is often found that resolution of the uncertainties in both the detailed types of chemical reactions, as well as the reaction rate constants, are of at least equal importance to an accurate turbulence model. Frequently, too, the computation time is determined primarily by the chemical reactions, rather than by the hydrodynamics.

R. C. MJOLSNESS

M. NECATI ÖZISIK, **Basic Heat Transfer.** McGraw-Hill, New York (1977). 572 pp.

THIS textbook is written for use in undergraduate level courses but can also serve as a reference volume for engineering graduates and industry. There is sufficient material, systematically arranged at different levels, for the spectrum of its possible uses to include: a first course in heat transfer at the junior level, a basic heat-transfer course at a higher level, or a two-quarter undergraduate heat-transfer sequence.

In Chapter 1 the basic concepts of heat transfer and SI system are discussed. The four chapters that follow are devoted to the derivation and the methods of solution of heat conduction problems. The analytical and numerical (finite difference technique) methods are presented with a concise and rigorous approach. It is regrettable that in view of the limited space available, the finite-element method is not discussed. Chapter 6 is devoted to the derivation of the equations of motion and energy. The detailed derivations of this chapter may be omitted without affecting the continuity of the subject. Chapters 7, 8 and 9 deal with heat transfer in internal and external flows. Basic concepts of the mechanism of turbulence are discussed and empirical correlations of heat transfer are presented. Free convection is treated in Chapter 10. Next three chapters provide a systematic analysis of radiative transfer in nonparticipating and participating media. In Chapters 14 and 15, a comprehensive treatment of heat transfer in condensation, boiling and heat exchangers is given. Finally, in Chapter 16, the analysis of mass transfer is closely tied to the analysis of heat transfer.

The systematic, simple and rigorous approach followed in Özisik's textbook will improve the effectiveness of teaching. The text is presented with the minimum amount of mathematical complexity and with careful description of the physical problems and physical significance of various quantities in the mathematical expressions.

The publication is excellent and I am pleased to recommend it to both students and professional colleagues.

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B. E. LAUNDER (Editor), **Studies in Convection: Theory, Measurement and Applications,** Vol. 2. Academic Press, London (1977). Price £8.80.

THIS volume of the series is devoted to aspects of convection relating to combustion, a topic which is receiving renewed interest due to its link with both the energy and environmental questions. The first two chapters are extensive reviews by P. A. Libby on variable density effects and convection in turbulent shear flows and by H. A. Becker on the use of light scattering techniques (marker nephelometry) for measuring concentrations in mixing and dilating flows. Both of these authors give very valuable surveys on their own and related work in these fields together with a development of their own approach to the theory of turbulent reacting flows. I was a little disappointed that Professor Libby did not amplify very much on the problem of counter-fluxes and "negative" turbulence generation which are apparent in his experiments with Stanford on helium mixing with air in a porous pipe; perhaps he is saving this for a later review. The problem does illustrate, however, the intriguing phenomena that await the convection specialist when he ventures into this field. Both of these reviews are recommended to such newcomers as being both readable and comprehensive as well as to workers already in the field.

The last two chapters present what are essentially research reports: S. Elgobashi on a numerical model for prediction of turbulent diffusion flames and D. T. Pratt on the computation of systems involving large numbers of simultaneous chemical reactions. Elgobashi's paper is largely his Ph.D. thesis and gives a full explanation of the theoretical approach together with some comparisons with experimental data. Pratt presents a novel approach to the calculation of a chemically reactive flow field which is capable of handling both equilibrium predictions and full chemical kinetic predictions. Turbulent mixing is treated by a conventional mixing-length/eddy viscosity model and the mixture is assumed locally homogeneous so that the interesting problem of "turbulent chemistry" of "micro-mixing effects" is avoided. Both of these papers are probably too long for normal publication in an academic journal and it is good that they have appeared in print so that they will be more accessible. It is preferable, however, that work of this type should go through the detailed examination by specialist referees that is normal with academic journals.

The jacket blurb implies that the series is attempting to provide both "up-to-date review articles by active research workers" and articles which "break new ground and focus attention on hitherto unpublished results and unrecorded facts". These two somewhat conflicting types of article are both represented in the present volume and there is indeed something for everyone. One is left wondering whether it might not be better for the series to concentrate on either reviews or on long research reports as one would think that the editorial procedures needed are quite different.

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B. E. LAUNDER (Editor), **Studies in Convection,** Vol. 2. Academic Press (1977).

THE SECOND volume of *Studies in Convection*, edited by Brian Launder, deals with theory, measurement and applications. The volume is devoted entirely to aspects of convection relating to chemical reaction and is directed to research workers and postgraduate students in the field of Combustion. It contains four separate articles by Paul Libby from the University of California, San Diego; Henry Becker from Queen's University, Ontario; Said Elghobashi from CHAM; and David Pratt from the University of Utah. All the authors are recognized authorities in the field of combustion and all of them discuss problems related to turbulent flow with chemical reaction.

Libbey's major contribution is in the improved understanding of the effects of variable density and reaction on turbulent shear flows. He has become well known for his use of a two sensor probe for measuring correlations between temperature and concentration in nonreacting flows. He shows the importance of Favre averaging, according to which the density is not decomposed but all flow variables, except the pressure, are mass averaged. Libby has made major contributions in experimental work and also in theoretical understanding. His experimental work provides him with a clear insight into the important physical processes and has allowed him to demonstrate the importance of facts such as flame angle on turbulence and the fluid mechanics of shear flows.

Becker pioneered the techniques for measuring concentration fluctuations by means of an optical probe based on light scatter principles. He was able to measure quantitatively the extent of turbulent mixing and provide much greater insight into the important phenomenon of unmixedness. In this volume, he coins the term "marker nephelometry" to describe this technique. I doubt whether it will be used universally but Becker, in his article, used this term as an umbrella to discuss, in general, his studies on mixing, turbulence and combustion. For those research workers looking for information on concentration variations in turbulent flows, both with and without chemical reaction, they will find a wealth of information in this well-written article.

Elghobashi's article is a study in the prediction of turbulent diffusion flames. The work has been greatly influenced by that of Spalding and Launder, and is based upon the standard numerical computations and mathematical models that have been used at Imperial College for many years. The special contribution of Elghobashi is his incorporation of both the effects of turbulent concentration fluctuations of chemical reaction and the effects of combustion on the flow. He, as many of his colleagues, claims that use of the k-ε turbulence model provides predictions which compare "reasonably well" with measurements. Those of us involved in making measurements in turbulent diffusion flames are not convinced that our knowledge and understanding of turbulent diffusion flames will come from this type of prediction procedure.

David Pratt has, in the past, introduced a number of chemical engineering concepts to the combustion community. In his article in this volume, he writes from a background of experience with homogeneous finite-rate chemistry, which he has adapted to a computational technique developed while he was a visitor at Imperial College. His paper deals with a number of details concerning the computational procedure and the calculations of chemical equilibrium.

The four articles in this volume will be a useful addition to the small body of literature in the field of turbulent combustion.

NORMAN CHIGIER