

for the study of stress on marine invertebrates, this book also succeeds as a nice review of the scientific background for such measurements and of problems of interpreting data. Accounts of research on the mussel *Mytilus edulis* and the hydroid *Campanularia flexuosa* predominate. Mussels are well studied and are used for monitoring pollutant uptake in many areas. The hydroid is a useful experimental bioassay organism, owing to the ease with which it can be propagated, and the potential for using cloning to eliminate its genetic variability in response.

The physiological section emphasizes "scope-for-growth" (the energy available for growth and reproduction) as a general indicator of integrated physiological response to the environment that decreases with increasing stress or pollution and that is positively correlated with fecundity and egg lipid content. Cytochemical measures include the stimulation of mixed-function oxidases and the destabilization of lysosomes, a process detectable at lower concentrations of toxic metals than are declines in integrated responses. Biochemical indicators of stress include some amino-acid abundances, adenyl energy charge, various enzyme activities, mixed-function oxidases, and metallothioneins.

A concluding synthesis argues that organisms respond adaptively and homeostatically to perturbations, thereby ameliorating the effects of disturbances. In summarizing the hypothetical effects of toxicants and associated homeostatic and adaptive responses at different levels of organization, the authors are a bit naive in suggesting that decreases in survival and gamete or larval viability should generally result in increased recruitment as an adaptive response that would neutralize disturbances in populations. If the ecological world were that simple, the authors' work would hardly be as important as it actually is for providing ways to detect the effects of environmental perturbations on biologically relevant variables in organisms before they are detectable with more cumbersome ecological surveys. A point worth remembering from this book is that tolerance and sensitivity are not mutually exclusive traits. Organisms having both attributes may be most suitable for experimental assays of environmental quality.

STEVEN OBREBSKI, *Tiburon Center for Environmental Studies, San Francisco State University, Tiburon, California*

#### RADIOACTIVITY IN THE ENVIRONMENT: SOURCES, DISTRIBUTION, AND SURVEILLANCE.

By Ronald L. Kathren. Published for OPA (Amsterdam) B. V. by Harwood Academic Press, Chur and

New York. \$66.00. xv + 397 p.; ill.; name and subject indexes. 1984.

This is an excellent handbook containing a wealth of information and statistical data. It should be noted, however, that the subtitle states very clear limits to what is covered: the sources, distribution, and surveillance (-monitoring) of environmental sources of radioactivity. Although the subject of biological half-lives, or turnover times, is given consideration, the entire subject of the biological effects of radioactivity, from the extreme of severe radiation sickness and death to the latent or long-delayed effects in the form of cancer in exposed persons or mutations and chromosomal damage expressed only in later generations, has been excluded from the coverage. Ecological effects are also excluded. Biologists will therefore find the volume a very useful reference work, but one that obviously needs a supplementary volume to assess the biological consequences of exposure. Within the specified limits, the author has treated the general nature and origins of radioactivity; doses received from environmental exposures; fallout from nuclear weapons explosions; radioactivity from nuclear reactors and the mining and processing of the fuel, as well as the intractable problem of radioactive wastes; atmospheric, aquatic, and terrestrial transport; biological transport, pathways, and turnover; monitoring programs (airborne, terrestrial, and aquatic); and an up-to-date chapter on radiological age dating.

BENTLEY GLASS, *Editor, The Quarterly Review of Biology*



#### NEURAL SCIENCES

##### PRIMARY NEURAL SUBSTRATES OF LEARNING AND BEHAVIORAL CHANGE.

Edited by Daniel L. Alkon and Joseph Farley. Cambridge University Press, Cambridge and New York. \$49.50. xi + 385 p.; ill.; index. 1984.

The neural bases of learning have become a focus of intense research in recent years. The beginnings of an integration of behavioral, neural systems, cellular, biophysical and molecular approaches characterize much of the field at this time. This volume provides a broad, selective, sample of the field, emphasizing reductionistic approaches at the molecular and cellular levels. The book is divided into three parts, each with an introduction by one of the editors: "Behavior" (3 chapters, 64 pp.), "Model Systems" (11 chapters, 224 pp.) and "Biophysics and Biochemistry" (4 chapters, 88

pp.). The chapters provide reviews of selected aspects of their respective authors' research, in several cases presented in a broad context. The level of discourse is sufficiently advanced to render the chapters of great interest to other workers in the field, yet much of the material is accessible to the general reader who is familiar with basic neurobiology.

