proximation to plasma turbulence, in which each mode is driven by its own intrinsic instability in the equilibrium, neglecting the interaction of the modes with each other. The next chapter takes up weak interaction between the modes, first in the absence of resonances and then in the presence of a sharp resonance. The third chapter treats strong turbulence, in which the coupling between modes is broad, including the weak coupling approximation and a phenomenological discussion of strong turbulence including hydrodynamic turbulence. Each of the first three chapters contains applications of the general theoretical discussion to various waves and growing modes. The fourth chapter occupies the last half of the book and is devoted to treatment of specific cases, and, in its last section, to an appraisal of the experimental information on turbulent plasma. Altogether, the review is the most comprehensive of plasma turbulence available at the present time.

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PROGRESS IN DIELECTRICS, VOL. 6, edited by J. B. Birks and J. Hart. 334 pages, diagrams, illustrations, 6 × 10 in. New York, Academic Press Inc., 1965. Price, $14.25.

The present volume of *Progress in Dielectrics* illustrates in a plastic manner the numerous interests concerned with dielectric materials. As a consequence the five articles contained therein are addressed to a variety of scientists.

The first article by W. F. Pickard on electrical forces in dielectrics contains a number of interesting historical observations; among them is an effect observed by Faraday (climbing of a liquid dielectric along two high-voltage electrodes dipped into it), subsequently forgotten, and rediscovered in recent years by Sumoto. This article is followed by a survey on polymeric semiconductors (A. Rembaum, J. Moacanin and H. A. Pohl).

The development of solid state devices naturally leads to the investigation of a great variety of materials, including polymers. This survey shows that the conduction process in such substances is not yet well understood. Mobilities as far as they are known are rather low, and it is still unclear whether the band model which is so successful in most inorganic semiconductors can be applied. One would conclude from this article that a theoretician will find plenty of scope in developing a systematic theory of conduction in polymers. There follows a discussion by Z. Croitoru on space charges in dielectrics. Space charge limited currents are of considerable importance, and the reader will find a survey of experimental results as well as an outline of the (semiphenomenological) theory. Article number four is simply a bibliography for 1963 (compiled by F. R. Lipsett) on energy transfer in polyacene solid solutions, which covers 25 pages!

The final article by S. A. Rice and J. Jortner on the theory of ionic and electronic mobility in liquids is the longest of the volume, spanning about 130 pages as compared with 150 pages for the first three articles. This review covers a very wide field. It requires kinetic theory of liquids for the purpose of ionic conductivity; generalization of polaron theory to liquids for the purpose of electronic conductivity, and it presents some of the interesting effects connected with quantized vortex rings in superfluid helium.

This last article assumes considerable theoretical knowledge; polaron theory, for instance, is unhesitatingly presented in terms of second quantization. The first three articles on the other hand are less ambitious in their theoretical requirements. The volume as a whole is unusually stimulating.

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STABILITY OF NONLINEAR CONTROL SYSTEMS, Vol. 13, by Solomon Lefschetz. 150 pages, diagrams, 6 × 9 in. New York, Academic Press, Inc., 1965. Price, $7.50.

This is a crisp, readable book on a current topic: absolute stability of control systems. The first few chapters are very elementary and acquaint the reader with the subject and its subtleties. Though the book includes the most recent results, the text presupposes little more than a basic knowledge of standard vector and matrix technique. The reader is led

to Lurie's necessary and sufficient condition for absolute stability of indirectly regulated systems, to the parallel results of Yacubovich, to a discussion of Aizerman's form of the problem, to multiple feedback systems, to the case of discontinuous characteristic functions, and to the parallel analysis of the more cumbersome direct control systems.

A physical or mechanical system, monitored without regulator by an ordinary differential system with constant coefficients, is monitored when regulated by an analogous but nonlinear system, the action of the regulator being represented by a single scalar characteristic function.

In Lurie's scheme (1951) necessary and sufficient conditions are sought for the stability of the equilibrium position (or of the actual motion) for any possible characteristic function. This is the concept of absolute stability, the main subject of the present very informative book. This concept has proved to be significant in applications (nuclear power reactors, space navigation, etc.). The results of Lurie, Popov, Lefschetz, and of a number of other mathematicians are relevant in this connection. The problems are related to questions of linear analysis, differential equations, and Fourier transforms. The most important tool for the discussion throughout the present selfcontained exposition, however, is Lyapunov's second method.

Subsequent chapters concern Popov's fundamental contribution (1961) and additional work of other mathematicians, notably Lefschetz's and LaSalle's. Here the use of Fourier transformations is required, but the present exposition is particularly simple. Variants of Popov's theorem are given in association with the use of various types of Lyapunov's functions. Further results of Yacubovich and of Morosan are given.

The last chapter is essentially an appendix with preliminary results, particularly on Lyapunov's matricial equation $A'B + BA = C$, thought of as an equation in A, and an example from the theory of nuclear power reactors.

This book facilitates the acquaintance with a theory still in a process of formation whose main results are of difficult access.

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THEORY OF OPTIMUM AERODYNAMIC SHAPES, Vol. 9, edited by Angelo Miele. 455 pages, diagrams, 6 × 9 in. New York, Academic Press Inc., 1965. Price, $16.50.

This book is concerned with applications of the calculus of variations in calculating optimum aerodynamic shapes, for example, the determination of the shape of the body of revolution which minimizes the pressure drag in linearized supersonic flow. It is no surprise to find that von Kármán first studied this problem in 1935, and all later research stems from this. An enormous amount of work has been devoted to the subject since then, and the present book gives an admirable survey of variational problems in supersonic, hypersonic and free-molecular flows.

This is an outstanding and remarkable book in that it collects together the original contributions of a number of distinguished authors from all over the world. The way in which the editor has succeeded in adding continuity to the whole volume by inserting original chapters of his own, and yet preserving the personal style of the separate contributor, will serve as a model for any such venture in the future.

However, to claim that the material here presented is of real practical value to the designer of supersonic and hypersonic vehicles is going too far. The solution to any given problem is no more accurate than the assumptions upon which it is based. Too often these assumptions are far removed from reality, as for instance the neglect of skin friction forces, or at best a very simple analytical variation of skin friction along the surface. Another glaring example is the assumption of the Newtonian pressure distribution law for hypersonic shapes. Even the inclusion of the centrifugal correction due to Busemann does not give an accurate representation of the pressure distribution in many practical cases.

Nevertheless the results which have been achieved so far provide upper bounds or optima for the designer to aim at. With the editor, this reviewer hopes that the book will stimulate further research and that in time "the calculus of variations will become a fundamental instrument in the design of optimum aerodynamic configurations".

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