to provoke a similar mix of reactions. I would say, however, that, despite its complexity and flexibility, ACT* is a more clearly specified theory than its precursors. It has evolved to the stage at which evasion of disconfirming evidence may not be an easy option. Furthermore, Anderson's stress on generality is something the field clearly needs. Perhaps it is premature or even impossible to develop a general theory of cognition, but we will never know unless someone is willing to give it a serious try. And in proposing specific mechanisms of inductive learning Anderson focuses attention on a topic now widely recognized as critical to gaining understanding of human intelligence.

Those familiar with Anderson's earlier monographs will find that, although his latest is not an easy book, it is clearly written and more concise than its predecessors. It deserves the attention of researchers in cognitive science.

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Microbial Habitats

Microbes in Their Natural Environments. Papers from a symposium, Conventry, England, April 1983. J. H. SLATER, R. WHITTENBURY, and J. W. T. WIMPENNY, Eds. Published for the Society for General Microbiology by Cambridge University Press, New York, 1983. x, 498 pp., illus. $67.50. Symposia of the Society for General Microbiology, 34.

This collection of 12 papers is the proceedings of the 34th symposium of the Society for General Microbiology. According to the editors, the book was intended to bring together a group of manuscripts that discuss "the reality of microbial life" in natural ecosystems. What constitutes ecological reality for the editors is unclear, but their actual goal appears to have been to assemble a group of papers on modern approaches to microbial ecology that emphasize mixtures of laboratory and field experimentation. Such approaches presumably are more likely to yield information that is relevant to natural ecological processes than are approaches that emphasize only field or only laboratory work. The editors have generally succeeded in assembling such a group of papers.

For example, the book contains an excellent paper by David C. White concerning methods for the analysis of microbial activities and biomass in situ. Topics examined include community composition status and the difficulty of applying analytical methods in situ without the introduction of artifacts. This paper should be required reading for all those who study microbes in situ.

Other particularly informative papers include one by Richard G. Burns and one by Darryl C. Reanney, Peter C. Gowland, and J. Howard Slater. The paper by Burns discusses enzyme-substrate interactions in soil, particularly interactions involving polysaccharases and proteinases. It is among the best reviews of this topic available. The paper by Reanney *et al.* presents a lucid discussion of genetic interactions among natural microbial populations. It contains valuable information regarding transfer mechanisms and how these may or may not function in natural ecosystems.

An interesting paper by J. Greg Zeikus discusses metabolic communication between biodegradative populations in nature. The paper contains 39 citations of Zeikus's work and is mostly a review of work performed in his laboratory during the past ten years. The review ranges over a variety of topics, concentrating on anaerobic degradation of biological polymers and methanogenesis in lake sediments. Discussions of mixed-population anaerobic food chains are interesting and useful updates of this very lively subject. One weakness in the paper is its oversimplification of what happens to the plant polymer lignin in anaerobic environments. The statement that "lignin and related high molecular weight aromatic polymers . . . are not significantly decomposed in anaerobic environments" is far from proven. It may turn out to be correct; however, one set of experiments from one environment (Lake Mendota sediments) is not a sufficient basis for such a sweeping generalization.

The quality of other papers in the book is variable but generally high. Topics discussed include spatially heterogeneous laboratory models and microcosms (Wimpenny, Lovitt, and Coombs), the relevance of pure culture studies to natural ecosystems (Tempest, Neijssel, and Zevenboom), mechanisms of microbial energy transduction and solute transport (Konings and Veldkamp), microbial adaptations toward survival in hostile environments (Dow, Whittenbury, and Carr), bacterial motility and taxes (Rowbury, Armitage, and King), microbes and their interactions with surfaces (Wardell, Brown, and Flannigan), the carbon cycle in aquatic ecosystems (Ormerod), and the challenges provided by nature to microbial survival in natural environments (Stewart).

This book should be useful for specialists in microbial ecology, particularly those of us who teach the subject to university students. It is a recommended acquisition for the libraries of most universities. The book provides a nice summary of some of the successes in this field.

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Plant Structures

Xylem Structure and the Ascent of Sap. MARTIN H. ZIMMERMANN. Springer-Verlag, New York, 1983. x, 143 pp., illus. $19.50. Springer Series in Wood Science.

The comparative morphology of wood provides us with a well-documented and dramatic evolutionary series. The invasion and occupation of land by higher plants were closely linked to the evolution of both a support and a water transport system, namely the xylem. Thus the vast majority of the land plants are aptly classified as the Tracheophyta. The cell walls of the xylem contain cellulose for strength, hemicellulose as a matrix, and lignin for rigidity. These cell wall constituents were fabricated into tube-like cells, that is, the tracheids. Support is provided by a tough, rigid wall of helically wound microfibrils of cellulose embedded in a matrix of hemicellulose and encrusted with lignin. For transport the tracheid is programmed to eliminate its cytoplasm at functional maturity, leaving a hollow center (lumen) to serve as a water conduit. Cell-to-cell transport is facilitated by interconnecting holes termed bordered pits. The borders and membranes of these pits are constructed in such a way that structural weakness due to the pitting is minimized. Tracheids in coniferous plants have perforated membranes that have thickened disks in the center that can fold over and seal off the pits under certain conditions.

As Martin Zimmermann points out in this excellent monograph, the tracheid was so successful that few improvements were made for 300 million years. With the advent of the angiosperms a xylem appeared that had fiber tracheids for support (primarily) and vessels for transport. Each fusiform initial of the cambium produces a vessel element, and these vessel elements align themselves vertically, eliminate their protoplasts and end walls (at least partially), and form hollow vessels that in ring-porous