BOOK REVIEWS

Drag Reduction in Fluid Flows
Edited by R. H. J. Sellin and R. T. Moses
John Wiley and Sons Limited, £39.95

This book collects the papers presented at the Fourth International Conference on Drag Reduction, held in Davos, Switzerland from July 31 to August 3, 1989. The papers are divided into eleven categories that presumably follow the presentation plan of the meeting. Essentially, however, the papers divide very naturally into those that discuss additives, those that discuss passive devices and those that discuss combinations of the two. As the editors point out in their preface, the addition of papers on passive devices is new and reflects the rapid growth of this relatively new area of research. The editors do not mention, as an item probably as noteworthy, that none of the papers are dedicated to laminar flow control studies. Not surprisingly then, for a meeting describing turbulent flow drag reduction techniques, the presentations are strongly weighted toward experiments.

Presentations in the additive category include those that examine theoretical models, rheology, heat and mass transfer, degradation studies, nonhomogeneous flows and applications. Most of the work is concerned with the drag reduction due to polymer additives. The least familiar topics in the additive category are those that deal with nonhomogeneous flows. Three out of four of these papers discuss pipe flow drag reduction through the injection of a relatively concentrated thread of polymer down the center (or in any event away from the wall) of the pipe. I believe that the jury is still out on whether this represents a new drag reduction mechanism or is merely a result of the polymer migrating to the wall region. Tastes will vary but I find the review article by Matthys on convective heat transfer to drag reducing fluids particularly interesting. It is an area of research that is physically interesting and of practical importance, but somehow has not received the attention it deserves. As an experimentalist, I am also particularly impressed by the clever experiment used by Vissmann and Bewersdorff to study the effect of pre-shearing on the elongational behavior of polymers.

The papers on passive devices are divided into the categories of theoretical models, riblets, outer layer devices and combined studies. To my knowledge, when we talk of passive devices we are speaking either of riblets, which are longitudinal elements (v-shaped are effective) with a height and spacing of some 15 wall units, or outer layer devices, which are short (several boundary layer thicknesses) plates or airfoils mounted in the outer portion of the boundary layer. Although riblets have been shown to give 6–8% skin friction reduction and overall drag reduction, it is not clear that outer region devices can produce enough skin friction drag reduction to overcome the drag of the device itself. Although the projected drag reduction for either of these devices is small when compared to additive techniques, they are the only techniques suitable for gas flows. Even in liquids, the passive devices may be useful as they do not have the problems that we find in the application of the additives, particularly for external flows. Originally the outer layer devices were called LEBUs for large eddy breakup units, but the interesting work presented here by Nagib, Wark and Naguib make it clear that large eddy suppression rather than breakup is really involved. Generally speaking, I find that the work on riblets points out the difficulty in establishing trends and drawing conclusions based on the small amount of drag reduction being measured. For example, while the group at NOSC was reporting that, contrary to their earlier findings, riblet drag reduction in pipes was no larger than that found on flat plates, the group at Bristol was confirming NOSC's earlier findings. Clearly these experiments are quite difficult. An interesting result from the riblet studies that is contained in several of the presentations is that riblets seem to delay transition or the development of flow in pipes. In the current volume, only two papers are presented on the effect of the combination of passive devices and additives. It is a safe bet that more will appear in the Fifth symposium.

In summary, I find a good deal of useful and interesting information in this volume. The presentations on the application of drag reduction techniques should be heartening to those who have spent much of their research careers pursuing the physic of these techniques. As with any collection of papers from a meeting, the quality of the work is not uniform. In addition, the papers are quite short and assume that the reader has a good understanding of the topic and of earlier research efforts. For those who would like more background in the area of drag reduction, I recommend the collection of review articles contained in "Viscous Drag Reduction in Boundary Layers" (Progress in Astronautics and Aeronautics, 123, Eds. Bushnel and Hefner, 1990).

Steve Deutsch

Heat Exchanger Design
Arthur P. Fraas
Second edition, John Wiley, New York, 1989, 547 pp.

The second edition of this book represents only a marginal update of the original edition from 1959, largely ignoring progress made in the last 30 years or so, as becomes obvious from even a cursory glance at the references. The author states that "this is not a text on heat transfer" and sets the objective "to look at the whole complex of technologies involved, ... such as vibration, thermal stresses, material compatibility, corrosion, fabrication techniques, cleaning requirements and reliability." Due to such broad objectives, this book is in fact an extremely uneven mixture of subjects, none of which is dealt with in an authoritative manner. Items related to the author's personal experiences (gas cooled reactors, liquid metals, steam generators and air exchangers) predominate out of proportion to more general subjects.

The book is divided into 20 chapters with a massive Appendix (120 pages, euphemistically called "Handbook") which, however, contains only the usual graphs and tables of physical properties, pre-computer era graphical solutions of common equations, and other sundry information, mostly reprints from (often obsolete) publications. The large page format (12×8.5 in.) is often wasted on unnecessarily large-scale illustrations, some of which are hardly relevant to the text.

Chapter 1, "Heat Exchanger Types and Construction" (22 pp.), and Chapter 2, "Heat Exchanger Fabrication" (15 pp.), deal predominantly with steam generators and air cooled exchangers and are otherwise too fragmented to be of any