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REVIEWS

The Physics of the Earth's Core: An Introduction. By PAUL MELCHIOR. Pergamon Press, 1986. 256 pp. £14.75 (paperback).

With this book the author successfully achieves his stated objective 'to offer (geodesists and other non-specialists) a kind of reference syllabus, or a key to a better understanding of the best theoretical papers in geophysics'. He does it by clearly and concisely summarizing many of the essential physical ideas required for an understanding of the Earth's core.

The book commences with a section entitled 'The Model of the Earth', which outlines what is currently known about the shape, rotation and internal structure of the Earth. The next section introduces the main thermodynamic variables and the relationships between them, in particular the Wiedemann–Franz law, the Grüneisen parameter, the Clausius–Clapeyron equation and Lindemann's law of fusion. Hydrodynamics is the subject of the third section, which at 69 pages is the longest in the book. It begins by deriving the continuity and Navier–Stokes equations, and goes on to cover dimensionless parameters, geostrophic flow, Taylor columns, the Boussinesq approximation, the β-plane formulation, the Greenspan and Poincaré equations, internal gravity waves, turbulence, boundary layers, spin-up, and convective instability. The next section introduces Maxwell's equations before focusing on the Earth's magnetic field and the magnetohydrodynamic theory relevant for understanding its generation. Both the $\alpha\omega$- and α^2-type dynamo models are discussed, as is the use of 'null flux curves' to place constraints on the motion of the core near the core–mantle boundary. The fifth and final section reviews the possible kinds of waves, energy sources and boundary layers in the core. Two important topics that it correctly emphasizes are core–mantle coupling, which can be inertial, viscous or magnetic, and compositional convection, which is driven by the release of light melt during the growth of a pure Fe inner core from an alloyed outer core.

The book has many positive features. In particular it is well typeset, with key equations presented in boxes, and it contains a large number of instructive figures. Additionally, a substantial bibliography is provided at the end of each section, and an appendix is included which helpfully contains estimates of many physical properties of the Earth. My main criticism is that readability is sometimes impaired by the book's casual disregard for punctuation, a not insignificant number of typographical errors, and an occasional failure to define variables.

In conclusion I commend the author for producing an informative reference which will be valued by many students and researchers involved in the exciting study of the Earth's core. Although the book is too brief to provide a thorough introduction to either thermodynamics, fluid mechanics or magnetohydrodynamics, or to review comprehensively recent research on the core, its excellent bibliographies list books and papers which do. The book will also prove useful to lecturers preparing introductory courses on the physics of the Earth's interior.

R. C. KERR

SHORTER NOTICES

Annual Review of Fluid Mechanics, Vol. 20. Edited by J. L. LUMLEY, M. D. VAN DYKE and H. L. REED. Annual Reviews Inc., 1988. 551 pp. $34.00 ($38.00 outside USA).

The titles and authors of the articles in this year's *Annual Review* are as follows:

The First Turbulence Measurements: A Tribute to Hugh L. Dryden, by A. M. Kuethe.
Fractals in Fluid Mechanics, by D. L. Turcotte.
Adaptive Wind Tunnels, by W. R. Sears and J. C. Erickson.
Multiphase Flow in Porous Media, by Pierre M. Adler and Howard Brenner.
Fluid Models of Geological Hotspots, by John A. Whitehead.
Remote Sensing of the Sea Surface, by O. M. Phillips.
Stokesian Dynamics, by John F. Brady and Georges Bossis.
Initial Stage of Water Impact, by A. A. Korobkin and V. V. Pukhnachov.
Magnetic Fields in the Solar Convection Zone: Magnetoconvection and Magnetic Buoyancy, by D. W. Hughes and M. R. E. Proctor.
Hamiltonian Fluid Mechanics, by Rick Salmon.
Surf-Zone Dynamics, by J. A. Battjes.
Sand Transport on the Continental Shelf, by K. R. Dyer and R. L. Soulsby.
Foam Flows, by Andrew M. Kraynik.
Instability Mechanisms in Shear-Flow Transition, by Bruce J. Bayly, Steven A. Orszag, and Thorwald Herbert.
Compliant Coatings, by James J. Riley, Mohamed Gad-el-Hak and Ralph W. Metcalfe.
Digital Image Processing in Flow Visualization, by Lambertus Hesselink.
Secondary Instability of Boundary Layers, by Thorwald Herbert.

