

look particularly promising. We can expect increasing help from the paleoclimatologists, who are hard at work in the central and southern Andes.

These are exciting times to be working in the neotropics. Merely keeping abreast of new developments is difficult, and integrating them is a major achievement. This book belongs on the shelf of anyone who is trying. Descimon assures us that refugiology will be overtaken by other approaches in due time. Perhaps; but, in good Latin American style, it has already spawned a revolution.

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Psychopharmacology

Neuroregulators and Psychiatric Disorders. Proceedings of a conference, Asilomar, Calif., Jan. 1976. EARL USDIN, DAVID A. HAMBURG, and JACK D. BARCHAS, Eds. Oxford University Press, New York, 1977. xxx, 628 pp., illus. \$29.50.

Our knowledge of the function and metabolism of neurotransmitters and of other compounds that regulate neuronal activity is much more advanced than is our understanding of the role of these compounds in psychiatric diseases. Much of the information we do have about the neurochemical correlates of psychiatric illness has come from studies of the effects of drugs on brain function. The investigation of the mechanism of action of the antischizophrenic drugs, the phenothiazines and butyrophenones, illustrates the important role of pharmacological studies in shaping our ideas in this field. In *Neuroregulators and Psychiatric Disorders*, Snyder and his colleagues review the evidence that these drugs are dopamine-receptor blocking agents. The blocking of dopamine receptors in the basal ganglia by the drugs almost certainly accounts for their production of side effects similar to the symptoms of Parkinson's disease. A plausible and widely held hypothesis is that the antischizophrenic actions of the drugs are due to their interaction with dopamine receptors elsewhere in the brain. A corollary of this hypothesis is that schizophrenia may involve an increase in the activity of dopaminergic neurons. As Matthysse emphasizes, however, there is little independent evidence for an increase in dopaminergic activity in schizophrenia. It is dangerous to extrapolate from the action of a drug to the pathophysiology of a disease.

The study of exogenous psychotogens

has also yielded insights into the relationship between neuronal function and psychiatric disease. Chronic amphetamine intoxication produces an illness that is very similar to schizophrenia and that may serve as a model for the disease. Ellinwood and his colleagues describe the changes that result from amphetamine administration and make a special effort to correlate the neurochemical and behavioral effects of the drug. The actions of hallucinogens are even more spectacular, but the relevance of these compounds to normal brain function or to psychiatric disease is still obscure. Five papers, by Saavedra, Koslow, Hollister, Friedhoff, and Gillin and Wyatt, discuss these compounds. It is conceivable that exogenous hallucinogens act by mimicking the effects of some endogenous compound and that the disordered metabolism of this hypothetical endogenous hallucinogen might be related to psychiatric illness. If there are endogenous hallucinogens, *N*-methylated tryptamine derivatives now appear to be the most likely candidates. Both tryptamine and a tryptamine *N*-methyltransferase activity are present in brain, and the hallucinogen *N,N*-dimethyltryptamine has been detected in blood.

The remaining chapters are devoted to other specific neuroregulatory compounds. Almost everyone's favorite compound, from prostaglandins to substance P, is discussed. Most of these chapters are similarly organized. They begin by reviewing the occurrence and distribution of some substance in brain, present some new data on the action or metabolism of the substance, and conclude with speculations about the possible role of the substance in mental illness. These chapters illustrate a fault common to much of the research in this field—a delusion of grandeur on the part of the investigator. Snyder *et al.* have pointed out the delusion clearly: "Of the literally millions of chemical systems in the human body, why should nature have chosen to inflict the 'schizophrenic abnormality' upon whatever specific chemical the experimentalist happens to be best equipped to measure?" (*Science* **184**, 1243 [1974]). Many of the chapters will serve as useful introductions to the compounds they discuss, however, and have good bibliographies.

