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Elementary Fluid Dynamics FREE

D. J. Acheson

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BOOK REVIEWS

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Editorial Policy: *If there is a negative review, the author of the book will be given a chance to respond to the review in this section of the Journal and the reviewer will be allowed to respond to the author's comments. [See "Book Reviews Editor's Note," J. Acoust. Soc. Am. **81**, 1651 (May 1987).]*

Fluid Physics for Oceanographers and Physicists

Jerome Williams and Samuel Elder

Pergamon, Oxford, 1989.
viii + 300 pp.

Elementary Fluid Dynamics

D. J. Acheson

Clarendon, Oxford, 1990.
ix + 397 pp. Price (paperback) $29.95.

While the major thrust of fluid dynamics is not acoustical in nature, there is enough overlap of the subject that warrants a review of such texts as these in the *Journal of the Acoustical Society of America.* Each of the texts is pedagogical in character, the first being the outgrowth of courses taught by the authors at the U.S. Naval Academy, and the second from experiences of the author at the University of Oxford. Each volume contains substantial numbers of problems. In the case of the Williams and Elder book, the numerical solutions of alternate problems are given, whereas Acheson includes a 30-page section of hints and answers to all the problems, a very valuable addition, even though it removes most of these problems from use by an instructor as homework assignments. However, it has the compensatory virtue of making the volume extremely useful for self-instruction.

The book by Williams and Elder contains 16 chapters. The authors begin at a very elementary position, reviewing much of the material on fluids that would be found in a strong elementary physics course. After devoting three chapters to the mechanical and thermodynamic properties of fluids, they present a short chapter on dimensional analysis that is a valuable one to the student undertaking a study of fluid dynamics without previous experience in such analysis. There is an amusing error in connection with their presentation of the Buckingham Pi theorem, i.e., they have granted a title of nobility to E. Buckingham, who was a homegrown American and, indeed, the father-in-law of the the late Prof. F. V. Hunt.

After three more chapters on fluid statics and kinematics, the proper study of fluid dynamics begins with the development of the Euler and Bernoulli equations. Emphasis here is placed on one-dimensional problems. Chapter 10 describes motion with rotation, including various aspects of vortices, while Chap. 11 develops the study of steady irrotational flow.

The rest of the text marches through forces on a body submerged in a fluid, streamlines, vortex lines and stream functions, the study of liquid jets, and concludes with two chapters on viscous fluids, boundary layers, and turbulence. The level of the book is elementary, with many line drawings to illustrate particular points. In view of its pedagogical nature, however, it is handicapped by the typing of many equations in single lines, with derivatives displayed with the use of a solidus. When these equations are presented in close-packed fashion, they present a discouraging scene to the reader, and do not facilitate easy understanding of the equations being developed. The problems at the end of each chapter are numerous and range from very elementary to challenging. Another useful feature of the book are the many worked examples throughout the text.

The book by Acheson starts at a considerably higher level of mathematical sophistication. In a sense, the books are almost sequential. Certainly, a person who had been exposed to *Fluid Physics* would be well prepared to undertake *Elementary Fluid Dynamics.* After an introductory chapter and a review of elementary viscous flow, Acheson presents the subject in six solid chapters, moving from waves and aerofoil theory to vortex motion, the Navier–Stokes equation, very viscous flow and concluding, as did Williams and Elder, with boundary layers, instability, and turbulence.

Acheson has a nice sense of the history of the subject and shares it with his readers. Such vignettes as Russell's description of the first observation of a soliton (1834) is a treasured moment of scientific discovery, and the quotation attributed to one of the Wright brothers in 1901, after the failure of their first attempt at glider design ("nobody will fly for a thousand years") make very human a subject that could be thought dull. There are many drawings, including interesting reproductions of some from original, classic papers in the field.

And where is acoustics in these volumes? In Acheson's work, it is concentrated in the chapter on waves, where the whole range of waves, from water ripples to sound to shock waves are developed. In the book by Williams and Elder, waves are discussed in the chapter on Bernoulli's equation, but the subject surfaces in a number of chapters. Each of these books could broaden the understanding of the acoustician in his study of the interrelation of sound waves and the nonsonic motions of the fluid world.

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Underwater Acoustic Systems Analysis (Second Edition)

William S. Burdic

Prentice-Hall, Englewood Cliffs, NJ, 1991.
xiii + 466 pp. Price $58.00.
ISBN: 0-13-947607-5.

Underwater Acoustic Systems Analysis is an excellent Masters' level text on signal processing for sonar. The book covers more than signal processing, however, as it includes much of the knowledge of ocean acoustics needed to understand sonar signals and to calculate sonar system performance. The emphasis is definitely on signals, rather than on the physical aspects of sound in the sea. The subject matter does not extend to displays or to the man–machine interface.

The book begins with a history of sonar, then covers wave theory and acoustic radiation, basic hydrophone and projector properties, and reflection from or transmission through, boundaries, plates, or refracting media.