Readers will note the usual mix of fundamental topics together with a wide range of applications. This year's volume is embellished with a holographic representation of a co-flowing jet eddy (in the article by Hesselink), the interpretation of which can be entertaining.

Transport of Suspended Solids in Open Channels. Edited by W. BECHTELER. Blakema, 1986. 268 pp. £35.

This volume comprises the Proceedings of a European Mechanics Colloquium held in Neubiberg, F.R.G., in June 1985. It contains a selection of 39 papers, in camera-ready form, on a variety of topics related to the Colloquium's theme by authors from 13 different countries. The book is structured into six major sections covering particle-fluid dynamics (7 papers), concentration distribution in steady flow (8 papers), reservoir sedimentation (6 papers), sediment resuspension (8 papers), sediment transport in unsteady flow (2 papers) and special topics including instrumentation (8 papers). With one exception, all the papers are devoted to the study of non-cohesive sediments. Also most of the papers refer to idealized flow situations covering rectangular basins and uniform, regular sectioned channels.

As would be expected in a volume of this kind, the quality of the individual papers varies considerably. There are no particularly notable contributions, with a number just being abstracts of previously published work. Also, the average of six printed pages per paper allows little scope for the authors to develop their subject.

Consequently, unless the reader is already familiar with the detail of the subject of a particular author, it is often difficult to determine what specific point the author is trying to make. In some instances brevity is taken to extremes, making the resulting contribution of little value. If the quality of all the papers were up to the standard required for publication in the recognized journals in this field, then there would be a good case for bringing them together in book form rather than letting them be scattered throughout a number of journals appearing at various times. Unfortunately, they are not all of such quality.

Environmental Hydraulics: Stratified Flows. By F. Bø. PEDERSEN. Springer, 1986. 278 pp. DM 58.

This volume of lecture notes discusses the principles behind those stratified flows that arise frequently in hydraulically treated environmental problems. The fluid part, of 23 pages, considers immiscible stratified flows. The second part, of 120 pages, presents a fairly comprehensive description of miscible flows with special chapters on dense bottom currents and vertical buoyant jets and plumes. The third part reprints eight papers by the author and one by F. A. Engelund, published over the last 15 years, which are included in order to depict the type of problems that can be solved by the author's approach. Almost all come from specific consultancy situations.

Tables of Progressive Gravity Waves. By J. M. WILLIAMS. Longman, 1985. 640 pp. £50.

The first 46 pages of this book present a brief introduction to the theory and mathematical formulae describing one of the oldest problems in fluid mechanics. This is the motion of an infinite train of uniform finite-amplitude progressive gravity waves on the free surface of an inviscid liquid of uniform undisturbed depth. The remainder of the book presents tables and two microfiches of a variety of properties such as displacements, velocities and accelerations of progressive waves of both infinitesimal and finite amplitude.

The Visual Display of Quantitative Information. By EDWARD R. TUFTE. Graphics Press, 1983. 197 pp. £20 or $34.

This instructive and entertaining book is about the presentation of data and the achievement of graphical excellence, defined as 'that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space'. It is nicely printed and set out, and drives home its points by reproducing many examples of data presentation, good and bad. The first part of the book reviews the development of graphical practice since the time of William Playfair (1759–1823), one of the first to see the value of replacing the conventional tables of numbers with systematic visual representations. Many examples are provided to show that graphics can be more revealing than tables, as when Dr John Snow plotted the location of deaths from cholera in central London in September 1854 on a map and saw that they almost all occurred among those who drank from a particular street water pump. Visual charts can also be persuasive, and so may mislead a reader if poorly designed, as for example when a journalist seeks to dramatize the change in yearly output of oil by representing each year's output by the size of a barrel without

saying whether the output is measured by the linear dimensions or the volume of the barrel. The second part of the book is more analytical and considers the principles of data graphics and ways in which graphics may be improved. Art and technique and numeracy are involved here, but there is nothing that a scientist cannot read with understanding and appreciation. The author coins the pleasing concept of the 'friendly data graphic' and lists the qualities that make for friendliness. Would that all the figures in this *Journal* had those qualities. Copies of this valuable book may be obtained only by ordering directly from Graphics Press, either at PO Box 8, Godalming, Surrey GU7 3HB, UK or at Box 430, Cheshire, CT 06410, USA.

