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REVIEWS

Fluid Mechanics. By L. D. LANDAU and E. M. LIFSHITZ. 2nd English edition. Pergamon Press, 1987. 539 pp. £45 or $68 (hardback), £18.50 or $29.50 (paperback).

The first English edition of this remarkable book was published in 1959 and was quickly recognized as an outstanding advanced text providing clear physical ideas and deep insight into the main areas of fluid mechanics (see *J. Fluid Mech.* vol. 8, 1960, p. 315 for a review). It also gave people in the West an introduction to the many interesting developments in fluid mechanics made in USSR during the preceding 20 years. *Fluid Mechanics* is one of ten volumes in the 'Course of Theoretical Physics' by the same two authors, a magnificent exercise in scientific unification which occupied Lifshitz in particular from 1937 until his death in 1985. Like Feynman in USA, Landau always thought about problems from first principles in his own way and came up with many original and illuminating ways of looking at things. This is nowhere more evident than in the volume on fluid mechanics, which, as Lifshitz records in the preface to this second English edition, had a special attraction for Landau. He goes on: 'He (Landau) gave it a part of his soul. That branch of theoretical physics, new to him at the time, caught his fancy, and in a very typical way he set about thinking through it *ab initio* and deriving its basics results.' Landau was unable to work after a car accident in 1962 and died in 1968, but Lifshitz has endeavoured to maintain the style of Landau's contributions and has completed the revision of various volumes in the 'Course' with the help of some of Landau's former students.

The second English edition of *Fluid Mechanics* differs from the first edition mainly by the addition of about 12 new sections. Three of them are consecutive sections in the middle of the chapter on turbulence and are entitled 'Quasi-periodic flow and frequency locking', 'Strange attractors', and 'Transition to turbulence by period doubling'. It was inevitable that the Russian physicists should see the modern ideas about the development of chaotic motions in dynamical systems as deserving of a place in *Fluid Mechanics*. In the preface Lifshitz writes about these ideas as follows: 'There have been important changes in our understanding of the mechanism whereby turbulence occurs. Although a consistent theory of turbulence is still a thing of the future, there is a reason to suppose that the right path has finally been found'. Lifshitz's supposition of a 'right path' presumably refers only to the development of turbulence; considerations of the properties of fully developed turbulence require rather different ideas, as one sees from the lack of any connection between the three new sections and the remainder of the chapter.

Other new sections are on waves in a rotating fluid, Rayleigh–Bénard instability, sound generation by turbulence, acoustic streaming, evolutionary shock waves, corrugation instability of shock waves, shock propagation in a pipe, shock waves in a relaxing medium, an imploding spherical shock wave, and shock waves in relativistic fluid dynamics. Shock waves thus figure prominently in the new material, again reflecting the interests of physicists. The very short chapter on fluctuations in fluid dynamics in the first edition is now to be found in the second (volume 9 of the 'Course') of the two volumes forming the second edition of *Statistical Physics*. Other changes are minor amendments, the addition of some references (mostly in the same

incomplete style as those in the first edition, with only a name and a year being specified), and the amalgamation of some consecutive short sections.

This book will continue to be a rich source of understanding of fluid mechanics for adequately prepared readers. It is not a systematic pedagogical text suitable for use as an adjunct to teaching. There is little about applications or experiments or empirical data. But for those who would like to be able to reason their way through fundamental fluid mechanics consistently, and find they need some guidance, there is no better aid than Landau & Lifshitz's *Fluid Mechanics*.

G. K. BATCHELOR

SHORTER NOTICES

Vortex Motion. Edited by H. HASIMOTO and T. KAMBE. North-Holland, 1988. 440 pp. £67.20.

This volume contains the proceedings of the IUTAM symposium on 'Fundamental aspects of vortex motion' held in Tokyo in September 1987, and is reprinted from volume 6 of *Fluid Dynamics Research*. There are seven general lectures and then a large number of contributed papers grouped under the following headings: two-dimensional vortices, ring and three-dimensional vortices, reconnection of vortices, vortex breakdown, stability and turbulence, vortex and sound, high speed flow, and stratified and rotating fluids. The meeting attracted many of the leading workers in vortex dynamics, and the general level of the papers published here is high. Among several interesting new developments is the numerical study of the interaction of two non-parallel straight vortex tubes. Present-day computers make it possible to follow the evolution of an incredibly complicated clot of tangled vortex lines before a relatively ordered structure reappears, and some of the general features of such interactions are beginning to be recognized.

Navier–Stokes Equations. By P. CONSTANTIN and C. FOIAS. University of Chicago Press, 1988. 190 pp. £27.95 or $34.95 (hardback), £11.95 or $14.95 (paperback).

