This classic experiment is now shown in general biology textbooks and it is so deceivingly straightforward that most of us think we know all about it. So was it really necessary to dedicate an entire book to the minute details of the genesis of the experiment? The answer is undoubtedly "yes" for three main reasons. First, the book is important as it debunks the apparently widespread belief that some people wake up in the morning and come up with genial ideas without much effort. Holmes demonstrates how such a "simple" experiment was extraordinarily complex both conceptually and technically. Although the reality of semiconservative replication now seems obvious, Holmes brings us back to a time where nothing was certain about the structure and function of DNA, particularly on the issue of its replication. It is in this context that the foresight of Meselson and Stahl needs to be judged. Second, Holmes argues that science does not proceed linearly, but uses unlikely routes. In this case, the idea of using different isotopes to uncover functional processes came to Meselson while attending a lecture by Monod on protein synthesis, only much later did Meselson and Stahl think of applying it to DNA replication. Third, this book is written in a gripping style. It is a "story in the form of a drama in several acts, with two central characters" (pp 4–5). At that time, analytical ultracentrifugation was excruciatingly slow. Only one sample could be run every 16 hours. It took an incredible amount of patience, careful planning, and guts to produce this most amazing experiment.

This book is essential for younger readers to learn about the processes of careful scientific method that lead to the "perfect experiment," and for readers with more experience in molecular biology, it brings back the same unaltered sense of awe that touched the community in 1958.

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GENERAL BIOLOGY

PLANT-ANIMAL INTERACTIONS: AN EVOLUTIONARY APPROACH.

Edited by Carlos M Herrera and Olle Pellmyr. Oxford and Malden (Massachusetts): Blackwell Science. $69.95 (paper). xii + 313 p + 4 pl; ill.; index. ISBN: 0–632–05267–8. 2002.

Thirty years ago, few scientists would have described their fields of study as "plant-animal interactions," and it was rare to find a symposium or a session of contributed papers on this topic at a national conference. Times have changed radically. Some such scientists have attained not only tenure, but even a certain respectability, and some universities (mine included) are developing courses in plant-animal interactions. Although the emergence of such courses marks something of a triumph for those of us who are hampered by the old boundaries among botany, zoology, agriculture, and entomology, it is certainly a challenge to characterize and delimit this sprawling "new" discipline. Like Frankenstein's monster, it has been stitched together from an unmatched set of components, some of which are in better shape than others. Aside from an early and idiosyncratic effort by Henry Howe and Lynn Westley (1988. *Ecological Relationships of Plants and Animals.* Oxford: Oxford University Press), we have lacked textbooks and summaries that span ranges broader than traditional subdisciplines (such as pollination biology). Now Herrera and Pellmyr, whose original and meticulous contributions have done much to inspire and shape current research in pollination and dispersal biology, have recruited a distinguished team of authors to assemble a broader view, aimed at upper-division undergraduate students and those starting graduate studies.

Each of the nine chapters is worthwhile; some are extraordinary. I view the book as an essential volume for active researchers, as well as the graduate students who form part of the intended audience. As for undergraduates, I am not sure how well the book will work to structure a course. First, the level of presentation tends to assume advanced knowledge of organismal biology, ecology, and evolutionary theory. Second, whatever discipline the editors tried to impose on the authors was insufficient to produce an integrated feeling or a homogeneous style to the chapters. Given the patchwork nature of the field itself, this is neither surprising nor fatal, but it may frustrate those undergraduates who simply want a unified account delivered in a magisterial voice. More sophisticated readers should be able to derive both interest and pleasure from the diversity of voices present in the work, but even those readers might wish that the editors had imposed more consistency. For example, empirical support for the Janzen-Connell hypothesis is presented in Chapter 3 as being "broad" (p 103), but in Chapter 5 as "equivocal" (p 145). The references cited by the chapter authors do not overlap. Readers deserve some reconciliation of these viewpoints, as well as elimination of the second, unnecessary, near-duplicate figure. Table 1.3 and Figure 2.23 independently discuss a taxonomy of coevolutionary patterns drawn primarily from the work of John Thompson, but the references differ, the

terminology is inconsistent, and there is no cross-reference that links the material in the two chapters.

