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REVIEWS

Principles of Continuum Mechanics. By M. N. L. NARASIMHAN. John Wiley & Sons, 1993. 567 pp. ISBN 0 471 54000 5. £48.95.

The balance of this book is strongly affected by the author's view that the occurrence in continuum mechanics of 'materials and boundary conditions involving a curvilinear geometry' necessitates the use of general tensors. The consequent development of tensor algebra and analysis fills 210 pages and the breadth of treatment of these chapters is maintained in an account of the Kinematics of Deformation occupying 89 pages. In the second half of the book, coverage of the basic principles is completed in chapters on The Stress Concept and the Thermomechanical Balance Laws (31 pages) and A Thermodynamic Approach to Constitutive Equations of Simple Materials (34), after which there are four chapters on particular types of continua. Two of them are devoted to Selected Topics in Elasticity (40) and Fluid Mechanics (61), and the last two (64) reflect the author's interest in generalized continuum mechanics, emphasizing particularly the theory of micropolar continua and its application to liquid crystals. The book opens with a short chapter on Basic Concepts of the Theory of Continuous Media and ends with a Bibliography.

The structure of continuum mechanics is clean and aesthetically pleasing and this is a compelling reason for presenting the subject as cogently and economically as possible. In the present book the scale of the preliminaries is oppressive and the exposition of continuum theory is beset by heavy symbolism, cumbersome derivations and well-meant but ill-focused commentary. It has been evident for 20 years or more that direct vector and tensor notations, supported where necessary by calculations in Cartesian coordinates, provide a natural and sufficient vehicle for the development of continuum theory. The greatly increased elaboration of Narasimhan's treatment exacts a high price for a modest increase in generality. In the last four chapters the only problems with curved boundaries involve an elliptical hole, in the context of linear isotropic elasticity, and viscous flow in a circular cylinder or annulus. These are poor advocates of the author's methodology.

One would expect a concern for generality to be accompanied by high standards of mathematical precision and rigour. Unfortunately, this is not the case and inadequacies in the provision of analytical details are especially regrettable. In continuum mechanics the specification of smoothness requirements is not a side-issue which can be left to the fastidious. The basic field equations are valid only if the functions involved are smooth enough: otherwise the results take a different form. The 'axiom of locality' used to derive field equations in Chapter 5 is a misleading nonsense, mystifying a simple and rigorous mathematical procedure. Other instances abound of the unsure and clumsy handling of mathematics: even the implicit function theorem is incorrectly stated.

Despite its recent date of publication, the book is only superficially modern. Over 80% of the references listed in the Bibliography are at least 20 years old and the latest entry to receive more than passing mention in the text appeared in 1976.

In sum, the approach to continuum mechanics favoured in this book is founded on a dubious premise and its development has serious shortcomings. The only distinctive feature is the inclusion of generalized continua, but the discussion is not substantial enough or sufficiently representative of contemporary work to deserve recommendation.

P. CHADWICK

SHORTER NOTICES

Hydrodynamics. By H. LAMB. Cambridge University Press, 1993. 738 pp. ISBN 0 521 45868 4. £19.95 or $17.95.

Lamb's *Hydrodynamics* is a nonpareil of our discipline, and it is enough to say here that the present, paperback reprint of the sixth (1932) edition differs from the Dover paperback only in price and in the addition of a nine-page historical essay by Russel E. Caflisch. This review is competently done and not without pedagogical value, although in some respects it suffers by comparison with Leslie Howarth's graceful and evocative 'One Hundred Years of Lamb's Hydrodynamics' (*J. Fluid Mech.* vol. 90, 1979, pp. 202–207) to which no reference is made. The UK price of £19.95 seems anomalously high *vis-a-vis* $17.95 in the US, presumably because the competition from Dover at $16.95 keeps the latter price down. Still, it is fitting for Cambridge to reprint, and even at £19.95 Lamb remains a best buy that deserves a commanding position on the shelves of every student of fluid mechanics.

Large Eddy Simulation of Complex Engineering and Geophysical Flows. Edited by B. GALPERIN and S. A. ORSZAG. Cambridge University Press, 1993. 600 pp. ISBN 0 521 43009 7. £50 or $74.95.

Large-eddy simulations (LES) are numerical simulations of the spatial and temporal motion fields of turbulent flows using discrete approximations that resolve the energy-carrying turbulent motions while modelling the fluxes carried by small-scale motions. This concept, which has been developed mainly since 1970, has reached a stage of development that makes it useful for a wide range of turbulent flows, with growing (but still limited) applicability to complex engineering and geophysical applications. The book contains the papers which were presented by an international group of experts at a workshop on 'Large Eddy Simulation: Where Do We Stand?', in 1990 at St Petersburg, Florida. The 27 extended, revised and well-edited contributions cover four topics: fundamentals; applications in engineering (incompressible, compressible and reacting flows); simulations in geophysics (atmospheric sciences, physical oceanography, and environmental flows); and LES on massively parallel computers (still at preliminary stage). The book starts with some interesting historical remarks by J. Smagorinsky, one of the founders of LES: he proposed what we today call the Smagorinsky model for subgrid-scale closure. Several further papers give an excellent overview on the state of the art in 1991, with several interesting application examples.