This little book records the lecture notes of graduate courses given by each of the two authors at their respective universities and printed from camera-ready typescript. The notes are about the mathematical properties of the Navier–Stokes equation, and are concerned with such questions as the existence, regularity and uniqueness of solutions, analyticity, eigenvalue asymptotics, and the upper bound for the dimension of the universal attractor for the two-dimensional Navier–Stokes equation. The mathematical techniques used are said to be elementary, but the word is being used in a relative sense.

Fluid Mechanics Source Book. Edited by S. P. PARKER. McGraw-Hill, 1988. 274 pp. £45.

This unusual book appears to be a compilation of entries relating to fluid mechanics from the McGraw-Hill *Encyclopedia of Science and Technology*. The names of the 60-odd original contributors are given beside their entries, and some names appear many times. Many of the entries are informative, especially where they relate to an instrument or a device or a specific application (such as the entry for 'Wind Tunnel'), but as a way of conveying fundamentals it leaves a lot to be desired. The section entitled 'Nonviscous flow', for example, consists of 10 independently written

snippets of information on Euler's equation, Bernoulli's theorem, D'Alembert's paradox, Kelvin's circulation theorem, potential flow, electrolytic tank, and hydraulic analog table, by different authors, and without any connecting text. Theory should not be divided up in this way, and it would have been more satisfactory for the original entries in the *Encyclopedia* to have been replaced by a single comprehensive article by one author. It must also be said that the standard of the entries varies widely. A red pencil wielded by an authoritative coordinating editor would have helped. Not recommended for students.

Encyclopedia of Fluid Mechanics; Vol. 7, Rheology and Non-Newtonian Flows. Edited by N. P. CHEREMISINOFF. Gulf Publishing Co., 1988. 1185 pp. $195.

The first six volumes of this great publishing project have already been noticed (*J. Fluid Mech.* vol. 196, 1988, p. 596), and now there is a volume on rheology and non-Newtonian flow. Like its predecessors, this volume is divided into a small number of sections, the headings of the three sections in this case being: (I) Flow dynamics and transport phenomena; (II) Slippage and drag phenomena; (III) Polymer rheology and processing. Within each section there are many chapters by different authors, and judging by the specialized character of the chapter titles they have mostly been chosen by the authors themselves. The chapter is thus the unit of information, and a reader wanting to know more about a particular topic will need to scan the chapter titles to see if his topic fits within one of them. The practical objectives of the *Encyclopedia* are especially evident in this volume. There is no theory to speak of, and the 'rheology' in the title refers to models of the constitutive relations for simple flow systems. A vast amount of data for various non-Newtonian fluids relevant in industry is presented, and this is the merit of the volume.

Fluid Film Lubrication – Osborne Reynolds Centenary. Edited by D. DOWSON, C. M. TAYLOR, M. GODET and D. BERTHE. Elsevier, 1987. 696 pp. Dfl 385.

The tribologists of Leeds and of Lyon have collaborated in the organization of annual international symposia since 1974, and this volume of large format and price records the proceedings of the 13th such meeting. The topic of the symposium was fluid film lubrication, in recognition of the publication of Reynolds' classic paper 'On the theory of lubrication and its application to Mr Beachamp Tower's experiments' 100 years previously in the *Philosophical Transactions of the Royal Society*. About 70 papers are printed in the volume from camera-ready copy, with the usual drawback that there are no running heads. For non-specialists the most interesting paper is the first, in which A. Cameron gives an historical account of the life of Reynolds and events associated with his paper on lubrication.

Interface Dynamics. Edited by D. DOWSON, C. M. TAYLOR, M. GODET and D. BERTHE. Elsevier, 1988. 395 pp. Dfl 290 or $152.75.

This is the proceedings of the 14th symposia on topics in tribology mentioned above, printed in the same large format and even larger price per page. The pre-symposium call for papers specified that 'contributions could range from Interface Formation to Interface Elimination' and might include contact stress fields, interface rheology, and boundary slip. Anyway, it was all about interfaces.

Annual Review of Fluid Mechanics, vol. 21. Edited by J. L. LUMLEY, M. D. VAN DYKE and H. L. REED. Annual Reviews Inc., 1989. 479 pp. $34.00 ($38.00 outside USA and Canada).

