*J. Fluid Mech.* (1989), *vol.* 199, *pp.* 594–596
*Printed in Great Britain*



# REVIEWS

**Cavitation and Tension in Liquids.** By D. H. Trevena. Adam Hilger, 1987. 125 pp. £22.50.

The author is well known for his work on the tensile strength of liquids. His book starts with a description of the early experiments by Donny and Berthelot which showed, about 150 years ago, that liquids can withstand tension. Subsequent chapters discuss the various techniques developed (improved Berthelot tube, centrifuge, ultrasonic, stress pulse) for more precise studies. Chapters on bubble studies, cavitation erosion and miscellaneous related topics follow and the book ends with a survey of the present position by Professor H. N. V. Temperley, who supervised some of Trevena's early research at Cambridge in the 1950s. What has kept this particular subject 'alive' over the years has been its relevance to a range of problems and the wide disparity in the values obtained for the tensile strengths of liquids (from a few bars up to about 300 bars). It is now clear that different experiments measure different quantities. Some give the adhesive strength between the liquid and its container (rather than the cohesive strength of the liquid), while with ultrasonic stressing, cavities can grow by 'rectified diffusion' thus lowering the failure stress. Stress pulse methods can be designed to directly stress the liquid but pulse duration is critical. Not surprisingly, higher strengths are obtained if special efforts are made to remove impurities, particles and gas from the liquid.

The book is relatively short and is basically about experiments. The embargo on mathematics is not entirely satisfactory, particularly in the area of cavity collapse. The author rightly points out that the problem is considerably more complex than Rayleigh's original solution, but it would have been instructive to see the form of the equations and to have data on the pressures, temperatures and times of collapse. Cavitation damage is too complex to be explained simply by a microjet and/or shock wave, and if various techniques for cavitation studies are to be given why not include a brief description of some of the cavitation tunnels in operation in many countries? Some of the referencing is a little obscure. In an area such as bubble dynamics, which has several excellent reviews (including many in *J. Fluid Mech.* and *Ann. Rev. Fluid Mech.*), it is a little unsatisfactory to give just four for further reading (p. 61), one of which is 25 years old and the others are internal reports or Ph.D. theses (no doubt excellent, but not easily accessible). The chapter on miscellaneous topics (cavitation in bearings, medicine, the ascent of sap in trees, etc.) is an intriguing one, though notable cases are missing, for example, the key roles that cavities play in explosive ignition and propagation. Some authors have explored the relation between the tensile failure of liquids and the fracture of brittle solids. (As Kolsky emphasises in this context, glasses are super-cooled liquids.) In both cases, 'defects' control the strength. In fracture mechanisms, it is possible to say something about the size and nature of the defects by working back from the measured strengths: the same ought to be possible with liquids. The reviewer is conscious that to expand and deepen the treatment would change the nature of the book. Its attractions are that it gives a concise and very readable account of experimental work in an important and fascinating area of fluid mechanics.

J. E. Field

SHORTER NOTICES

**Flow Visualization.** By WOLFGANG MERZKIRCH. Academic, 1987. 260 pp. $49.00.

This book is an updated version of the valuable first edition previously reviewed in this journal (*J. Fluid Mech.* vol. 70, 1975, p. 623). The basic format remains unchanged and the book is divided almost equally between (1) flow visualization techniques that add a foreign material to the fluid and (2) optical methods that detect changes in the refractive index of the fluid. Some rearrangement of material has occurred and much of the discussion has been modified and brought up to date. There are over 600 references, more than half of which have been published since the first edition of the book appeared in 1974. Also, many new figures and photographs have been added that illustrate the continuing strides being made in both techniques and applications. The book will remain a useful reference for both experimentalists and other researchers, and for students seeking an introduction to the variety of flow visualization techniques available.

