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REVIEWS

Non-Equilibrium Thermodynamics and its Statistical Foundations. By H. J. KREUZER. Clarendon Press, 1981. 438 pp. £45.00.

As stated in the Author's preface, 'non-equilibrium thermodynamics is a vast field of scientific endeavour...to cover all this ground thoroughly in one volume is impossible...therefore I have restricted myself to covering a few essential topics in depth.' However, this book, which like so many others before it grew out of a graduate course, is an attempt to cover *nearly* the whole field of the phenomenological theory and the statistical foundations of non-equilibrium thermodynamics – an impossible task to realise in 438 printed pages.

Leaving aside the introductory chapter, the first two chapters (2, 3) are devoted primarily to Prigogine's formulation of phenomenological irreversible thermodynamics. Hence, the Author describes the notion of the local equilibrium and, by virtue of this notion, he introduces the second law of thermodynamics as a direct extension of the equilibrium law. Next, Onsager's linear constitutive equations are discussed and illustrated by a few simple examples. Those chapters cover the material presented in the now classical monographs of S. R. de Groot and P. Mazur (1962) and of P. Glansdorf & I. Prigogine (1971). A brief presentation of stability and fluctuations in the next chapter is based on the latter of these two monographs and on the review paper of R. J. Knops and E. W. Wilkes (1973). Chapters 5 and 6 are devoted to problems of chemical reactions, phase transitions and Bénard convection somewhat as in H. Haken's (1977) monograph. The rather broad presentation of the Bénard problem is only loosely connected with the topic of the book and may be misleading for a student unfamiliar with the problems of non-equilibrium thermodynamics.

Chapters 7–12, forming about two-thirds of the book, are connected with the use of statistical mechanics and kinetic theory in formulating the laws of irreversible thermodynamics. Chapters 7–9 and 11 repeat the material of monographs by G. E. Uhlenbeck and G. W. Ford (1963), P. Resibois and M. de Leener (1977), and J. H. Ferziger and H. G. Kaper (1972). In chapter 7, the Author presents Liouville's equation and the BBGKY hierarchy which are in turn used to derive the macroscopic balance equations and some constitutive laws. It contains also a brief presentation of Boltzmann's equation and its constitutive consequences. Chapter 8 covers similar macroscopic relations derived from the quantum approach. Linear-response theory is presented in chapter 9. Chapter 11 is devoted to the asymptotic properties of thermodynamic relations and the approach to thermodynamic equilibrium. Chapter 10 is a compact presentation of the theory of master equations, which has also been described in, for example, the monograph of I. Oppenheim, K. E. Shuler and G. H. Weiss (1977).

The book can be considered either as a reference book or as a textbook for graduate students. Since a large part of recent research on the thermodynamic theory of materials, as developed in papers starting with Rivlin and followed by Coleman, Mizel, Edelen and Mueller, is not reflected in the book, and many recent references are not listed, it cannot be described as an up-to-date reference book giving a full presentation of the state of the art. The requirements for graduate-course textbooks are of course different and depend largely on the author's taste and the way the associated lectures are presented. As a textbook for more general use, a deeper

coverage of the fundamental topics and a closer connection between the different chapters could be desired.

The printing and reproduction of the involved three-dimensional graphs are of the high standard expected from Clarendon Press.

In spite of its imperfections this book should be available in the libraries where books on physics of material media are collected and consulted.

W. FISZDON and K. WILMANSKI

SHORTER NOTICES

The Theory of Homogeneous Turbulence. By G. K. BATCHELOR. Cambridge University Press, 1982. 197 pp. £6.95.

Readers of the *Journal* will surely welcome the reprinting of this well-known monograph in the new series of Cambridge Science Classics. Although first published in 1953, and although much of the discussion is inevitably outdated by more recent developments, the book remains a standard reference, and a text that all students of turbulence may study with pleasure and profit. Batchelor's reformulation of the Kolmogorov universal equilibrium theory, as presented in chapter VI, remains as lucid and as stimulating now as it was 30 years ago, when it had a profound influence on the development of the theoretical study of turbulence. And as regards the detailed description of the process of the nonlinear energy cascade, we can still echo the closing sentence of that chapter: 'A proper solution of the problem is awaited with great interest.'

