A Brain Structure

The Hippocampus. ROBERT L. ISAACSON and KARL H. PRIBRAM, Eds. Plenum, New York, 1986. Vol. 3, xviii, 438 pp., illus. $59.50. Vol. 4, xxiv, 374 pp., illus. $57.50.

These two new volumes of *The Hippocampus* treat discoveries that have occurred since 1975, when the first two volumes were published. As the editors point out, scientists study the hippocampus in part because it offers a useful model system in which to investigate certain fundamental neurobiological questions. Volume 3 contains chapters written largely from this perspective; though timely, informative, and well worth reading, they fail to explain the fascination that the hippocampal formation—the focus of more that 250 presentations at the 1986 Society for Neuroscience meetings—holds for neuroscientists. Volume 4 contains chapters that take a broader view of the hippocampal system and its role in overall brain function; these chapters must bear the burden of conveying the current excitement and sense of progress among hippocampus researchers.

Though individually interesting, the chapters of volume 4 collectively seem to confirm the impression of a graduate student quoted by Pribram that the hippocampus is "the black hole of neuroscience." This is unfortunate. Many would argue that we know more about the details of the hippocampal system (witness the chapters in volume 3) than any other brain system and that the involvement of the hippocampus in learning and memory makes it an ideal structure in which to study the biological bases of cognitive function. Though the exact nature of its role is not clear, most researchers agree in broad outline about what the hippocampus is doing, and even to some extent about how it is doing it. The reason this emerging consensus is not reflected in these volumes has to do with what has been omitted.

Several areas of research responsible for generating much of the excitement about the hippocampus are either underrepresented or not represented at all. First, there is at present intense interest in long-term potentiation (LTP) in the synapses of the hippocampus, both for what this phenomenon tells us about plasticity in mammalian brain circuitry and for what it suggests about the role of the hippocampal system in memory processes. The two chapters on LTP in volume 3 pay scant attention to functional issues. Nor is there any discussion in either of these volumes of how the structure of the hippocampus relates to its functions. Recent interest in parallel distributed processing (PDP) models in cognitive science has focused the attention of many investigators on the apparently distributed fashion in which the hippocampus operates. Structural simulations of this brain region are a goal of several investigators, and such models will surely tell us a great deal about how "matrix" memory could work in a biological system. In such connectionist models, memory is stored through changes in the connection weights between elements. The hippocampus is attracting attention not only because it is built like a matrix, but also because it has a prominent synaptic-weight change mechanism: LTP. This is heady stuff, but the interested reader will not find out about it in *The Hippocampus*.

Second, there is no discussion of hippocampal development in either of these volumes. Though a chapter in volume 2 of the series remains pertinent, much has happened in the past decade. The facts of hippocampal development are unusual, and they raise many exciting possibilities that are being actively explored. Put briefly, in most altricial species the hippocampus undergoes extensive postnatal maturation; therefore it is not operational early in life, and its development is open to considerable environmental influence. Given that the hippocampal system is implicated in memory for unique instances (discussed in volume 4 by Gerbrandt, Pico, and Ivy), its absence early in life is intriguing, to say the least. Several investigators, myself included, have speculated on the role this fact might play in infantile amnesia, a phenomenon first noted by Freud. This and other ramifications of the postnatal maturation pattern deserve more attention.

The chapter by Mahut and Moss in volume 4 does take up developmental issues, but it must serve double duty as the only discussion of the extensive work being done with primate models of hippocampal function. Such work is sharpening our notion of memory and increasing our understanding of the localization of particular functions to specific brain "modules." Though this chapter does its job well, I would have liked to see an entire chapter devoted to the issue of *which* specific memory functions the hippocampus is critical for. The results from the study of amnesic patients, widely reported even in the popular press, would be an obvious source.

Finally, there is no presentation of the spatial story. The notion that the hippocampus has a special role in creating internal spatial representations, or mental maps, continues to stimulate research. The carefully analyzed properties of single "place" neurons in the hippocampus of the freely moving animal may constitute the best data we have concerning the neural correlates of a complex cognitive function. Virtually everyone working on the hippocampus in the rat uses spatial behavior as the diagnostic tool to assess its functional status. A collection of papers on the hippocampus without a single chapter on the spatial hypothesis cannot be considered complete.

Let me close on a more positive note. These volumes contain a lot of good, hard work. I have already mentioned a few of my favorite papers. The chapter in volume 4 by Gabriel and his co-workers provides a thoughtful analysis of the kinds of things the hippocampus must be doing, at both the neural and conceptual level. Another chapter in volume 4, by Gray and Rawlins, attempts to bring together two important, but quite different, perspectives on hippocampus. The editors of *The Hippocampus* have shown us most of the major traditional vistas in hippocampal research. It will fall to others to show why the aisles full of hippocampus posters at scientific meetings are abuzz and why many physicists interested in studying the brain in the language of statistical thermodynamics are coming around asking questions about "place" cells, LTP, and the microstructure of the dentate gyrus.

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Troublesome Insects

Fire Ants and Leaf-Cutting Ants. Biology and Management. CLIFFORD S. LOFGREN and ROBERT K. VANDER MEER, Eds. Westview, Boulder, CO, 1986. xvi, 435 pp., illus. Paper, $45. Westview Studies in Insect Biology. From a conference, Gainesville, FL, March 1985.

Ants, wrote the Reverend William Gould in 1747, must be the work of "an ingenious Artificer," as they are so evidently intended for the moral instruction of mankind and the sustenance of game birds. On considering the fire and leaf-cutting ants, however, it is difficult to discern a providential design. The often devastating depredations of these insects have inspired a great deal of basic and applied research, to which this invaluable volume provides an excellent introduction. Some familiarity with ant biology is assumed. However, a wide range of readers will be interested in the thorough cataloguing of economic impact, the search for innovative management techniques, and the fundamental sociobiological studies for which these ants serve as models.

The fire ants *Solenopsis invicta* and *S. richteri* are opportunistic "weed" species. Intro-