

BOOK REVIEWS

ANDREW PORTEOUS, **Saline Water Distillation Process.** Longman, London (1957). pp. 147, £6.50

IT is only within the last 25 years that the production of fresh water by desalination of sea water has developed on a scale suitable for public and industrial water supply. Hence desalination as a technology is newer than such typical modern developments as civil aviation, petroleum refining, and plastics manufacture. While there are a few general texts, the major scientific literature of the subject is still contained in the many separate research and study papers which have proliferated in the last two decades. Porteous correctly notes in his preface one peculiar feature of the present literature of the subject, which is true of the few existing general texts as well as of the mass of separate papers: by far the major proportion of that literature is taken up with theoretically possible but not yet established processes; while the established viable process of distillation, which constitutes well over 86 per cent of working desalination plant gets relatively minor attention. He states that his aim is "to remedy this imbalance", and to provide technical readers with an introduction to the principles, design, and operation of distillation plants.

The double task thus defined by the author is of course extremely difficult and almost self-contradictory: the imbalance cannot be easily offset by a book of only 147 pages; and the weight of scientific analysis and knowledge, of engineering technology and practice in design and in operation, of economic planning and plant optimisation, which now exist for desalination by distillation, would require a much more massive treatise.

An introductory text to all these matters is certainly possible within the scope of the present book, but cannot be expected to achieve simultaneously both objectives, however desirable it might be to do so. The reader might however have anticipated a somewhat better result than has actually been achieved. For example, a fundamental critical appraisal of distillation in relation to other possible processes could have served both as introduction to distillation technology and as explanation of why it has so far outstripped the others.

The author has not attempted such an appraisal, and his actual approach compounds the difficulties. Apart from some very elementary thermodynamics and heat-transfer analysis, which would be relevant in any technology, he attempts no general study. Instead he selects from the mass of existing literature on desalination a fair proportion of those papers dealing with distillation, and presents them, in some cases with little alteration, and in all cases with little appraisal or judgement. The result is a good literature survey in desalination by distillation. But since it is a selection from the minor portion of a literature which is "imbalanced" to begin with, it is very far from accomplishing his intent.

Because of the lack of a systematic appraisal, the book is also unsatisfactory as an introduction to the subject. Thus for example the author omits modern developments in the general theory of distillation desalination, in which multi-stage-flash (MSF) and multiple-effect boiling (MEB) are clearly related as two ends of a general envelope of possible distillation processes. The analyses of each which he takes from the literature are therefore deficient in generality; and

he fails to note that in practice MEB always includes a substantial proportion of flash production (of the order of 20%). Thus he omits consideration of equilibration problems in MEB, and limits it entirely to MSF. The discussion of equilibrium is itself rather superficial and does not, for example, show the important interaction between heat transfer and equilibration which is at once one of the fascinations and one of the bugbears of distillation.

The author's presentation of a literature survey comes into its own however when he deals with the problems of scale and corrosion; and his chapter on these aspects is the most valuable in the book. Other operational problems—venting, surging, part-load operation, siting of water intake and brine return, pump design and requirements, combinations with power generation, construction, erection and commissioning, start-up and shut-down procedures—are barely discussed, or are absent altogether. A good discussion of conjunctive use of desalination along with conventional water supplies is provided by reproduction of the 1968 paper by Mawer and Burley of the Water Research Association.

The book is too technical to be of use to administrators, or to economists who have to consider desalination, and too *ad hoc* to be of use to the technologist and engineer requiring an introductory text on distillation principles and practice. Its value to the student is in the convenience of having a selection of relevant material in one binding.

R. S. SILVER

RODGER B. DOWDELL and H. W. STOLL (Editors). **Flow, Its Measurement and Control in Science and Industry.** Part I. 450 plus xlv pp. Instrument Society of America, Pittsburgh, 1974, £19.60.

THE TITLE on the cover does not make it clear that this is the Proceedings of the first Symposium on "Flow, Its Measurement, etc.", conceived as a parallel to the well-established series of symposia on "Temperature, Its Measurement, etc.". Titles of Proceedings volumes really would contain the word Proceedings!

