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BOOK REVIEWS

Prediction of Turbulent Reacting Flows in Practical Systems

T. Morel (Ed)

This slim volume contains three papers presented at the ASME's Fluid Engineering Division meeting at Boulder, Colorado, in June 1981. It follows ASME's recent trend of binding together collections of conference papers rather than issuing each manuscript as a separate preprint. This approach has a number of economic and logistic advantages for the authors, the readers and the Society itself. The papers, each in the nature of a survey article, address three overlapping aspects of the problem of calculating turbulent reacting flows of practical interest.

The contribution by Westbrook and Dryer, an entirely discursive article, considers chemical-kinetic aspects of the problem. The article by Jones and Whitelaw considers a wide range of topics at rather uneven depths: the section on numerical solution methods is fairly superficial, while the discussion on turbulence and the way it impinges on the problem of chemical reaction is much more authoritative. There would, one might suppose, be a strong interlinkage between these first two articles. One gets the impression, however, from the Jones–Whitelaw contribution that the questions of complex chemistry addressed by the Westbrook–Dryer paper are of only academic significance, while for their part, the latter authors discuss chemical reaction models in isolation from the questions of turbulence. This polarity of outlook, while reflecting the different background disciplines of the research workers concerned, is one that needs to be neutralised if many of the important problems of turbulent combustion are to be solved.

The final article by Harsha focuses on applications. His examples range from simple jets to recirculating flows and practical combustors. Through no fault of the reviewer, such surveys tend to produce a too favourable impression of the status of calculation methods, for his source material (ie the technical literature) is biased towards success: editors and authors share a disinclination to publish papers showing terrible agreement between experiments and computation. Overcoming this aversion to failure would be a further important step towards maturity in the understanding of turbulent reacting flows.

Collectively the articles give a timely, if ephemeral, snapshot of the current (or, rather, 1980) state of research in turbulent combustion. The volume is inexpensive and should be bought by anyone currently wishing to get more deeply into the subject. More than 180 papers are cited in the reviews and this alone is worth the cover price. It makes less sense as a library purchase, as the useful half life of the volume is probably not greater than two years.

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An Introduction to Thermodynamics

J. P. Todd and H. B. Ellis

The authors claim their material to be aimed primarily at Engineering Technologists in training. The topics are clearly presented and aimed at a level no higher than a first year undergraduate course in Engineering. The level of ability to which the book is suited is intermediate; it is certainly not for the academic, but not strictly for the applied engineer, even if there are many helpful, practical illustrations. The questions at the end of each chapter and selected answers will be appreciated by the student reader. Judged alongside a standard undergraduate text such as Rogers and Mayhew, this work covers a wide range of topics but in considerably less depth.

Apart from the material to be expected in an undergraduate first year course, there is a discussion of reheat in steam turbines, a section on thrust producing cycles, an elementary presentation of convection and radiation, and the concept of availability is introduced. However, there are two topics that are notably absent; any mention of combustion, and a treatment of gaseous mixtures (although psychrometry is discussed).

An interesting introduction leads on to a set of definitions: *energy*—'The capacity for doing work' *work*—a strictly mechanics formulation is used; and *heat*—a form of energy in transit across a boundary. The *system* is defined as a fixed volume and then dealt with in the usual three forms, the open system, the closed system, and the isolated system.

After a conventional presentation of the first law, the second law is presented using the axioms of Kelvin, Plant and Clausius, and by a useful simple reference to the concept of availability of energy. Entropy is introduced to the reader in the form:

$$\Delta s = \frac{dU}{T} + \frac{p\,dv}{T}$$

and the authors, at this and other points, make a careful distinction between intensive and extensive properties. The limiting nature of the third law is discussed, but the definition used, 'Entropy tends to a minimum constant value as the temperature tends to absolute zero', even with the qualification given, is not likely to help the new student to the subject.

This readable book attempts to tread the path between academic rigour and applied engineering, covering a wide field at a modest level. In this aim the book succeeds but the treatment used causes an academic thermodynamicist to ponder on the choice of basic definitions.

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Thermodynamic Principles of Energy Degrading

D. F. Moore

This volume may be said to consist of two parts. Over half of it is devoted to a review of topics lying in the province of classical thermodynamics with an emphasis on the Second Law, and the remainder of the book deals with some aspects of the Second Law Analysis.

The introductory treatment of the fundamentals is sound although, as is to be expected in such a slim volume, rather superficial except for the treatment of the Second Law and Reversibility to which two out of the six chapters have been devoted. The material is presented in a readable form, although some important definitions have been worded with inadequate precision.

The last two chapters dealing with the Second Law Analysis as such constitute a rather light-weight treatment of this important subject. The expressions derived have been restricted to simple processes and cycles involving work and heat transfer. A 'case study' is concerned with the use of Carnot Engines and Carnot Heat Pumps to improve space heating efficiency. It is therefore difficult to see how this book can be of benefit to 'researchers and practising engineers', to whom, according to the publishers, the book ought to appeal. They are, for instance, unlikely to learn from this book how to deal with problems involving combustion, chemical reactions, gas separation and jet propulsion, to mention just a few topics of possible practical interest. It appears that this book has not benefited to any noticeable extent from the vast number of original papers on the Second Law Analysis published in English or foreign languages and dealing with topics of practical interest to engineers. This is further illustrated by the complete absence of any references to such papers, except for a list of text books on thermodynamics given in the Bibliography. The absence of any references, in my view, is a serious drawback if the book is to appeal to the more serious type of reader.

The book might still be of some use to undergraduate students were it not for the confusing treatment of concepts related to irreversibility.To begin with there are too many synonymous terms used. In addition to plain irreversibility, in some chapters called 'irreversibility function', we have the equivalent concepts of 'change in unavailable energy' and 'energy degrading'. Furthermore, uncommon meaning is given to the term 'external irreversibility'. Expression (6.5) relates energy degrading to internal irreversibility and the change in unavailable energy. This relationship is never put to a test in a numerical example; however, the foundation on which it is based is demonstrated on a temperature–entropy diagram (Fig 6.4). This treatment assumes that an actual process involving work and heat interactions can be replaced with two component processes. In one component process the system is considered adiabatic and suffers all the friction of the actual process. The second component process corresponds to frictionless isobaric heat transfer. The fallacy of this treatment lies in the assumption that the combined irreversibility of the two component processes is the same as the irreversibility of the actual process. Quite clearly, without going into a more fundamental discussion, this cannot be so since the temperatures at which heat is transferred to (or from) the system in the two cases are different.

It is most disappointing that a book on the Second Law Analysis, for which there is a real need, should fall so far below the standard at which the writer could recommend it to any potential reader.

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