particularly appealing and should provide insights even for the experienced ocean acoustician.

The tendency to oversimplify models of the ocean, for example, by ignoring the effects of the boundaries on the acoustic field, has led in the past to gross discrepancies between prediction and measurement. Consequently, in some quarters, ocean acoustics is regarded as a black art. One of the admirable qualities of this book is that, by way of contrast, it treats sound propagation in the sea as a science in which well-defined physical laws are obeyed. There is no suggestion that it is an easy science; indeed, some particularly complicated problems are introduced and discussed in detail. However, it is the rationality of the approach itself which is important, for it is this which provides a basis for understanding acoustic transmission in the ocean. The book can be highly recommended to anyone with a serious interest in ocean acoustics. They should find it to be a valuable addition on their bookshelves.

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Acoustic Waveguides Applications to Oceanic Science—C. Allan Boyles. (New York, NY: Wiley, 1983, 321 pp., $58.00.) *Reviewed by Joseph Picone, Texas Instruments Inc., Dallas, TX 75266.*

Acoustic Waveguides is a new monograph which presents the fundamental principles of the theory of acoustic wave propagation in oceanic waveguides. The book is intended to be an introductory text for first-year graduate level students, though it should also serve as a reference book for the experienced scientist. While it is largely self-inclusive, with little or no background in oceanic science required, some background in both wave propagation and thermodynamics will be useful. As promised by the author, this book presents a very detailed mathematical analysis of several acoustic waveguides used to model acoustic propagation in the ocean.

Conceptually, the book is organized into three sections. In the first section, the author presents the fundamental concepts of hydrodynamics and thermodynamics, and the basic mathematical tools necessary for solving the partial differential equations encountered in the remainder of the book. The first two chapters are devoted to this background material, spanning over one-third of the book. The next section, probably the most fundamentally important to the book, contains two chapters dealing with exact solutions to the acoustic wave equation under the assumptions of both homogenous and inhomogenous layered models. Finally, the last three chapters of this book consist of approximate solutions to the wave equation, and the applications of both exact and approximate solutions to various specific oceanic models.

The first chapter of *Acoustic Waveguides* begins with some background material on hydrodynamics and thermodynamics, including such topics as conservation of momentum and energy for a perfect fluid, derivation of the acoustic wave equation, and acoustic boundary conditions. The main purpose of this chapter is to introduce the reader to the acoustic wave equation for a perfect fluid, as derived from some basic hydrodynamic equations. Throughout the text, the fluid is generally assumed to be a vertically stratified perfect fluid under the influence of a gravitational field.

The review material continues in the second chapter, in which the various techniques used throughout the text for solving partial differential equations are introduced. Included are discussions of such topics as separation of variables, the Sturm–Liouville problem, and eigenfunction analysis. The chapter concludes with a discussion of three types of special functions: Green's functions, Bessel functions, and Airy functions. As the author states, this chapter appears mostly as a convenience to the reader. Generally, the reader unfamiliar with these topics will find it extremely useful to consult more comprehensive references.

Chapters 3 and 4 deal with the solution of the wave equation under four simple geometries. First, the problem of a homogeneous layer bounded by an air-water interface and a rigid bottom is considered. The air-water interface implies that the total acoustic pressure vanishes everywhere at the surface of the fluid, while the rigid bottom is defined as an interface at which all acoustic energy is reflected with no phase shift after reflection. Next, this configuration is expanded to include two homogeneous layers bounded by the air–water interface and a rigid bottom. In the third configuration, the rigid bottom recedes to infinity, making the second homogeneous layer an infinite, homogeneous halfspace. Chapter 4 deals exclusively with an extension of the two-layer homogeneous model to N inhomogeneous layers.

At this point, the book moves from a discussion of analytic techniques to a discussion of practical techniques used in understanding wave propagation. In Chapter 5, approximate solutions of the wave equation drawn from ray theory are developed. This leads into a discussion of phenomena such as turnpoints, convergence zones, and caustics. This discussion on convergence zones continues in Chapter 6, in which the major topic is surface duct propagation. Two basic examples are considered in this chapter: a single channel North Atlantic profile, and a double channel North Atlantic profile.

The text concludes with a very brief chapter presenting some of the author's original research on realistic oceanic models. First, the problem of a refractive index which is both range- and depth-dependent is discussed. Second, the air–water interface is allowed to be a time-varying, randomly rough sea surface. The author seems to depart from the detailed style of the previous chapters, and quickly derives several equations with only a few supporting discussions of these results.

The major drawback of this book, as an academic textbook, is that it contains very few discussions of results, explanations of the significance of various equations, etc. Also, there are very few examples, and no exercises. Although the material is presented in a very systematic and well-organized fashion, the reader is largely left on his or her own when it comes to developing a comprehensive physical understanding of the material. In some sections of the book, such as the chapter on surface duct propagation (Chapter 6) or the introduction on caustics in Chapter 5, the author does an excellent job of describing the physical phenomena involved. Overall, it seems the book could use more of these discussions.

This book, by virtue of its highly theoretical approach, seems most useful as a good reference book on oceanic waveguides. Its strengths lie in its straightforward presentation of the difficult mathematics which inevitably result from solving practical wave propagation problems. This book is not intended to be a general textbook on acoustic waveguides, mainly because its scope has been limited to oceanic applications.

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Free-Electron Lasers—Thomas C. Marshall. (New York: Macmillan, 1985, 191 pp., bound, $24.95, ISBN 0-02-948-620-3.)

The author provides an integrated treatment of the operation and characteristics of the free-electron laser. He surveys activity in this fast-moving field and interprets it within the context of the physical models that are most widely understood. He begins with historical and conceptual background material; covers FEL theory in detail, including two-wave FELs and dense electron beam effects; explains electron orbital motion and slow-wave FELs; and concludes by describing collective and two-wave FEL experimentation.