J. Fluid Mech. (1998), *vol.* 376, *pp.* 376–378. Printed in the United Kingdom

BOOK REVIEWS

Engineering Fluid Mechanics, Sixth Edn. By J. A. ROBERTSON & C. T. CROWE. Wiley, 1997. 689 pp. ISBN 0 471 14735 4. £23.95.

This textbook is aimed primarily at students at tertiary level taking their first course in fluid mechanics. It covers comprehensively the main topics required in an undergraduate course: hydrostatics, control-volume analysis, Bernoulli's equation, momentum and energy principles, dimensional analysis, internal and external flows, compressible flows, turbomachinery and open channels. The final chapter presents a brief introduction to computational fluid mechanics with a number of sample codes provided. Useful additions have been made to this edition, including new problems and more emphasis on design, which is the core purpose of engineering.

The quality of the book is judged here on the basis of its potential not only to assist in the training of engineers to keep aircraft aloft, ships afloat and dams intact, but to delight, excite and stimulate a new generation of fluid dynamicists with the concepts and applications of fluid dynamics. In this regard, it is competing with a number of other textbooks that cover similar material in a similar fashion; for example, Douglas, Gasiorek & Swaffield (1995), Fox & McDonald (1994), Gerhart, Gross & Hochstein (1993), Janna (1993), and White (1994).

The authors state that the textbook is very readable in its format, and there is no reason to dispute this; its layout is organized and consistent, the descriptions are organized and succinct, and the figures are clear and simple. A more salient point, however, is whether the book seduces the reader into the field of fluid dynamics, stimulates and provokes the mind of the student, promotes critical discourse and wider reading, and presents fundamental concepts in a rigorous manner. As with most of the textbooks that seek to cover such a wide range of topics, the student will still need to rely on the teacher to a large extent.

Although engineers are primarily concerned with design and application, it is nonetheless essential that basic concepts are understood in a rigorous and precise manner. It is in this regard that some improvements in the textbook could be made. As an example of lack of rigour and precision, the important topic of vortices is confined to a brief section and is thus introduced: 'A flow for which the streamlines are concentric circles is called a vortex', which is neither a particularly helpful nor meaningful definition of such an inherently important flow feature. How vorticity is generated and then diffuses and convects away from boundaries is inadequately discussed, yet these issues are crucial to an understanding of the development of vortical structures which are the dominant features of many important fluid flows.

Overall, the new edition is solid and measured rather than stimulating and provocative, linear in its development of the subject rather than lateral, and traditional rather than contemporary (no mention of any WWW sources of information to offend the sensibilities of the traditional scholar!). Generally, it compares favourably with the other textbooks mentioned and therefore should be considered seriously as a prescribed text; it contains many examples, problems and references and it is economically produced. However, adding a dash of Batchelor (1967), in need of updating as it is, to a teaching course to provoke some serious consideration of the basic concepts of fluid dynamics will not go astray.

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Research Trends in Fluid Dynamics. Edited by J. L. LUMLEY, A. ACRIVOS, L. G. LEAL & S. LEIBOVICH. AIP PRESS, 1996. 328 pp. ISBN 1 56396 4597, $50.00.

The advancement of science depends upon both scientists to create and develop new ideas and on equipment and tools for them to explore and test those ideas. These resources cost money, which these days comes substantially from the public purse. There are many competing claims for such funds as are set aside by governments for the support of science, and this book, a report from the United States National Committee on Theoretical and Applied Mechanics (USNC/TAM), stakes a claim for the support of research into fluid mechanics.

The book is aimed primarily at programme managers and others with influence over how research funding is distributed but could be found interesting and useful by those embarking on research. Each of the twenty seven chapters, written by different authors, describes in broad outline the scope of a particular branch of fluid mechanics and the state of current knowledge and expertise within it. Included as specific subsections of each chapter are suggestions for the direction of future research and the needs in terms of new ideas, data and equipment.

It seems to me that a book of this nature could hope to inspire, to inform and, perhaps, to direct.

First to inspire. Fluid mechanics does not enjoy the sort of glamour and public attention attached to some other areas of science: cosmology; genetic engineering; atomic physics. So it is important to convey the excitement and challenge of fluid mechanics as well as its central importance to many natural phenomena and technological developments. This is the role of the Executive Summary, which precedes the main chapters and is aimed at the general reader, but I found it rather disappointing. The first examples mentioned (aircraft, ships, automobiles, pipelines) reinforce the image of the fluid mechanist as a nuts-and-bolts engineer. There are more attention-grabbing subjects that could have been brought to the fore, notably perhaps el Niño and other geophysical problems such as global warming and the enlarging ozone hole, all of which have enjoyed a lot of press in recent years and are at the forefront of public awareness. There are other exciting, modern applications of fluid mechanics to medicine, to renewable energy sources and to the production of advanced materials, for example, and, a little more abstractly, to pattern formation and chaos. These are the sort of topics which can and do inspire young people to do research in fluid mechanics and which can equally persuade governments and their agencies of its importance. Though some are the subject of later chapters, they are not highlighted as much as they might be in the Summary.

Secondly to inform. As a source of general information about a wide range of research topics in fluid mechanics, the book is much better. It is inevitable that a book

of this nature cannot hope to be exhaustive and the topics included reflect to some extent the subjective choices of the editors. That said, the chapters do cover the full range of Reynolds number, from molecular dynamics and suspensions mechanics to boundary layers and turbulence; and Mach number, with articles on acoustics and hypersonic flow. Articles on particular applications include geophysical and environmental flows and bio-fluid mechanics. I found many of the individual articles very interesting, giving a flavour of the historical development of a subject and an outline of its current status, with emphasis on the key challenges to be faced. I can imagine the book being a good briefing document for programme managers in unfamiliar territory, giving just enough background to begin a meaningful discussion. It could also be helpful for graduate students, for example, to read an appropriate article in advance of attending a research seminar. The reading would not take long and would give a sense of the overall context of the research field, which is often not conveyed in a specialized talk.

Finally to direct. The specific subsections on research needs could be dangerous if taken too literally. I am sure that it was not the intention of USNC/TAM to instruct programme managers as to which research topics should be supported and, tacitly therefore, which should not. Yet there always lurks such a danger once a report of this nature exists. Leibovich makes this point nicely in his own chapter stating, '… the identification of promising and significant directions for future research may be a fool's exercise. Nevertheless, that is our charge here. With trepidation, then, here is a step into dangerous waters.' I would have liked to have seen such a caveat expressed in the Foreword. With it in mind the book offers some helpful guidance. Without it, there is a risk that innovation may be suppressed.

As a whole, the book forms a collective, generalized research proposal for fluid mechanics. Individually, the chapters are general research proposals for specific areas of the subject and provide examples, both good and bad, of how proposals can be written. The best give a real sense of the important scientific issues; the worst, of which there are few, spout keywords and catch phrases without content.

So I would recommend to programme managers and to those learning to prepare proposals to read this book, but to read it judiciously.

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