It is necessary to consider the chapters largely on their own merits. The outlier is certainly Conrad Labandeira's paleontological/phylogenetic treatment of the history of plant-animal associations. The longest chapter by far, it is so information-dense that it needs its own appendix to explicate the complicated figures. These have audacious titles like "The fossil history of spore and pollen consumption, and pollination," or "The fossil record of plant-associated insect dietary guilds." Perhaps because I seldom read paleontological accounts, I was forcibly struck by this chapter. The volume of scholarship is staggering, as is the ingenuity of interpretation. Yet, I found myself simultaneously overwhelmed by the data density of the figures, but frustrated by the ultimate sparseness of the data. For example, Figure 2.6 records three instances of seed predation by insects from the Carboniferous, one from the Permian, and no more until the Cretaceous. What relationship does this record bear to what was really happening, which is presumably that millions of insects were attacking millions of seeds every day of the intervening hundreds of millions of years? Labandeira points out that certain types of fossil data "provide an inadequate inventory of the totality of past associations, but they are robust at higher taxonomic and ecological scales" (p 73). For a contemporary, process-oriented ecologist like myself, the question becomes "when do the scales addressed by the fossil record overlap usefully with the scales implicit in short-term experiments and fitness estimates in modern communities?"

Except for Peter Price's introductory chapter and John Thompson's concluding synthesis, the other chapters focus on the mechanisms of contemporary interactions. This is mainstream material for most of us in the field. The chapters differ intriguingly in how they use catalogs of case histories, taxonomies of interaction types, or theoretical models to present their syntheses. Kjell Danell and Roger Bergström depend heavily on categorization in their treatment of mammalian herbivory, presenting numerous tables and figures that show how different modes of feeding and digestion are distributed across animal taxa and continents. In contrast, Pellmyr approaches pollination phylogenetically, supplemented with numerous graphs showing the results of key experiments. Herrera masterfully combines these modes to consider seed dispersal, as do Sharon Strauss and Arthur Zangerl in their treatment of insect herbivory. Of these chapters, my favorite was that on granivory, by Philip Hulme and Craig Benkman, because of its greater emphasis on components of theory, such as the functional dependence of seed removal on seed density.

The complexity of species relationships frustrates attempts to separate this material cleanly. Herrera and Pellmyr recognize this ambiguity by grouping two sets of chapters as Mostly Antagonisms and Mostly Mutualisms. Even so, the chapter by Andrew Beattie and Lesley Hughes reveals such an array of ant-plant interactions that it fits neither of those and must be put in the Synthesis section. The other synthetic chapter is John Thompson's attempt to outline where the field is heading. Posing nine general questions and six more particular ones, he argues that progress will depend increasingly on expanding field investigations to larger spatial scales and enriching them with molecular tools and mathematical theory. Without exception, his questions are well considered, deep, and provocative. On such a rich intellectual diet, the field of plant-animal interactions seems poised to continue its explosive growth, with Herrera and Pellmyr's book attaining foundational status.

James D Thomson, *Editor*, The Quarterly Review of Biology

Life at the Limits: Organisms in Extreme Environments.

By David A Wharton. Cambridge and New York: Cambridge University Press. $25.00. xi + 307 p; ill.; index. ISBN: 0–521–78212–0. 2002.

Extreme environments are popular. *Time* had a five-page spread in its July 27, 2002 issue dealing with microorganisms in such places as deep-sea hydrothermal vents, Antarctic ice, and even inside rocks. These microbes are particularly interesting in view of the possibility that some sort of life could exist on other planets such as Mars, or elsewhere in the universe.

Life at the Limits is written at a level suitable for readers with some general science background and an interest in biology. It begins with a general introduction to extreme environments and what makes them extreme, followed by separate chapters on organisms living in very dry, very hot, or very cold environments. There is a chapter dealing with the origin of life and the question of extraterrestrial life. The final chapter recaps some of the previous themes, considers some physiological mechanisms of coping, and looks again at how these could have evolved. The glossary defines even the most basic terms clearly.

The conversational style is somewhat reminiscent of Lewis Thomas's work, *Lives of a Cell: Notes of a Biology Watcher* (1974. New York: Viking Press). The current volume was easy to read, but I found