J. Fluid Mech. (2002), *vol.* 461, *pp.* 408–410.
Printed in the United Kingdom

BOOK REVIEWS

Perspectives in Fluid Dynamics – A Collective Introduction to Current Research. Edited by G. K. Batchelor, H. K. Moffatt & M. G. Worster. Cambridge University Press, 2000. 646 pp. ISBN 0521 780616. £100.

J. Fluid Mech. (2002), *vol.* 461. DOI: 10.1017/S0022112002218972

George Batchelor's seminal textbook *An Introduction to Fluid Dynamics* was first published in 1967. It was reprinted in 1970 and a paperback edition was brought out in 1973. It has been reprinted roughly every two years ever since. In the Preface Batchelor discussed some of the constraints that he felt himself under in writing the book: "My original intention was to provide between two covers an introduction to all the main branches of fluid mechanics, but I soon found that this comprehensiveness was incompatible with the degree of thoroughness that I also had in mind." He says further: "I regard flow of an incompressible viscous fluid as being at the centre of fluid dynamics by virtue of its fundamental nature and its practical importance. Fluids with unusual properties are fashionable in research, but most of the basic dynamical ideas are revealed clearly in a study of rotational flow of a fluid with internal friction ... I regret that many important topics such as gas dynamics, surface waves, motion due to buoyancy forces, turbulence, heat and mass transfer, and magneto-fluid dynamics, are apparently ignored, but the subject is simply too large for proper treatment in one volume. If the reception given to the present book suggests that a second volume would be welcome, I may try later to make the coverage more nearly complete".

As fate would have it, *An Introduction, Part II* never appeared. That is, until now! The volume under review, compiled by Batchelor's students and colleagues, and with his impetus during the early stages, is an attempt, one might say, to provide something like the volume that Batchelor never found time to write. As a stand-alone volume it is admirable. The list of authors reads like a "Who's Who" of fluid mechanics. There are chapters by Davis and Pedley, Batchelor's successors in the editorial chair of this journal, by Couder, Garrett, Huerre and Jimenez, and by the heirs of the department that Batchelor founded: Huppert, Linden, McIntyre, Moffatt, and Worster. The two last-named appear as co-editors of the volume. The writers are so well known that anyone in fluid mechanics could immediately guess the subject of their respective chapters given their names! The style of writing is that of a review, but a didactic review in which the subject is developed systematically, at least to some extent, and not just a bibliography of current research papers with some perfunctory connecting text as one sees all too often these days.

Regarding the omissions that Batchelor lamented in 1967, we find some amends. There is, for example, a chapter on turbulence, although giving anything approaching a complete account in 50 pages is an almost impossible task. There is a chapter on MHD. There are aspects of heat and mass transfer scattered throughout several chapters. Surface waves and gas dynamics must wait, one assumes, until Part III. Geophysical and biological fluid dynamics receive a fair amount of coverage. Particularly, the former is covered in three chapters on geological fluid mechanics, the dynamic ocean, and global circulation in the atmosphere, respectively. The chapter on convection in the environment comes close to that same rubric. There are three

chapters on flows with interfaces. Couder's chapter on viscous fingering was probably my favourite, but all chapters are great reads and well worth studying.

One could take issue with the selection of topics, of course. Why, for example, is not more attention paid to the role of chaos or the role of solitons in fluid mechanics, arguably two of the main paradigms for much of 20th century research in the field? Why is there not a chapter on the profound advances made possible through computational fluid dynamics? It is amusing, perhaps even instructive, to compare the list of chapter titles with a volume such as *Research Directions in Fluid Mechanics*, edited by Acrivos, Leal, Leibovich & Lumley, published in 1996 by the American Institute of Physics. Admittedly, the two volumes serve quite different purposes and audiences, yet the differences and overlaps in topical coverage are quite interesting. If nothing else, this comparison suggests that the current book might just be the first in a series.

The editors write that "[a]uthors were charged with being didactic rather than providing a comprehensive survey of the literature…". Nevertheless, the citations run on to more than 750 references in total. By comparison Batchelor's original text has only about 170 cited papers. Returning once again to Batchelor's preface, he wrote: "Prandtl knew…the value of a clear photograph of a well-designed experimental flow system…". The editors of the current volume have taken that lesson to heart, and the book contains many splendid photographs of the flow phenomena under consideration. Several of these would be worthy of inclusion should another classic of our field, Van Dyke's *An Album of Fluid Motion* (Parabolic), ever see a second edition. There are no exercises in the book – the by-line of the title is *A Collective Introduction to Current Research.*

The book clearly belongs on the shelf of any serious student of fluid mechanics and of many researchers whose work touches on the subject of fluid mechanics in a substantial way. It is similar in spirit to general review or proceedings volumes, but of superior quality. Its main shortcoming – if that is even the right word – is simple to state: compared to Batchelor's text, this work has not had the benefit of the integration and organization that a single, penetrating mind can give to a large body of technical material. That has always been the hallmark of the great classic texts of science, and the legacy of many great scientists. Maybe we have to rethink all this: the days of the author who knows the entire field may have passed. Certainly, not many could have written authoritatively about all the subjects covered in this volume. Perhaps our classics in the future will, indeed, be written 'by committee'. One hopes not, but until an expositor and scientific organizer of Batchelor's caliber re-emerges in our field, well-edited collections such as this book are going to define the standard of what can be achieved.

H. Aref

SHORT NOTICE

Geometric Asymptotics for Nonlinear PDE. I. By V. P. Maslov & G. A. Omel'yanov. Translations of Mathematical Monographs, Vol. 202, American Mathematical Society, 2001. 285 pp. ISBN 0-8218-2109-1.

J. Fluid Mech. (2002), *vol.* 461. DOI: 10.1017/S0022112002228979

This monograph presents asymptotic techniques for describing the behaviour of localized nonlinear waves, such as solitary waves and shock waves, in a variable

background environment. The governing equations are often such well-known ones as the Korteweg–de Vries equation modified by the presence of variable coefficients or extra terms. For periodic nonlinear waves, when the background is slowly varying with respect to the wavelength and wave period, the Whitham averaging method is well-known and widely used. However, the application of similar averaging methods for solitary waves and shock waves is not so straightforward, and typically leads to non-uniformities in the tail regions of these waves. Developing methods for dealing with these difficulties has been an active research area for some years now, and it has to be said that the basic features are now well-understood. The first author, Professor Maslov, has made many contributions to the theory of asymptotic methods for both linear and nonlinear partial differential equations. This text presents the techniques, developed by Professor Maslov and his many collaborators, for handling the aforementioned difficulties, in which the inner/outer expansion methods usually employed are combined here into a single algorithm. The methods are presented through sample problems, many of which arise in fluid flows. Although the emphasis is on the mathematical techniques, readers of *JFM* will find several points of contact with the topics covered. The six chapters deal with Waves in One-Dimensional Media, Nonlinear Waves in Multidimensional Media, Asymptotic Solutions of Some Pseudodifferential Equations and Dynamical Sytems with Small Dispersion, Problems with a Free Boundary, Multi-Phase Asymptotic Solutions, and Asymptotics of Stationary Solutions of the Navier–Stokes Equations Describing Stretched Vortices. This last chapter, written jointly with A. I. Shafarevich, describes the application of these asymptotic techniques to localized vortices, and has particular topical interest.