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BOOK REVIEW

Herbivores: Their Interaction with Secondary Metabolites: edited by G. A. ROSENTHAL and D. H. JANZEN. Academic Press, New York, 1979. 718 pp. £34.60.

The close association between plants and their herbivores has generated an incredibly complex variety of chemical interactions involving secondary plant metabolites. Some of these chemicals are toxic to a potential predator or may act as antifeedants, others act as growth regulators having often subtle effects on herbivore development and reproduction. Still others act as attractants—as positive recognition signals for food and shelter or are involved in communicative responses often of a defensive or sexual nature. Thus these questions are often asked of secondary plant compounds: What are they? What are they for? Do they have any ecological significance? This book, a collection of essays edited by Gerald Rosenthal and Dan Janzen, sets out to answer these questions.

The book is divided into two parts. The first deals with "Ecological and Evolutionary Processes" and the second is devoted to the "Chemical Participants". A reversal of this order might have been more logical. The second half of the book is composed of twelve chapters, each written by an expert, on the secondary products encountered in plants. Chemical characterization and biosynthesis, isolation and distribution, physiological action and possible ecological roles are all covered. Non-protein amino-acids (G. Rosenthal and A. Bell), cyanogenic glycosides (E. Conn), alkaloids (T. Robinson), seed lipids (D. Seigler), glucosinolates (C. Van Etten and H. Tookey), terpenoids (T. J. Mabry and J. Gill), saponins (S. Applebaum and Y. Birk), phytohemagglutinins (I. Liener), proteinase inhibitors (C. Ryan), flavonoid pigments (J. B. Harborne), tannins and lignins (T. Swain) and insect hormones and antihormones (K. Sláma) are all given comprehensive coverage. No one should be deterred from these chapters since the information, regarding both structure and isolation, is given in a simple and concise manner. There are plenty of references allowing for a more detailed investigation of the appropriate literature. A recurrent theme in these chapters is the great diversity in herbivore response to a particular chemical or group of chemicals. As Rosenthal and Bell express this with regard to non-protein amino-acids "certain of these amino-acids are toxic to a wide range of animal species" whereas other herbivores "have evolved a biochemical capacity to reply to the chemical challenge" or as Janzen puts it "One beast's drink is another beast's poison." Wherever possible the ecological and adaptive advantages conferred on the plant by the presence of a particular compound is given but this is often unknown due to "lack of pertinent field data demonstrating the capacity of these secondary natural products to enhance over-all plant fitness". This lack of field information stresses the need for closer co-operation between phytochemists and ecologists.

The first half of the book "Ecological and Evolutionary Processess" has both factual and speculative chapters—again I would like to have seen these differently arranged. The herbivores viewpoint of allelochemics is given in two chapters—a general account of chemosensory systems and their function with emphasis on how animals perceive these secondary plant chemicals (R. Chapman and W. Blaney) and the highly effective mechanisms animals have for dealing with these toxic substances (L. Brattstein). Ways in which plants have adjusted their physiology and biochemistry to accommodate the presence of such potentially toxic substances within their cells is described by L. Fowden and P. Lea with particular reference to ways in which plants avoid autotoxicity by non-protein amino-acids. There is an interesting chapter on the interactions of allelochemics with nutrients in herbivore food (J. Reese), such interactions often explaining the deleterious effects of a given allelochemical.

In the more speculative chapters, D. Rhoades covers the biochemical evolution of plants and their herbivores. He suggests that patterns in plant defensive properties result from, and are maintained by, the interaction of selective influences exerted by the physical environment, competitive interactions, and herbivores, giving a dynamic equilibrium. Similarly, D. McKey (at some length!) describes selective factors influencing the distribution of plant natural products in time and space. F. Chew and J. Rodman attempt to compare the "cost" to the plant of producing a particular secondary compound and to relate this biosynthetic cost to ecological "benefit". At present we have little appreciation of exactly how to relate cost to benefit and this paper provides many interesting ideas encouraging further discussion and thought. D. Janzen concludes this section with a chapter on "new horizons" in the biology of plant defenses asking as usual a series of thought-provoking questions such as "How does one measure the impact of herbivory?"

It is a readable book, well referenced and provides a ready source of information for graduate students and research workers and people beginning in this field. Its publication shows that biochemical ecology has come of age—it is over forty years since Vincent Dethier first drew attention to the effect of plant natural products on insect food choice and Fraenkel's article in *Science* hammered home this message. As Ryan (this volume) says "The age of chemical ecology is upon us and it is our challenge to not simply accept it but consider it as an opportunity to pursue new imaginative research frontiers, with significant potential in areas of both fundamental and applied Science". So the message of this book to both chemists and ecologists is "Grasp it like a lad of mettle and soft as silk remains" (Sean O'Casey's Juno and the Paycock).

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