has been proposed. There should be vigorous discussion. Many arguments that are merely sketched should be made rigorous. Whatever the fate of individual points, I can only agree with Waddington, who writes in his introduction to the book: "Whether he is justified or not [in certain specific applications of his method] makes little difference to the basic importance of this book, which is the introduction, in a massive and thorough way, of topological thinking as a framework for theoretical biology [and other subjects]. As this branch of science gathers momentum, it will never in the future be able to neglect the topological approach, of which Thom has been the first significant advocate."

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Condensed Matter

Introduction to the Theory of Liquid Metals. T. E. FABER. Cambridge University Press, New York, 1972. xiv, 588 pp., illus. $37.50. Cambridge Monographs on Physics.

Liquid Metals. Chemistry and Physics. SYLVAN Z. BEER, Ed. Dekker, New York, 1972. x, 732 pp., illus. $35. Monographs and Textbooks in Material Sciences, vol. 4.

It cannot be a simple enterprise to write a text on liquid metals. Dense liquids fall within the confines of the condensed state of matter, and the foundations of the theory of these complex systems cannot, as yet, be regarded as part of the entrenched dogma of condensed-matter physics. Metals (or at any rate free-electron-like metals) are, in their regular solid forms, perhaps one of the better understood classes of matter, but this is certainly to a large extent a direct consequence of crystallinity.

Faber's text attempts to come to grips with the problem of expounding the nature of dense conducting fluids and their propinquity to both liquids and metals. Given the imposition of some rather stringent boundary conditions his effort is, on the whole, successful. The structure of the book is close to what one might expect: a lengthy introductory section on the electron theory of simple metals, two chapters dealing with the structural and dynamical aspects of simple liquids, a chapter devoted to the nature and manifestation of electron levels in disordered systems followed by one on the transport properties of liquid metals, and finally a discussion of the properties of alloys including more bizarre systems of which the mercury amalgams and liquid semiconductors are endemic.

The subject matter is exhaustively researched and the style is lucid, occasionally sardonic, and with a tincture of skepticism that eases one gently through the more jejune but unavoidable aspects of the lore of liquids. It is therefore regrettable that from the standpoint of the student (and, one might observe, his teacher) the price is prohibitive.

Many of the topics touched on in Faber's text are dealt with in much greater detail in the review papers included in the volume edited by Beer. In addition to extensive articles on both electron and mass transport, structure and dynamics, and equilibrium and nonequilibrium properties, there is contained in the book a considerable body of information of a more chemical and thermodynamic nature. Occasionally one has the impression that approaches which are successful in classifying the experimental information from insulating fluids (and their mixtures) will, *mutatis mutandis*, automatically apply in metallic systems. In this respect the importance of the interacting-electron gas on the gross properties of conducting fluids is more clearly exposed in Faber's text, and indeed many of the claims made by the contributors to Beer's volume can be found with acerbic and illuminating critiques in Faber's concordance.

As a compendium of papers on the nebulous forefront of research in liquid metals and alloys, Beer's book will have a certain value as a reference text. Unevenness of style is difficult to avoid with some 20 or so authors, but there is also a more troublesome variation in quality with which to contend.

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Paleogeophysics

Palaeomagnetism and Plate Tectonics. M. W. MCELHINNY. Cambridge University Press, New York, 1973. x, 358 pp., illus. $27.50. Cambridge Earth Science Series.

The measurement of the permanent or "fossil" magnetism of rocks in order to study the earth's magnetic field in the past is one of the few examples, and certainly the most significant example, of paleogeophysics. Not surprisingly, therefore, it is this branch of geophysics which has contributed most to geology. In particular it formed the basis of the so-called "revolution in earth sciences" within the past decade—a revolution not only in our understanding of the earth but also in that it has brought together the formerly rather disparate disciplines of geology and geophysics. The field itself provides an interesting blend of both geology and physics (as reflected in this text) which attracts students and experts alike.

In view of how much this subject has contributed to the earth sciences, within a comparatively short life-span of little more than 20 years, there are remarkably few texts which cover it adequately. Only one other has attempted to be as comprehensive as McElhinny's, that by Irving (*Paleomagnetism and Its Application to Geological and Geophysical Problems*, Wiley) published in 1964. Both books are classic and definitive texts, but needless to say Irving's has dated considerably as a result of developments relating to reversals of the earth's magnetic field, sea-floor spreading, and plate tectonics and of the acquisition of a great number of, typically higher-quality, paleomagnetic data. In many ways the title of Irving's book would be equally or more appropriate for this one, which is primarily a text on paleomagnetism rather than plate tectonics.

After outlining the nature of the earth's magnetic field and the assumptions and potential of paleomagnetism the author provides further background material in chapters on the basic principles and theory of rock magnetism and the procedures and techniques for the collection and measurement of samples and the analysis of results. This section ends with a particularly useful and detailed consideration of field and laboratory tests for the stability of remanent magnetization and a listing of minimum criteria for the reliability and hence acceptability of paleomagnetic results. Subsequently a chapter is de-

voted to a review, in terms of apparent polar-wander curves for different continental areas, of all data, available to the end of 1970, which meet these criteria. The data are also tabulated, area by area, in a 28-page appendix, giving the book added value as a work of reference. The remaining third of the book is devoted to a discussion of various aspects of reversals, sea-floor spreading, and plate tectonics, with particular attention paid to the paleomagnetic evidence for sea-floor spreading derived from oceanic magnetic anomalies and the geomagnetic-reversal time scale, and attempts to deduce past plate motions and continental configurations from paleomagnetic pole positions.

