Star formation rates and the related topic of chemical evolution are discussed by B. F. Madore and B. E. J. Pagel, respectively. Both reviews end on a cautious note because of the uncertainty about many aspects of these topics.

Radio and x-radiation are common properties of peculiar galaxies, objects outside the scope of this conference. But many normal galaxies display such phenomena on a reduced scale. R. D. Ekers discusses the radio continuum emission from normal galaxies and A. C. Fabian the x-rays from these systems and from clusters of galaxies.

The usefulness of these proceedings is enhanced by two indexes, one general and one of individual objects. A brief glossary of some of the jargon and abbreviations common to this topic is also included.

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Cognitive Science

Perspectives on Cognitive Science. Papers from a meeting, La Jolla, Calif., Aug. 1979. DONALD A. NORMAN, Ed. Ablex, Norwood, N.J., and Erlbaum, Hillsdale, N.J., 1981. x, 304 pp. $19.95.

Scientific progress usually leads to fragmentation and to a proliferation of subsciences. It is a rare but important occasion, therefore, when events reverse that trend, when specialists discover unexpected bonds between their specialties and join together in a common enterprise.

Such are the claims for the young field of cognitive science, which promises to integrate those parts of psychology, computer science, linguistics, neuroscience, anthropology, and philosophy that are dedicated to understanding the phenomena of cognition. Obviously, a clear statement of the shared problems, goals, methods, and theories underlying this integration would be enormously valuable to all concerned, so in August 1979 in La Jolla, California, an attempt was made to provide it.

"It was to be the 'defining meeting,' the meeting where many of those concerned with the birth of Cognitive Science could record its origins, speak of its hopes, and chart its course" (p. v). So writes Donald Norman in his prefatory description of the plans that brought together 11 eminent cognitive scientists. This book is the result.

However, the book turns out to be not so much defining as illustrative. And although the editor claims that it provides ten perspectives on cognitive science, "each viewing a different set of topics, each presented in a different style" (p. vi), there are really only two: one view favoring information-processing theories of cognition, the other objecting to them. Not surprisingly, those who agree offer a more coherent perspective than do those who object.

This contrast of views might have been predicted from the list of participants. Five of the contributors work in the branch of computer science that has come to be called artificial intelligence (A.I.); the other five represent neurobiology, psychology, linguistics, philosophy—disciplines not noted for seeing eye-to-eye about anything.

The conference was opened by Herbert A. Simon, who commented, "I think that most of us today would prefer to define cognitive science as the domain of inquiry that seeks to understand intelligent systems and the nature of intelligence" (p. 14). Obviously, Simon sees no need to distinguish cognitive science from A.I. Simon's colleague, Allen Newell, explains how the core of intelligence is provided by symbol structures and their manipulation. "The great news," Newell says, is that we now know "how it is possible for mind to exist in this physical universe" (p. 84). Together, Simon and Newell summarize what might be called the standard theory of cognition at the present time—the theory that serves as the point of origin for a space of theoretical alternatives, the theory that provides a landmark relative to which other views can be located. Compared with the theories available 25 years ago, the standard theory is clearly an impressive advance.

Marvin Minsky, another founding father of A.I., is less concerned to define cognitive science than to present his latest ideas about the nature and function of memory. Roger Schank illustrates how he has used computer programming to help him understand the role of memory in understanding language. Terry Winograd describes the gradual evolution of his own understanding of what it means to say that a person or a computer understands language: "The importance of a paradigm may not lie so much in the answers it provides as in the questions it leads one to consider" (p. 261). All three struggle toward basic redefinitions of the standard view, but redefinitions that preserve the insights gained from the standard theory that cognition is information processing.

These are distinguished scientists, whose chapters offer fascinating insights into current thinking in A.I. The other contributors are equally distinguished, but far more diverse. Their contributions will be read with interest by colleagues in their own disciplines, but they do not add up to a coherent alternative to the standard theory. Either the authors describe their own on-going work or they accept the standard theory as the criterion of relevance and try to relate their remarks to that. The former strategy leads to heterogeneity, the latter invites misunderstanding or trivialization.

The reader is left wondering what cognitive science really is. Is it a new science, synthesizing from half a dozen different disciplines those parts concerned with mental phenomena? Or is it merely a new name for artificial intelligence? A branch of A.I., perhaps, on a par with robotics or automata theory? The rhetoric of this book suggests the former view; its contents suggests the latter.

Those who believe the rhetoric (and some do feel that A.I. is trying to kidnap cognitive science) will not be satisfied with the general picture that emerges from this book. Their attempts to revise that picture can be expected to stir up much of the intellectual excitement in this field in the next few years.

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Plastids

Chloroplasts. J. REINERT, Ed. Springer-Verlag, New York, 1980. xxi, 240 pp., illus. $46. Results and Problems in Cell Differentiation, vol. 10.

Plastids may be considered the fundamental organelles of the living world, since they contain apparatus essential for the trapping of light energy and its conversion to chemical energy. In higher plants chloroplasts may account for over 50 percent of the soluble protein of leaves and store starch as a major carbohydrate. Plastids are not confined to terrestrial plants but also occur in aquatic plants, where they have developed specialized pigments to trap light from spectra attenuated by passage through water. In other circumstances they have also adapted to their immediate environment to become starch storage organelles (amyloplasts), to develop pigments other than the chlorophylls that confer