Book Reviews

Evolutionary Gradients

Biogeography and Adaptation. Patterns of Marine Life. GEERAT J. VERMEIJ. Harvard University Press, Cambridge, Mass., 1978. xvi, 332 pp., illus. $25.

Recreation for the Eyes and the Mind by Filippo Buonanni, the first printed book devoted to seashells, was published 298 years ago. A survey of the subsequent malacological literature indicates that an inordinate amount of attention has been devoted to the esthetic delights of shells and rather little thought has been given to the adaptive significance of their remarkably diverse forms. Vermeij's fascinating personal exploration of patterns in the size and shape of marine organisms will do much to restore the balance implied in Buonanni's title. It is recommended to all biologists concerned with evolution and biogeography.

The pervasive theme of Vermeij's book is that many of the intertidal, latitudinal, and interoceanic gradients in size and shape represent coevolutionary responses to gradients in predator and grazing pressure. This well-illustrated volume is packed with observations on mollusks, sessile invertebrates, and plants of the intertidal and shallow subtidal world. Emphasizing the tropical mollusks he knows best, Vermeij argues that thicker, larger, elaborately sculptured shells with modified apertures are more resistant to predation by crustaceans, fish, and other gastropods. He speculates that much of the spatial and temporal variation in mollusk shell form is interpretable in terms of adaptation to present and past gradients in predator pressure.

Vermeij is careful to point out that data are not available to prove the existence of the alleged gradients in predation pressure. Nevertheless, his speculations appear justified by the ample empirical evidence and by the critical discussions of the known exceptions. Indeed, one of his most valuable contributions is the continual mention of paradoxical situations and phenomena ripe for experimental investigation. The questions he raises range from the specific (why is *Sargassum* spinier in the Pacific than in the Atlantic?) to the general (why, as one moves toward the equator, do the photosynthetic animals replace the algae in significance?). In stressing the need for data on the sources and intensity of predation on single species throughout their ranges and for information on productivity as it relates to competition and predation, he notes the strengths of the comparative experimental approach as exemplified in recent studies by Birkeland, Lubchenco, Menge, and others.

The most ambitious section of this volume embodies Vermeij's attempt to account for the development of the gradients in antipredator adaptations. He notes that they are more highly developed in the biota of the Indo-West Pacific than elsewhere. Diversity is also highest there—two to four times higher (depending on the group) than in the Caribbean. He inquires whether the relationship is causal or fortuitous. Do organisms that differ in the expression of predator-related traits differ in their susceptibility to speciation and extinction? Abandoning the fashionable *r*- and *K*-selected species dichotomy, he follows Van Valen and Grime in recognizing three types of species (opportunistic, stress-tolerant, and biotically competent) and arguing that they will differ strikingly in their adaptability. Biotically competent (highly coevolved) species have the highest speciation rates because the destabilizing influence of coevolution assures that selection pressures are continually changing. Thus, biotic factors are the source of the greater evolutionary diversification in the tropics in general, and in the older and less disturbed (by Pleistocene climatic events) Indo-West Pacific in particular. Vermeij supports his ideas with an analysis of the biota divided by the emergence of the Panamanian land bridge in the last three million years. Those species pairs that have differentiated from one another on either side of the isthmus are far from a random sample of the total biota; biotically competent species have already evolved more than stress-tolerant and opportunistic ones. These ideas and observations will, of course, interest evolutionary biologists generally, for they bear on a whole range of problems that have hitherto been confronted primarily with data from terrestrial organisms.

Vermeij's hypothesis has considerable predictive value, as he shows in concluding analyses of the biotic interactions that occurred following the removal of various barriers to marine dispersal. His thorough discussion of the biological ramifications of the proposed sea level canal in Panama are a highlight of this volume.

As one of the first attempts to develop an evolutionary ecology of marine organisms, Vermeij's work deserves wide attention. It is well written and will prove an invaluable reference, as two-thirds of the more than 900 references are to publications less than 10 years old. For malacology (the term carries the stigma of sounding like "bad ecology") the book should prove invigorating: predator pressures may be estimated directly, and the relative importance of competition, environmental factors, and biomechanical considerations in determining shell form in individual cases must now be assessed. For other biologists the challenge of testing the generality of Vermeij's ideas must be confronted.

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Neurochemistry

Amino Acids as Chemical Transmitters. Proceedings of a NATO Advanced Study Institute, Oslo, Aug. 1977. FRODE FONNUM, Ed. Plenum, New York, 1978. xii, 748 pp., illus. $49.50. NATO Advanced Study Institutes Series A, vol. 16.

Amino acids have at last come into their own. Judging by the book under review, they have been accepted into the major league of transmitter neurochemistry and are attracting the kind of attention that has long been afforded the monoamines.

This book is made up mostly of short papers, with the emphasis on neurochemical studies of excitatory and inhibitory amino acids: the localization, uptake, metabolism, compartmentation, and release of amino acids and the properties of tissue receptors.

Some topics are discussed in several papers. An example is the notable potentiation by barbiturates and by the widely used benzodiazepine tranquilizers of inhibition mediated by gamma-aminobutyric acid (GABA). These drugs apparently do not operate directly on the GABA receptor, being particularly effective in antagonizing GABA antagonists rather than in enhancing the binding