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BOOK REVIEWS

Toward Foundations of Information Science. L. B. HEILPRIN (Ed). Knowledge Industry Publications, White Plains, NY (1985). viii + 232 pp., $34.95, ASIS members $27.95, ISBN 0-86729-149-4. Published for the American Society for Information Science.

Ever since it came into common usage, the term "information science" has been widely regarded as premature, if not pretentious, by people both inside and outside of the discipline bearing that name. That the discipline is concerned with information is obvious. Its basis as a science is not; it lacks a foundation of basic concepts and relationships of the kind that define, unify, and guide such disciplines as are readily accepted as sciences.

Within the professional society that gave this discipline its troubling name, the American Society for Information Science (ASIS), there is a group of researchers who are explicitly concerned with the search for adequate fundamental theory: the Special Interest Group on Foundations of Information Science. In sessions at the annual meetings of ASIS from 1978 through 1981, this group sponsored the presentation of a number of notable papers that both reviewed the status of the search for a satisfactory basis for a unified information science and examined approaches deserving further study. This book contains thirteen papers based on presentations made at those sessions. The editor, who was also an organizer of the original sessions, has gone to great lengths to give a sense of unity to the collected papers. He does this by providing both a foreword and an afterword to the collection as a whole, and by providing an introduction (as well as the concluding paper) for each of the four parts (chronological sessions) into which the papers have been grouped. This effort at unification is only partly successful, however, since Heilprin's summary essays, while careful and precise, are only slightly more friendly to the uninitiated reader than the highly theoretical papers he discusses. Unification of the collected papers and access to their content are hampered also by the absence of an index to this book. Nevertheless, it can be read and understood, and it deserves to be read.

The papers in Part I consider the suitability of Shannon's information theory as a basis for information science; they find it to be inadequate but disagree on the prospects for suitable adaptation. It is implied in these papers, and throughout the entire collection, that information science means information systems. The paper by Frederick R. Suppe in the first part (he has two more in other parts) is especially illuminating. He sees information science as inevitably connected to all parts of science, because science is the interaction of the human system with external or environmental systems which must, as all systems do, include information inputs, storage, transitions of state, manipulations, and output interfaces (stated also as "communication, control, representation, storage, and manipulation of information"). Shannon's information theory deals only with communication syntax, ignoring the semantic and pragmatic aspects of system interfacing. Rather than attempting to broaden information theory, Suppe sees as more promising the exploration of such underexplored alternatives as artificial intelligence, erotetic (question-and-answer) logic, adaptive systems theory, and philosophy of science.

In a related paper, Robert F. Barnes presents an original extension of Shannon's theory that broadens its applicability to information science by adding to it a second type of entropy value to represent the various possible meanings of the events communicated between information systems. This increased complexity destroys one's ability to use information theory to compare two events for "information content," which Barnes regards as a questionable loss. The advantage is that it permits a representation of "collective uncertainty" that is much closer to intuitive human treatment of information. In another paper, Pranas Zunde points out that information is a branch of mathematics, not an empirical derivation; he states a belief that information theory is still a powerful tool for progress if it is used in connection with other sciences and empirical laws. Heilprin concludes Part I with a paper that explains and compares different formulations that mathematicians have developed for the concept of "entropy"; Shannon's is not the only one. However, changing the formulation will still not serve to transform information theory from a necessary to a sufficient aspect of information science.

In the three remaining parts of the book, three other approaches to basic information science theory are examined: artificial intelligence methods, recipient-centered methods (human systems), and interpretation methods.

The papers on artificial intelligence, by Suppe, Charles Rieger, Frederick Hayes-Roth, and Heilprin, approach the problem from different directions, including: dealing with the black noise (non-Gaussian distribution of values) in real communication situations, achieving closure on alternatives in machine comprehension of text through hypothesis rejection, formulating the structure of ambiguity in order to facilitate comparison or matching, characterizing the process by which humans achieve acceptable abstractions of the characteristics of records or other objects.

The papers on the human recipient system, by David Harrah, George Stiny, and Heilprin, deal with the probabilistic perception of truth in messages that are received and analyzed, the possibility of developing a system language that incorporates adequate approximation of recipient affect (feeling and response toward the object or message), and explication of the unidirectional flow of information in human recipients and the necessary coupling among the communication channels that are involved. There are two papers in the final group on interpretation in observation and communication—the process by which an information recipient becomes informed, whether or not his system produces an output response. Suppe reinforces his earlier analysis of the role of black noise. Heilprin demonstrates mathematically that cognitive development in a recipient consists of associating the "variety" (information richness) of different objects or observations to form larger classes with lowered variety, i.e., abstract levels and hierarchies. Because of the brain's information channel limitations, logical thought and the communication of thought cannot occur until this cognitive development reaches some threshold of sufficiently high abstraction (low variety).

This is an important book, worth considering for personal collections. It should certainly be in every collection that is intended to serve researchers and system developers in information science and in related fields such as librarianship, management systems, cognitive studies, and education. Perhaps its greatest value is that it provides the means for a person who is a relative stranger to the theoretical aspects of information systems to quickly gain familiarity with the major lines of thought and the problems to be resolved. Most of the papers include lists of references or bibliographies that provide entrée to the relevant literature. The time lapse between original presentation of these papers and their publication is immaterial. This book is not concerned with transient details of technology. It is concerned with the discovery of the fundamental concepts and relationships that shape technology. Such foundations develop slowly. In information science they are by no means well developed yet, but the prospects are bright. And, even in their immature state, the concepts and relationships discussed in this book offer us convenient shortcuts to the threshold levels of mental abstraction that are necessary, as Heilprin explains, for productive thought.

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The Mind's New Science: A History of the Cognitive Revolution. H. GARDNER. Basic Books, New York, NY (1985). xv + 423 pp., $22.50, ISBN 0-465-04634-7.

For years I have been uneasy in the face of the increasing number of information scientists I encounter who seem firm in their conviction that the only viable foundation for an "information science" is the empirical analysis of the documentation in scholarly literatures. In this version of information science, bibliometrics is the theory and citation analysis is the method. A number of things trouble me about this notion, but foremost is the disquieting feeling that this paradigm would place information science at the very margins of the emerging information society. That is, I can not understand the intensity with which advocates of this paradigm insist that somehow bibliometrics is a mirror of nature.

And yet, despite my concerns about the inadequacies of the dominant paradigm candidate in information science, I found myself at a loss to imagine one that would be as persuasive and focused as the bibliometric model seems to be. Until now, that is, for I would like to suggest that Howard Gardner's *The Mind's New Science* offers us a detailed and forceful argument for a new cognitive science with significant implications for information scientists, and especially information science educators who are struggling to design curricula to meet the needs of the U.S. information industry.

Gardner, A MacArthur Prize Winner and author of the award winning *Frames of Mind: The Theory of Multiple Intelligences* (Basic Books, 1983), has written a brilliant analysis of what he terms the "cognitive revolution." It is impossible to adequately summarize this dense and interdisciplinary probe, but we can suggest what seem to be its central implications for information scientists.

Gardner's argument is complex, but essentially he insists that a revolutionary new "Cognitive Science" has been emerging in the United States since the early 1970's. While this new cognitive science