The book is arranged in four sections. The first consists of a single paper by Allen Newell surveying the field of artificial intelligence from several points of view and trying to explain why anybody should do such work. Unfortunately the paper was written some years ago and does not cover the sort of work on language and the representation of knowledge and belief to which much of the volume is devoted.

The next two sections cover theories about the mental programs that determine how we interpret and react to language. The writers in the first of these sections (Schank, Simmons, Wilks, and Winograd) put their emphasis on sophisticated techniques for discovering and representing the literal meanings of utterances. Colby and Abelson, who follow, are content with a cruder linguistic analysis and are more concerned with what significance the utterance has for the hearer. Colby's model of paranoid behavior, for instance, is concerned primarily with detecting the degree of hostility in the remarks addressed to it, and can do this to some extent by simply noting references to certain topics, without always recognizing what is being said about them. Abelson's simulation of a right-wing political ideologue is primed with a "masterscript" for world events, representing the myths by which it lives, and it tries to relate everything it is asked or told to this script. The only events it believes possible are the kind that occur in the script—that is, the Free World might defend neutral nations, but will never attack them—and, given an event that matches the script, the program is willing to predict what will happen next and ascribe motives to the actors involved.

The other four authors are interested primarily in advertising the merits of various theoretical tools for studying language. Winograd advocates the representation of knowledge by procedures—he wants to view knowing as largely a matter of knowing how—while Wilks uses "paraplates," Simmons "semantic networks," and Schank "conceptual dependency," a scheme for building up complicated concepts out of simpler ones that is also used by Abelson later on. Only Winograd describes a program that is sufficiently impressive in itself to force us to take his ideas seriously. The techniques of the others have to get by on whatever intuitive appeal they can muster.

Winograd's program displays a scene, consisting of a collection of blocks, on a television screen. It moves the blocks about on command and answers questions both about the scene and about its own actions. It is capable of understanding a wide range of English constructions.

The final section of the book consists of three papers, by Earl Hunt, Robert K. Lindsay, and Joseph D. Becker, using computational terminology to discuss some of the properties of human memory. Hunt, for example, suggests that "man is describable as a dual processor, dual memory system with extensive input-output buffering within each system." These writers are more concerned than the others to have their models learn from experience, but there is no serious attempt to account for the learning of skills as complex as those discussed in the previous sections.

The editors say in the preface that the collection "has been compiled to present more extensive information than that already disseminated in journal descriptions of artificial intelligence." They do not entirely succeed in this awkwardly expressed aim because the papers are mostly condensed or reworked versions of material that has appeared elsewhere and the reader often finds himself referred to the original for details. The book does afford a glimpse of some of the big names in the field, and, with its extensive bibliography, it provides a useful entry into the maze of literature on artificial intelligence. The students for whom it is evidently intended may find $13.50 a bit steep for such a service, however, especially in a rapidly changing area.

Finally, there are a number of misprints (especially in Newell's paper) and there is some hideous prose. A supposed authority on language should not write sentences like "one basic assumption presented in this work is that since it is true that people can understand natural language, it should be possible to imitate the human understanding process on a computer, if it is possible to state those processes explicitly" (Schank, p. 187). It is sometimes difficult to guess whether a sentence has been garbled by the author or the typesetter, as with "a semantic network is a structure that contains meanings of language arranged in network" (Simmons, p. 77). In either case, the editors were asleep at the switch.

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Regulators of Water Intake

The Neuropsychology of Thirst. New Findings and Advances in Concepts. A conference, Philadelphia, Dec. 1971. ALAN N. EPSTEIN, HARRY R. KISSILEFF, and ELIOT STELLAR, Eds. Winston, Washington, D.C., 1973 (distributor, Halsted [Wiley], New York). xviii, 358 pp., illus. $17.50.

Textbooks of physiology have universally emphasized the kidney as the prime maintainer of body water, and thirst has received relatively little attention. Except in a few species such as some desert-adapted rodents, the kidney alone cannot maintain body fluids, however, and periodic water intake is necessary. This volume would serve a valuable function even if its only virtue were that it points up the importance of thirst and the precision of its regulation.

The first chapters are devoted to the internal stimuli and the receptors that activate thirst. These chapters (by Blass, Peck, and Stricker) make it clear that fluid intake is controlled by extracellular fluid changes as well as by the more familiar intracellular or cellular dehydration mechanism. In fact the role of the latter mechanism is now in question. Andersson, one of the original proponents of the cellular dehydration hypothesis, has now altered his position and argues, in a rebuttal to the chapters of Blass and Peck, that specific Na^+ receptors are more important in thirst than are dehydration receptors. Notwithstanding this controversy, these chapters make clear that much progress has been made since the time the cellular dehydration hypothesis, let alone the "dry mouth" hypothesis, was considered a complete explanation of thirst.

The papers on central neural mechanisms in thirst are perhaps the least satisfying ones of the book, not because they are of lower quality but because they appear to be more concerned with the validity of central electrical stimulation as a research tool than with thirst directly. Mogenson's chapter is the one most concerned with thirst, yet it still directs much attention to the methodological problems of brain stimulation. Teitelbaum and Valenstein's chapters are concerned almost exclusively with methodological questions. For someone using this book to illustrate problems in physiological and behavioral research, however, this section might be the most useful of all.

