J. Fluid Mech. (1995), *vol.* 305, *pp.* 372–375

REVIEWS

Mobile Particle Systems. Edited by E. GUAZZELLI and L. OGER. Kluwer, 1995. 390 pp. ISBN 0 7923 3437 X.

This volume records the proceedings of a NATO Advanced Study Institute held in Corsica in July 1994. As every reviewer knows, it is normally difficult to produce an informative and interesting record of the heterogeneous material presented at an international conference. Readers find such volumes indigestible, and most are simply not read. However, this particular volume is worthy of notice, if only because it reveals the astonishing diversity of phenomena arising from motion of a mixture of two different phases of matter, one of which is a continuous fluid and the other is particulate. In an introductory article which is quite a tour-de-force E. J. Hinch describes in qualitative physical terms the numerous particular cases occurring in nature and industry and the associated phenomena and current attempts to explain them. He groups these particular cases under three headings, namely dispersions of particles in a viscous fluid, fluidized beds of particles with inertia, and granular materials free from any effect of the fluid phrase. There are then 20 specialized articles, 10 under the first heading and five under each of the other two. The authors appear to have tried to describe the present understanding of their chosen topics, and not to have written solely about their own research. The outcome is a readable volume, not a suitable text for students but a useful guide to current research on the strange behaviour of the many dynamical systems composed of mobile particles.

Could the publisher please note that running heads which tell a reader where he is in a volume would be welcome?

G. K. BATCHELOR

Introduction to Nonlinear Science. By G. NICOLIS. Cambridge University Press, 1995. 254 pp. ISBN 0 521 46228 2. £35 (hardback).

This book emerged from lecture courses given by the author at the University of Brussels. Its aim is to introduce the more 'modern', less classical, concepts in nonlinear science to graduate students and researchers in the sciences, applied mathematics and engineering. But this is not a book *about* fluid mechanics and indeed reference to that subject is minimal, in spite of its being a great source of nonlinear problems; exceptionally there is some discussion of thermal convection, but even then the epoch-making paper of Malkus & Veronis is not cited. Perhaps those two authors will feel comforted by being placed in the same class as G. I. Taylor, Brooke Benjamin, Benney, Stewartson, Coles, Donnelly, Mullin, Nishioka, Levchenko, Saffman, H. B. Squire and many others, all of whom have made fascinating and remarkable contributions to the exposure of nonlinear fluid-mechanical phenomena but whose work is not mentioned here.

I would not, however, wish to deter readers of the *Journal of Fluid Mechanics* from taking an interest in and making a study of this book. Many of the nonlinear systems that are discussed, including the complex Ginzburg–Landau equation, play a significant role in fluid mechanics as evolution equations for amplitude and phase of a wave system for example. Thus fluid dynamics lies in the background and the author concentrates quite properly on the mathematical structures and techniques, which are valuable for the mastery and solution of real problems. It is the ubiquitous nature of nonlinear science that plays some part in its universal fascination, as illustrated both by the famous Benjamin–Feir discovery of the side-band instability of Stokes' water waves and by Eckhaus' parallel and independent studies of side-band instabilities for non-conservative systems (such as Taylor vortices and thermal convection). Their work has wide relevance in the sciences.

I believe that this book by Nicolis forms an admirable basis for a course for graduate students of the sciences, engineering and applied mathematics, but not for those who want or need mathematical rigour: the proving of theorems is not the pattern here. The student will gain a good introduction to concepts of phase space, invariant manifolds, mappings, attractors, fractals, chaos and so forth to add perhaps to an armoury of other theoretical and/or experimental techniques. It is a pleasure to recommend this book to readers of *JFM*.

J. T. STUART

Computational Modeling for Fluid Flow and Interfacial Transport. By W. SHYY. Elsevier, 1994. 504 pp. ISBN 0-444-81760-3. Dfl 395.

This monograph commences from the basic concepts of finite-difference discretization methods, goes on to describe some of the techniques currently used in modelling macroscopic effects in fluid flow and concludes with an exposition of numerical methods in interfacial transport.

The first part constitutes a brief review of a few techniques in numerical analysis of differential equations. The approach is descriptive, rather than theoretical, and some of the claims of the reported stability analysis are imprecise. Having said this, much of the material is fundamental to the practice of computing fluid flows and it is put to good use later in the book.

The chapters on fluid flow describe a number of valid contemporary approaches, with an emphasis on pressure-based algorithms. A few modern techniques are presented, in particular the approach of composite grids and total variation-diminishing methods. The exposition is firmly rooted in finite-difference methods, with the exception of a brief description of the technique of finite volumes. This means that perhaps the most powerful modern techniques in the modelling of fluid flow, e.g. finite elements, boundary elements, spectral methods and vorticity methods, are not mentioned at all. In fairness, however, finite differences are distinguished by their ease of application and this monograph presents valuable material in support of this contention.