Several themes run throughout the book. These include vertebrate-invertebrate comparisons at behavioral and neural levels; the search for specific neural circuits that mediate learning phenomena such as habituation, sensitization, and associative conditioning; and the extension of contemporary findings in behavioral conditioning to the study of learning in invertebrates. Most readers outside the field may be surprised and impressed by the great amount of research activity and accomplishment during the past few years.

Traditional comparative accounts of learning have emphasized differences between vertebrates and animals without backbones. The present trend, as exemplified in several contributions, is to seek similarities. A major impetus for this activity arises from advances in the study and identification of specific neuronal circuits that underlie associative learning, as studied for classical conditioning in molluscs. Modern psychological research has revealed that classical conditioning is actually highly complex—thus the interest in determining the extent to which invertebrates also display complex conditioning phenomena. Chapters in this book provide an affirmative answer for molluscs and honeybees. These behavioral findings have strengthened arguments for the possible conservation of learning mechanisms across phyla, including perhaps a particularly interesting vertebrate, *Homo sapiens*. Discussion of this topic is properly cautious and circumspect, but one is struck pleasantly by the enthusiasm and vigor of the field as represented in this volume.

Another finding that may strike the reader as counterintuitive is the consistent finding of learning-induced changes in the responses of neurons within sensory systems. Examples in this book include a photoreceptor of *Hermisenda*, first order tactile neurons in *Aplysia*, and second order visual neurons in the honeybee and pigeon.

The volume is well illustrated, and the high quality of the contributions certainly commends the book to the interested reader. The price may reflect production costs but nonetheless may deter some potential purchasers. The only blemish in an otherwise excellent and stimulating book is the inadequate index.

NORMAN M. WEINBERGER, *Psychobiology and Center for the Neurobiology of Learning & Memory, University of California, Irvine, California*

BRAIN IMAGING AND BRAIN FUNCTION. *Research Publications: Association for Research in Nervous and Mental Disease, Volume 63.*

*Edited by Louis Sokoloff. Raven Press, New York.*

\$59.50. xvii + 290 p.; ill.; subject index. 1985.

This well-edited and well-illustrated volume gives a magnificent overview of current brain-imaging techniques, of their theoretical background, of the experimental and clinical results obtained so far, and of the enormous potential of the field, most of whose leading workers have contributed to it. Seymour S. Kety and Niels A. Lassen describe the theory of and methods for measuring cerebral blood flow with radioisotopes. Louis Sokoloff summarizes his pathbreaking deoxyglucose method for making regional measurements of the cerebral metabolic rate. He describes its theory, including the operational equation for calculating regional cerebral glucose utilization. Sokoloff deals at length with what is by now the well-known criticism of his technique concerning the influence of phosphatase activity, stating, "Of the three reports alleging significant phosphatase activity at all time during the deoxyglucose procedure, two are demonstrably invalid, and the third cannot be confirmed by careful experimentation" (p. 44).

Raichle and collaborators describe the use of  $^{15}\text{O}$  oxygen radiopharmaceuticals in positron emission tomography (PET). Kennedy, as well as Macko and Mishkin, report on studies of visual pathways conducted on monkeys. Hitherto unknown spreads of visual activation in the temporal lobes, homolaterally and contralaterally, are shown. Roland summarizes his studies on the activation of cortical fields in humans using  $^{133}\text{Xe}$  xenon. Several of his findings concerning higher mental functions are also considered in PET studies reported both by Reivich et al. and by Mazziotta and Phelps. New clinical findings on cerebrovascular disease using  $^{15}\text{O}$  oxygen PET studies are reported by Frackowiak. Focal hypometabolism and hypermetabolism in epilepsy patients are described by Engel, Ackerman, Kuhl and Phelps. From the NIH, di Chiro reports on PET studies of brain tumors. The classical PET studies of Kuhl et al. on Huntington's disease and dementia are excellently summarized. A more difficult field, the use of PET techniques in affective disorders, is dealt with by Phelps et al. Finally, NMR imaging techniques are summarized by Oldendorf (theory), Norman and Brant-Zawadzki (brain anatomy), and Haselgrove et al. (neurochemistry).

This volume can be recommended for all workers who need a comprehensive and solid review of current brain imaging techniques and their experimental and clinical applications.

DAVID H. INGVAR, *Clinical Neurophysiology, University Hospital, Lund, Sweden*