the emerging evidence but also a useful source book, with about a quarter of the text devoted to hundreds of bibliographic citations. Although precise resolution of the roles played by GABA during CNS development and full understanding of the underlying cellular and molecular mechanisms demand considerably more detailed and systematic scientific effort, the multidisciplinary data reviewed in this book represent a clear commencement to the enterprise. The advent of specific probes for genomic sequences that encode glutamic acid decarboxylase, the enzyme considered rate-limiting in GABA synthesis, and for sequences that encode specific GABA-receptor epitopes should help to reveal more exactly when and where GABAergic circuits evolve in the developing CNS. Demonstration of physiologically elaborated signals mediated by GABA at synaptic and extrasynaptic sites on differentiating neurons and on various glial elements during development will require innovative strategies.

The value of this book lies in its concise and convincing identification of a worthwhile area for investigation. It could serve as a starting point for graduate and postdoctoral students, as well as for career neuroscientists in search of a new and potentially exciting line of investigation.

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Plant Ecology

Seed Dispersal. DAVID R. MURRAY, Ed. Academic Press, Orlando, FL, 1987. xiv, 322 pp., illus. $49.95.

When John Harper pointed out that one of the advantages to the study of the population biology of plants is that they sit there and wait to be counted he obviously was not thinking about seed dispersal. To the plant demographer, tracing the fates of dispersing seeds seems a difficult task in all but the simplest systems of abiotic dispersal. Historically such measurements have not been standard concerns of students of plant dispersal, who have been largely systematists preoccupied with biogeographic issues. Thus we now have a wide knowledge of the dispersal-associated structures of fruits and seeds and a considerable lore of events of dispersal and seed survival in seawater or in the guts or fur of various animals, but dispersal ecologists are only beginning to examine the seed shadows generated by different dispersal agents, the fates of seeds during and following the different forms of transport, and the consequences of all this for the ecology and evolution of the organisms concerned. This book, along with a recent symposium volume (A. Estrada and T. H. Fleming, Eds., *Frugivores and Seed Dispersal,* Junk, 1986), is indicative of a growing interest in the ecology of seeds. It reviews much of the literature and thus gives us a useful reflection of the state of dispersal ecology. The book should provide a valuable introduction and orientation for graduate students and other researchers interested in exploring this literature.

Perhaps the status of dispersal ecology is best understood by comparison with floral and pollination biology. Pollination biology has grown rapidly in the last 15 years under the impetus of increased interest in experimental plant population ecology and application to plants of insights from ecological and evolutionary theory. The theoretical developments have included use of selection thinking and of ideas derived from cost-of-sex arguments, Fisher's sex-ratio theory, and Bateman's principle of resource limitation for female function and mate limitation for male function. Seed and fruit ecology is undergoing a similar growth but at a slower rate and perhaps with a delayed onset. Some of the more exciting experimental developments have been attempts to document the advantages acquired by parents and offspring through dispersal. Also, theoretical insights are beginning to emerge that, combined with the new experimental approaches, could spur a period of rapid advance in dispersal ecology similar to that in pollination ecology. One theoretical effort that has had an organizing effect on some aspects of dispersal ecology is the application of foraging theory to dispersal by vertebrates (reviewed here by Howe). Theoretical developments from a more plant-centered point of view may be beginning to have an impact as well. For example, theoretical studies of the last 10 years have shown that, in addition to playing a role in gene flow, seed dispersal has three main population dynamic functions: escaping or hedging against environmental variability, escaping the effects of crowding, and escaping the effects of sib competition. The first two of these functions correspond roughly to Howe's colonization and escape hypotheses (functionally, his directed dispersal hypothesis must be a special case of one of the above, when the suitable habitat is rare and is readily discriminated). Little empirical work has been done to document or distinguish among these functions (especially the last).

The present volume perhaps represents a transitional stage in the history of dispersal ecology. Much of it consists of descriptive natural history, yet at least some of the authors seem to be grappling with the issues of putting dispersal ecology on a firm theoretical foundation while calling for integrated studies of the costs and benefits of the various means of dispersal.

The book contains seven chapters, four of which are devoted to dispersal vectors (wind and autodispersal, water, fruit-eating birds and mammals, and seed-eating rodents), one to dispersal in relation to fire, one to syndromes in Australian *Acacia,* and one to the evolutionary history of dispersal as revealed by the fossil record. The approaches taken by the contributors vary. For example, Burrows's chapter on aerial motion treats the physics of seed dispersal from first principles, coming to a number of useful and interesting conclusions about the dispersal potential of some broad categories of seed morphologies but not attempting to review the literature on actual distributions and distances attained. Murray's chapter on water dispersal focuses almost completely on dispersal by ocean currents, taking a systematic-biogeographic approach. O'Dowd and Gill's chapter on dispersal syndromes in *Acacia* is interesting in its approach to defining dispersal syndromes with a principal-components analysis of fruit traits calibrated with ecological observations of dispersal biology. The next two chapters provide broad overviews of dispersal by vertebrates, placing their observations in what for lack of a better phrase I will call a modern ecological framework. Howe summarizes a considerable literature in terms of questions of general ecological and evolutionary interest, such as optimal foraging theory, diffuse coevolution, and coexistence mechanisms. The chapter by Price and Jenkins is a useful compilation of a literature on rodent foraging behavior that may be unfamiliar to many botanists interested in the fates of seeds. The authors present a "fate diagram" that outlines in detail the potential destinies of seeds in relation to rodents. Tiffney's contribution places the dispersal ecology of extant plants in a macroevolutionary perspective. He suggests that complex modern animal dispersal syndromes became established for the first time around the Cretaceous-Tertiary boundary, 70 million years ago, though fleshy fruits associated with reptile dispersal were abundant as early as the Pennsylvanian. The Australo-Malaysian flavor of a number of the chapters is refreshing, with serotenous-fruited proteaceous shrubs replacing the Northern Hemisphere pine-coned counterparts and with discussions of, for example, arillate acacias.

As for mechanical features of the book, the lack of titles of articles in the bibliography is annoying and impairs the book's usefulness as a guide to the vast and scat-

tered dispersal literature. Also, contrary to fairly consistent usage throughout this book, "dispersible" is not spelled with an *a*.

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Books Received

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