

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 high 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.

DAVID S. WOODRUFF

Department of Biological Sciences,
Purdue University,
West Lafayette, Indiana 47907

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

of GABA to receptors (Dray and Bowery, Olsen *et al.*). On the other hand, GABA binding is consistently increased after freezing and thawing and after treatment with Triton X-100 (Enna, Lloyd and Dreksler, Olsen *et al.*). According to Johnston and Kennedy, these procedures remove an endogenous inhibitor, probably phosphatidyl ethanolamine (though in even more recent studies by Costa and his colleagues, the inhibitor appears to be a protein, which is competitively antagonized by benzodiazepines). If the activity of receptors can be modulated by such endogenous factors, we have an intriguing, "new" mode of regulating the efficacy of synaptic transmission.

GABA probably also plays a significant role in primary afferent depolarization. As Curtis points out in his detailed review of "pre- and non-synaptic" actions, it seems that GABA receptors are present on all neurons, in both the peripheral and the central nervous system. Since GABA also appears to be released by between a quarter and a half of all nerve endings in the brain, it may well be the most important single transmitter in the vertebrate nervous system.

It is surprising that so few studies of GABA uptake have been set in the wider context of cellular mechanisms of neutral amino acid transport; according to the generally accepted Schultz-Curran scheme, amino acids are taken up in conjunction with sodium ions and the effective driving force is the sodium electrochemical gradient. Even the thoughtful discussion of GABA transport by Levi *et al.* fails to take this into consideration. The essential role of the membrane potential is explicitly stated only by Henn *et al.*, in a report on glial mechanisms of GABA uptake. Two other features that may be of functional significance are largely ignored: the uptake process is potentially electrogenic and may be reversible when the electrochemical gradient is reversed.

The excitatory amino acids, glutamate and aspartate, are now receiving almost as much attention as GABA and glycine (Aprison and Nadi contribute a full review of glycine as a transmitter in the spinal cord and medulla). According to Fonnum, all efferent pathways from the cerebral cortex probably operate by releasing glutamate. Storm-Mathisen believes that several hippocampal afferent and efferent pathways release glutamate, aspartate, or both. Cotman and Hamberger provide particularly strong evidence that the excitatory action of the perforant pathway to the dentate gyrus is mediated by glutamate.

Several papers discuss the mode of removal of glutamate released by activity (Berl and Clarke, Van den Berg *et al.*, Hamberger *et al.*, and Bradford *et al.*). The removal may occur principally by uptake into glial cells, where glutamate is transformed into glutamine. As an inactive agent, glutamine can be safely released to the extracellular fluid (including the cerebrospinal fluid), from which it is taken up by nerve endings as required for reconversion to glutamate or GABA. There is a clear parallel with the recycling of acetylcholine via choline at cholinergic junctions. Each system seems to play its own variation on the general theme. In this instance, the enzyme that converts the active transmitter into the inactive intermediate is localized in glia instead of being present at the receptor surface.

As is reemphasized here by Bradford *et al.*, amino acid transmitters appear to be released from a cytoplasmic pool in nerve endings rather than via vesicles. One hopes that the experts on vesicle kinetics will take note of this challenge to the hypothesis of vesicular release and generate some much-needed morphological evidence bearing on vesicle turnover at central synapses.

Although the book has been put together commendably quickly, much of the material is likely to be of only ephemeral value. Few of the papers are comprehensive reviews, and some important topics—notably electrophysiological studies of mechanisms of action, particularly the puzzling and contradictory results obtained with excitatory amino acids—are hardly covered. The price of the book surely puts it beyond the resources of most investigators. But as a useful source of up-to-date information and references it should be made available in libraries.

K. KRNEVIĆ

Department of Physiology,
McGill University,
Montreal, Quebec H3G 1Y6, Canada

Books Received

Additives for Plastics. Vol. 1, State of the Art. Raymond B. Seymour, Ed. Academic Press, New York, 1978. viii, 280 pp., illus. \$17.50.

Biochemistry of Carbohydrates II. D. J. Manners, Ed. University Park Press, Baltimore, 1978. xii, 260 pp., illus. \$29.50. International Review of Biochemistry, vol. 16.

