Functional Dynamics of Phytophagous Insects. T. N. Ananthakrishnan, ed. Oxford & IBH, 66, Janpath, New Delhi 110 001. 1994. viii + 304 pp. Price: Rs 550.

One-third of a million insect species are known to be phytophagous and constitute one-quarter of all living beings[1]. The number of recorded lepidopteran species alone, which are mostly phytophagous, is one order of magnitude greater than all species of birds and mammals put together – a staggering diversity which continues to overwhelm entomologists. The obvious success of phytophagy as a mode of life for insects testifies to their triumph in the evolutionary battle against plants. But plants have not been silent victims of insect onslaught either. They have waged their own evolutionary battle and what one sees today is a dynamic equilibrium in a continuing race. Interactions between insects and their host plants were first put into a comprehensive evolutionary perspective by Ehrlich and Raven's[2] classic paper, which triggered off an intense flurry of research activity. So strong has been its influence that almost all of plant morphology and plant secondary chemistry have since been attributed to selective pressure exerted by phytophagous insects. The book under review, coming close on the heels of another landmark publication in this area[3], is a laudable attempt at summarizing the mind-boggling literature on ecological and evolutionary aspects of insect–plant interactions.

Is geographic variation in plant allelochemicals of any significance to insect herbivores? In their chapter Johnson and Scriber address this question with examples from nonagricultural systems by dissecting out the ecogeographic variation in plant chemistry into historical, genetic, altitudinal and latitudinal factors. And how do phytochemicals alter insect behaviour? The chapter by Norris gives a brief overview of the major classes of chemical messengers, which is followed by a detailed discussion on the mechanism by which insects respond to chemicals. The idea that many common chemical messengers are both elicited and perceived by sulphydryl/disulphide-dependent mechanism of the receptors is convincingly argued. His call for detailed investigations of chemical communication at electrochemical level for a better understanding of cell–cell and environment–cell exchange of chemically based energy would hopefully attract more chemists to biology. The chapter on the physiological basis of feeding and oviposition behaviour in moths by Ramaswamy is an excellent review of the current knowledge on the role of proximate factors in host finding in moths. At the simplest level, host recognition and acceptance involves integration of inputs from several sensory modalities such as vision, mechanoreception and chemoreception. The internal metabolic state of the insect, the ontogenetic and phylogenetic influences on the mechanism of host selection add several levels of complexity to the dynamics of insect–plant interactions.

Do plants possess chemicals that provide both positive and negative stimuli and influence host selection? Dethier[4] had suggested that a balance of positive and negative stimuli could be present in the plants and the ultimate behavioural response of the insect depends on the balance between internal state of the insect as regards motivation and degree of satiety and external stimuli. This was further elaborated by Miller and Strickler[5], who proposed a 'rolling fulcrum model' wherein the internal excitatory/depressor factors could tip the balance in favour of host acceptance or rejection. This issue is examined by Renewick and Huang in the chapter on chemical stimuli mediating oviposition by lepidoptera. The authors review their work with the *Pieris–Crucifer* system, wherein the host plants have chemicals that are both oviposition stimulants and deterrents. Their results show quite convincingly that final rejection or acceptance of a host depends on the insect's assessment of the balance of stimulants and deterrents.

Ananthakrishnan, Venkatesan and Sridhar examine the effect of relative levels of nutrients and other chemicals like phenols, fatty acids and flavonoids in different plant parts on feeding and reproduction in the lepidopteran pest complex of cotton. The authors argue that this information can be of much use in managing insect pests of cotton by manipulating plant chemistry. Uthamasamy reviews the behavioural processes involved in host selection by the bollworm complex on different varieties of cotton. The emphasis here, however, is more on the effect of plant morphology on host acceptance by bollworms.

'Your enemy's enemy is your best friend.' That even plants believe in this is convincingly shown by Whitman and Nordlund in the seventh chapter. While reviewing the tritrophic interactions between plants, herbivores and their natural enemies, the authors present evidence to show that plants actually 'communicate' with natural enemies of their enemies, i.e. with the enemies of herbivores. Damage by herbivores induces the plants to produce chemicals that not only attract but actually serve as road maps to the natural enemies of herbivores. The chapter ends with a tempting speculation that these chemical beacons, 'kairomones' as they are called, hold great potential for solving pest problems.

Whitaker, Blum and Slansky Jr. attempt to trace the possible evolutionary path of

carnivory in phytophagous insects. The authors appeal for more careful and detailed study of such facultative carnivory since many instances of carnivory are either overlooked or not reported.

Another insightful and particularly enjoyable chapter also tackles the same theme, viz. plant defence against herbivores through tritrophic interaction. Whitman takes us on a fascinating journey into the world of plants and the elaborate strategies (nonchemical) employed by them to defend themselves against herbivores. The role of floral nectar, pollen, extrafloral nectaries, food bodies for ants, and domatia (shelters) in plant defence against herbivores by encouraging action of natural enemies is discussed in detail.

Interaction between gall-inducing insects and their host plants is reviewed by Raman in perhaps the toughest chapter, if one were to consider the extent of information published. The burgeoning literature on adaptional integration of host plant and galling insect species, host chemistry, chemical ecology of host selection, insect feeding, gall induction and the response of the host tissue is effectively summarized, but perhaps not sufficiently synthesized.

When two organisms are so closely linked as a plant and its insect pest/guest, the extinction of one is bound to increase the chances of extinction of the other. The issue of host specificity, metapopulations and conservation, using *Drosophila magnaquinaria* and its host plant as the model system, is addressed in the last chapter and the impact of small patches of host plants on the populations of the monophagous fruit fly is discussed.

All the chapters of this book, written by experts in their respective fields, are well researched. A more or less uniform presentation of chapters is also commendable for a multiauthored book as this one. The book, however, has its share of printer's devils. For instance, 'Lepidoptera' is spelt wrongly in the contents page and the legend to Figures on p. 253 is incorrect. Although each chapter can be read independently, they could still have been arranged into smaller subsections following a theme. Overall, the book offers a wealth of information to entomologists and will serve as an excellent companion volume to the recently published book on a related theme[3]. Undoubtedly, it should find a place on every library shelf. But unless publishers in India produce inexpensive paperback editions to accompany hard-cover library editions, the habit of buying books for personal use will surely go extinct.

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2. Ehrlich, P. R. and Raven, P. H., *Evolution*, 1964, **18**, 586–608.
3. Rosenthal, G. A. and Berenbaum, M. R., *Herbivores: Their Interactions with Secondary Plant Metabolites*, Academic Press, New York, 1992, vols I & II, pp. 488 and pp. 493.
4. Dethier, V. G., *Entomol. Exp. Appl.*, 1982, **31**, 49–56.
5. Miller, J. R. and Strickler, K. L., in *Chemical Ecology of Insects* (eds Bell, W. and Carde, R), Chapman and Hall, London, 1984, pp. 127–155.

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