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REVIEW

Waves on Fluid Interfaces. Edited by R. E. MEYER. Academic Press, 1983. 359 pp. $25.00.

This collected work consists of fifteen invited addresses given at a Madison Research Center Symposium during October 1982.

P. G. Saffman ('Finite-amplitude interfacial waves') and H. C. Yuen ('Instability of finite-amplitude interfacial waves') both consider waves at the interface between unbounded inviscid fluids which have differing mean horizontal velocities. Though sufficiently short waves exhibit Kelvin–Helmholtz instability, they mainly study the nonlinear dynamics of longer, linear-stable waves. Some new results are given, along with a brief review of cases with zero mean flow (but Saffman's remarks on negative-energy waves are unoriginal). J.-M. Vanden-Broeck ('Finite-amplitude water waves with surface tension') and G. R. Baker ('Generalized vortex methods for free-surface flows') describe analytical and numerical methods for inviscid, large-amplitude disturbances; the former discusses waves of permanent form while the latter considers growing disturbances in gravitationally unstable or accelerating liquid layers. 'A review of solution methods for viscous flow in the presence of deformable boundaries', by L. G. Leal, mainly concerns motion of a droplet or particle near a fluid–fluid interface at small and moderate Reynolds numbers.

An enjoyable short piece by P. Concus, 'On existence criteria for fluid interfaces in the absence of gravity', describes equilibrium configurations in partially filled containers, under the action of surface tension only. Surprising results for cylindrical containers with polygonal cross-sections are borne out by experiment. H. T. Davis, on 'Capillary waves and interfacial structure', develops an approximate gradient-theory approach to determine molecular-scale interfacial structure, in the presence of thermally generated capillary waves. M. W. Kim, J. Bock and J. S. Huang examine small-scale 'Interfacial and critical phenomena in microemulsions' by optical scattering. J. Melcher focuses on 'Electrohydrodynamic surface waves' and instabilities in liquid layers, with applications which include printing by ink jets and droplets.

T. Maxworthy reviews observations of 'Solitary waves on density interfaces' in laboratory, sea and atmosphere, with emphasis on the effect of rotation. T. J. Hanratty ('Interfacial instabilities caused by airflow over a thin liquid layer') and S. P. Lin ('Film waves') look at waves and instabilities in thin viscous layers: the former mainly discusses linear instabilities with approximately represented variable wind stresses, while the latter emphasizes weakly nonlinear theories for waves in liquid films flowing down an incline. It seems that no adequate theory yet exists for wave amplitudes comparable to film thickness. S. Davis describes a somewhat speculative model for the spontaneous 'Rupture of thin liquid films' on rigid boundaries: this incorporates a notional depth-dependent body force attributed to intermolecular forces.

E. B. Dussan V. reviews work on 'The moving contact line' at solid–liquid–gas junctions with emphasis on the validity, or otherwise, of the no-slip condition and on the resolution of the contact-line singularity which occurs in most theoretical models. The volume concludes with an account by S. Weinbaum of mathematical models of transfer processes across 'The endothelial interface between tissue and blood'.

Papers are reproduced from camera-ready typescripts in differing typefaces. Diagrams and photographs are well reproduced and each article provides a list of references. There is an index and a light sprinkling of misprints.

As with all such collections, the quality of contributions is uneven. Such new work as is presented will doubtless appear also in appropriate journals. A few of the reviews are too condensed or partial to be of much help to the reader wishing to enter a new field. Though each topic treated concerns some aspect of fluid interfaces, the range is wide. Accordingly, most readers of this journal should find something of interest. The book presents an interesting selection but no authoritative overview.

A. D. D. CRAIK

SHORTER NOTICES

Collocation Techniques for Modeling Compositional Flows in Oil Reservoirs. By MYRON B. ALLEN. Springer, 1984. 210 pp. DM 38.00 (soft cover).

This book is the sixth volume in the Springer *Lecture Notes in Engineering* series. It contains an extended account of a numerical method for modelling multiphase, multicomponent flows in porous media. The method is intended for the simulation of tertiary oil recovery processes by miscible gas flooding. A number of one-dimensional simulations of such flows are presented as illustrations of the use of the method.

Current commercial reservoir simulation programs, without exception, use finite-difference methods to solve the partial differential equations of fluid flow. At each timestep a set of algebraic equations is solved to obtain the thermodynamic properties of the reservoir fluids. In contrast, Allen here proposes the use of a finite-element collocation technique for the spatial discretization, and the initial construction of a database from which the fluid thermodynamic properties can be obtained by interpolation. To ensure stability in these convection-dominated flows, a modified collocation method with upstream weighting is introduced. The use of finite elements offers greater accuracy than finite differences, while the thermodynamic interpolation saves a great deal of computer time.

This book will be of interest to workers concerned with numerical modelling of oil reservoirs. The wider question, of whether the mathematical models used (multiphase Darcy's law and local thermodynamic equilibrium) are faithful representations of the physical mechanisms acting, is not addressed.

Convection in Liquids. By J. K. PLATTEN and J. C. LEGROS. Springer, 1984. 679 pp. DM 180.