Numerical Fluid Dynamics. Edited by R. VICHNEVETSKY. North-Holland, 1987. 213 pp. Dfl.200.

Most of the eleven papers in this book were presented at a workshop held at Atlanta, Georgia, in April 1985, and are here reprinted from *Applied Numerical Mathematics*, vol. 3, 1987. Some of the papers are reviews of developments in particular areas of fluid mechanics which have been made possible by numerical simulations and some are about computational techniques. The authors are authoritative and the articles appear to be well written. But like any volume of proceedings of a meeting, the book is a collection of uncoordinated articles and the appeal for a reader will lie in a particular article or two. It is difficult to see the point of republishing articles that have already appeared in a journal.

Polymers in Colloid Systems. Edited by TH. F. TADROS. Elsevier, 1988. 412 pp. US $155.25 or Dfl.295.00.

This volume of proceedings of an international conference held at Veldhoven, The Netherlands, in September 1987 is reprinted from *Colloids and Surfaces*, vol. 31, 1988. The 29 papers reproduced here are mostly concerned with polymer adsorption at interfaces, stability (that is to say, the tendency not to flocculate) of dispersions of small particles in the presence of adsorbing polymers, and the rheology of polymer solutions. There is an emphasis on experiments and experimental techniques.

Annual Review of Numerical Mechanics and Heat Transfer, vol. 1. Edited by T. C. CHAWLA. Hemisphere, 1987. 454 pp. DM158.

Notwithstanding the name, this first volume of a new series is not from the *Annual Reviews* stable although the aims are similar. The volume contains eight separate articles, the authors and titles being as follows:

C. L. Tien & B. L Drolen, Thermal radiation in particulate media with dependent and independent scattering;

G. Comini & S. del Giudice, Pressure–velocity coupling in incompressible fluid flow;

D. J. Evans, New explicit methods for the numerical solution of diffusion problems;

J. I. Ramos, Numerical methods for one-dimensional reaction–diffusion equations arising in combustion theory;

A. Bejan, Buckling flows: a new frontier in fluid mechanics;

S. H. Chan, Numerical methods for multidimensional radiative transfer analysis in participating media;

S. Fukusako & N. Seki, Fundamental aspects of analytical and numerical methods on freezing and melting heat-transfer problems;

F. B. Cheung & T. C. Chawla, Complex heat-transfer processes in heat-generating horizontal fluid layers.

Frontiers of Fluid Mechanics. Edited by SHEN YUAN. Pergamon Press and Peking University Press, 1988. 1265 pp. £140 or $250.

This very large volume reproduces, in camera-ready copy form, the papers presented in English at an international conference on fluid mechanics in Beijing in July 1987. The Chinese organizers of the conference were motivated by the belief that, although there are numerous symposia on specialized topics in fluid mechanics, it would be useful to provide a forum for a cross-sectional review of the discipline as a whole. In the event there were relatively few invited review-type lectures, and these lectures occupy only the first 43 pages. The book is primarily a record of the very large number of contributed papers on highly specialized topics, and a reader – or a listener at the conference – would have to do a good deal of hard work to extract from this profusion of individual contributions a grasp of the current trends, the growing points as distinct from the fashionable areas, and the new ideas. However, since many of the authors of the contributed papers are Chinese, what we in the West can see from the book is the Chinese view of problems in fluid mechanics worthy of investigation at the present time. Apart from some understandable biases, such as an emphasis on rather technical problems arising in practical engineering contexts and an under-representation of topics that demand the use of big computers, the spread of research topics is surprisingly similar to that likely to be found at any other international conference. Despite the short time since the Cultural Revolution stopped most research in China and blocked contacts with foreigners, Chinese research in fluid mechanics appears to be going forward in parallel with the international effort.