A. ISERLES

SHORT NOTICES

Nonlinear Oscillations, 2nd Edn. By A. H. NAYFEH and D. T. MOOK. Wiley, 1995. 704 pp. ISBN 0 471 12142 8. $59.95

This second edition appears to be identical with the first edition published in 1979.

Convection Heat Transfer, 2nd Edn. By A. BEJAN. Wiley, 1995. 623 pp. ISBN 0 471 57972 6. £54.

This second edition is a generally updated and revised version of the text first published in 1984.

Introduction to Fluid Mechanics, 4th Edn. By R. W. FOX and A. T. MCDONALD. Wiley, 1994. 781 pp. ISBN 0 471 59274 9. £19.95.

This fourth edition of a text for engineering students differs from previous editions by using SI units.

Modelling of Oceanic Vortices. Edited by G. J. F. VAN HEIJST. North-Holland, 1994. 353 pp. ISBN 0 444 85782 6. Dfl 95.

The 38 self-contained articles in this book are intended abstracts of the lectures given at an international conference at Amsterdam in May 1993. In total they give an up-to-date picture of a topic which is growing rapidly.

Rarefied Gas Dynamics 19. Edited by J. K. HARVEY and R. G. LORD. Oxford University Press, 1995. Two-volume set: 1487 pp. ISBN 0 198 5650 5. £93.

This pair of thick volumes records the 300 papers and 15 invited lectures presented at the 19th International Symposium on rarefied gas dynamics held at Oxford in July 1994.

Scaling Phenomena in Fluid Mechanics. By G. I. BARENBLATT. Cambridge University Press, 1995. 50 pp. ISBN 0 521 46920 1. £3.

This nicely produced booklet contains the text of the author's inaugural lecture on his election to the G. I. Taylor Professorship of Fluid Mechanics at Cambridge. It describes a wide range of physical phenomena to which the concept of 'scaling', or similarity, may usefully be applied.

Exercises de Mécanique des Milieux Continus. Edited by H. DUMONTET, G. DUVAUT, F. LENE, P. MULLER and N. TURBE. Masson, 1994. 223 pp. ISBN 2 225 8446 7. 135 F.

Each of the three parts of this book, on kinematics, linear elasticity, and fluid mechanics respectively, consists of a summary of the governing equations and basic relations followed by a number of exercises. The authors apparently have mathematically trained students in mind. Other students are likely to find the exercises very 'dry'. There are few diagrams showing families of streamlines in the third part, but plenty of algebraic descriptions of fluid flow.

Physicochemical Hydrodynamics, 2nd Edn. By R. F. PROBSTEIN. Wiley, 1994. 400 pp. ISBN 0 471 01011 1. £58.

This second edition of a research monograph is a revised and enlarged version of the first edition published in 1989. The first edition was reviewed in *J. Fluid Mech.* vol. 228, 1991, p. 692.

Theoretical, Experimental and Numerical Contributions to the Mechanics of Fluids and Solids. Edited by J. CASEY and M. CROCHET. Birkhauser, 1995. 848 pp. ISBN 3 764 35139 X. DM 418.

This massive and expensive book is a collection of papers published as a special issue of volume 46 of *Z. Angew Math. Phys.*, 1995. Initially intended as a celebration of Paul Naghdi's 70th birthday it was transformed to a publication in his honour when he died on 9 July 1994. The book contains a biographical sketch of Paul Naghdi (30 pp.), a list of his publications (15 pp.) and 38 articles by colleagues on areas of mechanics which interested him.

Tables for the Calculation of Friction in Internal Flows. By H. R. WALLINGFORD and D. I. H. BARR. Thomas Telford, 1995. 331 pp. ISBN 0 727 72046 5. £45.

This large-format volume gives data concerning the frictional resistance to the flow of incompressible Newtonian fluids in smooth and rough tubes and ducts.

High Reynolds Number Flows Using Liquid and Gaseous Helium. Edited by R. J. DONNELLY. Springer, 1991. 284 pp. ISBN 3 540 97475 X. DM 188.

Liquid and gaseous helium at low temperature have very low viscosities, thereby raising the possibility of a cryogenic wind tunnel in which the Reynolds number of the flow past a model would be large, large enough in particular to simulate flow past large bodies such as aeroplanes. This volume records the papers presented at a conference at Oregon on the use of liquid and gaseous helium to generate flow at high Reynolds number. The emphasis is on the practical aspects of testing under these conditions, not on the results obtained.