Floods Due to High Winds and Tides. Edited by D. H. PEREGRINE. Academic, 1981. 106 pp. £9.40, $19.50.

This short book consists of six papers and two abstracts of lectures presented at a conference at the University of Bristol on 9 January 1980. All the authors work in England and the conference concentrated on the effects of severe storms acting on the shallow seas around Great Britain. Among the topics discussed are numerical models and their meteorological inputs for storm surge predictions and their use in the Storm Tide Warning Service. Other topics include aspects of the fundamental fluid mechanics employed in the numerical models. One paper describes work with specific references to the Thames Barrier currently under construction. A personal account of the conference has been presented by Ferriss in the *IMA Bulletin*, October 1980.

Advances in Fluid Mechanics. Lecture Notes in Physics, Volume 148. Edited by E. KRAUSE. Springer, 1981. 361 pp. DM43, $20.10.

These lecture notes reproduce the opening address and papers presented at a conference in Aachen to inaugurate the new building of the Aerodynamisches Institut. The opening address by F. Schultz-Grunow of Aachen traces the history of the Aerodynamisches Institut and includes a photograph of the participants of a conference held in 1929 to inaugurate the first extension of the Institute. This is followed by a paper on education, training and research in the engineering sciences by H. W. Liepmann of Caltech. The remaining twelve papers discuss various aspects of biological fluid mechanics, heterogeneous flows, vortex motion, transition to turbulence and turbulent shear flows, shock-wave boundary-layer interaction and aerodynamics.

Advances in Applied Mechanics, Volume 21. Edited by C.-S. YIH. Academic, 1981. 253 pp. $43.50.

This volume contains three articles on theoretical elasticity by English applied mathematicians. B. L. N. Kennett discusses how the excitation of elastic waves within a horizontally stratified structure can be analysed in terms of reflection and transmission matrices. L. J. Walpole presents a mathematically rigorous foundation for the analysis of the elastic behaviour of composite materials. J. R. Willis discusses a number of different mathematical techniques used in determining the bulk elastic properties of composites or polycrystals whose properties vary significantly on a microscopic lengthscale.

Advances in Applied Mechanics, Volume 22. Edited by C.-S. YIH. Academic, 1982. 327 pp. $53.

This volume returns to the mechanics of fluids with three reviews:

Aspects of suspension shear flows, by S. L. Lee (65 pp.),

Nonlinear dynamics of deep-water gravity waves, by H. C. Yuen & B. M. Lake (163 pp.),

Instability and transition in buoyancy-induced flows, by B. Gebhart (85 pp.).

In the Preface, Chia-Shun Yih signals his resignation as Editor of the series after a 10-year, 12-volume stint. He deserves congratulations for having maintained and promoted the high standards of the series established since its foundation in 1948 by von Mises and von Kármán.

Annual Review of Fluid Mechanics. Volume 14. Edited by M. VAN DYKE, J. V. WEHAUSEN and J. L. LUMLEY. Annual Reviews Inc., 1982. 456 pp. $22.

The interesting series of articles that make up this year's reviews are as follows.

Vilhelm Bjerknes and his students, A. Eliassen.

Sediment ripples and dunes, F. Engelund & J. Fredsøe.

Strongly nonlinear waves, L. W. Schwartz & J. D. Fenton.

Topology of three-dimensional separated flows, M. Tobak & D. J. Peake.

Dynamics of glaciers and large ice masses, K. Hutter.

The mathematical theory of frontogenesis, B. J. Hoskins.

Dynamics of lakes, reservoirs, and cooling ponds, J. Imberger & P. F. Hamblin.

Turbulent jets and plumes, E. J. List.

Gravity currents in the laboratory, atmosphere and ocean, J. E. Simpson.

The fluid dynamics of heart valves: experimental, theoretical, and computational methods, C. S. Peskin.