Although thirst seems preeminently the result of a homeostatic system, it is well to note that nonhomeostatic controls are also of importance in any scheme that would attempt to explain water intake. This is suggested in Peck's article and dealt with more fully in chapters by Kissileff and Falk, who show the importance of considering such processes as prandial and schedule-induced drinking for a full understanding of water intake. In addition, Oatley, using computer simulation to develop a formal theory of thirst, further downgrades homeostatic mechanisms to the status of an emergency system. He hypothesizes that anticipatory mechanisms operating in a feed-forward mode to prevent deficits may be more important in day-to-day regulation than homeostatic mechanisms that repair deficits. It is evident from the chapters by Fisher, Harvey, Lehr, Setler, and Smith that the neurochemistry of thirst is in the greatest state of flux. In the '60's it seemed as if cholinergic mechanisms alone were basic to thirst. That early promise, however, has not been fulfilled. We now know that there are "thirsts" rather than a single thirst, and it also seems clear that it is "highly unlikely that any of the major components of thirst utilize or are entirely dependent upon a single transmitter substance" (Fisher, p. 260).

It is hard not to like a book that shows a sense of history, manifesting a feeling for progress while not overlooking the controversies that remain. This is a model of what a conference report should be. Most of the authors look beyond their latest results to the implications of their work. The book is nicely rounded out by a historical chapter by Fitzsimons showing the contributions of different approaches to this important problem. Epstein's chapter ends the book showing how far we have come and outlining the remaining problems, particularly those having to do with the role of angiotensin in thirst induction.

This book suggests that we are not at the "beginning of the end" of thirst research but more nearly at the "end of the beginning," in that the major control mechanisms appear to have been identified, many of the remaining problems, even if they engender controversy, are at least known, and efforts to deal with them have begun. This is not a book for the beginning student since, like most conference reports, it assumes much knowledge of its subjects. But the volume shows so clearly both the power and the limitations of a homeostatic approach that no serious student of physiological and behavioral control systems should miss it.

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Plasma Turbulence

Plasma Astrophysics. S. A. KAPLAN and V. N. TSYTOVICH. Translated from the Russian by D. ter Haar. Pergamon, New York, 1974. xiv, 302 pp., illus. $28.50. International Series of Monographs in Natural Philosophy, vol. 59.

The term "plasma astrophysics" has been used at least since 1966 to describe the fertile area in which plasma physics finds application to astrophysics. What one might now regard as the first book on the subject, Alfvén's *Cosmical Electrodynamics*, published in 1950, had a less definitive but more colorful title. In writing a treatise on plasma astrophysics, the author or authors face formidable problems. It is necessary to present the principal concepts and processes of plasma physics; to summarize the observational data for the principal astrophysical phenomena that are believed to involve plasma processes; and to present and evaluate models of the phenomena.

The authors of the present book are well qualified for this undertaking. Kaplan is an astrophysicist with special interests in radio astronomy, and Tsytovich is a plasma physicist who has made fundamental contributions to the theory of nonlinear processes and turbulence in plasmas with application to astrophysical phenomena.

The whole book is in fact based on the theory of plasma turbulence as it has been developed by Tsytovich and his colleagues. Their approach is to use quantum-mechanical concepts and notation even though all calculations are non-quantum-mechanical. This is a powerful and economical method for obtaining formulas for relevant plasma processes, although the formulas can of course be derived by other methods. Detailed and exact derivations of formulas for nonlinear processes are not given in this book; some simplified and approximate derivations are given, but the reader is referred to journal articles for exact treatments. This could be discouraging to a reader who wishes to master the physics of plasma turbulence, which constitutes chapter 1, but it is a reasonable procedure for the authors to adopt in order to cut the plasma physics down to size.

A more serious criticism is that plasma turbulence is only one branch of plasma physics, although it may be an important branch, especially in astrophysics. By ignoring macroscopic phenomena and phenomena depending upon gradients and inhomogeneities, the authors omit orbit theory, most transport coefficients, macroscopic instabilities such as the Rayleigh-Taylor instability, force-free fields, and particle acceleration (other than stochastic acceleration). As a consequence of this bias, subsequent discussion of astrophysical phenomena is somewhat limited.

Chapter 2, concerned with sporadic radio emission of the sun, gives a thorough and valuable account of data and theory on this topic, but there is only a brief reference to the nature of flares, which are responsible for most types of solar radio emission. Similarly, in discussing type II radio bursts, the authors give an excellent treatment of acceleration in shock fronts and the generation of electromagnetic waves by stream-induced plasma oscillations, but make no mention of the processes by which shock waves might be produced.

The same strengths and weaknesses show up in the remaining two chapters. In chapter 3, concerned with galactic nuclei, radio galaxies, and quasars, there is a thorough discussion of various processes for generation of radio waves by relativistic particles, yet there is no discussion of possible explosion mechanisms that give rise to double radio clouds or of the structure of these clouds. Similarly one finds in chapter 4, concerned with pulsars, a valuable treatment of possible plasma radiation processes involving relativistic particles and very strong magnetic fields but no discussion of the problem of conversion of rotational energy of the neutron star into the energy of relativistic particle streams.

The net result seems to be that the book carries the wrong title. If it were called, for instance, "Plasma Turbulence and Its Role in Astrophysics," one could understand the selection of material and applaud the skill and insight with which the theory of plasma turbulence is brought to bear upon current astro-