

REVIEWS

Particulate Two-Phase Flow. Edited by M. C. ROCO. Butterworth–Heinemann, 1993. 1002 pp. ISBN 07506-92758. £95.

As stated in the Preface, this collection is intended to provide a series of articles (involving 50 authors or co-authors) on ‘Trends for Particulate Two-Phase Flow Research’. The objective was that authors would provide not only the usual type of review material, but would indicate important trends and directions in their respective sub-fields of the field of multiphase flow. There were the additional expectations that format, structure and notation would be standardized amongst the contributions, with each offering an initial section on a review, a second on industrial relevance and a third on future research directions. The book as it exists falls short of these expectations, and any involving the range of material and the diversity of authorship must.

The view of the field taken in this book is extraordinarily broad, encompassing everything from aerosol dynamics through suspensions of neutrally and non-neutrally buoyant particles, sedimentation, emulsions and bubbly flows, fluidized beds, to granular flows. The approaches are equally broad: there are contributions on theory including direct numerical simulation, continuum modelling, and engineering modelling, and experimental techniques ranging from flow visualization, quantitative image analysis, particle-image and Doppler velocimetry, etc. There was an admirable effort made to standardize both the format and the nomenclature throughout the book and for the most part this is successful, even to the point of engaging in ‘bibliographic revisionism’ in changing the titles of published papers when these used nomenclature different than that agreed upon for the texts!

The book is divided into two main parts, *Experiments on Two-Phase Flow Microstructure* and *Modeling and Numerical Simulations*. The titles and authorship of the various chapters are as follows: (1) Techniques for analyzing the behavior of concentrated suspensions, J. Abbott, L. A. Mondy, A. L. Graham, and H. Brenner; (2) Simultaneous imaging of the velocity fields of two phases, X. C. Liu and R. Adrian; (3) Quantitative multipoint measurements and visualization of dense liquid–solid flows using laser induced photochemical anemometry (LIPA), R. Falco and D. Nocera; (4) Magnetic resonance imaging of multiphase systems, J. E. Maneval, R. L. Powell, M. J. McCarthy and K. L. McCarthy; (5) The rheology of concentrated suspensions of non-colloidal particles, A. Acrivos; (6) Measurement of the shear-induced microstructure of concentrated suspensions of non-colloidal spheres, D. Leighton and I. Rampall; (7) Channel flows of granular materials and their rheological implications, H. Ahn and C. Brennen; (8) The effect of particles on the turbulence in a boundary layer, G. Hetsroni; (9) Unsteady motion of dense suspensions and rheological behavior, S. L. Soo and C. Zhu; (10) Finite size effects in fluidized suspension experiments, D. Joseph; (11) Dispersion stability: a thin film model for concentrated colloidal dispersions, D. T. Wasan and A. D. Nikolov; (12) Structure and mechanisms of electro-rheological (ER) fluids, H. Conrad; (13) Periodic liquid–solid flow microstructure in a centrifugal pump, M. C. Roco, T. Cader and O. Masbernat; (14) Aerosol dynamics, R. Flagan; (15) Formation of uniform precipitates: advances and unresolved questions, C. Zukoski; (16) Analytical modeling of multiphase flow, D. A. Drew and R. T. Lahey, Jr.; (17) Dynamics of concentrated colloidal dispersions: statistical mechanical approaches, W. B. Russel; (18) Particle dispersion by organized

turbulent structures, C. Crowe, J. N. Chung and T. R. Troutt; (19) Use of Lagrangian statistics to describe turbulent dispersed flows, T. J. Hanratty and J. L. Binder; (20) Gas–solid flow in pipes, R. Jackson; (21) Expert systems in solids handling, G. Klinzing and S. V. Dhodapkar; (22) Hydrodynamic modeling of circulating and bubbling fluidized beds, D. Gidaspow; (23) Bubble flow in liquid–solid suspensions, L.-S. Fan and K. Tsuchiya; (24) Liquefaction and solidification, H. Kytomaa; (25) Numerical simulation of inelastic, frictional particle–particle interactions, O. R. Walton; (26) Stokesian Dynamics simulation of particulate flows, J. Brady; (27) Numerical simulation of suspension flow on high performance computers, S. Kim and Y. O. Fuentes; (28) Numerical simulation of the motion of particles at large Reynolds numbers, A. S. Sangani and A. Prosperetti.