There are several noteworthy omissions from this volume. Although Ciarello discusses the biochemical genetics of the catecholamine biosynthetic enzymes, the genetics of schizophrenia is mentioned only in passing. This omission is particularly curious because Kety, who has done the pioneering work

on this subject, was a participant in the conference from which the book stems. His research has served as a model for the design of well-controlled studies of schizophrenia and has provided some of the most compelling evidence that the disease does have a biological basis.

The book contains only a few minor errors. The editors' use of Trp instead of Trp as an abbreviation for tryptophan is idiosyncratic but inconsequential; their use of TRY as an abbreviation for tryptamine, however, invites unnecessary confusion. And the editors have allowed several unfortunate neologisms to creep into the book. One can only hope that "schizotoxin," whatever it is supposed to mean, does not become a permanent addition to our vocabulary.

This is an attractive and well-edited book. On the whole, it provides a valuable survey of the current state of this exciting and important field.

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On Heisenberg's Discovery

The Uncertainty Principle and Foundations of Quantum Mechanics. A Fifty Years' Survey. WILLIAM C. PRICE and SEYMOUR S. CHISICK, Eds. Wiley-Interscience, New York, 1977. xviii, 572 pp., illus. \$42.

This book commemorates the 50th anniversary of Heisenberg's discovery of matrix mechanics. It consists of brief reminiscences by him on the uncertainty relations and 24 essays of great diversity in subject and value by various authors.

About half of the essays are devoted to aspects of the foundations of quantum mechanics. Gudder's "Four approaches to axiomatic quantum mechanics" is a splendid survey, with judicious comments from a unifying viewpoint. Sławianowski's analysis of versions of the correspondence principle—for example, the WKB (Wentzel-Kramers-Brillouin) approximation and the limits of high quantum numbers and of $\hbar \rightarrow 0$ —is a profound contribution. Ludwig's operational formulation of quantum mechanics in terms of preparing systems and recording is careful but ponderous. Kraus's beautiful paper surveys previous results on the impossibility of photon position observables and cogently argues for relaxing conditions so as to permit their construction; his application of Ludwig's general ideas on measurement provides better evidence for their value than the latter's own exposition. There are two

papers on the time-energy uncertainty relations, one by Rayski and Rayski, Jr., that is careful and persuasive and one by Recami that is loose in its treatment of a space of states and a proposed time operator. Kuryshkin's paper aims at an alteration of quantum mechanics in which all statistical predictions are based on a joint coordinate-momentum probability distribution, but he neglects to say what conditions must be satisfied (whether locality in Bell's sense must be satisfied, for example) and to consider crucial mathematical existence questions. There are two papers on the measurement problem, one by Lanz that is competent but condensed and one by Rylov that erroneously concludes that the time-energy uncertainty relation limits momentum measurements (the error arising from his assumption that measurement should be performed quickly, in principle instantaneously). Papp's "Quantum theory of the natural space-time units" has many ideas, but his loose exposition leaves one skeptical.

Four papers on quantum field theory are on a high level. Rühl and Yunn contribute an illuminating study of representations of the conformal group, with special reference to causality. Streit gives a readable introduction to the difficult subject of constructive field theories. Feldman makes an important contribution to the study of the correspondence principle by exhibiting that the electromagnetic and gravitational fields behave differently as limits of massive quantum theories. It is hard to assess the value of Roothaan and Detrich's "Relativistic electromagnetic interaction without quantum electrodynamics" in spite of their careful calculations, since they cannot deal with pair creation and annihilation.

Two papers on mathematical methods and four on applications (to white dwarfs, organic charge transfer salts, and nuclei) are all impressive.

Three papers are primarily philosophical. Reece extracts the common moral of accepting uncertainty from Heisenberg's principle, Gödel's incompleteness theorem, and Popper's methodological argument against confirmation. This conflation is thoroughly erroneous if quantum mechanics is an objective and complete theory, for then the uncertainty relations stem from objective limitations on the definiteness of dynamical variables rather than on human faculties. Bohm points out that there are non-positivist as well as postivist elements in Heisenberg's thought and claims that his concepts of potentiality and of the "irreducible act of participation in the process

of observation" are important philosophical contributions. Clarke speculates attractively (along the lines of Penrose) about a modified quantum theory that will be cosmological and non-anthropocentric in character.

