found only in the restricted groups of plants upon which growth occurred. With the surge of activity 3 decades ago in insect feeding behavioral studies and the consequent accumulation of numerous instances of the essentiality of particular plant secondary chemicals as releasers of feeding, the “token stimulant” theory came to pervade the field. Though all sorts of exceptions were duly noted, the mental set inculcated by the more extreme examples of dependence on specific token chemicals tended to the view that feeding was regulated by essentially positive stimuli: for omnivores and polyphages these were probably the nutrients as such, and nutrients were frequently found to be necessary co-stimulants also for fastidious feeders which, in addition, required a token stimulant. Since feeding thus tended to be envisaged as the result of positive stimulation, if it was narrowly restricted in a particular insect species, this fastidiousness was conceived to have arisen by the evolution of a demand of peculiar chemical stimulation without which the mechanics of ingestion would be abrogated. From this period may be dated the genesis of wide interest among entomologists in 2 previously dormant theoretical areas. First, plant secondary substances, hitherto the province of specialist chemists, pharmacologists, and botanists somewhat out of the mainstream of both animal and plant physiological chemistry, became of widely ramifying significance for behavioral zoology and ecological biology in general. Secondly, explanations of increasing ecological subtlety were proposed for the apparent strangeness of an insect species becoming evolutionarily fixated on a useless and often, as judged by the generality of other animals, noxious chemical; hence arose the burgeoning speculative field of plant-animal coevolution.

The token stimulant theory soon elicited some backlash with the proposition that secondary plant chemicals were usually more likely to act negatively as feeding inhibitors, countermanding positive feeding stimuli of a generalized sort deriving from ubiquitous components of prospective food, such as nutrients. This sort of spec-

ulation furthermore provided an obviously appealing reason for plants to have invested evolutionary labor in producing such seemingly useless materials as secondary chemicals. On this view, the undoubted cases of a requirement for positive token stimuli were considered to form a minority, even rare subset; more usually, plant secondary substances were held to reduce, by feeding inhibition, the host range of an insect, even of the large numbers of extremely polyphagous species (previously not looked at too critically from this point of view, and in this book very well documented with respect to locusts). The extreme swing of this particular pendulum produced the suggestion that while positive token stimulants might account for some examples of oligophagy, monophagy, if it truly existed, would result from a species becoming sensitive to inhibition by secondary chemicals of one sort or another in all plant species other than its one specific host. This in turn was going too far, and there are well authenticated examples (as discussed in the chapter on seed beetles) of true, species specific monophagy. Be that as it may, the difficulties inherent in attempting to comprehend why any dependence on token stimulants (or any other kind of secondary-chemical-based feeding restriction) should have evolved in insect species have been the prime factor in forcing more attention in recent years on the benefits that plants may gain from investment in odd biochemicals and how both plants and animals may complexly interact for their own evolutionary advantages once such chemicals have evolved. I must say I found the chapter on orchid/bee pseudocopulation the most fascinating exposition of these matters as seen from a plant's-eye angle: the proposition that these orchids, with the coevolutionary help of the bees, transformed a standard food-inspired attraction for potential insect pollinators into mimicry of the sexual attractions of specific female bees is an aesthetically appealing construct, which to one's regret at present lacks the identification in appropriate female bees of the appropriate orchid-specific scent chemicals.

This book presents components of all the foregoing ideas on feeding regulation as contributory to the current understanding of insect-plant relationships. The greatest changes over recent years stem from the appreciation of an expanded role for physiological effects on insect growth of secondary chemicals which act as toxicants, anti-feedants, digestion inhibitors, etc. More theoretical attention has also been placed on the detoxifying mechanisms that must have evolved for species which prefer plants characterized by substances that are noxious to the generality of other animals. With increasing awareness of an enormously intricate network of chemical interactions, not only between animals and plants, but also between plants and other plants or microorganisms, the term “secondary chemicals” is condemned by some as outdated and needing replacement by terminology of more functional connotation. The grounds for this, it is held, are that these diverse biochemicals may have evolved for functional purposes that are every bit as important to fitness and species survival as the proper functioning of the “primary” metabolic and structural biochemicals. Secondary chemicals were originally so designated at a time when they seemed to lack obvious botanical functions, and hence were considered chance byproducts of vital metabolic pathways, perhaps forms of reserve nutrients or a means of sequestering excess and potentially autotoxic metabolites. Whether they should now be called allelochemicals or some such thing will depend on one's predilections in apportioning probability levels to the speculative schemes of coevolution proffered in this vol-

ume. Being myself prone to feelings that meaningless randomness is widely built into the nature of things, I suggest a careful scrutiny of the chapter "All elopathy: Adaptation or Accident?" before too readily embracing the belief that all is allelochemical.