The computation of transonic potential flows, D. A. Caughey.

Unsteady airfoils, W. J. McCroskey.

Low-gravity fluid flows, S. Ostrach.

The strange attractor theory of turbulence, O. E. Lanford III.

Dynamics of oil ganglia during immiscible displacement in water-wet porous media, A. C. Payatakes.

Numerical methods in free-surface flows, R. W. Yeung.

Scattering Techniques Applied to Supramolecular and Nonequilibrium Systems. Edited by S.-H. CHEN, B. CHU and R. NOSSAL. Plenum, 1981. 928 pp. $95.

This large volume contains the Proceedings of a NATO Advanced Study Institute held at Wellesley, Ma., USA, 3–12 August 1980. The emphasis is on colloidal, polymer and biological systems, and on optical and related techniques by which their structure and dynamics may be studied.

Unsteady Turbulent Shear Flow. Edited by R. MICHEL, J. CONSTEIX and R. HONDEVILLE. Springer, 1981. 424 pp. $41.50.

This volume (produced by photographic reproduction from submitted papers) contains the Proceedings of the IUTAM symposium held in Toulouse, France, 5–8 May 1981; 34 papers on effects of unsteadiness (e.g. pulsating mean flow) in turbulent boundary layers, jets, wakes, etc.

Numerical Modelling in Diffusion Convection. Edited by J. CALDWELL and A. O. MOSCARDINI. Pentech, 1982. 270 pp. £18.

'The theme chosen for the Polymodel 4 Conference held at Sunderland Polytechnic in May 1981 was Diffusion Convection because of its present high interest to both academics and industry.' Those who know what diffusion is and what convection is may wonder what 'diffusion convection' could possibly be, other than the simultaneous and possibly interactive operation of the two processes; and this is indeed what is intended by the above title. The volume contains four introductory lectures, eight workshop problems (including 'Numerical Modelling of Heat Flow in the Human Torso'!) and two computer codes.

Numerical Solution of Partial Differential Equations. Edited by J. NOYE, North-Holland, 1982. 647 pp. $93.

An entirely Australian production this, being the proceedings of the 1981 Conference on Numerical Solutions of P.D.E.s held at the University of Melbourne, 23–27 August, and containing four invited contributions and twenty submitted papers; photographic reproduction from original text.

Nonlinear Phenomena at Phase Transitions and Instabilities. Edited by T. RISTE. Plenum, 1982. 481 pp. $59.50.

This is the Proceedings of a NATO Advanced Study Institute (the sixth in a series devoted to phase transitions and instabilities!) held in Geilo, Norway, 29 March–9 April 1981. In the tradition of ASIs, it contains some substantial contributions of an expository nature, and some research contributions. The former include discussions of Bénard-type instabilities, crystal growth, and melting problems.

Wave Propagation in Viscoelastic Media. Edited by F. MAINARDI. Pitman, 1982. 272 pp. $11.95.

This paperback contains eleven papers presented at Euromech 127 (Taormina, Sicily, April 1980). The papers have been retyped in uniform style, and reproduction is

photographic. Seismic-wave propagation in the Earth's mantle appears to provide the main motivation for this area of study.

Engineering Applications of Computational Hydraulics—Volume 1. Edited by M. B. ABBOTT and J. A. CUNGE, Pitman, 1982. 262 pp. £27.50.

Written as a tribute to Alexandre Preissmann, this volume contains 11 chapters written by his colleagues on numerical and computational methods for open channel flow problems.

Implementation of Finite-Element Methods for Navier Stokes Equations. By F. THOMASSET. Springer, 1981. 161 pp. $33.60.

This is one of the Springer series on Computational Physics (three previous volumes in this series having been *Numerical Methods in Fluid Dynamics* by M. Holt, *Unsteady Viscous Flows* by D. Telionis, and *Finite Difference Techniques for Vectorized Fluid Dynamics Calculations*, by D. Book). The present work emerges from the Institut National de Recherche en Informatique et an Automatique in France; upwind finite element schemes are described and compared in application with more conventional numerical methods.