J. Fluid Mech. (1981), *vol.* 107, *pp.* 533–536
Printed in Great Britain

REVIEWS

Natural Convection Heat and Mass Transfer. By Y. JALURIA. Pergamon, 1980. 326 pp. $57.00.

Numerical Heat Transfer and Fluid Flow. By S. V. PATANKAR. Hemisphere-McGraw-Hill, 1980. 197 pp. $22.50 or £13.50.

Although these books are concerned with aspects of fluid mechanics and heat transfer, they are very different in purpose. That of Professor Jaluria is intended as a reference compendium of information on natural convection heat transfer and that of Professor Patankar is a text, suitable for senior undergraduates or post-graduate students, concerned with numerical methods and their application to fluid flow and heat transfer. There are, however, similarities in that both books stem from the recent research activities of their authors and both are published within comparatively new series. In addition, both authors have associations with the Indian Institute of Technology at Kanpur.

Professor Jaluria's book has the clear flavour of a research monograph. It has been prepared photographically, from a typed text, and is the fifth book in a Series of Reports, Reviews and Computer Programs relevant to the Science and Applications of Heat and Mass Transfer. It is the first book in this Series to attempt to deal comprehensively with a major part of the related subject matter. Apart from the discussion of mass transfer and experimental methods, which could usefully have been incorporated in other chapters, the arrangement of the book is helpful to the reader. The material reflects the considerable research activity in the last thirty years but it is a little surprising that two-thirds of the references are dated before 1970. Half of the post-1970 references stem from the author and his former colleagues at Cornell University; this is less surprising but hardly a true indication of the distribution of useful efforts. The chapter dealing with the internal flows is perhaps least satisfactory in that reference to important recent work reported from Russia and the West has been omitted; the paper by Catton (*Proc. 6th Int. Heat Transfer Conference*, vol. 2 (1978), pp. 305–310) will provide interested readers with a useful supplement to this chapter.

Numerical solutions to differential equations appropriate to fluid flow will be familiar to readers of the *Journal of Fluid Mechanics* and the subject has undoubtedly grown in the last ten years. It is relevant to note that the author's earlier book (Patankar and Spalding, *Heat and Mass Transfer in Boundary Layers*, 2nd edn (1970), Intertext) and based on his Doctoral thesis, played an important part in encouraging further work on this topic. The present book is clearly based on extensive experience of teaching the subject and of using the methods which are described. It is much less of a monograph than the 1970 book and covers a wide range of material with a content and style which are appropriate to the reader for whom the book is intended. It is intended to be introductory and 'for the potential practitioner of numerical heat transfer and fluid flow; it is not intended for the experts in the subject area'.

Professor Patankar's book deals with equations and numerical methods in separate

chapters before considering the application of finite-difference methods to heat conduction. Convection and diffusion are then discussed, in terms of finite difference assumptions, before applications to flow problems are discussed; in this context, the so-called SIMPLE algorithm is described. Further numerical details, special topics including the finite-element method and examples are discussed in three brief chapters. The book is useful and has been carefully and well prepared. It is undoubtedly parochial in that its comments on procedures alternative to those used by the author are brief or absent. In addition, and perhaps of greatest importance in view of the stated purpose, the examples of fluid flow calculations create an impression of engineering usefulness of the overall calculation methods; the impression is easy to create but, as a great deal of recent work has shown, its realization varies greatly with flow configuration, assumptions and user.

J. H. WHITELAW

Rheological Techniques. By R. W. WHORLOW. Ellis Horwood and Halsted Press, 1980. 447 pp. £26.80.

Anyone who is interested in quantitative experimental investigation of the deformation and flow of materials in the wide range between the Newtonian liquid and the Hookean solid will find much useful information in this book. Those of us who avoid actually doing experiments but wish to interpret and use experimental results would also profit from familiarity with much that the author has to say.

The main topics discussed are steady flow through tubes (capillary viscometry), steady flow between relatively rotating cylinders or cone and plate (rotational viscometry), time-dependent behaviour under constant loading or constant rate of deformation (creep, stress growth and stress relaxation), behaviour of materials when subjected to oscillation in a variety of ways (dynamic tests) and wave propagation. These topics occupy chapters 2–6 and are flanked by an introductory chapter on deformation, stress and some 'miscellaneous rheological techniques', and a concluding chapter on the analysis of time-dependent flow behaviour for linearly viscoelastic material response. There is a unique appendix tabulating the features of much commercially available apparatus, and giving addresses of firms and their agents, which the Secretary of the British Society of Rheology will find invaluable in dealing with enquiries.

The book clearly invites comparison with *Rheometry* by K. Walters (see *Applied Mechanics Reviews*, vol. 29 (1976), p. 1474), and the author does refer to Walters extensively. The two books are largely complementary, from Whorlow the physicist and Walters the mathematician, and the backgrounds of the two authors influence both the choice of topics and their treatment. As an example of this we may note Whorlow's use of non-rigorous derivation of equations from physical principles, with the usual δx, δt formulation, which is aimed at giving understanding of the significance of the equations. One does wonder how many readers there are who will need the detail offered in this way and at the same time will appreciate the careful and detailed discussions of matters of experiment and interpretation. (This may be a compliment rather than a criticism – there is something for everyone here.)

