the α- and β-cells of the pancreatic islets. Finally, recent data at least raise the possibility that certain "neurosecretory" neurons concerned with the control of anterior pituitary secretion are bipolar, with one process secreting a hypothalamic hormone into the hypophyseal portal vessels and another process presumably secreting the same hormone in the anterior hypothalamus as a synaptic transmitter. Given these facts, one wonders about the continued utility of the term "neurosecretion." Our debt to the concept is great, but perhaps it is now time to move on to other, less ambiguous terms which better describe the operation of the nervous system as we understand it today.

WILLIAM F. GANONG
Department of Physiology, University of California School of Medicine, San Francisco

Anatomy and Habitat

Ecological Strategies of Xylem Evolution. SHERWIN CARLQUIST. University of California Press, Berkeley, 1975. xii, 260 pp. + plates. $12.50.

Carlquist's book is the result of ideas he has developed after many years of observation. As a comparative plant anatomist with an extensive collection of wood samples from all over the world, Carlquist clearly recognizes the influence of specific environmental conditions upon xylem structure. It is quite unusual that a plant anatomist is concerned with the physiology (in this case mainly the water balance) and the habitat of the species with which he is dealing.

The study of the relationship between plant structure and function is not new, having been a widely recognized line of research at least since the first edition of Haberlandt's *Physiological Plant Anatomy* in 1884. Carlquist's book goes one important step further. It explains the structure of a particular plant tissue by reference to its environment as well as its function. The complex tissue xylem is analyzed through the main groups of vascular plants. The results, whenever possible, are related to the specific environmental conditions. Example: Desert and chaparral shrubs have much shorter and narrower vessel elements than dicotyledons in general. This feature has an adaptive advantage because these narrower vessel elements withstand collapsing better than wider ones (xylem tensions in the creosote bush approach −80 bars).

In order to make his point the author frequently uses frankly teleological terminology, but it is apparent that it is used only as a means for pregnant expression.

The book is not easy to read. There are no concessions to the biologist who is not familiar with xylem anatomy. A wealth of information, much of which has come from Carlquist's own research, is accumulated. Xylem features of the principal groups of vascular plants are treated in separate chapters, and structural patterns and their phylogenetic implications are thoroughly discussed. The stelar theory, specialization in dicotyledon wood, and sieve elements are other topics considered. Abundant information is gained from the examination of tropical trees of the Southern Hemisphere. This is an important contribution because the present understanding of xylem structure has been based largely on anatomical data accumulated from the deciduous trees and conifers of the temperate zone of the Northern Hemisphere.

Some randomly chosen topics may serve as examples of the points brought forward in the book: The success of the angiosperms compared to the other groups of vascular plants is explained by the structural efficiency of the flowering plant's conductive system; gymnosperms are not really limited in geographical range but more in diversity of habitat. They have not radiated into the xeric environment. The lack of vessel elements has restricted them to the mesic environment. The fact that the length of their reproductive cycle prevents the evolution of annuals imposes another restraint on the gymnosperms; the evolutionary transition from the scalariform thickening to the more advanced simple perforation plate in the dicotyledonous vessel element is polyphyletic; the dimensions of vessel elements have to be evaluated in terms of environmental conditions. On this last point it becomes clear that much more ecological information is needed. The anatomical data accumulated in the literature rarely include information regarding the ecological situation of the sample species. The author himself complains that he is forced "to couple relatively precise anatomical details with vague ecological observations." Even an apparently uniform tropical rain forest shows enough microclimatic variation to account for distinct species distributions and the exposure of individual trees to different environmental conditions.

The author makes it clear that he does not have answers to all the questions he raises. Neither does he expect all his conclusions, which are often speculative, to be accepted without criticism. The book is full of stimulating and unorthodox ideas; future research on the phylogeny of vascular plants has to take them into account.

JOCHEN KUMMEROW
Department of Botany, San Diego State University, San Diego, California

Plant Reproduction

Pollen. Biology, Biochemistry, Management. R. G. STANLEY and H. F. LINSKENS. Springer-Verlag, New York, 1974. x, 308 pp., illus. $24.60.

Pollen is a most unusual biological material. Essential for the reproduction of both angiosperms and gymnosperms, it has long fascinated botanists and plant breeders. The many ways in which pollen has been studied are reflected in this important new book by Stanley and Linskens, both of whom have made significant contributions to our understanding of the subject.

The book covers three major aspects of work with pollen. The first section, which is entitled Biology, gives a very good review of the development of pollen, including the origin and development of the sperm cells. Included in this section is a chapter on wall formation, which is still one of the less known aspects of pollen development. The wall of the pollen grain is one of the most intensely examined and studied cell walls in existence, and yet there remain many problems concerning its formation and indeed its chemistry. This material is well reviewed by Stanley and Linskens. In this section they also deal with a miscellany of other subjects, including dehiscence, size range, quantity produced, and distribution.

These lead them quite naturally into the management of pollen. Pollen is commercially collected and used in agriculture and in breeding, but pollen collection and storage are rarely treated in books on pollen. Stanley and Linskens devote a section to this topic and include a wealth of interesting and important information. The chapter on the nutritive role of pollen, which deals with the role of bees in collecting it and the relevant physiology, is intriguing.