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Cognition as Integration

The Process of Cognition. ARTHUR L. BLUMENTHAL. Prentice-Hall, Englewood Cliffs, N.J., 1977. x, 230 pp., illus. \$9.95.

In this provocative book, Arthur Blumenthal develops an original conceptual framework that is intended to encompass every aspect of cognitive psychology from visual masking to concept formation. Indeed, he goes beyond cognition; his theory, like Wundt's a century ago, deals with emotion and motivation as well as the intellect. Comparison with Wundt is not irrelevant, because Blumenthal places his own work in an appropriate historical context. Unlike most modern theorists, he does not make the mistake of supposing that cognitive psychology sprang full-blown from the head of the digital computer in this generation. One of the most attractive features of his book is the frequent citation of 19th-century references for phenomena that are usually thought of as recent discoveries. The "magical number seven," for example, was established by Jevons in 1871; the "Brown-Peterson" technique for studying subspan recall was invented by Daniels in 1895; "Sperling's method" of partial report was used by Wundt in 1899.

Blumenthal believes that the basic cognitive process is the selective *control* of mental life. We are constantly bombarded by internal and external stimuli; without mechanisms of integration and selection, we would experience only chaos. For this reason, we have evolved various ways of integrating stimuli over time. Different chapters of *The Process of Cognition* describe different kinds of time-binding, ranging in scope from milliseconds to decades. This device allows Blumenthal to deal with a great many aspects of cognition in an orderly way. Moreover, integrative mechanisms of different temporal scope are not independent: they are unified by effect and emotion, which "link enduring needs and dispositions to the psychological present," and by the self-concept, which

is "perhaps the most important longer temporal integration we ever form."

The book is clearly and systematically organized. Each chapter describes one particular level of temporal integration. The general principles involved are always set out first, followed by selected experimental findings to illustrate them and then by a chapter summary. Blumenthal begins by considering "rapid attentional integrations," ranging from 50 to 250 milliseconds, which are said to account for such effects as the time-intensity tradeoff in vision, masking, apparent movement, and memory scanning. These rapid integrations depend on the existence of preattentive buffers such as iconic and echoic memory; these buffers also account for such other well-known phenomena as temporal judgment and rhythm. The outputs of the "rapid attentional integrations" are stored in short-term memory. The chapter on this subject deals not only with the well-known short-term storage experiments, but also with hesitations in speech, attention waves, and mental blocks. The characteristics of the buffers and of short-term memory, taken together, produce the classical "spans" of immediate memory and apprehension. Emotions, whose three characteristic dimensions have been repeatedly confirmed by investigators from Wundt to Osgood, augment and direct the processes of attention; Blumenthal's chapter on emotion includes a very interesting section on the psychology of music. Memory and learning are treated as longer temporal integrations. They are always "constructive" (in Bartlett's sense) at first, but may become "automatized" later so that they no longer require attention. The final substantive chapter deals with cognitive style and cognitive control, the self-concept, speech, problem-solving, and other higher processes.

The notion that organisms must struggle to impose organization on a chaos of sensory inputs is widely held, though few have defended it as imaginatively as Blumenthal does in this book. Almost all psychology textbooks now refer to the "bombardment" of stimuli that allegedly threatens to overwhelm us at every moment. For my part, I don't believe it. Information does not force itself upon us; we have to pick it up. With increasing skill we become attuned to increasingly subtle kinds of information, extending over longer periods of time. The schemata that enable us to hear musical themes or understand spoken sentences are not composites of briefer spans, held together only by the force of emotion; they are readinesses for infor-