While I cannot claim to have read the entire book, I did read approximately half the chapters in detail and skimmed the remainder. As a result of the breadth of vision, there is an inevitable diversity in emphasis, quality and relevance to two-phase flow represented in the various chapters. Some, such as Chapters 2, 4, 6, 7, 8, 12, 17, 18, 25 and 26 are excellent and achieve the objectives set by the editor. Others, notably Chapters 1, 10, 11, 13, 15 and 28 are very highly specialized and in many cases emphasize only the authors' own work and particular point of view at the expense of a treatment that might be either more balanced or of more general interest. In addition, there are many contributions (Chapters 3, 5, 9, 16, 22 and 23) on subjects that have been well-discussed in readily available reviews (such as those to be found in *Ann. Rev. Fluid Mech.*), handbooks, or research monographs that one wonders about the need to include them here. Finally, as in any collection of this length and breadth, there are the odd Chapters (15, 21 and 27) that have little fluid mechanics in them and are peripheral to the main thrust of the book.

Two of the often-heard justifications for collections such as this on multiphase flow are: (i) multiphase flow is truly interdisciplinary and such collections allow physicists, applied mathematicians, and engineering scientists – including chemical, civil and mechanical engineers – to become aware of advances in other disciplines, and (ii) such collections allow the unity of the subject to become apparent and to be exploited. While the former is generally true, the latter may be only to a limited extent. It is this reviewer's opinion that this book pushes the latter point of view to the limit, encompassing as it does such topics peripheral to multiphase flow such as the chemistry of dyes, data structures for parallel computation and particle growth under quiescent conditions, as well as flow problems as diverse as aerosol dynamics and granular media, in which the hydrodynamic coupling between phases is either non-existent or of tertiary importance in determining flow behaviour. It is an unlikely and unusually broad reader who will find a significant fraction of the topics in this book of interest. Even if that were the case, the diversity of style, quality and depth of coverage in the various chapters make it difficult to recommend this book for a personal collection, as it would be better served by any of the more focused treatments of particular topics of interest. However, the diversity of topics covered in the book make it a useful addition to any library for which a significant holding in multiphase flow is important.

G. M. HOMSY

Stories from a 20th-Century Life. By WILLIAM REES SEARS. Parabolic Press, 1994. 292 pp. ISBN 0-915760 04 5, \$12 (paperback), \$22 (Hardback).

This is a most unusual book to be reviewed between the covers of the *Journal of Fluid Mechanics*. This is quite clear as soon as one removes it from its packing envelope. The

front cover is dominated by a caricature of Professor Sears; glasses, prominent chin, wispy hair and wry, crinkly smile, all the features those who have met him will have no difficulty in recognizing. While there are some very interesting technical tit-bits tucked away in its pages the author's real purpose is to discuss not only his own life as a practitioner of the art and science of fluid mechanics but to introduce us also to the lighter, and sometimes the not-so-light, side of many of the people he has met and with whom he has worked during his more than sixty years in the 'front-lines'. Up to this time I cannot remember reading in this journal a review of a book that had such an aim in mind. Perhaps there should be more. A listing of the names involved would immediately make it clear that he is discussing some of the most famous scientists to have graced the subject over the past half-century or so, and while he treats them all with respect he is not above pointing out some of the foibles. He is well known as a raconteur of hundreds of amusing and often revealing anecdotes about his friends and acquaintances, and as he states 'some of them may even be true!' To this end he has developed, or more likely was born with, an uncanny ability to remember the minutest details of people and places many years after the fact. Coupled with this he has the force of personality to be able to recount these events to a wide, usually rapt, audience in clever and amusing ways, and as he states in the Introduction, the best of them also 'make a point'. His timing is usually impeccable. As the reader will have already realized this reviewer is one of his fans and suggests that you could do far worse on a rainy afternoon than to curl up in your favourite chair and swallow this book in two or three hours of light reading. No equations, no diagrams, no exercises for the reader, just good fun.

To those of you who do not know Professor Sears my advice would be to skip the first two chapters on his early life up to his entry into Caltech as a graduate student in 1934, since most of this material is probably not of general interest. At this point we are introduced for the first time to the subject of the majority of the, sometimes-true, anecdotes, Theodore von Kármán. Later the whole of chapter 8 is devoted to this subject including my favourite story concerning the 'urgent' message that von Kármán once received but did not open for a long time because it was, after all, only the sender who thought it urgent! A revealing glimpse of the von Kármán personality! Here we read vignettes about Clark Millikan, the Clauser twins, H.-S. Tsien, Hans Wolfgang Liepmann among many others and, of course, meet Mabel Rhodes, von Kármán's secretary, who eventually became Mrs Sears. There are even some provocative remarks concerning his contacts with Richard Feynman. Professor Sears went on to teach at Caltech for a short time before joining the Northrop Corporation during the Second World War. There he was involved in the design of the P-61 'Black Widow' and the XB-35, the famous 'Flying Wing'. Chapters 6 and 7 are devoted to the years Professor Sears spent as Head of the Graduate School of Aeronautical Engineering at Cornell University. The stories become very dense at this point with many well known fluid dynamics personalities involved, among many Nicholas Rott, Arthur Kantrowitz and George Batchelor. Chapter 9 is devoted to Professor Sears' great recreational passion, flying, which he only recently gave up at the age of eighty two! Finally in 1974 or so Professor Sears started his next, and likely not final, career as a Professor at The University of Arizona where I am sure he is still a major force.

