

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 overwhelm-

ing 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 CO₂, methods used to measure photosynthesis, respiration of photosyn-

thetic tissues in light, and the role of various environmental factors on net photosynthesis. Each subject is examined in a scholarly manner, and work published through 1967 is covered.

Physiological and biochemical interpretations of the mechanisms of the processes discussed are avoided. Thus, although Heath is a world leader in research on stomatal movement and CO_2 enters leaves through stomatal pores, he provides no information about how guard cells carry out this essential function.

Both sides of controversial questions are presented fairly. However, portions of the book dealing with photorespiration (the process by which certain species evolve CO_2 in the light) might be misleading to someone encountering this subject for the first time. It is stated (p. 139) that there is relatively little difference in photosynthetic efficiency (CO_2 uptake per unit of leaf area) between herbaceous species, although it is now well established that species may differ in efficiency by at least two- to threefold. Much of these differences can be explained by variation in photorespiration, as evidenced by direct and indirect measurements. Nevertheless, the author believes (p. 173) that it is "problematical" whether photorespiration occurs at high rates in an atmosphere containing 300 parts of CO_2 per million (normal air). Decker, in 1959, had already shown that the post-illumination burst, a measure of photorespiration which like all other methods underestimates it, is the same at the CO_2 compensation point (45 ppm) as at 300 ppm and that photorespiration greatly exceeds dark respiration in many species.

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Plant Science Chronicle

A Short History of Botany in the United States. JOSEPH EWAN, Ed. Hafner, New York, 1969. x, 174 pp. \$7.50.

In his preface to this book, the president of the XI International Botanical Congress, K. V. Thimann, makes a significant statement that "there is, of course, no 'American Botany.'" But the occurrence of the congress in Seattle in August 1969 provided an opportunity for a number of American bot-

anists to summarize the events in their respective fields of plant science.

Joseph Ewan, who undertook to edit this work, presents at the beginning a chronology of events pertaining to botany, starting in 300 B.C. He admits that this chronology is subjective, but the summary is so fascinating to read that it is easy to ignore the incompleteness in some areas and the triviality of some of the events listed in others.

In this book the science of botany has been divided into the "traditional" areas. This organization works for the earlier history of the subject, but obviously there are problems as one approaches the present, with considerable interdigitating of fields. For example, "pteridology" cannot be considered completely separate from "plant genetics and cytology," because a great deal of contemporary work on ferns involves the cytological approach. Similarly, experimental plant morphology gets short shrift because it is neither completely physiological nor completely morphological. There had to be some kind of separation of topics, however, and any scheme would have had a certain degree of arbitrariness about it.

Naturally, a book of essays by different authors results in a degree of unevenness. Some essays here, such as the contribution of Sterling Hendricks on "Plant physiology" and that of E. D. Rudolph on "Bryology and lichenology," are well organized and trace the development of their subject by periods. Others (examples are "Morphology and anatomy" by Sherwin Carlquist and "Taxonomy" by Charles Heiser) are more informal and less tightly organized. On the whole, Ewan did an excellent job in making his selections; my principal complaint is that many of the authors are among the giants in their fields and that a collective sense of modesty among them must have been responsible for omission of some of their own important contributions in recent years.

In spite of the announcement (which appears more than once in the book) that there is no such thing as an American Botany, the book tends to be principally a chronicling of events that occurred in this country, and as a result it becomes a little sterile, failing to give a clear picture of the development of the science as a whole. And this development cannot be outlined without reference to the persistent and continuous interaction of botany in the United States with that in other parts of the

world. There have been more transfusions since the initial impetus in each of the fields of botany, and the thread in the story of the growth of American Botany is not confined to the northern part of the Western Hemisphere.

Nevertheless, the book serves a useful function in allowing us to step back for a moment, to look at what has been done locally, to determine what trends have developed, and to try to decide where we should go now. We have all profited from the occasion of the XI International Botanical Congress, the enthusiasm and energy of Joseph Ewan, and the thoughtful essays of the authors.

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Phagocytes

The Macrophage. NANCY N. PEARSALL and RUSSELL S. WEISER. Lea and Febiger, Philadelphia, 1970. x, 206 pp. \$8.50.

Although mononuclear phagocytes were once considered to act wholly as scavengers, they are now believed by many to be capable of a wide variety of functions, particularly in immune mechanisms. Rightly or wrongly, some role has been ascribed to these cells in virtually every aspect of the immune response. Pearsall and Weiser, who are active contributors to this field, have provided us with a highly readable review of the widely scattered recent literature on this subject and have interjected their own thoughts concerning the significance of some of the data. Their stated object is twofold: to consolidate the information in order to provide a comprehensive characterization of the macrophages for those who are unfamiliar with the field, and to review some of the more recent work concerning these cells for those who are already familiar with it.

The result is a concise but comprehensive account which deals not only with the possible roles of macrophages in the formation of antibody and in cell-mediated immunity but also with the structure, origin, and metabolism of these cells. Current evidence concerning the ontogenetic and functional relationships of macrophages and other cells is also discussed. Such diverse topics as the synthesis of interferon and the inactivation of thromboplastin