In summary, this book goes beyond the requirements, and presumably the pockets, of undergraduates, but as a comprehensive and authoritative treatise on paleomagnetism it will be invaluable to graduate students and research workers. In his preface the author expresses the hope that this book will form "a basis for an extended lecture course in paleomagnetism, and . . . an up-to-date review . . . of the subject." I can only say that to my mind he has succeeded admirably.

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Studies of Biomembranes

Perspectives in Membrane Biophysics. A Tribute to Kenneth S. Cole. D. P. AGIN, Ed. Gordon and Breach, New York, 1972. viii, 318 pp., illus. $18.50.

K. S. Cole is a father of membrane biophysics and so it is fitting that a book be published in tribute to him. It is unfortunate that the tribute to a man who has made so many incisive contributions should be a collection of papers with little attempt at editorial perspective or synthesis, but I am afraid that is the nature of the book. While the information in the papers is quite valuable, it has for the most part already appeared in print elsewhere, and so the intellectual justification for publication is not clear.

Specific comment should be made about Narahashi's paper on the pharmacology of axonal and end plate membranes, which shows again the close interaction of biophysics, physiology, and pharmacology. No sooner is a new biophysical technique developed to answer physiological questions than it is applied to study the action of interesting drugs. Narahashi's work suggests that future experiments on the detailed pharmacology of axons will routinely use voltage clamp methods.

T. L. Hill's speculative discussion of possible mechanisms for the movement of ions across nerve membranes is noteworthy because it uses the Hodgkin-Huxley analysis "as a starting point for a molecular theory [since] it is a little hard to believe that [their analysis] is entirely empirical and completely divorced from molecular realities." It is nice to hear these words after so many years in which the work of Hodgkin and Huxley has been ignored or misunderstood in much theoretical analysis. It would be particularly helpful now if theoretical models were based on mechanisms observed in model experiments on bilayers treated with "ionophores" and if the models were used to make predictions of phenomena, which could be checked experimentally. In this way theoretical studies would leave the realm of speculation and enter the mainstream of research on the mechanism of the action potential.

The contribution of Adrian, Chandler, and Hodgkin has not been published elsewhere and is helpful because it extends and rederives Cole's theorem, a most useful result for determining the electrical properties of a small patch of isolated (perhaps nonlinear) membrane from the properties of a long cylinder of the membrane. Some readers will wish that the authors had explicitly stated the requirement that $\partial i_m/\partial x = 0$ (at constant membrane potential V; i_m is the membrane current, x the longitudinal coordinate). A discussion of the manner in which i_m can still depend on x (indirectly through the dependence of V on x) might also have been helpful in removing some of the confusion concerning the derivation and domain of validity of Cole's theorem. The derivation presented is nonetheless most powerful and useful, permitting insight into a number of stability problems and allowing generalization to certain time-dependent situations. It is unfortunate that the stability problems of the voltage clamp and the action potential itself have not received more attention from applied mathematicians, for inclusion of the time dependence of the system seems to pose a lovely problem in stability theory, perhaps amenable to treatment by singular perturbation theory.

A future area of growth for membrane biophysics is described by Keynes, who points out that because of the quality and thoroughness of Cole's work "capacity has become the most neglected property of nerve." Measurements of capacitance can now be made with great accuracy, and it may be possible to make such measurements dynamically during the time course of interesting biological phenomena such as the generation of action potential. In this way changes in membrane structure may be studied.

The book unfortunately does not include any contribution from P. Fatt, who, with his wife, G. Falk, has developed Cole's impedance measuring techniques into a method to determine the pathways by which current flows across cells, the pathways which make up the equivalent circuit of cells. This method of analysis has provided quite detailed information concerning the electrical ultrastructure of muscle fibers and may prove helpful in analyzing the electrical properties of other, more complicated, cells and tissues.

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New Journals Received

Cultural Hermeneutics. Vol. 1, No. 1, Apr. 1973. Four issues a year. Editor: David M. Rasmussen (Boston College, Chestnut Hill, Mass.). D. Reidel Publishing Co., P.O. Box 17, Dordrecht, Holland. $26.78.

Journal of Raman Spectroscopy. Vol. 1, No. 1, Apr. 1973. One volume a year. Editors: D. A. Long (University of Bradford, Yorkshire, England) and H. J. Bernstein (National Research Council of Canada, Ottawa). D. Reidel Publishing Co., P.O. Box 17, Dordrecht, Holland. $67.83.

Pediatric Radiology. Vol. 1, No. 1, Mar. 1973. Four issues per volume. Springer-Verlag, 175 Fifth Ave., New York, N.Y. 10010. $42.15.

Progress in Neurobiology. Vol. 1, Part 1, May 1973. Editors: G. A. Kerkut (University of Southampton, Highfield, England) and J. W. Phillis (University of Manitoba, Winnipeg, Canada). Pergamon Press, Fairview Park, Elmsford, N.Y. 10523. Vol. 1, Part 1, $6.

Social Change. Vol. 1, No. 1, May 1973. Four issues per volume. Editors: Victor Gioscia (Center for the Study of Social Change, New York) and Philip Slater (Greenhouse, Boston). Gordon and Breach, One Park Ave., New York, N.Y. 10016. Vol. 1 to libraries, $24; to individuals $12; to students, $6.