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BOOK REVIEWS

Measurement of Two-Phase-Flow Parameters. G. F. Hewitt, Academic Press, New York (1978), 287pp.

There is a slander about Professors which says that, if some of them have no knowledge about a certain scientific field, or very little, they deliver a lecture or write a book so as to become familiar with the subject. G. F. Hewitt is (unfortunately in respect of his didactic abilities) not a Professor; and certainly not in this regard. He is, rather, an outstanding and internationally known expert in the field of two-phase flow-measuring techniques, thanks to his great experience as leader of the Harwell Laboratories for many years.

The development and handling of reliable, exact and informative measurement techniques in the field of fluid dynamics requires great experience and experimental aptitude. These difficulties are raised to a higher power when the fluid is a multiphase one, like a gas–liquid mixture. G. F. Hewitt has not presented only his own experience and that of the Harwell group; he has collected much information and know-how from all over the world. This is made evident by the more than one thousand references included in the book.

The book not only gives an outstanding survey of modern measuring techniques for gas–liquid-flow developed throughout the world; and it also provides an introduction to experimental practice; and it provides a mass of valuable knowledge gained by using the described methods.

It is especially advantageous for the reader and user of this book that the chapters are not arranged according to special measuring techniques or instruments; instead the interesting variables to be measured, i.e. the two-phase flow parameters, serve as a key for organizing the book. For this to be done it was necessary, first of all, to classify these parameters. The author did this by distinguishing the importance of the variables to be measured. First priority was given to all parameters interesting to designers, such as pressure drop, heat and mass transfer, quality and mass flow. Steady-state as well as transient conditions were included in this deliberation. Parameters of the second and third order (such as flow distribution, flow pattern, droplet- or bubble-spectrum and entrainment) provide information leading to a better understanding of the primary parameters and help to evolve more physically significant mathematical models.

The emphasis of the presentation lies not in the description of conventional measuring techniques used for many years, but in the conveying of fundamental know-how about new and advanced methods. In addition, electrical and optical equipment and probes are dealt with in detail.

The book can claim, with good reason, to expound extensively, and mostly in an up-to-date and technically advanced manner, the modern developments in the field of two-phase flow measuring techniques. The know-how collected here will hardly be found, in this concentration, in another book. This is also the reason why the book does not aim to give detailed advice like a manual; but rather to be a guide, presenting the methods and guiding the reader. On the other hand, not only measuring techniques and their applications are described in an easily understandable and compact way, but also a critical analysis is made of the results gained with these techniques; and an interpretation is given with respect to the comprehension and theoretical description of the fluid dynamic phenomena. The limitations of using measuring techniques, and of their accuracy, are clearly demonstrated.

The book indeed is addressed primarily to experimentalists in research laboratories; however, it is also of great interest to, and an excellent help for, engineers and physicists in industry engaged in design and operation of apparatus and plants working under two-phase-flow conditions. It helps the researcher in designing his test rigs and in planning his experiments. The practical expert can deduce from the book valuable and precise hints for his tasks in calculating the fluid dynamic layout and for two-phase heat and mass transfer.

F. Mayinger

Aerodynamic Heating and Thermal Protection Systems. Leroy S. Fletcher, ed., Vol. 59 of Progress in Astronautics & Aeronautics, Series Editor-in-Chief, Martin Summerfield, AIAA, New York (1978), 424pp.

The papers that go together to make up this book have been drawn from two AIAA Meetings held in January 1977 (15th Aerospace Science Meeting, Los Angeles, California) and in June of the same year (12th Thermophysics Conference, Albuquerque, New Mexico), and have been, in the Editor's words "revised and updated especially for this volume". The copyright date of the book is 1978.

The book is divided into three main chapters with the titles Aerothermal Environment, Plume Radiation and Thermal Protection Systems. Thus, the eight papers contained in the first chapter are concerned with aspects of fluid motion and convective heat transfer as they arise in such situations as, for example, entry into planetary atmospheres, as well as the kind of flow fields encountered in the base regions of vehicles and the complex shape of the Space Shuttle in its launch configuration. One topic discussed here is the production of vortices in wakes or shear layers that impinge upon a body; such flows are also encountered near the base of buildings in the earth's boundary layer and the fact serves to remind one of the breadth of applications of studies in fluid mechanics and how one field can profit from studies in another.

The second chapter has three papers that deal with both calculations and measurement of infrared radiation from rocket exhaust plumes and with estimations of radiance and transmission from water vapour and carbon dioxide.

Finally, ten papers go to make up Chapter 3; they deal, in general terms, with ablation problems. This chapter has a substantial content of experimental work, but it begins with a fairly lengthy discussion of theoretical estimates of melt-through phenomena in metal plates subjected to tangential air flow. The subject has obvious applications to the matter of atmospheric re-entry, but it clearly has significance in other fields too.

Indeed, application to other fields than space flight is a theme that is explicitly mentioned by the editor in his Preface when he remarks that thermophysics (or what one might perhaps call more-than-usually-complicated heat transfer) is a science that is finding increasing application in pollution studies and in energy collection, conversion and storage. Not all of the papers that go to make up the book are immediately assessable as having significance outside their own (important) field of study; some are, of course, but it is easy to see how the expertise that is represented here is capable of solving the types of problems just described.

