rather than in terms of the syntactic properties of codes and messages, may be convenient now but are likely to be provisional.

Chapter 4 deals with species identification in aggregational systems (cellular, sessile, mobile, social, and interspecific) and dispersal systems (ritualized fighting, aggressive displays, and territorial behavior). Chapter 5 is devoted to social cooperation, involving such items of information as alarm signals (subclassified here as indicators of departure, distress, warning, and the like) and food signals; it also contains a summary of what is known about the chemical guidance system of ants and the dances of the honeybee, but there is no mention of information transmission in the honeybee by means of sound, certain uses of which have been amply demonstrated by H. Esch and by A. M. Wenner.

In chapter 6, the authors take up, channel-by-channel, signals involved in sexual attraction and recognition, remarking somewhat enigmatically that, "In these processes, communication reaches its highest development." In the next two chapters, they briefly consider signals to further courtship and mating in such taxa as annelids, molluscs, crabs, scorpions, insects, and several vertebrates, and in a lengthier excursus, displays used by spiders; then they take up some of the ways in which parent-young relationships entail communication.

Under the heading "Sources of error in animal communication," the authors discuss the development of dialects and of cross-reactivity, by which they mean the development of reactions by a receiver to signals other than those appropriate to the species for the temporal and spatial context in which they are observed. These are fascinating topics that yield different results depending on whether the problem of efficiency is approached from the point of view of the encoder's or the decoder's ensemble. In the human situation, for example, an individual is often capable of decoding more than one dialect of a language, but his capacity to encode is more likely to be limited to just one.

A sketchy outline of evolutionary theory leads to pertinent observations about the evolution of communication and reassertion of the ethological hypothesis that "communication signals usually originate as modified intention movements." The authors' intimations concerning the differences between human and animal communication underline the urgent need for a fresh approach, cutting across established academic disciplines, to the meaningful problems of zoosemiotics.

The value of this splendid little book is enhanced by nine pages of selected references, an index table of animal groups and systems of communication classified by function, and an index of subjects and names. There are also 24 illustrations, mostly line drawings.

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Plasma Physics

Plasma Kinetic Theory. D. C. Montgomery and D. A. Tidman. McGraw-Hill, New York, 1964. xii + 293 pp. Illus. $11.50.

This monograph is intended for the serious student or researcher in plasma physics and will serve as an excellent introduction to the subject for the student who is well grounded in the classical kinetic theory of neutral particles and the basic mathematics of theoretical physics. The authors do not pretend to discuss every topic that could conceivably be included under the title, but instead expend their energies and pages trying to give the reader a deeper understanding of some of the most widely discussed (and often, therefore, the most widely misunderstood) problems in the field. They make a great effort to point out which parts of the treatments must be taken as assumptions; then they try to give the reader a feeling for which assumptions are reasonable and which are made out of mathematical necessity rather than on the basis of well-founded physical facts. The authors apologize for their lack of emphasis on experiments, but continually demonstrate their awareness of the "unfortunate separation" between the theories of highly idealized models and experiments on extremely complicated natural or laboratory systems. Whenever they can, they point out paths that may eventually provide links between the two.

The book is arranged in three parts. In the first the authors discuss the aims and limitations of classical kinetic theory, beginning with an heuristic derivation of the Boltzmann equation, description of attempts to apply it to plasmas, and discussion of the Fokker-Planck equation. The BBGKY approach to kinetic theory and discussion of the Vlasov equation, the adiabatic assumption, the Balescu-Lenard equation, and statistical fluctuations in plasmas are presented in part 2. In part 3 the authors apply the formalisms to some wave and nonlinear phenomena, discuss attempts at fluid dynamic descriptions of plasmas, and treat certain radiation and electromagnetic wave scattering problems. The final chapter is reserved for comments on three experiments that the authors feel offer promise of bridging the "unfortunate separation"—the positive ion electrostatic oscillation experiments, the observations of incoherent backscatter from the ionosphere, and the computer "experiments" with simplified models of plasmas.

In my opinion, the book will prove quite useful to the student and to the researcher, both of whom should be much concerned with understanding the present state of plasma kinetic theory, particularly its limitations and weaknesses, and its relation to experiments.

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Chemical Engineering

Advances in Heat Transfer. vol. 1. Thomas F. Irvine, Jr., and James P. Harnett, Eds. Academic Press, New York, 1964. xi + 459 pp. Illus. $16.

The editors of this compilation of reviews of the current literature in six areas of heat transfer research have, for the most part, selected interesting and timely topics that should be of interest to those working in related areas as well as to the heat transfer specialist.

The sections on thermal radiation and electric and magnetic effects on heat transfer to electrically conducting fluids are novel and well done, while Luikov's review of heat and mass transfer in capillary porous bodies brings a large amount of Russian work to the attention of the English-speaking

researcher. Unfortunately the section is restricted to the Russian literature, and little reference is made to other research in the field.

