Int. J. Heat Mass Transfer. Vol. 20, pp. 1269–1270. Pergamon Press 1977. Printed in Great Britain

# BOOK REVIEWS

## **Combustion Measurements**, R. GOULARD. Hemisphere, New York (1976).

CONTRARY to outward appearances such as its title, index, form of the hard-back cover and inscription on its spine, etc., this volume is not a text book reviewing the subject but the proceedings—complete with discussions after papers—of a meeting in the Project SQUID series. The contents include, *inter alia*, contributions on: Combustion modelling; Measurement of combustion reaction kinetics; Combustor design; Optical measurements such as laser velocimetry, absorption–emission resonance techniques, scattering including Raman and Rayleigh measurements, interferometry including holography and two wave-length methods; Probe measurements in laminar and turbulent flows, Measurements on the size, concentration and velocity of particulates; and Reviews of the state of the art with recommendations for the future.

The editor ably discharged the unenviable task of collating some very heterogeneous material. The contributions vary in length from over 20 to under 2 pages and in presentation from the excellent to the droll. I thought the final "Review and Suggested Experiments", by Goulard, Miller and Bilger, a masterly and successful attempt at bringing forth order from chaos. There are several good accounts of novel diagnostic methods which one would have wished to see greatly expanded. The session on laser scattering measurements, for example, provides a very useful summary of the state of the art.

To discharge the reviewer's task honestly, one must comment on the other end of the spectrum also. There is one sad little article reviewing interferometry which never rises beyond the Mach–Zender interferometer or the six references, all due to the author and his students. The supposition that it must be intended as a review—and one for the totally uninitiated—is based on passages such as "Electromagnetic light travels in the form of wave trains. The change from bright to dark to bright is said to result in a *fringe shift* of one. Two fringe shifts occur when the path lengths differ by two $\lambda$..." etc. Somewhat less entertaining are statements such as "The only early work known using interferometry was by Ross and El Wakil." The definition of "early" here is 1960 and it is a little saddening to anyone with a smattering of optical background to recollect Schardin's publication of Mach–Zender interferograms of flames in 1933. Even as regards his discovery of the limitations of two wave-length interferometry, the author was anticipated by well over a decade by L. H. Olsen in the Third Combustion Symposium.

However, parts of the discussion leave one in no doubt that the book is not intended for the reader with a background in optics. In support of this, I cannot resist quoting verbatim the following passage, concerning the use of laser velocimetry, from the spontaneously rendered and in places highly entertaining discussion: "But a person who has a good education, is intelligent and knows how to make measurements, can learn certainly within one year how to use this instrument". Could the training period be reduced somewhat, one wonders, if a small electric shock were administered whenever an error was made?

This is a collection of papers very diverse as regards presentation, length and quality, but all dealing with a subject of vital importance. That alone would motivate your reviewer to spread what light and happiness he could. If the outcome appears to lack a little in charity, it is due, in no small measure, to the price of the volume. Unlike earlier proceedings of the Project Squid Workshops this one is on sale by Academic Press at £21.05! Far be it from me to suggest any such thing, but my electronic pocket calculator (which constantly compels me to invent problems for it to solve) informs me that the contents of the entire volume could be xeroxed for only 0.32072 times that amount.

FELIX WEINBERG

## BHALCHANDRA V. KARLEKAR and ROBERT M. DESMOND, **Engineering Heat Transfer**. West, St. Paul, MN. 580 pp. Price $19.95 (1977).

THIS text book, written primarily for use in undergraduate level courses, comprises eleven chapters, thirteen appendices on units and dimensions, conversion factors and property values, and finally an index. In addition, there is a separate manual of hand-written solutions to the problems found at the end of each chapter in the book.

Following an introduction to heat transfer, conduction, radiation and convection are dealt with in detail and in an orthodox manner. A comprehensive chapter on numerical methods in heat conduction follows the conduction section while a useful chapter entitled "Fluid flow background for convection heat transfer" precedes the sections on forced convection and natural convection. The last two chapters are concerned with fins and heat exchangers and heat transfer with change of phase.

I find this book of particular value for teaching purposes. The authors are clearly aware of the students' (and the teachers'!) needs, and the provision of worked sample problems and the complementrary solutions manual in both the English engineering system of units and SI units must surely result in the book being widely used particularly in the academic field. (The tables of property values and other parameters using both systems of units will be helpful during the transition period from one system to the other.)

The "physical interpretation" aspect and the frequent reference to common experiences and real situations will assist the beginner before he encounters the mathematical analyses which are themselves very clearly presented.

On the whole there is a good balance in the academic content although I would like to have seen more on the Reynolds analogy and its extensions. The authors have made good use of the electrical analogue in this edition; they might also consider the inclusion of the similarity of heat transfer with mass transfer in future versions of their book.

"Engineering Heat Transfer" is a very worthwhile addition to the literature in this area of study. The publication is excellent and I shall have no hesitation in recommending the book to both students and professional colleagues.