I think it is clear by now that I believe as many people as possible should read this entertaining book. For a change price is unlikely to be a consideration. At \$12 for the paperback edition it is one of the true bargains extant, thanks to the ingenuity and foresight of the publishing house, The Parabolic Press, operated by Professor Milton

Van Dyke, recently retired from Stanford University, one of whose other listings is the widely studied and appreciated *An Album of Fluid Motion*.

TONY MAXWORTHY

SHORTER NOTICES

Convective Boiling and Condensation (3rd Edn). By J. G. COLLIER and J. R. THOME. Oxford, 1994. 596 pp. ISBN 0 19 856282 9. £90.

The text of the third edition of this well-known book has been expanded considerably since the publication of the first edition in 1972. Nevertheless, the structure remains the same, concentrating for the greater part on empirical approaches to the many and diverse aspects of convective boiling. Boiling heat transfer is a complex process and does not respond well to mathematical analysis but the plant designer still requires a methodology and accurate data for the specification of heat transfer equipment. This book was originally written to supply that need and the third edition perpetuates the tradition by updating where necessary and incorporating relevant research from the last decade. In this respect the coverage is very complete but the more analytically minded engineer who might be seeking greater physical understanding of the boiling process itself should be warned that he is unlikely to find it in this book. The empiricism is laid on thick and fast and correlations from the literature are often quoted with little or no explanation of the underlying physics which (presumably) led to their formulation.

Despite the title, this is a book predominantly about boiling rather than condensation (a topic which, interestingly enough, responds much better to mathematical analysis). The single chapter devoted to film and dropwise condensation has remained largely unchanged from the first edition despite a substantial research effort in the intervening years which is barely mentioned. A chapter on multicomponent boiling and condensation has been added, however, and this provides a good introduction to an increasingly important field.

Marine Light Field Statistics. By R. E. WALKER. Wiley, 1994. 675 pp. ISBN 0 471 31046 8 £74.

Marine light field statistics might appear to be a rather specialized topic, but it forms an important part of a much wider subject with many practical applications. This subject is the interaction of electromagnetic radiation with the sea surface, and the present book deals with natural sources such as the sun and clear or clouded skies. The author first introduces some of the basic concepts and methods used in the field and then passes to an exposition of radiative transport theory. The effect of the atmosphere on light is discussed fully, and so too are the various scattering and absorption effects that occur naturally. Light can penetrate to some depth in the ocean and the optical properties of sea water are considered in detail. Other specialized topics covered include sun glitter, and the radiometry of clear and clouded skies. There are also chapters on subjects of key importance in the wider field. Sea surface statistics is dealt with at length in one chapter and the statistics of refracted light in another. The final chapter discusses the complicated phenomenon of wave-breaking and white caps. These more general topics are central to studies of the operation of sea-borne radars and lasers, radio communication close to the sea surface, and remote sensing of the ocean, both active and passive, from aircraft and satellites. The text is clearly written and the author gives

numerous references to literature in the field. The reader who wishes to enter the specialized area of marine light fields will find this volume an excellent guide. Moreover, the broader perspective given by the full treatments of the more general topics will be welcomed by those working in related fields.

Hydraulics in Water and Waste-Water Treatment Technology. By I. HORVÁTH.
John Wiley & Sons, 1994. 319 pp. ISBN 0 471 94422 X. £36.95.

The subject of this book is the flow of polluted water through the various components of water and waste treatment plants. These are for the treatment of almost pure water to achieve potable quality and for the equally important treatment of sewage and other wastes to extract solids and colloids of various types in order to enable a discharge of liquid that is, to some extent, environmentally friendly. The approach of the book is entirely practical, the general context is not touched upon. The topics are ordered into Mechanical, Chemical and Biological Treatment, with the first twice the length of the other two combined. A large part of the Mechanical Treatment section concerns settling and filtering of particles, flocs and oily drops. In line with the book's title, the sections on Chemical and Biological Treatment also have much hydraulic detail of flow through filtering equipment, etc. but aspects related to the various reactions within the equipment are also included. For major topics there is a brief survey of hydrodynamic aspects, before a descriptive account of flows and the equipment. This includes the presentation of formulae and curves together with some statements on best practice.