

introduced the important concepts in a logical order (relating one concept to another) in an attempt to develop a system of thought from beginning to end. The book is clearly written and the notation is usually that of most standard texts on general physics. Most of the sections are thorough and well presented, with some detailed discussion of a few applications of intrinsic interest to students. Another asset of the text is the clear and helpful diagrams sprinkled liberally throughout.

As with most texts, this one will be found to have its advantages and disadvantages, many of which vary in importance with the particular instructor's interests and ideas. Some will question the elementary mathematics or the order in which the material is presented, but neither should be of major consequence. Instructors should certainly consider this text for their students in an elementary, noncalculus, general physics course.

WITH MATHEMATICAL RIGOR

RADIATIVE TRANSFER ON DISCRETE SPACES. By Rudolph W. Preisendorfer. 462 pp. Pergamon, New York, 1965.

by *T. Teichmann*

Problems of radiative transfer have long held great physical interest because of their application to problems of stellar structure. In recent years, this interest has increased and become more urgent because similar questions play an important role in reactor physics and in high-temperature phenomena of various types (for example, ablation, shock waves). In the course of this development, the general structure of the theory (pioneered by Schuster and Schwarzschild) has become mathematically more precise and sophisticated due largely to the work of Ambrartzumian and Chandrasekhar, using global as well as local formulations of the problem. At the same time, substantial

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The reviewer, a physicist with the General Dynamics Corporation, has been concerned in recent years with a variety of transport and transfer problems of nuclear radiation and of point explosions.

improvements in quantitative results were achieved with numerical methods stimulated largely by nonastrophysical applications.

The author, whose interest has been particularly in optical transfer problems in the atmosphere and the oceans (carried out at the Scripps Institution of Oceanography), has set as his objective the precise and vigorous mathematical formulation of essentially the entire gamut of radiative-transfer problems, both to illuminate their conceptual foundation and to indicate and facilitate numerical techniques which may not be apparent from the formal structure of the equations.

The work is scholarly and extensive, replete with bibliographic notes and detailed verbal descriptions of the operational and physical significance of the various concepts and relations which occur in the theory. The latter are often very illuminating and unique but do not, in this reviewer's opinion, have the impact they should because of the author's penchant for using notations particularly adapted to a rigorous mathematical formulation rather than to physical perspicuity. This effect is not alleviated by the substantially uniform mathematical precision—rather than a more gradual transition from the heuristic to the rigorous. Actually any given topic is not difficult to cover, despite the above comments; it is rather the total mass of careful mathematical detail that tends to become formidable.

Following the description of basic philosophies and concepts and the continuous equations of transfer in various forms, a major portion of the book is devoted to the formulation of radiative-transfer problems in discrete spaces; it serves both to provide further insights and more particularly to provide an effective guide to numerical methods.

Finally extended discussions are given, with the same general approach of effects of polarization, of the probabilistic interpretation of the transfer process, and of its derivation from the laws of electromagnetism.

To summarize, this book plumbs the concepts and general methods of the field very thoroughly. Specific

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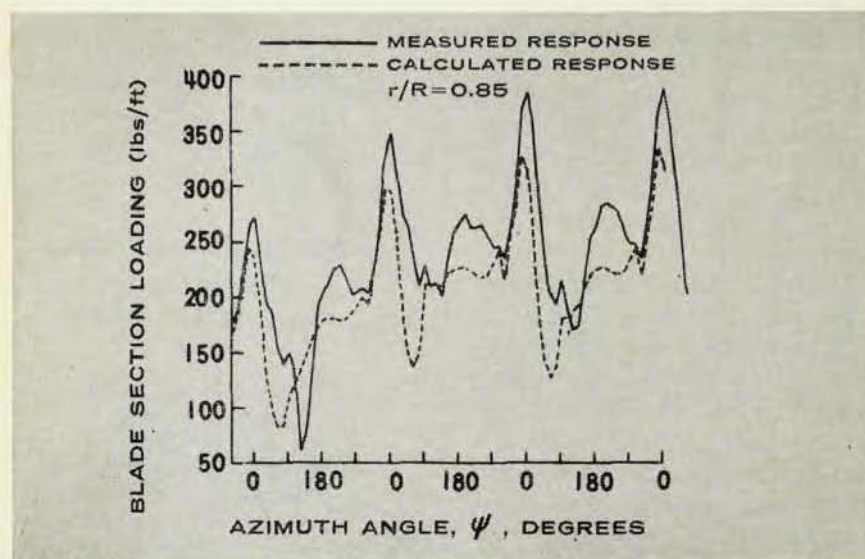
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FURTHER PROGRESS IN HELICOPTER ROTOR LOAD PREDICTION

Continuing its tradition of research in aeroelastic problems, Cornell Aeronautical Laboratory is developing improved methods for predicting airloads on helicopter rotor blades as a critical step in developing more efficient and longer life blades and in reducing vibration levels in future helicopters.

In a recent program employing a complex, non-periodic representation of the rotor wake, for example, CAL investigated the aerodynamic loadings and response of rotor blades undergoing transients in collective pitch. Predicted results were in good agreement with measured results; one result, obtained for up collective pitch at cruise speed, is depicted below. As a consequence of these initial successes, our analysis now has expanded to include further refinements in the wake modeling and other elastic degrees of freedom believed pertinent for advanced helicopter designs.



Improved prediction methods developed at CAL already have contributed to advances in the state of the art of blade design. The Laboratory's program in this problem area is continuing under Army sponsorship to investigate both single and tandem rotors in steady-state and transient flight. In allied programs, the aerodynamic forces developed by VTOL propellers during transitional flight and the aerodynamic characteristics of wings immersed in the propeller slipstream also are being analyzed.

Working in an environment of modern equipment and techniques, the CAL technical staff continues to make research advances in these and other fields. Typical areas include computer sciences, flight research, avionics, aerospace vehicle research, hypersonics, electromagnetics, applied physics, operations research, transportation and systems research.

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analytical methods are not presented, though the discrete space techniques seem readily translatable to numerical methods. The ubiquity of mathematical abstraction, nomenclature, and rigor, whose presence separately would be praiseworthy, tends to obscure otherwise clear discussions.

THEORY AND DESIGN PRACTICE

POWER TRAVELLING-WAVE TUBES. By J. F. Gittins. 276 pp. American Elsevier, New York, 1965. \$10.00.

by Hans J. Hagger

Since the publication of Pierce's famous book on travelling-wave tubes, which cleared up the interaction mechanism between an electron beam and a waveguide structure from a theoretical point of view, a large number of papers has appeared, but a book disclosing theory and design practice was missing. Gittins, a British expert in this field, aimed to write a treatise on travelling-wave tube design that would give practical advice for construction and the theory that rules the design parameters, for both conventional and crossed-field devices.

The introductory chapter gives a brief survey of travelling-wave tube history and indicates, by describing some typical tubes, the topics of the book. Chapter 2 deals with the basic interaction theory of both forward and backward waves from the point of view of vector addition of the circuit voltages. Summaries of Pierce's small signal theory and of Slater's large signal approach and some remarks on velocity tapers are included. In chapter 3 slow-wave structures, such as the helix, the cross-wound helix, and periodically loaded waveguide structures, as well as coupled-cavity systems are explained by using the ω - β diagram or by the filter theory. The clover-leaf structure by Chodorow—a very important circuit for power travelling-wave tubes—is described but, unfortunately, not analysed. This is a pity because the British specialists have done excellent work on this

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The reviewer, a specialist in electricity and electronics, is associated with Albiwerk Zurich.