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REVIEWS

Natural Convection from Combustion Sources. By M. P. MURGAI. Oxford & IBH Publishing Co., New Delhi, 1977. 377 pp. Rs. 16.50.

Similarity Analysis in Fire Research. By M. P. MURGAI. Oxford & IBH Publishing Co., New Delhi, 1977. 132 pp. Rs. 10.00.

A fire of almost any kind is a complex process and when it is initially uncontrolled and unwanted it represents perhaps the most complicated of all combustion phenomena. It will certainly involve a turbulent flow field, with a significant contribution to the associated energy transfer processes coming from thermal radiation. These awkward physical features will coexist with all of the usual flow phenomena especially those associated with buoyant motion in real atmospheres, which must include the effects of chemical change as well as those of changes of phase. A sound understanding of many of the separate elements of this complicated situation has been built up, and it is now possible to conceive of attempts to put these elements together in order to understand and quantify the whole pattern of accidental fires. In pushing such attempts forward it is valuable to have a clear and authoritative view of what has gone before and the provision of such a view is the task that the author of the two present works has set himself. The two books are very much companion volumes and, while it is easily possible to envisage reading the larger of the two without possessing the shorter work on similarity methods, it is not so easy to do the reverse. It is reasonable to deal with the two volumes as if they were one.

The work starts with an extensive purely verbal description of the processes associated with fires, with some emphasis given to the role played by natural convection. This is followed by a listing and explanation of the numerous basic conservation and transfer equations that are necessary for a proper mathematical treatment of the problem. All of the associated dimensionless parameters are introduced, together with boundary-layer simplifications that are consistent with the tall slender character of most plumes above free-burning fires.

Much the most space is devoted to a discussion of plumes that are free of chemical reaction, with the latter idealized as a point or other source of energy. Some attention is given to mixing-length models, but the author favours the entrainment-constant concept. The behaviour of plumes in dry and moist atmospheres, with or without radiation, and in a variety of ambient conditions, is examined in detail.

Some description of the combustion zone in free-burning fires is provided, with the relative brevity of the account signifying that this matter has not been studied in great detail yet. Apart from some Appendices, the first book concludes with a quite extensive account of fire storms, fire-whirls and related vortical phenomena in buoyant atmospheres. The account contains a large measure of descriptive, non-mathematical, work backed up by a number of photographs of such events. Unfortunately these have not reproduced well and it is rather difficult to make anything at all of one or two of them. The books are published in India, and some difficulties (about which the author is constrained to comment in his Preface) have been experienced with rather idiosyncratic type faces. It is unfortunate that the photographs

are not clearer but, with that exception, the printing occasions no difficulty for the reader.

The title of the shorter of the two books makes an explanation of its content almost superfluous. In such a complex topic the number of parameters is very great, so that dimensional and similarity analysis has an unusually important part to play. This is especially true when attempting to correlate experimental work, of course, and there is some concentration of effort on the problems posed by fires in enclosures in this context.

Anyone contemplating either experimental or theoretical research on the problem of fires would be well advised to consult Dr Murgai's books.

J. F. CLARKE

Mechanics of Fluids. By N. S. GOVINDA RAO. Orient Longman, 1976. 477 pp.; many diagrams, no plates.

This is a textbook for engineering undergraduates and is appropriate to those countries where the dominant work is in irrigation and drainage. The plan of the book follows the ancient and honourable method of worked examples (perhaps one-third of the book) interspersed with short explanations. It will therefore be useful to students preparing for examinations of that sort, and acquiring the necessary facility of engineers in numerical problem-solving.

Much of the book follows the tradition of Lewitt's *Hydraulics*, first edition 1923, of firmly tying a basic principle to the solution of certain classes of problem, rather than to give an ordered and logical progression of ideas. Thus it is unfortunate to those accustomed to the fluid mechanics of the 1960–70 era to find the first mention of momentum on p. 261, whereas energy, via Bernoulli's equation, is at p. 41; or to find potential flow confused with the Hele Shaw analogy, and discussed in only three pages.

Students taught from this book will later meet, with a sense of shock, the fluid mechanics of books usually noticed in this Journal. The publishers have done a disservice by allowing this volume to be disseminated amongst the unwary, and it is extraordinary that the Indo-American Book Trust should have subsidized it.

J. R. D. FRANCIS

Mathematische Methoden der Strömungsmechanik. By WILHELM SCHNEIDER. Friedr. Vieweg & Sohn, 1978. 291 pp. DM 39.80.

This book (in German) is based on lectures which the author has given at the Technical Universities of Aachen and Vienna. In the author's experience it is not always easy for engineers concerned with fluid mechanics to acquire the kind of mathematics that will help them to solve their problems without becoming overmuch involved with and discouraged by mathematical theory. The author attempts to find a middle way. A considerable number of methods are illustrated, each by means of an example which is worked out and then discussed in some detail. The book is divided into five parts: (*A*) basic concepts, (*B*) methods for the exact solution of nonlinear partial differential equations, (*C*) perturbation methods I, (*D*) methods for the

solution of linear partial differential equations, (E) perturbation methods II. There are many references to fairly recent literature.

It is not to be expected that so many topics can be covered in any great depth in 250 pages. I am sure that lectures of this kind given by the author are of great value in the training of engineers and will encourage them to overcome their fear of mathematics, to seek the advice of applied mathematicians, and ultimately (if appropriate) to become themselves confident in the use of mathematics. I would however expect most readers of the Journal of Fluid Mechanics to have passed beyond this stage.

F. URSELL

Problems of Stellar Convection. Proceedings of Colloquium No. 38 of the International Astronomical Union, held in Nice, 16–20 August 1976. Edited by E. A. SPIEGEL and J. P. ZAHN. Springer, 1977. 363 pp. $15.50.

In the last ten or fifteen years there have begun serious attempts to apply modern ideas of gas dynamics to the problem of compressible thermal convection in stars. The problem is difficult because the dimensionless parameters involved lie far outside the range accessible in the laboratory; it is important because many questions of stellar structure and evolution appear to hinge on it. This volume contains summaries of most of the developments in the field since Spiegel's 1971 and 1972 reviews in *Annual Reviews of Astronomy and Astrophysics*, though it is not a substitute for the long-promised Part III of that series.

The book comprises 27 articles by 25 different authors. Most of the articles are rather closely related to the central topic and the overall quality is higher than that often found in conference proceedings. There are several articles on observational studies of convection, in the sun as well as in other stars. Some analogous problems in meteorology are discussed. Mixing-length theory, until now the almost universally used tool for stellar structure calculations, is well covered in several contributions; but the application of truncated modal expansions, a subject to which both of the editors have contributed, unfortunately is not. Direct numerical computations of compressible convection are briefly discussed. The influence of rotation and that of magnetic fields are well treated. There are three articles on penetrative convection, a subject of importance for stellar structure. Several interesting papers deal with topics such as thermosolutal convection, convection in a very strong radiation field, and waves, and there is a short section on turbulence.

Most of the papers are clearly written, and several contain extensive bibliographies. The book is essential reading for workers in stellar convection theory, and it can be recommended to anyone interested in the applications of fluid dynamics to astrophysical problems.

N. H. BAKER