This hardback volume, produced from camera-ready copy, is divided into four parts. In Part A (chapters I and II) the physical laws necessary for the study of convection are introduced and many pertinent numerical techniques are described. Part B (chapters III–V) covers the topics of planar and cylindrical flows of Newtonian fluids and the flow stability of non-Newtonian fluids. Non-isothermal one-component systems are discussed in Part C (chapters VI–VIII): more specifically, chapters VI and VII cover free and forced convection respectively, and chapter VIII covers mixed convection. Finally, in Part D (chapters IX and X) both free and mixed convection in multicomponent fluids are discussed.

The authors are disciples and collaborators of the Brussels school of thermodynamics. They give the reader a good introduction to three aspects of convection research:

experimental, numerical and theoretical, but the main emphasis is numerical. For example, chapter VI contains a thorough treatment of the Bénard problem: laboratory methods are demonstrated, numerical results such as the calculation of critical Rayleigh numbers are presented, nonlinear results are presented at length, and a section on the Lorenz equations and chaos is also included.

The authors do not assume much previous knowledge of convection and the volume is well presented and easy to read. Despite many misprints (including one on the spine) and the lack of an index, this work could be recommended to anyone working in the field of convection.

Mesoscale Meteorology – Theories, Observations and Models. Edited by D. K. Lilly and T. Gal-Chen. D. Reidel, 1983, 781 pp. Dfl. 220.00.

This volume is based on lectures given at the NATO Advanced Study Institute on Mesoscale Meteorology – Theories, Observations & Models, held in France in July 1982. Mesoscale in this context is taken to refer to weather events on scales of 10–1000 km. Topics covered include regional and cyclonic scale motions, fronts, mesoscale instabilities, buoyancy waves and topographic forcing, buoyant convection, boundary layers and observing technology. There are substantial contributions by Joanne Simpson (cumulus convection), F. Sanders (synoptic-scale forcing of the mesoscale, observations of fronts, prediction of severe convection), K. A. Emmanuel (symmetric instability, cumulus interaction with large scale), D. K. Lilly (nonlinear waves, dynamics of rotating thunderstorms), and J. C. Wyngaard (planetary boundary layer), together with joint papers by A. Buzzi and A. Speranza (lee cyclogenesis) and M. J. Miller and M. W. Moncrieff (simulation of organized deep convection).

Low Reynolds Number Flow Heat Exchangers. Edited by S. Kakaç, R. K. Shah and A. E. Bergles. Hemisphere, 1983, 1016 pp. DM 310.00.

In 1983, on the one-hundredth anniversary of the publication of Graetz's pioneering paper on heat transfer in laminar flow, the fourth NATO Advanced Study Institute on heat transfer was organized as a forum for presenting state-of-the art papers on heat transfer in laminar and low-Reynolds-number turbulent flows. The meeting was primarily a high-level teaching activity for scientists, engineers and graduate students and this volume represents the archival record of the communications.

Topics covered include the fundamental and hydraulic aspects of laminar forced convection, low-Reynolds-number turbulent, and laminar non-Newtonian flows. Traditional heat exchanger geometries are considered in detail (flow inside tubes and over tube bundles, gravity flow over vertical and horizontal tubes), but there are also articles describing sophisticated numerical techniques capable of computing flows in more complex situations. After a general review of heat exchanger design methodology, compact and non-compact exchangers are treated in some detail and additional topics include heat-transfer augmentation and fouling of equipment.

Taken as a whole, the volume comprises a very complete and up-to-date reference work and will surely fulfil its stated objective of stimulating research in this very important area of engineering design.

Heat and Mass Transfer in Rotating Machinery. Edited by D. E. METZGER and N. H. AFGAN. Hemisphere, 1984, 713 pp. DM 198.00.

This volume comprises the Proceedings of the Fourteenth Symposium of the International Centre for Heat and Mass Transfer, held in Dubrovnik, Yugoslavia in September 1982. The papers cover a wide range of engineering applications with an emphasis on heat, rather than mass, transfer. For publication they have been grouped under the following headings: Rotating Tubes and Channels (6 papers), Rotating Surfaces and Enclosures (11 papers), Experimental Techniques (8 papers), Gas Turbines (10 papers), Steam Turbines (6 papers), Rotating Heat Pipes and Thermosyphons (6 papers).

As might be expected, heat-transfer problems in gas turbines formed the main preoccupation of the Symposium and there are a large number of papers concerned with the film cooling and internal cooling of turbine blades. The cooling of turbine disks and flows in seals and bearings are also well represented. The section on steam turbines is concerned with wetness phenomena and includes interesting papers on the prediction of blade erosion and the effect of impurities on the spontaneous nucleation of water droplets from the vapour.

Apart from turbomachinery, other applications include the cooling of large electrical generators, particular attention being directed to the effects on heat transfer of the secondary flows resulting from the centrifugal and Coriolis forces. Finally the section on rotating heat pipes introduces some novel ideas in the application of heat-pipe technology to the cooling of gas-turbine blades, electric motors and braking systems.