kelp-strewn beaches, the interminable rain, fog, and mystery.

Though Steller was to spend only 10 hours on the Alaska mainland, he discovered a host of new plants and animals. Linnaeus called him a born collector "who has earned great and precious glory." He is remembered best for Steller's jay and the extinct Steller's sea cow (the giant northern manatee), but many other animals bear his name —the legendary white raven, the eagle, the greenling rock trout, the eider, and the sea monkey (which no one else has seen). Places along the route of travel also commemorate him—Steller's Hill, Steller's Mountain, and Steller's Arch. Following Bering's expedition with its news of sea otters, seals, and other treasures, a wild stampede occurred far greater than the Klondike Gold Rush, and so began a carnage that brought not only animal species but even the native people almost to extinction.

"This is," as Frank Defresne says in his foreword, "more than a thrilling adventure story. It is a vivid word picture of Alaska's pioneer naturalist and what he observed. It is a solid contribution to American natural history as well as an important restoration of our nation's neglected past." Scientists and historians should not overlook this book. Those who love Alaska and the Aleutians will treasure it.

SIGURD F. OLSON

Ely, Minnesota

Magnetofluidmechanics

The Electromagnetodynamics of Fluids. W. F. HUGHES and F. J. YOUNG. Wiley, New York, 1966. 662 pp., illus. $17.50.

In the last decade magnetohydrodynamics and plasma physics have emerged to form an important branch of science. *The Electromagnetodynamics of Fluids* is a text for a graduate course or for the professional engineer who wishes to acquaint himself with the continuum or fluid aspects of this field.

After reviewing the principles of special relativity, the authors treat the electrodynamics of moving media and work several examples in detail to illustrate how to apply the principles. The electromagnetic body force in a fluid medium is introduced and the electromagnetic stress tensor formulated. After showing how the fluid equations of hydrodynamics are modified by electromagnetic effects, Hughes and Young discuss the assumptions which are made in reducing to the usual magnetohydrodynamic approximation. This material, which comprises a fourth of the book, provides a good treatment of the basic principles of magnetofluidmechanics. The remainder of the book consists of applications to viscous magnetohydrodynamic flow, both steady and transient or alternating, plane waves in unbounded and bounded fluids, discontinuities and shocks, and magnetoaerodynamics. Many excellent problems are presented.

The book's coverage seems somewhat uneven. In some areas considerable detail is presented. Expansion would be desirable in other places, such as the discussions of discontinuities and shock waves. In many places the authors repeat themselves unnecessarily. Equations are often written several times with only minor changes or in component form. Obvious vector identities could have been eliminated. With only a modest amount of effort the book could have been shortened considerably without sacrificing clarity. There are too many typographic errors for so expensive a book.

JOHN L. JOHNSON

Westinghouse Research Laboratories and Plasma Physics Laboratory, Princeton University, Princeton, New Jersey

Quantum Theory and Mathematics

Theory of Groups in Classical and Quantum Physics. Vol. 1, Mathematical Structures and the Foundations of Quantum Theory. THÉO KAHAN. Translated from the French edition (Paris, 1960) by H. Ingram. A. R. Edmonds, Translation Ed. Elsevier, New York, 1966. 590 pp., illus. $37.50.

Investigations of the structure of fundamental particles have demonstrated, more convincingly than before, that the theory of group representations is a powerful tool in the study of quantum systems [see, for example, *Science* **152**, 1048 (1966)]. The theory has been found to be indispensable for describing intricate symmetries and the so-called "quantum numbers" that characterize various states of a quantum mechanical system. Such a group-theoretical description could be termed "global," for the internal properties of the system may not be known in detail. More recently, the theory of group representations is being used in an elegant manner to provide us with a complete dynamical framework for quantum theory. The present state of research in theoretical physics indicates that some modern algebraic theories—noncompact groups, general associative algebras, and so on —that until recently were thought to be too abstract to be useful in physics will play an essential role in the developments of the near future. It is remarkable that since the beginning of theoretical physics every major new step had its own distinct mathematical discipline from which it is inseparable, as though each new level of natural philosophy requires a new language. From the infinitesimal calculus and ordinary differential equations in Newtonian mechanics, to partial differential equations in Maxwellian field theory, to linear algebra and operators in Hilbert space in the quantum mechanics of Heisenberg and Dirac, to the theory of functions of complex variables in *S*-matrix theory, the mathematics has been not merely a tool but fundamentally interwoven with the physical concepts. One then rightly wonders about the relationship of mathematical invention and physical theory and asks whether we are perhaps coming closer to the idea of Plato that the ultimate of matter is nothing but geometric forms.

The book reviewed here, which was written by Kahan in collaboration with P. Cavaillès, R. Gouvarné, T. D. Newton, G. Rideau, G. Lochak, and R. Nataf, is perhaps the most extensive book in the field. It is repetitious and lacks unity and coherence, but these faults may be an advantage for those who have time to go through the book, in that they will be able to study the same things described from different points of view. Thus, in Part 1, Theory of Groups and Axiomatized Mathematics for the Use of Physicists, and Part 3, Theory of Abstract Groups, the mathematical concepts are discussed in detail from the physicist's and the mathematician's point of view, respectively. Part 2, by Newton, deals with the important inhomogeneous

Lorentz group and its representations. Parts 4 and 5, written by Rideau, cover representation theory of finite groups and of permutation group. Finally, Part 6 is an exposition and development of quantum theory—no group theory is involved here—followed, in Part 7, by a complete discussion, by Nataf, of the rotation group and its representations.