This is an attractive book, the best I have seen on these contentious topics for many years. If I have harped on its high quota of speculation, this is not to be taken as a carping criticism, for I regard speculation as essential to good science, to be published for general consumption and incitement to counterspeculation rather than confined to the private discourse of initiates. All entomologists concerned with insect dietetics, feeding behavior, nutrition, and theoretical ecology will wish to peruse these pages. The matters dealt with are fundamental to an understanding of the resistance of plants to foragers and parasites, both plant and animal, and thus it behooves those applied biologists aiming to sophisticate the practices of pest control to keep abreast of what is currently thought to make particular organisms attack particular sorts of plants.

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ECOLOGICAL METHODS WITH PARTICULAR REFERENCE TO THE STUDY OF INSECT POPULATIONS, 2nd ed., by T.R.E. Southwood. 1979. Halsted Press, John Wiley and Sons, New York 524 pp.

Twelve years after the 1st edition, *Ecological Methods* has been revised by Professor Southwood and made an even more valuable source book. The new edition is more complete, with over 100 pages of new information. The sections receiving special attention in this edition include predictive population models, systems analysis and modeling in ecology, and diversity and species packing.

Methodology is crucial to all ecological studies. The procedures employed determine the time invested by the investigator and in the end determine the validity and success of the results.

Professor Southwood cogently points out that the new computer and calculator technology have revolutionized ecology. New analyses and new presentations of the data are possible, but some may attempt to make good data out of bad. Southwood aptly points out that the computer/calculator technology cannot "make a 'silk purse' of sound insight out of a 'sow's ear' of unreliable raw data."

With the sophistication of current presentations of ecological data, the value of simplicity has sometimes been missed. Often, as Southwood points out, simple graphic presentations are of immense value "as a means of recognizing new patterns and gaining fresh insights" of the assembled data.

Because of the wealth of information on ecological methods, this book is valuable to all field scientists, including beginners. The clear, detailed descriptions of procedures and methods make it easily read and understood. This is the quality of an outstanding book.

Although the new sections and revision of earlier sections add a great deal to the new edition, the basic value of the book still lies with the methods of sampling and measuring populations. These procedures range from trapping and marking to counting caterpillar frass.

Southwood deals both with terrestrial and aquatic environments and explains how sampling procedures must be selected or adapted to different habitats.

The book is indeed unique, ranging from descriptions of simple trapping techniques to sophisticated population modeling. Professor Southwood is a rare ecologist with this breadth of knowledge and expertise. Clearly his book is an essential reference source for all field biologists investigating the numbers of animals in nature.

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FUNDAMENTALS OF PLANT-PEST CONTROL, by Daniel Altman Roberts. 1978. W. H. Freeman and Company, San Francisco. 242 pp. \$17.50.

In the words of the author, "The book is meant to make students of schools, colleges, and universities aware of plant-pest control as a unifying multidisciplinary science in its own right. It is also meant to provide a foundation on which plant-pest control specialists of the future may build useful and productive careers."

The book is written in 3 parts and in general it is restricted to control of crop pests. Part I (Chapters 1-5) presents plant pest control as a science that unifies the several disciplines concerned with plant pests and their control. Part II (Chapters 6-10) introduces the several disciplines and gives an overview of procedures used in the control of plant pathogens (including nematodes), harmful insects and other arthropods, weeds and vermin. Part III (Chapters 11 and 12) considers the systems approach to plant-pest control in an agricultural perspective.

In the 1st chapter the author establishes the agricultural ecosystem and the depredations to crops by plant-pests. Chapters 2 and 3 are devoted to the structure and function of crop plants. These chapters are an integral part of this book and offer the reader a clear and succinct review of this subject.

Chapter 4 gives a brief introduction to the dynamics of plant-pest populations. Although this chapter presents several of the basic concepts of ecology as they relate to pest population dynamics, it is too brief to do this topic justice. A more expanded account of this subject would greatly aid the students in interfacing the principles of ecology and plant-pest control.

Chapter 5 is devoted to the elements of plant-pest control. This chapter is meant to develop the concepts so basic to plant pest control. It is in this chapter where most pest management specialists would be at the greatest variance with the author. In this chapter the author introduces terminology and principles that are not completely compatible with those developed by entomologists over the past 25 years. For example, the economic threshold level is defined as, "the population (of a pest) that produces damage equal to the cost of preventing that damage." To most economic entomologists this definition has been generally reserved for the economic injury level. It is also in this chapter where the author states that the term pest management "erroneously suggests that people manage crop-plant pests when, in fact, all they manage are the pest control procedures." The author must surely recognize that the control procedures are only 'tools' through which the pest management special-