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