to the unresolved experimental data than are nonlinear effects. However, determining the limits of validity of singular perturbation theory is an important part of freeing fluid dynamics from its heuristic past. Shear-flow turbulence (O. M. Phillips) is an "elementary" problem that one expects will remain an annual review topic for many years. Phillips applies quasilinear theory to rationalize aspects of the energy-releasing processes and to test his enriched "eddy viscosity" model. Recent studies by L. N. Howard and F. Busse, which are not reviewed, provide an alternative, and more quantitative, route to the exploration of turbulence energetics.

Biophysical fluid dynamics is included in a thorough review of blood flow studies (R. T. Jones) and a superbly synthesized assessment of aquatic animal propulsion (M. J. Lighthill). Lighthill concludes that we can understand the evolutionary shaping of fish and marine mammals from known principles without resort to any mysterious control of drag by these animals. An article on surface-tension-driven phenomena (V. G. Levich and V. S. Krylov) is not specifically addressed to biological problems, but certainly can be of value to the biophysicist.

Planetary fluid dynamics reviews include recent work on buoyant plumes (J. S. Turner), the fascinating behavior of nonviscous stratified flows (C.-S. Yih), shock waves and radiation (Ya. B. Zel'dovich and Yu. P. Raizer), and electrohydrodynamics (J. R. Melcher and G. I. Taylor). Applications of shock wave theory range from studies of melting transitions in solids to the emission of x-rays from neutron starts—that is, they range from tested deductions to implausible speculation. Electrohydrodynamics is the study of flows induced by coulomb forces. In the review critical comparison is made of analytical models of waves, convection, and instability with experiments in weakly conducting laboratory fluids. One foresees numerous applications in both biophysics and astrophysics.

The editors promise survey articles on geophysical fluid dynamics (flow in rotating systems, tides, and atmospheric boundary layers) in a forthcoming volume. I hope they can include more of the recent work on nonlinear flow and nonlinear stability theory.

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Weak Turbulence

Theory of Turbulent Plasma. A. A. VEDENOV. Translated from the Russian edition by Scripta Technica. S. Chomet, Transl. Ed. Iliffe, London; Elsevier, New York, 1968. 128 pp. $5.50.

Modern plasma physics, it is generally conceded, began with the controlled thermonuclear reactor programs initiated in the U.S., the U.S.S.R., and elsewhere in the early 1950's. A major preoccupation of the next ten years was the problem of plasma stability. This period saw a considerable development, based upon linearized theories, of our understanding of how plasmas unstably amplify small amplitude waves. An International Atomic Energy Agency conference on controlled thermonuclear fusion, held in 1962 in Salzburg, marked the beginning of a new important phase. Three papers, two American and one Russian, laid the foundation of weak-turbulence theory, wherein the effects of various instabilities are analyzed. (In many cases, the nonlinearities in plasma turbulence are weak, permitting use of the extensive body of linear theory and elegant perturbation schemes.) A rapid development of formal weak-turbulence theory followed, particularly in Russia. Now we have available three monographs—Kadomtsev's *Plasma Turbulence* (Academic Press, 1965), Sagdeev and Galeev's *Nonlinear Plasma Theory* (Benjamin, 1969), and Vedenov's *Theory of Turbulent Plasma*, under review here—by some of the leading Soviet weak-turbulence theoreticians which reflect the state of Russian understanding in 1966. Regrettably, this knowledge is still not completely disseminated in the U.S. Several things have happened since 1966, such as the increased interest in large amplitude single waves, which are not completely covered in these volumes. In addition, there are very few references to experimental verifications of weak-turbulence theory. For these reasons, these monographs are unlikely to become authoritative reference books. Their greatest value is in training theoretical intuition about various nonlinear plasma processes. The books are essential for advanced graduate students and researchers primarily because of their elegant presentation of the Russian philosophy of plasma physics.

Vedenov's book has several important virtues. First and foremost is its spare simplicity. The author has eschewed complicated or controversial topics to concentrate upon simple derivations of fundamental processes. He presents intuitive and simple derivations of many basic instabilities so that students will not be lost in the later sections devoted to their nonlinear consequences. In the nonlinear discussion, Vedenov stresses only the basic processes and their theoretical structure such as the quasilinear theory and mode-coupling. The nonlinear analysis of various instabilities are more thoroughly discussed in the Sagdeev and Galeev book. The nonlinear wave-particle interaction, such as nonlinear Landau damping, treated in both Kadomtsev's and Sagdeev and Galeev's books, is completely omitted here. Despite these omissions, this is an excellent introduction, for whatever is treated here is presented with elegance and lucidity. Physical concepts, and not mathematical techniques, are emphasized throughout. For these reasons, then, this book is in some ways the most accessible of the three to students. Of course, it may be said that Vedenov's arguments are so sophisticated that his book is deceptively simple; nevertheless it is simple.

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Progress Reports in Meteoritics

Meteorite Research. Proceedings of a symposium, Vienna, Aug. 1968. PETER M. MILLMAN, Ed. Springer-Verlag, New York; Reidel, Dordrecht, Holland, 1969. xvi + 944 pp., illus. $48. Astrophysics and Space Science Library, vol. 12.

Current research on the origin and history of meteorites is represented by 73 papers delivered to this symposium sponsored by the International Atomic Energy Agency. The majority of the papers clearly are progress reports, containing new data which raise as many new questions as they offer solutions to problems and which give few final answers.

