Int. J. Heat Mass Transfer. Vol. 11, pp. 1213. Pergamon Press 1968. Printed in Great Britain

BOOK REVIEWS

G. K. BATCHELOR, **An Introduction to Fluid Dynamics.** Cambridge University Press, Cambridge (1967). Price 75*s*.

THAT there is a shortage of good text-books on fluid dynamics suitable for undergraduate students of applied mathematics, has long been well known to teachers of the subject. It is therefore particularly gratifying that someone as eminent as Professor George Batchelor, with a distinct point of view and the ability to express it clearly and succinctly, should have responded to the need. Not that one expects a single book to answer all the problems of teaching fluid dynamics, and this book certainly does not; but the contribution which it makes should be satisfying even to anyone who has standards as exacting as those of Professor Batchelor himself.

Like all his predecessors, Professor Batchelor has found that his book became much larger than he anticipated, and even at 600 pages it provides what he modestly calls an "*Introduction* to Fluid Dynamics". Let it be said that, whatever else may have been sacrificed in keeping this book down to extra large (rather than Magnum) size, breadth has not been sacrificed, for the author has dealt clearly and concisely with an immense range of topics.

The chapter headings are:

The physical properties of fluids
Kinematics of the flow field
Equations governing the motion of a fluid
Flow of a uniform incompressible viscous fluid
Flow at large Reynolds number: effects of viscosity
Irrotational flow theory and its applications
Flow of effectively inviscid fluid with vorticity.

N. CURLE

The Mathematical Institute
The University of St. Andrews
St. Andrews, Scotland

A. H. P. SKELLAND, **Non-Newtonian Flow and Heat Transfer.** 469 pp. John Wiley, London (1967). Price 140*s*.

DURING the past decade, publications in the field of non-Newtonian technology have appeared at an ever-increasing rate; so Professor Skelland's book, which presents a very comprehensive and up-to-date review of the subject, will be welcomed by many, particularly those who are concerned with this subject from an engineering point of view.

A large part of the text is devoted to the quantitative design procedures which are available for the prediction of the laminar-flow behaviour of time-independent non-Newtonian fluids in simple situations, such as the flow through straight tubes and annuli. This may appear, at first sight, very restricting; but in fact many of the problems with which engineers are faced can often be handled with adequate accuracy by the methods described. However, even for these simple fluids, the treatment of more complicated problems, such as those involving flow in geometries other than straight tubes, turbulent flow, heat transfer and mixing, is still based largely on highly empirical treatments; and these are not in a very well-developed state. The flow behaviour of the more complicated fluids, for which the shear stress is not uniquely determined by the instantaneous rate of strain, is not well developed even for simple flow situations. The study of fluids which exhibit elastic behaviour has advanced little in recent years, and the theoretical treatments which are available are, as yet, of little significance to practising engineers. This is particularly unfortunate because it is these more complicated viscoelastic fluids which are becoming more and more frequently encountered in industry.

The opening chapter gives a detailed classification of fluid behaviour, and describes many of the empirical models which have been proposed, even though these have little theoretical significance and are of doubtful utility. A review of the various experimental methods for the characterization of fluid properties is then given. The treatment of the capillary-tube, cone-and-plate and rotating-cylinder geometries for simple time-independent fluids, is well presented; but the experimental characterization of the more complicated viscoelastic fluids is hardly adequate. Only the characterization of these fluids by normal-stress measurement is included; and there is no mention of frequency-response analysis, which is commonly accepted as the preferred method of characterization.

The next three chapters are concerned with a detailed treatment of the behaviour of time-independent fluids in laminar flow; an empirical treatment of turbulent flow is then given. This part of the book will be of great benefit to many who are faced with design problems involving non-Newtonian fluids.

The last two chapters are concerned with mixing and heat transfer in non-Newtonian systems; although many useful relationships are given, it is clear that work in these areas is still highly empirical. In heat transfer, a quantitative treatment is possible only in laminar-flow situations leading to solutions of the Graetz type.

This book is a very welcome addition to the literature on non-Newtonian fluids and will be useful both to practising engineers and also to students. The latter will derive great benefit from the many good examples which are included.

W. L. WILKINSON

Postgraduate School of Studies
in Chemical Engineering
University of Bradford
Yorkshire, England