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.

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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.

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