The fourteen articles which make up this years *Annual Review* are as follows:

Turbulence Control in Wall Flows, by D. M. Bushnell and C. B. McGinley.
Mathematical Analysis of Viscoelastic Flows, by M. Renardy.
Hypervelocity Aerodynamics with Chemical Nonequilibrium, by R. J. Stalker.
Colloid Transport by Interfacial Forces, by J. L. Anderson.
Turbulent Diffusion Flames, by R. W. Bilger.
Boundary-Layer Receptivity to Long-Wave Free-Stream Disturbances, by M. E. Goldstein and L. S. Hultgren.
Biofluid Mechanics, by R. Skalak, N. Özkaya, and T. C. Skalak.
Turbulent Boundary-Layer Separation, by R. L. Simpson.
Stability of Three-Dimensional Boundary Layers, by H. L. Reed and W. S. Saric.
Coherent Structures in Transitional and Turbulent Free Shear Flows, by J. T. C. Liu.
Atmospheric Dispersion of Dense Gases, by R. E. Britter.
New Directions in Computational Fluid Dynamics, by J. P. Boris.
Rarefied Gas Dynamics, by E. P. Muntz.
Ocean Turbulence, by A. E. Gargett.

The volume concludes as usual with compilative indices of contributing authors and article titles for the complete series of 21 volumes. The usual first article of historical type is missing from this volume.

Perspectives in Turbulence Studies. Edited by H. U. MEIER and P. BRADSHAW. Springer, 1987. 503 pp. DM 118.

This volume records the proceedings of a symposium held at Göttingen in honour of J. C. Rotta on the occasion of his 75th birthday. Rotta is well known for his fundamental contributions to turbulence research made at a time when few reliable experimental data on turbulence structure were available and when attempts at modelling turbulence structure and performing numerical studies on homogeneous and shear flow turbulence were in their infancy. As early as 1951 he published a significant contribution to the theory of modelling shear flow turbulence. The methods of prediction that he pioneered still remain in force today. Dr Rotta made many scientific friends during his life-long work on turbulence at Göttingen, and these and others who hold him in high regard have contributed to the proceedings of the symposium. The standard of the 16 papers reproduced here is higher than those in most conference proceedings. Some have a review character, and some are about particular recent developments.

Numerical Methods for Fluid Dynamics III. Edited by K. W. MORTON and M. J. BAINES. Oxford University Press, 1988. 529 pp. £50.

This volume contains 14 invited papers and 32 contributed papers from the Third Conference on Numerical Methods for Fluid Dynamics, which was held at Oxford University in March 1988 under the joint auspices of the Institute for Computational Fluid Dynamics and the Institute of Mathematics and its Applications. Three main

themes were selected for the Conference: numerical algorithms, including their behaviour and performance; grid generation techniques; and unsteady flows. The contributing authors, almost all of whom reside in Europe, came from universities, government research establishments and private industry. This wide affiliation is reflected in the papers. The collection of papers would have perhaps been made more useful by an introductory contribution giving an overview of the subject – or even just the papers included – at the beginning of the volume and a subject index at the end.

Eleventh International Conference on Fluid Sealing. Edited by B. S. NAU. Elsevier, 1987. 781 pp. £80.

Seals are a key component in plant and machinery throughout industry, and their failure can lead both to expensive loss of production and to serious health and safety hazards. Forty-one papers considering various aspects of sealing make up this volume which is the proceedings of a conference held at Cannes in April 1987. Most members of the organizing committee are from industry and only five of the papers are categorized under the heading of 'research'. Pride of place in the volume, and coming right after the list of contents, is given to three company advertisements for particular seals.

Nonlinear Hydrodynamic Modeling: A Mathematical Introduction. Edited by H. N. SHIRER. Springer, 1987. 546 pp. DM 75.50.

These lecture notes aim to provide an introduction to the nonlinear analysis of solutions to truncated models of fluid systems. Such truncated systems and the volume itself build on the pioneering work by Lorenz that lead to his famous third-order equations. There are 18 chapters, written by 12 different authors. The first three chapters introduce the basic concepts behind, and creation of, truncated models. The next seven chapters discuss various aspects of the time-independent solutions. Four chapters then review the behaviour of temporally periodic solutions. The final four chapters analyse solutions that are temporally more complicated. The monograph is an outcome of a graduate meteorology seminar on nonlinear hydrodynamics held at the Pennsylvania State University in 1984.

Turbulent Shear Flows 5. Edited by F. DURST, B. E. LAUNDER, J. L. LUMLEY, F. W. SCHMIDT and J. H. WHITELAW. Springer, 1987. 361 pp. DM 228.

This volume contains the proceedings of the fifth international symposium in the well-known series on turbulent shear flows held at two-yearly intervals. The 25 papers printed here represent a small fraction of the symposium presentations, and are grouped under four general headings, viz. homogeneous and simple flows, free shear flows, wall flows, and reacting flows, each with a useful introduction. Many of the papers are worth reading, but the interval of nearly two years between the symposium and publication is unfortunate.