Hydrodynamics of Ship Propellers. By J. P. BRESLIN and P. ANDERSON. Cambridge University Press, 1994. 559 pp. ISBN 0 521 41360 5. £60.

As well as covering the flow around propellers the book deals with the hydrodynamic forces and moments which a propeller exerts on its shaft and on the ship hull. Relevant hydrodynamics and mathematical results are included in order that the book may be used as a university course text, a guide for self-tuition and a reference book for ship design. The development of the subject starts with flow due to distributions of singularities and proceeds through various topics on hydrofoils before a discussion of cavitation. Various models of propeller flows are discussed including many practical aspects such as the influence of the hull's wake, and intermittent cavitation. There are many comparisons between theory and experiment, and although the book appears to be remarkably comprehensive the authors indicate areas where further study is needed.

Pressure Surge in Pipe and Duct Systems. By J. A. SWAFFIELD and A. P. BOLDY. Ashgate Publishing Co., 1993. 358 pp. ISBN 0 291 39796 4. £55.

Unsteady fluid flow in pipes is the major topic of this book. There is an account of the history of its study followed by a summary of the major topics. The basic differential equations are derived and the characteristics and their importance discussed. Pipe networks and the various devices, such as pumps, valves etc., that may be found on a network are then modelled to give full sets of equations and boundary conditions. There is frequent mention of aspects related to computation of solutions and illustrations from such solutions. The topics of trapped air and of cavitation are dealt with. Although the book does not go so far as to discuss two-phase flow, there is a substantial chapter on flows in sloping pipes with a free surface. There is a chapter on surge control and suppression, and some Fortran programs are given.

Ship Hydrodynamics, Water Waves and Asymptotics: Collected Papers of F. Ursell, 1946–1992. World Scientific, 1994. Vol. I, 568 pp.; Vol. II, 408 pp.

These two volumes reproduce all the papers published by Fritz Ursell, Emeritus Professor of Applied Mathematics in the University of Manchester. The papers are in four groups, the first, which occupies the whole of Volume I, being papers on 'Ship hydrodynamics and linear theory of water waves'. The next three groups, in Volume II, are labelled as 'Aerodynamics and acoustics', 'Mathematical methods', and 'Oceanography'. Each group is accompanied by some interesting comments on the more important papers, explaining their origin and purpose and associated unresolved issues. A festschrift which marked Professor Ursell's retirement in 1990 was reviewed in *J. Fluid Mech.* vol. 251, 1993, p. 722.

Mixing and Transport in the Environment. Edited by K. BEVIN, P. C. CHATWIN and J. MILLBANK. Wiley, 1994. 458 pp. £75.

This is a memorial volume for Catherine M. Allen (1954–91), who was interested in the physical mechanisms of mixing and transport in the environment, particularly the water environment. Her research had a breadth of scope which is reflected in this collective work. Fresh water systems provide the theme for the first eight papers. The colour sonographs presented by Thorpe & Curé from field observations in Loch Ness are particularly eye-catching. Their graph-theoretic interpretations of the field observations typifies the cross-disciplinary character of much of this volume. Tidal systems is the theme for the next nine papers. This includes a comprehensive review by Van Dam of discrete particle simulations of shear dispersion – a topic on which Cath Allen wrote an influential paper (*Proc. R. Soc. Lond.* A, vol. 381, 1982, pp. 179–194). The final five papers are given the collective title 'Developing theories of transport and dispersion'. This includes extensive experimental work conducted by Linden & Simpson on continuous releases of dense fluid from elevated point sources in a cross-flow. Such complex combinations of features arise in many practical applications and require careful demarcation of the different regimes in which a single physical process dominates. Appropriately, three of the papers in this volume have been completed by collaborators in joint work with Cath Allen.

Annual Review of Fluid Mechanics, vol. 27. Edited by J. L. LUMLEY and M. VAN DYKE. Annual Reviews Inc., 1995. 586 pp. $47 in USA, $52 elsewhere.

Here is the list of articles and authors in the current volume of this periodical:

50 years of turbulence research in China, by P.-Y. Chou and R.-L. Chou.
Supersonic jet noise, by Christopher K. W. Tam.
High angle-of-attack aerodynamics, by Gary E. Erickson.
Thermohaline ocean processes and models, by J. A. Whitehead.
Of ocean waves and sea ice, by Vernon A. Squire, John P. Dugan, Peter Wadhams, Philip J. Rottier and Antony K. Liu.
Constitutive equations for polymeric liquids, by R. Byron Bird and John M. Wiest.
Numerical weather prediction, by T. N. Krishnamurti.
Biological–physical interactions in the upper ocean: the role of vertical and small-scale transport processes, by K. L. Denman and A. E. Gargett.
Continuum deductions from molecular hydrodynamics, by Joel Koplik and Jayanth R. Banavar.
Dynamics of Jovian atmospheres, by Timothy E. Dowling.
Solitary waves and homoclinic orbits, by N. J. Balmforth.
Mixing enhancement in supersonic free shear flows, by E. J. Gutmark, K. C. Schadow and K. H. Yu.
Baroclinic instability, by R. T. Pierrehumbert and K. L. Swanson.
The measurement of vorticity in turbulent flows, by James M. Wallace and John F. Foss.
Convection instabilities in nematic liquid crystals, by Lorenz Kramer and Werner Pesch.