H. BARROW
March, 1977.

## JUI SHENG HSIEH, **Principles of Thermodynamics**, McGraw Hill, New York (1975), pp.xx & 512, £14.45.

I HAVE had great difficulty in deciding for whom this book is intended. It is undoubtedly, as the author states, a text book on classical thermodynamics for students who have already had some exposure to the subject. In the United Kingdom most second year science or engineering students would find the text quite straightforward; the author himself suggests it is suitable for senior or postgraduate students in the United States. However, what does present difficulties is the intended discipline. The problem is that the book deals with a large number of subjects, including magnetic systems, superconductivity and elastic systems as well as the more conventional topics: equations of state, multcomponent fluid systems, chemical reactions, rather briefly and superficially. Professor Hsieh is a mechanical engineer and in his preface he singles out mechanical and chemical engineers for special mention. Yet I cannot imagine many teachers of engineering finding this book suitable for adoption in their course. There is no mention of compression or expansion processes or power generation; the chemical engineer will note also the absence of any discussion on refrigeration and the total inadequacy, for his purposes, of the chapter on chemical reactions. Perhaps one should take one's clue from the title—"Principles of Thermodynamics"—which might suggest a book on an altogether higher plane. But if this was the author's intention then I am afraid he has not been too successful. All too often one comes across sections that lack rigour and are at times misleading or, more rarely, simply wrong. At £14.45 in the U.K., I do not think many people will find the book a good buy.

G. SAVILLE

D. R. GASKELL, **Introduction to Metallurgical Thermodynamics,** McGraw Hill, New York (1973). pp xx & 520.

THIS student text book is intended for use by materials scientists and metallurgists and should cover most of their undergraduate needs. It discusses the subject in quite a leisurely manner although the order in which the fundamental topics are covered does seem to this reviewer, at least, rather idiosyncratic at times. However, any student who masters the contents of this book should leave with a sound working knowledge of metallurgical thermodynamics.

The author takes an essentially classical approach to the subject with only a brief aside on the statistical interpretation of entropy. This latter is not, of course, a rigorous exposition and it leaves much unsaid, but it is good to see an account of elementary statistical ideas which does not fall into the usual trap of describing only configurational entropy when it is thermal entropy which is the most frequently encountered.

The first half of the book is concerned with fundamentals—the laws of thermodynamics and their immediate consequences—and the applications quoted as examples are almost always based on the gaseous state, and often the perfect gaseous state at that. It is not until the second half of the book that one reaches systems of metallurgical interest when the discussion turns to the thermodynamics of solutions and chemically reacting mixtures.

There are numerous worked exercises throughout the book and problems for the student to tackle himself. Apart from a mention of S.I. in the preface, the units used are almost exclusively the calorie, the atmosphere and the entropy unit, which suggests that the book might date rather quickly. Indeed, my main criticism of the book is its use of rather dated examples which although no doubt based on experimental data which are little worse than modern measurements, do not lead the student to believe that what he is studying is an active subject. It is probably through the author's use of dated material that he was led to describe, correctly, on one page the absolute temperature of the ice point as 273.15 K, and then eight pages further on discuss at length the ideal gas scale based on the absolute zero being at $-273.16$ K, a situation which is ideally designed to confuse the student when one remembers that the modern definition of the triple point of water (not the ice point) is 273.16 K exactly.

G. SAVILLE

EUGENE F. ADIUTORI, **The New Heat Transfer, Vol. 3, Equipment Design and Analysis.** Ventura Press, Cincinnati (1977).

THIS book gives details of calculations relating to specific pieces of equipment, given the necessary specifications and appropriate heat flux–temperature difference relationships. It does not deal with the theory and mechanism of heat-transfer processes. It is not a text book suitable for students but may prove useful for those designers who are happy with Adiutori's "new" notation.

In the early chapters the author continues his tirade against the heat-transfer coefficient, transport properties and dimensionless groups. One can agree that quantities such as heat-transfer coefficient, which are not properties, have limited usefulness. When the ratio between the heat flux $q$ and the temperature difference $\Delta T$ is not constant, it is not generally helpful to introduce a third variable $h = q/\Delta T$ into the problem.

The argument against the heat-transfer coefficient does not, however, hold for "genuine" properties such as electrical resistance. Thus, having noted that for a given conductor at a fixed temperature, the ratio of the applied potential to the electric current is constant, I can see no advantage in refusing (as does Adiutori) to acknowledge the existence of a *property* of the conductor, its resistance, which is independent of the current and potential. Similarly, to take an example which Adiutori does not use, given the proportionality between the force acting on a body and its acceleration, I do not think it is helpful to ignore the inference that there exists a property of the body, its mass.

The author proposes that general non-dimensional relationships be replaced by specific ones, each valid for a particular fluid. The roles played by the various fluid properties are replaced by a single temperature dependence. This gives a much simpler relationship which would prove useful where extensive computation was required for the special case. Adiutori does not draw attention to the fact that many (as many as there are fluids of interest) equations are required to replace one general relationship and that, while an equation for any fluid can be obtained from the general one (if the temperature dependence of each of the fluid properties is known) equations for different fluids cannot be obtained from an equation for a particular one.

The use of symbols to denote quantities "in" specific units (i.e. the true quantity *divided by* its units) rather than to denote the quantity itself (i.e. the *product* of a number and units) is claimed to be "better from an engineering standpoint". An obvious disadvantage of this is that different symbols are required to accommodate all possible units. More serious, this practice obscures the fact that a physical quantity is a product of a number and units. Further, it is not possible to check the dimensional homogeneity of equations. The sort of confusion that can arise may be illustrated by an example from the book. The equation given [p. 1.45, equation (77)] for the pressure drop for laminar flow in a pipe is:

$$\Delta P_{\text{lam}} = \frac{32\,\mu L}{g D^2} V$$

where $g$ is given in the nomenclature "gravity constant". Apart from the misleading implication that gravity is involved in this problem, no value is given for $g$. In order that the above equation shall give the correct result, with the units used for the other quantities, $g$ is, in fact, approximately equal to the number $6 \times 10^{10}$!

While some parts of this book may be useful, it seems to me that Adiutori takes a restricted view of the subject and wishes to avoid those generalisations which lead to insights and advances.

J. W. ROSE