Book Review

Water Waves: The Mathematical Theory with Application, by J. J. Stoker. Published by Wiley-Interscience, New York, 1957. $42.95, 567 pp.

The purpose of this book, *Water Waves* as the author says, is to connect the mathematical theory of waves with the physical behavior of the free surface of water subjected to forces, together with concrete physical applications. The book is divided into four parts. In part one comprised of **Chapters 1** and **2** the basic equations of hydrodynamics of an incompressible fluid in an irrotational flow are presented, and two approximate theories are discussed. One is the small amplitude waves and the other is shallow water theory.

Part two is divided into three subdivisions and is concerned with the small amplitude wave theory. In Subdivision A, which consists of **Chapters 3–5,** simple harmonic wave motions are developed. The ideas of standing and traveling waves are presented and the uniqueness of the solution is discussed in Chapter 3. Chapter 4 treats some simple harmonic forced oscillations, in contrast with the free vibrations discussed in Chapter 3. In Chapters 3 and 4 the water depth was assumed constant. Chapter 5 deals with simple harmonic waves for cases in which the water depth is not constant. Various methods for treating problems of propagation of progressing waves over a uniformly sloping beach are presented. Again, the uniqueness of the solution is discussed and a uniqueness theorem is derived. In Subdivision B, that comprised of **Chapter 6,** problems involving transient motions are treated. The Fourier transform technique is explained and used to obtain solutions for different cases. Subdivision C, which is the final subdivision in Part 2 consisting of **Chapters 7–9,** deals with small disturbances created in a stream that initially has a uniform velocity and horizontal free surface. Chapter 7 deals with waves in a uniform depth. In Chapter 8, ship waves are treated in detail. The ship is regarded as a point disturbance moving over the surface (Kelvin's theory). Finally, Chapter 9 presents a general theory for the motion of a ship regarded as a rigid floating body. The theory is obtained by a development of all conditions of the nonlinear boundary problem.

Part three is concerned with the shallow water theory and consists of **Chapters 10 and 11.** This theory leads to a system of nonlinear partial differential equations that are, in certain cases, analogous to the equations of compressible gases. In Chapter 10, the theory of characteristics, which is the basis for the problems discussed in this part, is presented in detail. The problems treated in Chapter 10 include the propagation of disturbances into still water, the motion resulting from the breaking of a dam, and braking of waves in shallow water. This chapter concludes with a few applications of the linearized version of the shallow water theory. Chapter 11 deals with mathematical hydraulics, referring to wave motion in rivers or other open channels with rough sides. The problems in this chapter differ from those in Chapter 10 because of the additional forces arising from the rough sides of the channels, but the differential equations remain of the same type so the characteristics method applies. The first problem dealt with is that of the steady motion of inclined channels. Then the problem of propagation of a flood down a river is discussed. The solutions for these two

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problems are obtained by numerical methods and explained in detail.

Finally, Part four **(Chapter 12),** closes the book with some solutions based on exact nonlinear theory. Solutions in the form of a power series in time are used for problems where the initial motion for short time can be determined in general. Problems of the collapse of columns of liquid resting on a rigid horizontal plane are treated by the Lagrange representation, rather than the Euler one that is used throughout the book.

Water Waves: The Mathematical Theory with Application is well written and easy to follow although sometimes it involves too much detail for the casual reader. For the researcher, the reference is valuable. The author, in my opinion, did in fact achieve the goal he set for himself. Because of its mathematical nature, and the detailed and in-depth coverage of the subject, the book is recommended for graduate students and researchers.

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