The third section of the book is on pollen biochemistry. Here the authors do an outstanding job. A chapter on the general chemistry of pollen is followed by individual ones on carbohydrates and cell walls, organic acids, amino acids and proteins, pollinosis, nucleic acids, enzymes and cofactors, pollen pigments, and growth regulators. Again, there is a wealth of in-

formation in these chapters, and they are a good survey of the current status of pollen biochemistry.

The literature review is extensive and is particularly good for papers from the '30's to the '60's. For a book published in 1974 there are relatively few references for the late '60's and '70's. This does not, however, detract from the usefulness of the volume, which should be in the library of anyone interested in pollen.

WILLIAM A. JENSEN
Department of Botany,
University of California, Berkeley

Biological Psychiatry

Experimental Approaches to Psychopathology. MITCHELL L. KIETZMAN, SAMUEL SUTTON, and JOSEPH ZUBIN, Eds. Academic Press, New York, 1975. xviii, 488 pp., illus. $19. Personality and Psychopathology, 15.

The chapters of this book originated as papers presented at a Biometrics Research Workshop in February 1968. The fact that many of the chapters remain informative and interesting after a publication delay of nearly eight years is both a testimony to the farsightedness of the authors and an indictment of progress in the field.

The chapters focus on experimental studies of psychological phenomena—attention, arousal, and learning—and on their physiological basis. For that reason, the workshop was a harbinger of a split in the ranks of biological psychiatrists. Now, the division between the two viewpoints on psychopathology is more clear. In one camp are the researchers represented in this volume—investigators whose biological investigations begin with behavioral observations and psychological theories of psychopathology and who attempt to study the physiology of the central nervous system or cardiovascular response to expand or objectify basically psychological theories.

In the other camp are researchers entirely omitted from this volume—investigators whose research in human psychopathology proceeds from new knowledge about brain neurochemistry and the pharmacology of synaptic transmission gained primarily in animal or in vitro experiments. On a working level, they tend to view psychopathology as an epiphenomenon riding on a sick synapse. From this viewpoint, psychopathology is of interest as an indicator of neurochemical malfunction rather than as a phenomenon to be studied in its own right.

Both camps have made progress in the last eight years, and it is hard to deny that the saltatory advances of neurochemistry are the more extensive and comprehensive. However, the difficulty in establishing connections between neurochemical phenomena and the complex and peculiar behavior and thought in the schizophrenic patient or disturbed child is troublesome.

In their cogent introduction, the editors explain their emphasis on neurophysiology and learning models as resulting from the increasing body of experiments that attempt to make these difficult connections: "Scientific models are merely scaffolds for building bridges across gaps in knowledge." They aim the scientific effort at the gaps between concepts such as arousal or attention that have relevance both as clinical observations and in neurophysiology, and not at the chasm between synapse and schizophrenia.

Arousal and attention superficially seem to be quite separate psychological issues on an acute psychiatric ward; patients running around in circles are overaroused and patients who walk through a pool of urine are not attending to where they are going. In an experimental setting, however, does a fast reaction time represent a highly aroused, eager patient or a relaxed, attentive one? The editors have somewhat artificially divided the book into four sections—Arousal, Attention, Learning, and Methodological Issues. The chapter authors have wisely seen the attention-arousal problem as critical in approaching the physiology of psychopathology. In his unique way Hernández-Péon, in a chapter written shortly before his death, shapes a speculative neurophysiological integration of attentional and arousal mechanisms into a model of psychopathology. In an up-to-date (containing 1974 work) chapter, Horn discusses neurophysiological experiments on the attention-arousal problem. Using reaction time paradigms, Zubin focuses on the attentional deficits of schizophrenics, whereas Zahn follows the arousal response to "attentional" tasks; both have updated their chapters and include some unpublished data and new speculations. Even many of the chapters in the learning section (Martin and Levey, Lang *et al.*, and Maltzman) address the attention-arousal issue with autonomic reactivity measurements.

Perceptual aspects of attention and arousal are discussed in the chapters on human evoked potential by Callaway and Jones and by Shagass and Overton. A critique of evoked potential methodology is then given by Vaughan. All three chapters are somewhat out of date, both because of rapid progress in the field and because these authors have all published newer material quite extensively. Vaughan's methodological criticisms of the evoked response work, while still important, have been largely taken into account in newer studies by both Callaway and Shagass.

Useful summaries of methodological strategies such as pupillography (Hakerem and Lidsky), temporal judgment (Goldstone), and psychomotor techniques (King) are provided. The chapter by Miller on visceral learning is a valuable review of whole series of his experiments.

Venables suggests the utility of concepts borrowed from information theory and communications engineering in the study of psychopathology—signal-noise separation, channel capacity, storage, and so forth. This approach is now becoming increasingly popular and I am sure Venables is pleased that published experiments are overtaking his speculations in the chapter.

To borrow Venables's method, this volume may be best seen in perspective if we view psychopathology as a repairman views a poorly performing computer. These authors generally approach the problem as an error in the basic system software or in wiring, probably present when the computer was delivered from the factory. Psychosocial or psychoanalytic investigators see mistakes in current operating programs. The neurochemical group searches for abnormal metal oxide deposition in transistors. All three will find many chapters valuable and the theoretical sections still highly pertinent.

MONTE BUCHSBAUM
Adult Psychiatry Branch,
National Institute of Mental Health,
Bethesda, Maryland

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