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 nonpositivist 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 nonanthropocentric 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-

mation that will appear over time. The theoretical advantages of considering memory as a long-range temporal integration are needlessly thrown away if one treats it just as a defense mechanism against a supposedly intrusive world.

Other readers, who may not share my disagreement with the author on this central point, will find other things to criticize. Blumenthal is far too casual about temporal parameters in the millisecond range; for example, he takes every experimental time constant under 250 milliseconds as equivalent to every other. He also has a remarkably old-fashioned idea of the perception of motion, treating it as a failure of simultaneity rather than as an independent process. His reading is not always critical enough: he has a touching faith in a few 1960's studies of cognitive style (that have never been replicated), in the early Quillian-inspired studies of semantic memory, and in many other experiments that just don't work as well as his theoretical enthusiasm would require. But such faults are easily forgiven in an author who writes so well, who reminds us of so much important psychological history, and who has tried so hard and so ingeniously to see cognitive psychology as an intelligible whole.

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## Marine Ecology

**Biology of Benthic Organisms**. Papers from a symposium, Galway, Ireland, Oct. 1976. B. F. KEEGAN, P. O. CÉIDIGH, and P. J. S. BOADEN, Eds. Pergamon, New York, 1977. xxxiv, 630 pp., illus. \$50.

The broad title of this volume belies its contents. Except for an occasional paper on population genetics or physiology, the research discussed can be classified as either population or community ecology, with a strong emphasis on fieldwork. However, even within this narrower context there is an almost fatal lack of focus. The editors never indicate a rationale for a symposium on benthic ecology. There are too many papers, most of which are too short (63 are contained in 630 pages). With the customary accoutrements of illustrations, references, abstract, and the like there is little room for full presentation of data, detailed analysis, or development of new ideas. The internal organization that might have provided a collective focus is also lacking (the papers are merely arranged alphabetically by author). Obviously related papers, whether by theme, geographical area, habitat, or taxa studied, are scattered throughout, so that any convergent or divergent trends in benthic research are obscured.

Given these constraints, many papers still manage to convey, at least in a cursory way, the present concerns of benthic ecology. First, benthic ecology is still basically a field science with a greater emphasis on methodology and data than on theory, and that is evident in these papers. The book has an abundance of general survey papers, but in addition there are a noticeable number of studies that show imaginative use of new and old methodology to investigate specific hypotheses. These include such papers as Reise's report on the use of caging experiments in contrasting the significant effects of predators in a homogeneous habitat (a mudflat) with the lack of any similar effect in physically heterogeneous environments (seagrass beds), or Jackson's preliminary report on the use of artificial substrates to investigate the effects of habitat size on colonization, competitive interactions, and community structure. Other examples include Arntz's use of an "unsuccessful" cage experiment in examining oxygen depletion and increased predation around secondary habitat islands (the cages), or Buhr and Winter's careful combination of fieldwork and laboratory experiments to link high population densities of the poylychaete *Lanice conchilega* with its dual methods of feeding.

Second, several papers present stimulating, if not new, concepts for benthic ecology. Certainly the most novel approach is that of Barnes and Barnes. Instead of viewing the water-borne larvae of benthic species as only a means for distribution (the traditional view of most benthic ecologists) they discuss the hypothesis that these larvae are quantitatively and qualitatively necessary (as food) to that planktonic system. Their stimulating and sometimes speculative discussion underscores the great need for research in the most neglected area of benthic ecology, its link to the water above. Ölscher and Fedra examine a very different link with the water column, active and passive suspension feeding. By analyzing feeding efficiency, they show how suspension feeders can shuttle the necessary nutrients and energy from the water into soft-bottom communities, thus justifying their view of these animals as "secondary producers" rather than consumers. In a sense West, de Burgh, and Jeal further this view by cataloging the increasing number and kinds of benthic species that can absorb dissolved free amino acids from the water. If this process is significant in the gross nutrition of such a wide range of taxa, its importance to benthic populations and communities is in need of evaluation.

Third, there are an appreciable number of very different but generally well-conceived studies, whose merit may depend on the tastes of the individual reader. Some that I found to be of particular interest include Gerdes's linking of *Amphiura* colonization with long-term current history; Hartnoll's contrasting of the reproductive strategies of two coexisting species of *Alcyonium*, one basically sexual and the other asexual; Rex's correlation of deep-sea zonation rates with trophic level; and Warner's modeling of the ideal shape for filter-feeding organisms.

However, even with these and many other interesting papers, this volume cannot rise above its format. There is neither the detail the specialist would want nor the overall organization, evaluation, and perspective to attract the generalist.

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## Books Received

**Cryobiochemistry**. An Introduction. Pierre Douzou. Academic Press, New York, 1977. x, 286 pp., illus. \$24.65.

**Cutaneous Toxicity**. Victor A. Drill and Paul Lazar, Eds. Academic Press, New York, 1977. x, 278 pp., illus. \$14.50.

**Desertification**. Environmental Degradation in and around Arid Lands. Michael H. Glantz, Ed. Westview Press, Boulder, 1977. xix, 346 pp., illus. \$20.

**Developmental Art Theory**. Geraldine H. Williams and Mary M. Wood. University Park Press, Baltimore, 1977. x, 198 pp., illus. Paper, \$9.75.

**Disturbances in Body Fluid Osmolality**. Thomas E. Andreoli, Jared J. Grantham, and Floyd C. Rector, Jr., Eds. American Physiological Society, Bethesda, Md., 1977 (distributor, Williams and Wilkins, Baltimore). viii, 50 pp., illus. \$25.

**Early History of Planck's Radiation Law**. Hans Kangro. Translated from the German edition (Wiesbaden, 1970). Crane, Russak, New York, 1977. xviii, 282 pp., illus. \$39.50.

**Ecological Perspectives in Behavior Analysis**. Papers from a conference, Lawrence, Kans., Oct. 1976. Ann Rogers-Warren and Steven F. Warren, Eds. University Park Press, Baltimore, 1977. xiv, 250 pp. \$15.75.

**Ecology and Systematics of Foraminifera in Two Thalassia Habitats, Jamaica, West Indies**. Martin A. Buzas, Roberta K. Smith, and Kenneth A. Beem, Smithsonian Institution Press, Washington, 1977. 139 pp., illus. Paper.

**Essays on Individuality**. Felix Morley, Ed.

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