J. Fluid Mech. (2004), *vol.* 521, *p.* 380. © 2004 Cambridge University Press
Printed in the United Kingdom

BOOK REVIEW

Waves and Compressible Flow. By H. Ockendon & J. R. Ockendon. Springer, 2004. 188 pp. ISBN 0 387 40399 X. £46.00.
J. Fluid Mech. (2004), *vol.* 521, DOI: 10.1017/S0022112004001168

This book, based on a lecture course given for many years to applied mathematics students at Oxford University, is an introduction to the theory of linear and nonlinear waves in fluids, including the theory of shock waves. The course evolved organically, reflecting the authors' involvement in research, especially their education of so many research students who have gone on to distinguished careers in research. Although the book emphasizes waves in which the restoring force arises from the fluid's compressibility, examples are given of incompressible waves, e.g. surface gravity waves and waves in rotating flows, and also some non-fluid waves, e.g. in electromagnetism and elasticity. Thus, besides the Mach number, one finds mention of the Froude number and the Rossby number, and the methods expounded are useful generally. These include Fourier series and integrals, stationary phase, and the WKB approximation, and they are related to such basic wave concepts as the dispersion relation, group velocity, and rays. Standard topics included are resonance, scattering, cut-off in waveguides, Riemann invariants, and simple waves.

The book is extraordinarily accurate and free of misprints, though one remark on page 141 gave me pause for thought. Here the reader might conclude that a 'rarefaction shock', in which the pressure decreases as the fluid passes through the shock, is always impossible. This is a correct conclusion for a perfect gas, but not for a so-called 'dense gas' or 'Bethe–Zel'dovich–Thompson fluid', in which the equation of state relating pressure and volume at fixed entropy is not convex near the thermodynamic triple point. Such gases defy our normal intuition, because they permit not only rarefaction shocks but also Prandtl–Meyer compression fans, rather than expansion fans. Details of this fascinating niche in compressible flow theory may be found in Monaco, Cramer & Watson, *J. Fluid Mech.* vol. 330, 1997, p. 31.

I enjoyed reading this book. The equations are 'clean', i.e. informative without containing lengthy expressions in special functions, and the exposition is lucid and interesting. This gives the book a most attractive and enticing appearance, and I'm certain that many readers who browse through it will wish to buy a copy. The exercises, ninety-one in total, are excellent. They contain many interesting results, but at the same time look 'doable' – in contrast to the exercises in Lighthill's book *Waves in Fluids* (Cambridge University Press, 1978), which are surely too difficult for many people, and in contrast to Whitham's book *Linear and Nonlinear Waves* (Wiley, 1974), which contains no exercises at all. The discipline imposed on the authors of being required to set tractable examination questions year after year at Oxford, subject to the constraint that the questions must be of educational value for future research workers, has here paid handsome dividends in leading to a valuable resource. A beginner who worked through these exercises would not only enjoy himself or herself, but would rapidly acquire mastery of techniques used over and over again in *JFM* and many other journals besides.

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