It has to be said that the book does not have an up-to-the-minute air about it, but in many of the topics covered this is hardly necessary and in fact there are over thirty references (from over 500) dating from 1977 or later. It is also important to point out

one self-imposed limitation, that normal stress measurements are not treated at length. In addition the reviewer has some qualms about the treatment of instabilities, based largely on two articles in the 1969 volume (number 5) of *Rheology* (edited by F. R. Eirich); there have been several subsequent critical reviews and a significant advance in our understanding throughout the last decade. Perhaps more important are the all too brief treatment of transient behaviour (in rotational instruments), the signs of misunderstanding in the brief discussion of elongational viscosity ('measured ... under both constant stress and constant strain rate conditions. Initially the values differed, but at very large elongations the values agreed'), and the absence of discussion of techniques for measuring recoverable strain. Allied to this last is the less than helpful offering of two formulae (1.38*a*, *b*) for recoverable shear, without any guidance for the non-expert. Later 'recoverable shear strain at the wall' is put in quotes by Whorlow, apparently as a warning to interpret with caution, but again without explicit comment. Finally the reviewer must take Whorlow to task for describing in the same paragraph (of section 4.4.1) uniaxial elongation carried out (i) at constant strain rate by Meissner, and (ii) in spinning (involving extension of a continuously extruded filament which is not, in general, uniform). There is admittedly some disagreement among aficionadoes about interpretation, but it does seem reprehensible to omit a clear statement of the differences (at least to the extent given in the previous sentence).

But these criticisms are of small sections in a comprehensive treatment of experimental rheology, and the topics about which the reviewer complains are at least mentioned (which is not so in all rheology books). As a source of information and careful discussion of techniques for measuring the relation between shear stress and rate of shear strain, and the linear viscoelastic response of materials, the book is unrivalled. It is well produced and the reviewer has detected no printing errors of substance, though one final conceptual faux pas will be noticed by readers of this journal – on page 25 the description of streamline flow depends on a definition recognizable as that of a streakline, and this is followed by the statement that flow which is not streamline (and, by inference here, steady) is turbulent. In spite of these shortcomings the reviewer recommends Whorlow's text to physicists, engineers and mathematicians as a worthy account of a fascinating branch of physics.

C. J. S. Petrie

Shorter Notices

Rheology. Volume 1, Principles, 421 pp., $45.00. **Volume 2, Fluids,** 673 pp., $69.50. **Volume 3, Applications,** 785 pp., $69.50. Edited by G. Astarita, G. Manucci and L. Nicholais. Plenum Press, 1980.

These three large volumes record, by photocopying of the typescripts, the invited lectures and submitted papers presented at the 7th International Congress on Rheology at Naples in September 1980. The first volume contains the 17 invited lectures, which collectively give an interesting picture of the present state of development of the subject. The range of material covered is impressively wide, and many quite different approaches are represented. 'Rheology' has different meanings for different people, and it would take a participant of unusual versatility to listen to all these lectures with understanding. The variety among the contributed papers (21 in

volume 1, 123 in volume 2, 118 in volume 3) is even more daunting. Polymer materials are prominent, especially in the papers in the third volume. For rheologists these volumes will be a mine of information about current developments.

A Profile of Horace Lamb. Arranged by R. RADOK and S. RADOK. Math. Dept. Report no. 2, Cook Univ. of N. Queensland, 1980. 102 pp. £4.50 or US $10 or Aus. $9.

Lamb was the Professor of Mathematics and Physics at the University of Adelaide from 1876 to 1884, and the two Radoks, both with Adelaide connections, have honoured his memory by means of this collection of information about his life and work, reproduced from typescript under the rather unlikely aegis of the infant University of North Queensland. It consists of a bibliography of Lamb's published works, a set of abstracts of or extracts from these papers and articles and books, and two obituary memoirs on Lamb, one by Glazebrook for the Royal Society and one by G. I. Taylor for *Nature*. Readers will find it a valuable compendium of the work of a man who had a significant influence on teaching, and to a lesser extent also on research, in hydrodynamics and other areas of classical mathematical physics. (For an impression of the continuing influence of Lamb's greatest work, his *Hydrodynamics*, see the review by Howarth in this *Journal*, vol. 90, 1979, p. 202.) But it is difficult and tiresome to use, as a consequence of the almost total lack of editorial explanation of what is being presented. Nothing is described specifically; no distinction is made between an abstract of one of Lamb's papers prepared by the editors and a quotation from the paper itself; and the source of one of the abstracts or extracts can only be determined by referring to the separate bibliography at the back. An early second edition, please!

Modelling Hydroelastic Vibrations. By O. HASZPRA. Pitman, 1979. 136 pp. £7.00

The modelling referred to in the title of this book is laboratory modelling. The structures with which the book is primarily concerned are hydraulic structures such as movable weirs, locks, etc. The main part of the book is the third chapter, which devotes nearly 40 pages to the scaling problems associated with modelling hydrodynamic and elastic forces. The remaining chapters discuss experimental verification, techniques and examples.