

and the object-relative mode. The former mode is determined by both strictly proximal information and information about some relation between an object and the observer, whereas the latter mode is determined exclusively by information about relations between visual objects. The subject-relative-object-relative distinction provides an excellent framework for interpreting Mack's interesting experiments on the perception of motion and stability during pursuit eye movements.

In addition to the central notion of perceptual modes, several other themes are evident in many of the papers in the volume. One of these is an interest in the adaptive nature of perception as a basis for action. Trevarthen quite directly discusses the relation between perceiving and acting, from psychobiological and developmental perspectives. This concern with the perception-action link is also found in Lee's nice analysis of the types of visual information used for planning and controlling such general activities as balancing, orienting, and locomoting. A second theme common to several of the chapters is the idea—attributable primarily to J. J. Gibson—that perception is the direct, unmediated pickup of information over time. Shaw and Pittenger adopt a strong Gibsonian position in their discussion of the relation between perceiving events of short duration (such as the motion of the second hand on a clock) and events of long duration (such as the motion of the hour hand). They argue against an overly simplified constructivist account of the perception of slow change, namely the view that change is inferred from successive comparisons of static images of the object undergoing change. Instead, they claim that perception of both slow and fast change is the pickup of information specifying the continuous transformation underlying the change. This concern with the direct perception of invariant information is echoed in the final summary chapter by Turvey and Prindle. And an information-based view of perception is evident in Hagen's discussion of the factors contributing to judgments of depth and distance relations in pictures.

In the introductory chapter, Pick and Saltzman suggest that the use of different perceptual modes might result in patterns of individual differences or in discontinuities in the development of processing skills. These are very interesting suggestions, I think, and it is disappointing to find little systematic consideration of developmental trends or individual differences in the subsequent chapters.

Another issue which Pick and Saltzman point to, but which none of the other papers addresses, concerns the organization and control of sets of perceptual modes. Do the various dimensions on which modal differences in perception are found operate independently, or are they perhaps organized in a hierarchical fashion?

Despite some of these shortcomings, the papers in this volume demonstrate that the concept of perceptual mode is a promising one that will provide a useful theoretical and empirical tool for other perceptual psychologists.

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Brain Biochemistry

Interactions between Putative Neurotransmitters in the Brain. Papers from a symposium. S. GARATTINI, J. F. PUJOL, and R. SAMANIN, Eds. Raven, New York, 1978. xvi, 416 pp., illus. \$27.50. Monographs of the Mario Negri Institute for Pharmacological Research, Milan.

The symposium upon which this book is based took place before any comprehensive mapping of neuropeptide pathways and is therefore confined to an account of interactions between the more traditional transmitter candidates. Relatively few brain regions are covered in any detail and almost 200 pages are devoted to the organization of nigrostriatal circuitry.

Of the authors dealing with the nigrostriatal system, Ladinsky *et al.* and Costa and Cheney present exhaustive evidence for an inhibitory dopaminergic input onto striatal cholinergic neurons. The relationship between acetylcholine and dopamine in the striatum is likely to be rather more involved, however; Hery *et al.* present evidence that the release of dopamine in the striatum is enhanced by cholinergic agonists acting at presynaptic nicotinic and muscarinic receptors. The emphasis on neurochemistry in these chapters is representative of the book as a whole, and it is a pity that many pertinent neurophysiological studies are not included. For instance the work of Kitai (*Exp. Brain Res.* **24**, 351 [1976]) and others has provided strong evidence that dopamine may in fact be excitatory, not inhibitory, in the striatum.

A similarly complex picture is emerging in the substantia nigra. Cuello and

Iversen present evidence that dopamine released from dendrites may act presynaptically to regulate raphe and striatopallidal inputs to the nigra. Cheramy *et al.* describe the elegant *in vivo* push-pull techniques they have used to examine the effects of transmitters on dopamine release from both the dendrites and the terminals of nigrostriatal neurons. On the basis of their experiments they suggest the possibility of multiple target sites for GABA (gamma-aminobutyric acid) within the nigra, both directly on dopaminergic neurons and on inhibitory nigral interneurons. The application of neuronal spike train analysis to investigate inputs to nigral cells is discussed by Groves *et al.*, although rather more is made of the technique than of the results generated by it.

The most rewarding section of the book examines the organization of the serotonergic projection from the raphe nuclei to the locus ceruleus. An excellent chapter by Sakai *et al.* on the anatomy of projections to the raphe and locus ceruleus is followed by compelling autoradiographic (Descarries and Léger) and immunocytochemical (Pickel *et al.*) evidence for the serotonergic innervation of noradrenergic neurons in the locus ceruleus. Complementary biochemical studies are summarized by Pujol *et al.*, but again a chapter on the neurophysiology of this system is missing.

Two of the remaining chapters, by Costa and by Hoffer *et al.*, examine the roles of GABA and noradrenaline in the cerebellum although neither chapter is strictly concerned with transmitter interaction. Muricidal behavior in rats, which is discussed by Mandel *et al.*, does not readily lend itself as a model for transmitter interactions and is rather out of context in this book.

The most disappointing aspect of the book is its limited choice of subject matter; many regions, such as the hippocampus, in which the anatomy is sufficiently well characterized to provide a firm basis for the analysis of transmitter action are mentioned only in passing. However, many chapters in the book provide objective reviews and should prove useful, particularly to those interested in the central actions of the monoamine transmitters. A volume with similar aims that incorporated studies of neuropeptides would make the diagrams of synaptic circuitry included in many chapters seem greatly oversimplified.

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