Neurons and Their Patterns

The Fine Structure of the Nervous System. The Cells and Their Processes. ALAN PETERS, SANFORD L. PALAY, and HENRY DE F. WEBSTER. Harper and Row, New York, 1970. xviii, 206 pp., illus. $18.75.

Perhaps electron micrographs ought to carry labels warning that prolonged viewing may be addicting. For as with peanuts and certain types of potato chips, it is almost impossible to stop with just one. The esthetic beauty of a well-done micrograph often transcends the value of the information derived, an aura that fades when electron microscopists overprove their points with picture after picture in symposia and seminars. Yet when the details of fine structure become important to a particular experimental quest, one encounters the paradoxical situation in which the pertinent communications are often illustrated with a few examples of the typical and an equal number of the atypical. As a result, the student scientist who wanted to learn the basic language of fine structural analysis could opt either to peruse the few available cytological atlases or to become a microscopist himself. For most tissues and organs, a few selected electron micrographs can ordinarily give the basic characteristics, since the cells tend to fall into rather uniform populations. This is not the case for the brain, however. Here the cells, although grouped under the generic terms neuron or neuroglia, may differ widely from region to region and within particular classes found together within a specific region. Furthermore, the intricate systems of intercellular connections which characterize the nervous system are not approximated by any other tissue, and electron microscopy offers a means to clarify and delineate these relationships.

The authors have recognized this need, and this long-awaited book offers a comprehensive attempt to provide it. Beginning with a historical view of the neurocytological arguments between the great masters of the silver staining era, the authors describe all aspects of neuronal and neuroglial structure. The finest details are given for those regions of the nervous system in which the authors have taken particular interest: the spinal cord and the cerebral and cerebellar cortices. Approximately a third of the book consists of extensively labeled electron micrographs that will give the reader an opportunity to test his ability to decipher the overwhelming and often bewildering array of structural details.

As long as the text sticks with fine-structural descriptions, it is impossible to raise any significant criticism. But prolonged description of the number of ribosomes in a row or the number of layers in a myelin sheath does tend to set the mind to wandering. To combat this tendency, the text is pleasantly peppered with covert epigraphs, including such cytological bon mots as "the form of the dendritic tree provides a topographic map of the world as seen by a cell." While there are certain sections which could use a bit more flavoring, the authors' desire to stimulate curiosity fortunately overpowers the tendency to list all minute details as though they were meaningful.

Occasionally, however, the book leaves the shores of descriptive cytology and attempts to make functional correlations such as one between the configuration of ribosomes and the size of the protein synthesized, or between the electron-opacity of a synaptic vesicle and its content or function. Then the book becomes less helpful and occasionally confusing, as in the example of the molecular biological interpretations of the relationships between neurons and glia and their individual responses to imposed hyperactivity.

But for the reader who perseveres through the first few chapters on the cytoplasmic characteristics of neurons and glia (the chapter on glia has a very lengthy and repetitive section on myelin), the last two chapters, on the synapse and the neuropil, are well worth the effort. By and large, it is synaptic analysis that holds the keys to the relationships between nerve cells and to the correlation of structure with function and chemistry. Indeed, it was the electron microscope that gave the final answer in support of Cajal's neuronal doctrine by proving that the membranes of contacting nerve cells remain separated and that nerve cells are thus each individual entities. For those few who might be unaware, it was Palay who first provided this information for synapses of the central nervous system.

One can hardly conceive of a more experienced or better-qualified combination of investigators to provide the equivalent of a Guide Michelin to the fine structure of the brain. But somehow, after one has eaten that first dollop of the appetizer and stopped, it seems natural that hunger will again arise for the next steps, namely, the experimental techniques by which the neural fine structure can indeed be analyzed to the point of providing insight into function rather than supporting the requirements of electrophysiology. Those who study this book will certainly be able to tell axons from dendrites at a glance, and with a little practice to discern synaptic junctions from puncta adherentia. They will not be able to tell how to determine where that nerve terminal arose, or what criteria might be useful in inferring functional activity. Although the inconsistencies in the reproduction of the electron micrographs may be wholly the fault of the publishers, it is difficult to understand why there are no data on the preparative techniques used which might account for the variations in contrast, membrane structure, and the relative electron-staining of "membrane thickenings," intraperiod lines, glycogen, and collagen. The references to cytochemical techniques are sparse, and the compilation of the bibliographies on this subject seems to have stopped much earlier than in the case of microtubules and neurofilaments.

Beyond providing an introduction to a complicated field, this book gives insight into the aims and concerns of the men who wrote it. The experimentalist might wish they had given us more in this serving, but it is a fine first course. After all, the best time to stop offering appetizers may be when the next course comes into sight.

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Plant Processes

The Physiological Aspects of Photosynthesis. O. V. S. HEATH. Stanford University Press, Stanford, Calif., 1969. x, 310 pp. + plates. $8.50.

This book emphasizes areas of "botanical plant physiology" rather than the biochemistry and physics on the one hand or studies of photosynthesis by plants in communities on the other. Heath decided on an unbalanced presentation in the hope of encouraging the intermingling of various disciplines that is essential to a better understanding of photosynthesis and how it functions. The topics are covered from a historical point of view, are discussed in relation to higher plants and algae, and include subjects like the diffusion path of CO_2, methods used to measure photosynthesis, respiration of photosyn-