The Biochemistry of Myasthenia Gravis and Muscular Dystrophy. Papers from a workshop, Bath, England, Mar. 1977. G. G. Lunt and R. M. Marchbanks, Eds. Academic Press, New York, 1978. xvi, 374 pp., illus. \$25.75.

CRC Handbook of Chemistry and Physics. Robert C. Weast and Melvin J. Astle, Eds. CRC Press, West Palm Beach, Fla., ed. 59, 1978. Various pages, illus. \$44.95.

The Dark Range. A Naturalist's Night Notebook. David Rains Wallace. Illustrated by Roger Bayless. Sierra Club Books, San Francisco, 1978. xii, 132 pp. Cloth, \$15; paper, \$8.95. A Yolla Bolly Press Book.

Fundamentals of Gastroenterology. Including Workbook. Lawrie W. Powell and Douglas W. Piper, Eds. University Park Press, Baltimore, 1978. x, 202 pp. Paper, \$14.95. Second edition of *Introductory Gastroenterology*.

Genetic Epidemiology. Papers from a symposium, Honolulu, Oct. 1977. Newton E. Morton and Chin Sik Chung, Eds. Academic Press, New York, 1978. x, 550 pp., illus. \$22.

Humangrowth. An Essay on Growth, Values and the Quality of Life. Harlan Cleveland and Thomas W. Wilson, Jr. Aspen Institute for Humanistic Studies, Palo Alto, Calif., 1978. xii, 58 pp. Paper, \$3.

Ice or Fire? Surviving Climatic Change. D. S. Halacy, Jr. Harper and Row, New York, 1978. xii, 212 pp. \$9.95.

Immunobiology of *Neisseria gonorrhoeae*. Proceedings of a conference, San Francisco, Jan. 1978. Geo. F. Brooks, Emil C. Gotschlich, King K. Holmes, William D. Sawyer, and Frank E. Young, Eds. American Society for Microbiology, Washington, D.C., 1978. xxii, 400 pp., illus. \$15.

Immunofluorescence and Related Staining Techniques. Proceedings of a conference, Vienna, Apr. 1978. W. Knapp, K. Holubar, and G. Wick, Eds. Elsevier/North-Holland, New York, 1978. xiv, 364 pp., illus. \$51.

Introduction to System Sensitivity Theory. Paul M. Frank. Academic Press, New York, 1978. xiv, 386 pp., illus. \$19.

Key Works to the Fauna and Flora of the British Isles and Northwestern Europe. G. J. Kerrich, D. L. Hawksworth, and R. W. Sims, Eds. Published for the Systematics Association by Academic Press, New York, 1978. xii, 180 pp. \$16.15. The Systematics Association Special Volume No. 9.

A Laboratory Manual for Schools and Colleges. John Creedy. Heinemann, Exeter, N.H., 1978. x, 248 pp., illus. + index. \$25.

Language Intervention Strategies. Richard L. Schiefelbusch, Marilyn Barket, and Robert Hoyt, Eds. University Park Press, Baltimore, 1978. xii, 420 pp. \$15.75.

Mössbauer Isomer Shifts. G. K. Shenoy and F. E. Wagner, Eds. North-Holland, Amsterdam, 1978 (U.S. distributor, Elsevier, New York). x, 956 pp., illus. \$106.75.

Muddling toward Frugality. Warren Johnson. Sierra Club Books, San Francisco, 1978. 252 pp. \$6.95.

Mutagenesis. W. Gary Flamm and Myron A. Mehlman, Eds. Hemisphere, Washington, D.C., and Halsted (Wiley), New York, 1978. xii, 402 pp., illus. \$24.50.

The Nature of Life. Proceedings of a conference, St. Peter, Minn., Oct. 1977. William H. Heidcamp, Ed. University Park Press, Baltimore, 1978. xii, 180 pp., illus. Paper, \$9.95.

Negative Strand Viruses and the Host Cell. Papers from a symposium, Cambridge, England, Aug. 1977. B. W. J. Mahy and R. D. Barry, Eds. Academic Press, New York, 1978. xxiv, 862 pp., illus. \$46.50.

New American Pocket Medical Dictionary. Nancy Roper, Adapted from the 13th British edition by Jane Clark Jackson. Scribner, New York, 1978. x, 380 pp. Paper, \$5.95.

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