The second volume, in preparation, will be devoted to applications in classical physics, in the quantum theory of atoms and molecules, solid state physics, nuclear physics, nuclear reactions, and elementary particles.

A. O. BARUT
Department of Physics,
University of Colorado, Boulder

Metal Hydrides

Hydrogen Compounds of the Metallic Elements. K. M. MACKAY. Spon, London; Barnes and Noble, New York, 1966. 192 pp., illus. $10.

This generally excellent book achieves its goal of providing an introduction to the subject of metal hydrides suitable for seniors and graduate students. A book of less than 200 pages normally provides little more than an introduction; nevertheless, the extensive tables of physical properties of the hydrides which this one contains extend its value significantly beyond that of an introductory text.

The author is to be commended for his balanced view of current theories. His discussion of theories of bonding in transition-metal hydrides is particularly good; he takes the experimentalist's point of view and is not overly impressed with the powers of theory. Even his discussion of the much-overworked theory of $p\pi$—$d\pi$ bonding in silicon hydrides and derivatives is restrained. This is a very good policy, for often books written at this level leave the student with the impression that theory not only explains all but predicts all.

Many students will need help in understanding parts of Mackay's presentation. A few words of explanation of the van Arkel iodine process and the Kroll process, for example, would have been extremely helpful. Moreover, the presentation of crystallographic data will confuse the typical student; the book would have been far more valuable had drawings of the representative structures been presented.

The book unfortunately does not discuss commercial aspects of metal hydrides and may therefore leave the student with the mistaken notion that these compounds are commercially useless. Thus there are only passing references to hydroformylation and stereospecific polymerization. In the discussions of the ternary U-Zr-H system, no mention is made of the important and unique role this system plays in pulsed reactors of the Triga type.

In general the misprints that occur in the book should cause little confusion. Neither will the grammatical slips do more than annoy. The book would be much more useful if the subject index were better, and, even more important, if an author index had been included. But these are minor objections; all in all this book provides an excellent introduction to the subject of metal hydrides.

JAMES A. IBERS
Department of Chemistry,
Northwestern University,
Evanston, Illinois

Reproduction in Fishes

Modes of Reproduction in Fishes. CHARLES M. BREDER, JR., and DONN ERIC ROSEN. Natural History Press, Garden City, N.Y., 1966. 957 pp., illus. $17.50.

When I first met Charles M. Breder, Jr., in the early 1930's he was already gathering information on the reproduction of fishes. Now, after at least 33 years, the results of this research have been published. The primary goals of Breder and Rosen's study were to amass all available information on the subject, to classify, appraise, analyze, and digest it, and to make it available in a form useful to students of ecology, ichthyology, morphology, physiology, endocrinology, and psychology.

During the preparation of the book over 20,000 known fish species were considered. About 1500 kinds are mentioned briefly, and the breeding habits of about 300 kinds are fully described; for another 100 species reproductive behavior is imperfectly known. Among over 600 fish families, there are about 17 whose modes of reproduction are reasonably well known. Fish culturists have contributed data largely on the Salmonidae, Esocidae, Cyprinidae, and Centrarchidae; aquarists have published observations mostly on the Characinidae, Cyprinidae, Cyprinodontidae, Poeciliidae, Cichlidae, and Anabantidae; and ichthyologists have published extensively on all the above-listed families and on the Petromyzontidae, Amiidae, Clupeidae, Gasterosteidae, Syngnathidae, Percidae, Cottidae, and Batrachoididae.

Breder and Rosen have attempted to arrange all data under the following headings: breeding season; breeding site; migration; secondary sexual characters; sex discrimination; competitions for mates; courtship; mating; and parental care. Because some of the authors whom they quote at length followed a different system, however, this order is not rigidly adhered to.

Detailed information is recorded in the Systematic Section (pp. 9–603). In the summary (pp. 605–17) the class Agnatha is reported to have diverse modes of reproduction. The Myxini produce eggs unlike those of any other vertebrate and deposit them in deep water on the sea floor, whereas the Petromyzontes reproduce in running streams with breeding behavior resembling that of certain teleosts. In the Gnathostomes, all elasmobranchs and chimaeras have internal fertilization effected by the mixopterygia, and living young or egg-cases are produced. Modes of reproduction among teleosts are varied and complex, as shown in the charts (pp. 620–75) which summarize reproduction down to the family level. In these charts reproduction is divided into seven modes. The modes overlap considerably, however, and I was unable to find a clear-cut definition that distinguishes the divisions.

The bibliography (pp. 679–910) gives an almost complete list of references between 1916 and 1959, with only a few after that date. Earlier papers are not cited because they are listed in Bashford Dean's *Bibliography of Fishes*. However, I note a few papers were overlooked for the period between 1916 and 1959, for example, one on the nesting habits of *Gobiodon citrinus* [*Smithsonian Inst. Ann. Rept. 1947*, 305 (1948)].

Breder and Rosen have always maintained the highest professional standards, and in this book they have unquestionably accomplished their objective of producing a comprehensive, useful work.

LEONARD P. SCHULTZ
Smithsonian Institution,
Washington, D. C.