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-

physical problems. Since the theory of plasma turbulence is one of the most important aspects of plasma physics from an astrophysical point of view, anyone concerned with plasma astrophysics will profit greatly by studying this book.

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Photopolarimetry

Planets, Stars and Nebulae Studied with Photopolarimetry. T. GEHRELS, Ed. University of Arizona Press, Tucson, 1974. xvi, 1134 pp., illus. $27.50.

Polarization (linear and circular) is the most recent and perhaps the last of the properties of light to be utilized to gain information about stars and planets. This book heralds the maturity of the use of polarization in the remote sensing of astronomical objects.

To produce this book a colloquium was held. About a dozen reviewers were invited long in advance to produce papers treating major topics and dealing in a logical manner with the many complexities of the subject. Guidelines for the terminology, symbols, and conventions to be used were established beforehand in the hope that the book would become a cohesive whole without the confusion of terms and the redundancy that obtain in most symposium volumes. After the colloquium the papers were rewritten and edited for publication.

Appreciating that the astronomer's development of photopolarization methods would be interesting to scientists outside of astronomy and would be of special interest to environmentalists, the editor has included papers on polarization in ocean water, the general environment, and the turbid atmosphere of Los Angeles. There is also a paper on the nature of polarimeters in animals.

As an astronomer who does not practice the art of making polarimetric measurements or designing polarimeters, I found the article by K. Serkowski especially interesting. He gives directions for producing accurate polarimetric measurements for those who are not already experts in the field. Many early results and interpretations of polarimetric observations were spurious, often because of systematic errors. Five or ten years ago, in my own field of planetary physics, I tended to discount any conclusion based upon polarization measurements. The book reveals that the situation has changed. In recent years the precision of polarimetric measurements has increased from a part in a few hundred to a part in a few thousand, and in some cases to parts per million, as the result of close attention to sources of errors.

As for the editor's attempt to make the volume a "cohesive whole," the reviewer feels that it was only partly successful. For example, a number of authors independently introduce the Stokes parameters and their transformation through Mueller matrices, and in each case a different notation is used.

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Sea Borders

The Ocean Basins and Margins. ALAN E. M. NAIRN and FRANCIS G. STEHLI, Eds. Vol. 1, The South Atlantic. xvi, 584 pp., illus. + maps. $38. Vol. 2, The North Atlantic, xiv, 598 pp., illus. $38. Plenum, New York, 1973–74.

The vast amount of information that has been gathered along the continental margins and in the ocean basins of the world during the last decade has contributed mightily to the revolution that has taken place in the earth sciences, and it is of great value to have it summarized in a single set of volumes. The editors of *The Ocean Basins and Margins* have assembled a group of contributors who are eminently (often uniquely) qualified to provide such a summary.

Volume 1 deals with the South Atlantic region from the Scotia Arc to the equatorial region. An introduction by the editors sums up the geological and geophysical data relevant to the history of the South Atlantic and provides a good background for the more detailed treatments that follow. These are excellent papers, but the collection is not what the title of the work would lead one to expect. Bigarella provides an excellent description of the Amazon and Parnaiba basins of Brazil, but these are primarily internal to the South American craton. The marginal basins are discussed by Asmus and Ponte. Both the internal and the marginal basins of Argentina are treated by Urien and Zambrano. Dalziel and Elliot present a long discussion of the Scotia Arc and Antarctic margin that provides a summary of the geophysical data together with a detailed treatment of the geological structure and development of the region. Rust provides a discussion of the Paleozoic evolution of South Africa. Martin similarly summarizes the geology of the west side of Africa from the Cape of Good Hope to 17° south latitude. Franks and Nairn deal with the marginal basins of equatorial West Africa and Machens with those of the Gulf of Guinea.

These papers treat the Cambrian and later geology of the South Atlantic region with some style, but they discuss to only a limited extent the transition from continent to ocean and they hardly deal with the ocean basin at all. They are followed by excellent treatments of the Precambrian chronology of lands bordering the South Atlantic by Hurley and Rand, discussions of the Precambrian chronology of the South American craton by Almeida *et al.*, and a discussion of late Precambrian-early Paleozoic events in West Africa by Grant. The geology of South Atlantic islands is covered by Baker and the history of the opening of the South Atlantic by Ladd *et al.*

The second volume, dealing with the North Atlantic, shows some improvement in focus. It includes articles by Keen on the continental margin of eastern North America, concentrating heavily on the Canadian margin and neglecting many of the recent data obtained off the eastern United States; by Noltimier on the geophysics of the North Atlantic basin, unfortunately underillustrated; by Owen on the western approaches; by Vigneaux on the Bay of Biscay; and by Stehli on the Blake-Bahama region. The late Precambrian and Paleozoic geology surrounding the North Atlantic is summarized by Williams *et al.*, Birkelund *et al.*, Dewey, and Nicholson for the Appalachian-Caldonide region, including Scandinavia and Greenland, and an excellent paper by Dillon and Sougy on West Africa and the Canary and Cape Verde islands supplements the paper by Grant in volume 1. Noë-Nygaard provides a first-rate summary of the volcanism in the far North Atlantic, Ridley *et al.* cover the Azores, and Fitch and colleagues provide an excellent summary of radiometric ages and their significance in the North Atlantic region.