The discussion sessions included Early History of Meteorites, Composition and Structure (5 sessions), Isotope Studies and Chronology (3 sessions), and Orbits. These broad topics are closely interrelated, and papers in all sessions have bearing on the central problems of meteoritics, which remain unsolved. For instance, new Monte Carlo calculations

of meteorite orbits, determinations of cosmic-ray-produced isotopes, measurements of fossil charged-cosmic-ray-particle tracks, and photographic observations of fireballs, reported in this volume, are diverse approaches to the questions of where meteorites come from and how they became small bodies. The calculations suggest that the orbital characteristics and cosmic-ray exposure of chondritic meteorites preclude their derivation from observed asteroids or comets. The photographic network data suggest that meteorites are not made of the same material that produces most fireballs. Thus the sources of meteorites are as unclear as ever.

As another example of diverse approaches to a general problem, the concentration of the light elements lithium and boron, fossil fission tracks from now extinct plutonium-244, rubidium-strontium age determinations, and many petrographic observations and elemental determinations reported here bear on the early history of the solar system, from nucleosynthesis to the accretion of the meteorite parent bodies. Most meteorites were formed at the very beginning of solar-system history, but despite much observational evidence, the nature of the processes that led to formation of chondritic meteorites is not clear. Possibilities suggested in this volume range from primary condensation of chondrules from a nebular vapor or liquid to their formation by a secondary process such as impact melting. Evidence of subsequent physical mixing and complex chemical fractionations in chondrites, discussed in many of the papers, indicates that they have complicated developmental histories. Many other areas of meteorite research are included in specialized papers.

References to this book by specialists will be numerous. Many will undoubtedly obtain their information in the form of reprints rather than by purchasing the book, which has a price that will discourage all but ardent meteoriticist bibliophiles and librarians from purchasing it. Although the specialization of the reports may discourage the general reader, he may find interest in the diversity of the approaches and imaginative analytical techniques used to study meteorites and to shed light on some important boundary conditions of solar-system evolution. This will be the last major collection of meteorite data published prior to the analysis of returned lunar samples, an endeavor that will be joined by many of the participants in this symposium. It will be interesting to look back—perhaps as early as a year from now—to see if major perturbations in meteorite studies will result from investigations of lunar materials and processes.

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Vertebrate Hormones

Perspectives in Endocrinology. Hormones in the Lives of Lower Vertebrates. E. J. W. BARRINGTON and C. BARKER JØRGENSEN, Eds. Academic Press, New York, 1968. xvi + 584 pp., illus. $22.50.

"Hormones in the Lives of Lower Vertebrates," the subtitle of this volume, is descriptive of the material covered. Comparative references are made to the higher vertebrates, but the fishes and amphibians are emphasized throughout, with the former receiving by far the greater attention. Although much of the literature reviewed has been well worn by several surveys during the past decade, each of the eight chapters provides a new emphasis or treats some particular aspect of endocrinology in more detail; much of the recent literature on fish and amphibian endocrinology is covered, and all chapters contain valuable leads to potentially fruitful areas of research.

Two of the most valuable chapters come from the editors. In the introductory chapter, Barrington discusses "Phylogenetic perspectives in vertebrate endocrinology" in a thoughtful vein and gives a balanced treatment of current theories of animal evolution as they touch on comparative endocrinology. He evaluates the probable role of hormones in several evolutionary processes and discusses possibilities of phylogeny in both endocrine and target organs. This overview will be a welcome one to the comparative physiologist and the general zoologist as well as the comparative endocrinologist. In addition, this chapter fills in several chinks not covered in other chapters so that the book, in its entirety, covers most of the important topics in comparative endocrinology with respect to the lower vertebrates.

Jørgensen's chapter, "Central nervous control of adenohypophysial functions," which concludes the book, assembles scattered literature on a subject that has been much less frequently reviewed than the other topics covered in this volume. It will serve as an excellent background for future studies in this important field.

The topics considered in the remaining six chapters have been more frequently reviewed. They are comprehensive, authoritative treatments by masters of their fields; each will probably provide some particular point of interest for its readers. This reader found the chapter by J. Maetz on salt and water metabolism an especially careful and valuable review of a broad field where the advances of the past decade have been extremely rapid. W. A. Barr on "Patterns of ovarian activity" emphasizes the lack of precise knowledge of the endocrinology of ovarian function at the cell and tissue level. B. Lofts on "Patterns of testicular activity" reviews current research on a subject of which knowledge is rapidly increasing and discusses, in some detail, the Sertoli cell, which has received all too little attention. H. J. A. Koch's chapter on "Migration" considers the endocrinology of anadromous and catadromous migrations; for this reader the entire chapter revealed the lack of progress in our understanding of the role of hormones in regulating mechanisms of migration. The spate of optimistic research—initiated over two decades ago—has provided many endocrinological and physiological facts concerning fish but has not significantly advanced our knowledge of mechanisms of migration. B. Baggerman discusses the endocrinology of reproductive and parental behavior of fishes against a background of ethological theory. She summarizes in detail and attempts to evaluate most of the research on *Gasterosteus aculeatus*, which is the only fish whose endocrinology in relation to behavior has been systematically investigated in more than one laboratory. Finally, P. G. W. J. Van Oordt summarizes in a masterly way the voluminous literature on pituitary cytology. Many unsolved problems remain, and Van Oordt's review should greatly assist those who become interested in them.

On the whole, there is much of interest in all the chapters, and this reviewer is glad to recommend the volume to research workers and students of the physiology of the lower vertebrates. It provides an up-to-date synopsis of a very broad area of vertebrate comparative endocrinology.

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