The specialist in fluid mechanics will already be familiar with the integral methods reviewed by Goodman, but Goodman's analysis of the developments and application of this mathematical technique to heat transfer problems may stimulate further improvements and refinements in the method.

There is some doubt that our knowledge with respect to boiling and two-phase flow has reached the definitive state that justifies the continual rehashing of these fields in books of this type, but any attempt to unify and organize their literature must be applauded. Although a large amount of the literature referred to in the section on boiling has been considered in previous reviews, much updating has been done here. The article, however, reflects the chaotic condition of the literature in the field.

Similar difficulties arise in organizing the literature on two-phase flow, but here the book tends to supplement previous reviews by emphasizing the extensive work performed in various European laboratories, especially those of the atomic energy authorities. The list of references included is particularly thorough.

The book should be useful to anyone engaged in heat transfer research. It is hoped that an equally excellent choice of contributors will be made for any future volumes.

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Geophysics

Paleomagnetism and Its Application to Geological and Geophysical Problems. E. Irving. Wiley, New York, 1964. xviii + 399 pp. Illus. $19.50.

This volume, as the first textbook in English devoted to paleomagnetism, represents an important milestone in the development of a new and rapidly growing field of geophysics. Despite the diversity of its origins, modern paleomagnetism bears the unmistakable imprint of a handful of men who worked in England during the early 1950's, in particular Blackett, Clegg, Hospers, Fisher, Runcorn, Creer, and Irving. The statistical and graphical methods for presenting paleomagnetic results developed by this group are now used universally, and the present reawakening of interest in the perennial geophysical problems of polar wandering and continental drift derives largely from their work. Irving may speak not only as one who has been a leader in framing these larger problems, but also with the authority of an experimentalist who, with his work in Australia, has produced a virtually unequalled body of paleomagnetic data.

One question has often been posed: Is the paleomagnetic evidence for polar wandering and continental drift really conclusive? Many geophysicists remain unconvinced, partly because of the increasing complexity and growing numbers of degrees of freedom of the geophysical models needed to explain all of the paleomagnetic observations in terms of polar wandering and continental drift. The present volume avoids the rhetoric of advocacy but, nonetheless, is a book with the central viewpoint that continental drift and polar wandering are supported paleomagnetically. Discrepant data are attributed to inadequate technique or to intracontinental deformation.

The subjects discussed include magnetic properties of rocks, secular variation, analysis of directions of magnetization, reliability, ancient directions of the field, reversals, intensity determinations, paleolatitudes, and special applications to geology. There is no discussion of apparatus or of methods of calculating magnetic directions. Many subjects are covered by reference to some particular study from the literature which is summarized in clear, concise language with abundant illustrations. The chapter on statistical analysis is outstanding. However, the list of articles covered is large and not especially selective, and the general result, while preserving a good feeling for the original experimental evidence, resembles an extended review article without the fresh, integrated approach that one might expect in a new text.

The author has rendered a great service by compiling paleomagnetic results current to October 1963. He has taken a courageous and an admirable step by indicating results that fail to satisfy reasonable "minimum reliability criteria." There are the inevitable misprints—the description of the study of the Hawaiian lavas, for example, states that directions of remanent magnetization changed significantly on partial demagnetization, whereas the original reference states they did not. But such lapses are rare and perhaps may serve as a reminder that the list is intended as a guide and not as a substitute for consulting original sources.

The most original part of the volume is an extended comparison of ancient paleomagnetic latitudes with various independent indicators of climatic conditions. Sets of observations are found to be consistent only when both the paleomagnetic and the independent paleoclimatic results are based on deposits of the same age from the same area. The occurrence of both polar wandering and continental drift are inferred from this. Compelling evidence for polar wandering is given by the demonstration that in Australia, as the paleomagnetically determined latitude abruptly increased by more than 50° between the Devonian and the Carboniferous Periods, coral reefs disappeared from Australia and glaciations began. No one seriously interested in the problem of polar wandering and continental drift can afford to be unfamiliar with this work.

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Particle Physics

Nucleon Structure. Proceedings of the international conference held in June 1963. Robert Hofstadter and Leonard I. Schiff, Eds. Stanford University Press, Stanford, Calif., 1964. x + 421 pp. Illus. $12.50.

The word nucleon in the book title refers collectively to the particles proton and neutron. Thirty years ago these entities, together with the electron, constituted the full list of the ultimate building blocks of matter. That list has since grown, prodigiously! According to some ways of counting, the known varieties of "elementary" particles now number more than 100. They transform into each other in endless ways—in collision processes and in spontaneous disintegrations of one particle into others. Indeed, the word particle has come to