The book itself is nicely produced, despite its necessarily rather fragmented structure. There is a fair uniformity in the typefaces used for each paper, above all it is legible, and even the photographs have been well-enough reproduced to be informative (not always the case these days). Such books are always more for library shelves than for the collections of individuals, and I believe that readers should make sure that their Libraries have a copy.

JOHN F. CLARKE

Turbulent Forced Convection in Channels and Rod Bundles: Theory and Applications to Heat Exchangers and Nuclear Reactors. S. KAKAC and D. B. SPALDING, Vols. I and II. Hemisphere (1979).

AT A NATO Advanced Study Institute held in Istanbul in 1978 sixteen invited lecturers reviewed advances in current knowledge of turbulent forced convection in pipes, channels and bundles of rods or tubes. In addition fifteen research reports were contributed. This material is presented in these two volumes and provides a comprehensive guide to the current state of knowledge on turbulent forced convection. The Institute was a summer school and the material will be readily accessible to many people from new research workers to practising engineers.

The two volumes cover a broad range of topics (not all coherent with the title theme) and there are some excellent review lectures. These include Pletcher on current approaches to turbulence modelling, Spalding on the solution of the conservation equations, Bergles on augmentation of heat transfer, Durst on hot-wire and laser–Doppler techniques, and Collier on two phase flows within rod bundles. A number of intriguing phenomena are reported: some of these can be found for example in the lecture by Jackson and Hall on the influences of buoyancy on heat transfer in vertical tubes. Zaric gives a comprehensive review of the intense research into the physics of turbulence, which has revealed evidence of coherent structures in the wall layers of turbulent flows. The suggestions by the review lecturers for further research on turbulence and forced convection are a valuable part of the publication.

The material brought together in these volumes is evidence of a considerable retreat from some of the more optimistic claims made for the predictive power of turbulence models and numerical solution procedures. A number of contributors provide a sober and balanced assessment of these procedures although it is rarely made clear why a particular model is felt to be inadequate. Specific criticism of existing models is more valuable than a general call for more validation. The scarcity of good reliable experimental work is noted in several papers and there is some agreement that models need to be based on very careful measurements of the turbulence structure (especially in complex geometries) rather than on their ability to reproduce the gross features of turbulent flow.

It must be said that several papers (mainly from authors whose native language is not English) are marred by many typing errors some of which verge on the plausible: on p. 436 "the viscous sublayer and the butter layer". The publishers may also note that the text on p. 597 is incomplete and the abrupt ending of a paper on p. 1034 also suggests that some text is missing.

Nevertheless, the two volumes contain an up-to-date account of progress in turbulent forced convection in complex channels, point to deficiencies in current knowledge, and indicate areas in which further work is required. They will be useful and informative to a range of workers including designers, specialists who wish to broaden their knowledge and young research workers.

W. J. SEALE

Recent Developments in Theoretical and Experimental Fluid Mechanics. U. MÜLLER, K. G. ROSENER and B. SCHMIDT (editors), Springer, Berlin (1979). 642 pp. Price $48.40.

THIS volume is a fiftieth birthday Festschrift for Professor J. Zierep of Karlsrühe; and, though some of its contents show the signs of artificial stimulation associated with such occasions, the volume as a whole serves as an excellent introduction to current activities, especially by German fluid-dynamicists.

Part I, entitled Compressible Flow, has chapters on: transonic flow; supersonic flow; nozzle flow; rarefied-gas flow; and computational gas dynamics. In Part II, entitled Incompressible Flow, the chapters concern: stability phenomena; boundary layers; jet flow; airfoil theory; fluid machinery; and miscellaneous problems. There is also a list of publications by Professor Zierep, and a respectful and informative dedication to him. The individual papers are in either English or German, the former language being predominant.

Although it is not especially appropriate in a review for this journal to comment extensively upon the purely hydrodynamic papers, that by Rizzi does deserve comment; for it shows, by way of numerical computations, how remarkably successful is an early analytical expression, devised by Zierep himself, in predicting the shape and position of the shock which is formed ahead of blunt slender bodies when the Mach number is only slightly greater than unity. Transonic flows being so troublesome to predict as a rule, it is encouraging to know that, approached with insight and a flair for simplification, they can sometimes be found to obey conveniently formulated rules.

For heat-transfer specialists, one of the most interesting papers is that of Jischa and Rieke, who derive, from a differential equation for the turbulent heat flux, the expression:

$$Pr_t = A + B(Pr + 1)/Pr,$$

where A and B are constants to be determined empirically. They show that, with $A = 0.825$ and $B = 0.0309$, this equation fits the liquid–metal data as well as does the formula of Rohsenow and Cohen (previously the best available); but it is a better fit for air.

Other papers concerned with heat and mass transfer processes deal with, among other things: the "granular" (cellular?) appearance of the outer layers of the solar atmosphere; the motion of red corpuscles in the arteries; various convective instabilities; and heat transfer in the channels of a rotary heat exchanger.

Reproduced photographically from typescript of high quality but varying styles, and proof-read with understandable trans-lingual fallibility, the book cannot be put in the topmost bibliographical category; but it is well bound, and agreeable to handle; and it should certainly be bought by libraries attempting comprehensive coverage of fluid mechanics or convective heat transfer.

D. BRIAN SPALDING