**Flow Visualization IV.** Edited by CLAUDE VÉRET. Hemisphere/Springer, 1987. 918 pp. DM 298.00.

This volume contains the Proceedings of the Fourth International Symposium on Flow Visualization held in Paris, France in August 1986. The Symposium brought together more than 250 researchers from 22 countries and 154 contributions are included in the present volume. A wide range of techniques are described, including holography, schlieren, and speckle methods, laser-induced fluorescence, interferometry and applications of digital image processing. These techniques are applied to a variety of problems, from the classical, e.g. jet flow, flow past aerofoils, flow fields in engines, to the not so classical, e.g. the flow fields around golf balls and dragonflies. The present volume is a rich source of the variety of flow visualization techniques, optical and non-optical, available for studying a variety of flow situations, in addition to providing many interesting black-and-white reproductions of flow visualization experiments.

**Measurement and Control in Liquid Metal Processing.** Edited by R. J. MOREAU. Martinus Nijhoff, 1987. 204 pp. Dfl. 155.00 or US$ 75.50 or £56.50.

This book is the proceedings of the fourth workshop of the CIATF with the same title, held in Prague in 1986 in conjunction with the 53rd International Foundry Congress. It is divided into three sections reflecting the conference sessions: (1) measurement procedures and equipment (six papers) including measurement of temperature, composition and quality of melts; (2) fluid flow phenomena (six papers) including discussions of the crucible induction furnace and mould filling, but with limited attention to the fluid behaviour; and (3) automation (four papers) describing automatic control systems in foundries. There is also a six page summary of discussions held at the conference. The book is well illustrated, with few equations and an emphasis on practical techniques in the foundry environment rather than on fluid dynamical processes. As a result, it is likely to be of interest mainly to those directly involved with the metallurgical industry.

**Numerical Recipes in C: The Art of Scientific Computing.** By W. H. PRESS, B. P. FLANNERY, S. A. TEUKOLSKY and W. T. VETTERLING. Cambridge University Press, 1988. 735 pp. £27.50.

The desk-top personal computer proliferates, and many are now located in the offices of fluid dynamicists. But appropriate software can be a problem. *Numerical Recipes in C* is a sequel to an earlier, highly successful, version for Fortran and Pascal. The 'numerical recipes' on offer are ready-to-use subroutines, for each of which there is a general discussion, a certain amount of analytical mathematics and discussion of algorithmics. Of interest to fluid dynamicists will be the sections on the solution of linear algebraic equations, root finding and nonlinear sets of equations, interpolation, integration, special functions, eigensystems, Fourier transform spectral methods, integration of ordinary differential equations and an introductory chapter for partial differential equations. *Numerical Recipes* provides an opportunity to compile a library of suitable proven computer subroutines, and as such is worthy of consideration in one of its versions.

**Computational Fluid Dynamics.** By T. K. BOSE. Wiley Eastern, 1988. 214 pp. £18.95.

The title of this book is misleading since the author is almost wholly concerned with inviscid, irrotational flows. Only one viscous-flow problem receives attention, and that is at zero Reynolds number as an example of the finite-element method. A substantial part of the book is devoted to transonic flow problems using both the full potential equation, and the transonic small-perturbation approximation of it. Both steady and unsteady flows are discussed. There is a chapter on panel methods, essentially for incompressible potential flow, and a chapter on the finite-element method. A brief account of particle and fluid-in-cell methods concludes the book. There is an up-to-date list of references, and within the constraints he has set himself the author has done a more then competent job.

**Finite Elements in Fluids, Vol. 7.** Edited by R. H. GALLAGHER, R. GLOWINSKI, P. M. GRESHO, J. T. ODEN and O. C. ZIENKIEWICZ. Wiley, 1988. 314 pp. £49.95.

This volume contains fifteen selected, and extended, papers which were presented at the Sixth International Conference on Finite Elements in Flow Problems held at Antibes-Juan les Pins during June 1986. The scope of the articles published here is wide-ranging, it includes methods for the Euler and Navier-Stokes equations, transonic and high-speed flows, free-surface flows, visco-elastic fluid flow and combustion phenomena. Compared with previous volumes in this series, compressible and turbulent flow simulations feature more prominently. As may be expected the flexibility of the finite-element method, in local mesh refinement and the treatment of boundary conditions on arbitrarily shaped boundaries, is in evidence as for example in free-surface flows and wrinkled flame propagation.