The symposium was held during 5 days in 1971 (the Editors apologise for the delay in publication) and covered a very large part of its very large subject. This, the first of three volumes, contains 48 of the 163 papers presented, but includes no discussions, the saving grace of many otherwise undistinguished proceedings. Thus, far from being the authoritative *textbook* which this reviewer, at least, hoped for as he opened it, this book differs in appearance from the 1971 bound volume of a journal mainly by being divided into sections on different aspects of the subject. The simulation of a journal includes the welcome feature of a 24-page, 2-column subject index to all three volumes. The Editors do not state how the papers submitted for the meeting were reviewed or what fraction was accepted, but it is generally believed that conference organizers are less discriminating than journal editors, and one must therefore ask what fraction of the papers would have achieved publication in—say—this

journal. The fraction is, I think, $O(1)$, perhaps as large as 0.8 to 0.9, although a few of the papers are rather perfunctory short notes. Only about three-quarters of the papers make specific contributions to flow measurement and control; the remainder are on more general fluid-mechanic subjects though none is outrageously irrelevant. Therefore this book is competitive in quality with a hypothetical "Journal of Flow Measurement and Control" and, at about £4 per hundred attractively-produced pages, not too uncompetitive in price.

The present volume has sections entitled: Flow characteristics, Laminar flow characteristics and open channel flow, Open channel flow, Multiphase flow, Non-steady flows, Critical (i.e. sonic) flow characteristics, Fluid dynamics of flows, Environmental flow measurement, Cryogenic flow measurement, Velocity and pressure measurements, and Measurements in fluid mechanics. The titles of the other volumes are II—*Flow Measuring Devices* and III—*Flow Measurement and Control—Biological Fluid Flows* (volume III has two separate sections covering the two halves of its title). The book—and probably the Conference as a whole—would have been more coherent if some of the section headings had been more precise, eliminating the mildly-irrelevant papers. However it is a moderately worthwhile acquisition for libraries of institutions with wide-ranging interests in fluid mechanics, and it would certainly broaden the mind of any individual reader.

PETER BRADSHAW

J. S. M. BOTTERILL, **Fluid-bed Heat Transfer**. Academic Press, London (1975)

THE EXCELLENT heat transfer characteristics of gas-solid fluidised beds have been recognised ever since these devices were first applied in the chemical and petroleum industries. As a direct consequence of the gas-bubble-induced circulation of particles within the bed, coefficients of heat transfer between gas and particles and between bed and surfaces are of a high order and make fluidised beds attractive units for processes where high heat-transfer rates or close control of temperature are important. The field of gas-solid fluidisation, however, is bedevilled more than most with problems of scale-up, and the behaviour of a large fluid bed, whether it is a chemical reactor, combustor or whatever, is frequently very different, and unaccountably so, from that of a laboratory or even semi-technical scale unit. The reason for this

lies in the fact that many of the properties of the bed, including the heat-transfer properties, are determined by the dynamics of both gas bubbles and solid particles, and these dynamics are strongly influenced, often in a poorly understood way, by the scale of operation. Gas bubbles whose size is known to be a function of bed height can grow to considerably greater dimensions in an industrial unit (which may be anything up to 15 m in diameter and 20 m deep) than in a bench scale bed; and the results of this unrestricted growth are hard to predict with confidence. The effect of the gas distributor on bed performance is another example of an aspect of design about which a great deal of ignorance exists.

There is no doubt, however, that the basic mechanisms of heat transfer in fluidised beds are now fairly well understood; and this book, written by a leading authority in the field, provides a good guide to the voluminous literature on the subject. Furthermore, Dr. Botterill emphasises with a refreshing clarity not always found in research papers the central problem of relating the mechanisms to industrial practice. Thus on p. 152, referring to the several well-known correlations between Nusselt and Reynolds numbers for gas-to-solids heat transfer: "... the correlated results not only involve fluid/particle heat transfer but also an effect of solids convection within the bed and so cannot be expected to apply in systems which are markedly different dynamically from those used in the experimental studies." And again on p. 230: "... the fundamental models (of bed to surface heat transfer) reviewed ... above have very limited value for predictive purposes because the necessary parameters needed for their application are not generally known." This careful delineation of the areas of applicability of the work reviewed is one of the strengths of the book; and, within these self-imposed limits, the author gives a comprehensive account of the research literature up to 1973.

The book is divided into five chapters; and it is perhaps surprising that the first three of these are devoted not to heat transfer at all but to a summary of the basic principles of fluidisation: The Fluidised State, Gas-Fluidised Bed Behaviour; Solids Transport. Chapter Four deals with heat transfer mechanisms, and with its 150 or so references forms the central core of the book. The last chapter is concerned with heat transfer to immersed surfaces. A minor criticism is that so little space is given to fluid-bed combustion; although mention is made of it in several places throughout the book, it would have been preferable to have had a section devoted specifically to this increasingly important topic.

Fluid Bed Heat Transfer is well written in an authoritative style; and its production is up to the publisher's usual high standard. It is a valuable addition to the literature on both fluidisation and heat transfer and deserves to be widely read.

J. G. YATES