

**Neural Mechanisms in Behavior.** *D. McFadden (Ed.)*. Springer-Verlag, New York, 1980, 308 pp. Price: \$24.90.

This book is the outcome of a two-day symposium held at the University of Texas (Austin) in March, 1978. The conference commemorated the 50th anniversary of the Department of Psychology and the 30th anniversary of the Hixon Symposium, published as *Cerebral Mechanisms in Behavior* after which the format of this book is modeled. Each of the seven participants presents a comprehensive review of his research area and the interests of the group represent the full spectrum of neurobehavioral work, including sensory and motor behavior and mechanisms of conditioning and arousal. Among the more interesting aspects of the book are the discussion sections following each chapter, which have been transcribed directly to preserve the flavor of the interactions between the participants.

In the first chapter, Jerzy Rose reviews experiments of his group in Wisconsin on neural correlates of psychoacoustic experiences. Responses of single neurons in the auditory nerve and the cochlear nucleus were evoked by combinations of tones which produce particular perceptual re-

sponses. Even at these early stages in the auditory system, response patterns of single neurons correlate clearly with psychoacoustic phenomena such as monaural masking, combination of tones, and threshold detection.

The second chapter, by Robert M. Boynton, considers how the "design of the eye" has been optimized to detect photons: their number and direction for form vision and their frequency for color vision. Analyzing the technical problems solved by the eye, Boynton helps us appreciate the astonishing sophistication of its design.

An elegant essay by Floyd Ratliff reviews the analysis of visual patterns by retinal cells. The linear analysis of the limulus retina is succinctly summarized in a mathematical model incorporating lateral inhibition. This is developed with a generous quantity of helpful illustrations, which illuminate such issues as equivalent classes of edge stimuli that evoke identical responses in a lateral inhibition network. Ratliff then describes the nonlinear analysis of X and Y cells in cat retina, and concludes with some speculation about the future of visual system research. He suggests that some notions like feature detectors may be less useful in the long run than a complete mathematical analysis of the neural responses. The chapter is clearly organized and provides an excellent introduction to the quantitative approach to visual system physiology.

Next, Horace B. Barlow develops an explanation of cortical function of extracting information, in terms of statistical information theory. The perception of symmetries and spatial patterns in random dot displays is explained by the concepts of detection theory and then related to the known responses of single cells in striate and peristriate cortical areas. This is a welcome attempt to deal with some higher functions of cerebral cortex, namely the extraction of information from sensory input.

Under the title "The Search for the En-

gram, 2." Richard F. Thompson considers the neural mechanisms underlying a classical conditioning of an eyelid response in the rabbit. Using an air puff to the eye as the unconditioned stimulus and a tone as the conditioned stimulus, Thompson and colleagues have characterized the development of a classical conditioning of the eyelid closure and have found cells in the hippocampus whose response patterns parallel the development and features of the conditioned responses. The search is now on for further cells in related regions that would help explain the distribution of this engram in the nervous system.

In his chapter "Brain Mechanisms in Voluntary Movement," Edward V. Evarts provides a comprehensive and readable account of experiments relating motor cortex cells to limb movements. Activity of pyramidal tract neurons, seen as a final common pathway to motoneurons, is characterized in relation to reaction time movements triggered by auditory and somatosensory stimuli. The responses of motor cortex cells to peripheral input during various movements is reviewed, with particular emphasis on the enhancement of somesthetic response during fine controlled movements. Quoting from Hughlings Jackson, William James, and Karl Lashley, Evarts provides a synthesis of views to explain the common feature of the programming of voluntary movements, namely the intended goal. This chapter is an excellent summary of Evarts' motor cortex work, and the subsequent discussion touches on several additional topics, e.g., the role of cerebellum in the vestibulo-ocular reflex.

The last chapter, by Eric R. Kandel, summarizes the neural mechanisms of behavioral arousal as exemplified, in particular, by experiments with aplasia. Examining various sites in the aplasia nervous system during habituation and sensitization, Kandel and collaborators found changes underlying both types of behavioral modification at the synapses made

by sensory neurons. Experiments on the molecular mechanism of sensitization have led Kandel and colleagues to implicate cyclic AMP as a modulator of transmitter release, via calcium conductance.

A final round-table discussion by all the participants attempts to synthesize current findings with regard to localization of function in the central nervous system. In sum, this book is a valuable and readable summary of the research interests and current concerns of a distinguished group of neurobiologists; it could be recommended to any student or researcher interested in the neural mechanisms of behavior. Finally, Springer-Verlag deserves credit for excellent production at a reasonable price.

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