conversion of solar energy into electricity and storage of solar energy by Kattani; refrigeration and air-conditioning by Brinkworth, solar heating and cooling of homes by Yellott; solar production of hydrogen by Veziroglu and Kakac; solar energy measuring equipment by Wood; fundamentals of water desalination by Howe and Tleimat; economics of solar energy by Sayigh.

This book can be divided into four parts, apart from the first and last chapters written by the editor: chapter 1 dealing with the scope and advantages of solar energy and serving as a short introduction to this book, and chapter 21 at the end of the book, discussing costings of solar appliances. The first part, containing chapters 2 and 5, discusses the nature of the sun, solar radiation spectrum, estimation of total, direct and diffuse radiation, and heat-transfer fundamentals for solar energy utilization. The second part composed of chapters 6, 7 and 8, outlines fundamentals, fabrication, and uses of water and air heaters. The third part having chapters 9 and 11, deals with optics, concentrating collectors and solar furnaces. The fourth part, represented by chapters 10 and 12 to 20, discusses various applications of solar energy, e.g. solar pond, solar distillation, photovoltaic conversion of solar energy, solar refrigeration, solar hydrogen production space applications and solar measuring equipment.

Apart from the few errors and repetitions which are bound to occur in such a book of wide scope, the reviewer considers the contents of each chapter to be well rounded; but detail is sacrificed to clarity of the concept, particularly in chapter 16 (refrigeration and air-conditioning) which is rather elementary and lacking details and diagrams of actual systems or projects, and chapter 17 (solar heating and cooling of homes) which is a general and brief presentation of some applications in U.S.A. The editor has laid special emphasis on the engineering aspects of the topics, so the book is best suited as an engineers reference book, but each subject covered is more exhaustively discussed in other books and documents, particularly those of the U.S. Energy Research and Development Administration (ERDA) which are not on the list of references at end of the book.

Although the editor intended to make the book a truly international textbook, yet being himself Arabian, he concentrated more on information and data concerning the Arab countries; thus in chapter 4, sunshine hours and ambient conditions curves, iso-radiation maps and tables of total solar radiation and comparison between the estimated and measured values, are only for Arab locations and territories.

Finally, the reviewer finds this book unique in covering nearly all topics of solar energy, and feels that the clarity and neatness of presentation is a classic and a help for everyone interested in solar energy, and in the design and operation of solar equipment.

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D. R. PITTS and L. E. SISSOM, **Theory and Problems of Heat Transfer, (Schaum's Outline Series).** McGraw-Hill, New York (1978).

IN THEIR books Professors Pitts and Sissom have attempted to achieve a number of ambitious objectives. Firstly and perhaps most importantly they have attempted to write a text book that will be suitable for use by lecturers and students in tutorials and for self-study. The number of worked examples (296) and problems means that the book is worth buying for this fact alone. Secondly they have covered a number of areas; and major topics (Conduction, Convection, Radiation, Boiling and Condensation and Heat Exchangers) are covered in sufficient detail to ensure that the appropriate chapters could form the basis of several undergraduate courses. Thirdly, in their attempt at striking a balance between a mathematical approach based upon rate equations and an empirical approach, they have in the main been successful. In particular the chapters on conduction give a balanced approach to the analytical and numerical methods available for the solution of the underlying equations. The examples illustrate the usefulness of these techniques and underpin the theory. A number of flow charts and Computer programs are given. (These chapters provide an excellent background for any Engineering Mathematics Lecturer; much of the mathematical detail would however need much expansion.) Finally, due importance is given to a precise definition of the particular problem being considered and all important relationships are clearly highlighted.

The authors are to be complimented on their work and I am sure that the book will find its way on to many bookshelves where it will be a valuable supplementary text book and source of exercises and problems.

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D. B. SPALDING (Editor), **Physicochemical Hydrodynamics, V.G. Levich Festschrift.** Advance Publications, London (1977), pp. X/V 1076.

THESE two substantial volumes contain the contributions to the conference held in Oxford in July 1977 to mark the sixtieth birthday of Benjamin Levich. The title is that used by Levich for his famous book first published in 1952. One of the outstanding features of this collection is an article by Levich himself describing the subject he invented and the problems which face it in its present state of development. Reading this article (which of course could not be presented by Levich personally at the conference) one is forcefully reminded that the Soviet Government has yet again impeded the progress of science by its shortsighted policy of preventing one of its ablest citizens from exercizing his remarkable talent to the full.

It is impossible in a brief review to do justice to the extraordinary range of topics covered by the seventy or more papers, but the headings of the sections may give some idea: Physical Transport, Interface Mechanics, Interspersed Phases, Chemical Hydrodynamics, Electrophysics, Electrochemistry. It is abundantly clear that this is no formal tribute to a great man but, what is far more important, part of active scientific progress, a lively cross-fertilization process in which scientists from different disciplines can learn what their colleagues are doing. In this way the lines which have diverged from the origin in 1952 can be linked and again new directions discovered. Thus it is a tribute of which the recipient and the donors can justly be proud. Professor Spalding and his colleagues who undertook the large amount of work involved in organizing the conference and the publication deserve our grateful thanks.

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M. P. MURGAI, **Natural Convection from Combustion Sources.** Oxford and IBH (1976). pp. 377. **Similarity Analysis in Fire Research.** Mohan Primlani (1976). pp. 132.

THESE volumes are closely related as to substive physical phenomena treated, and still more so as to underlying philosophy. The author attempts comprehensive treatment

of convection induced by fires, both open and enclosed. For the most part, the subject does not admit rigorous and detailed analysis. Such quantitative understanding as exists is vitally dependent on physical modeling concepts, typically retaining only the coarsest flow features, as refined in the light of experimental information from diverse sources. Application of similarity concepts to develop correlations and for interpretation of data to elucidate physical concepts is a prominent feature of fire research, and is deservedly emphasized in the present work.

Unquestionably, there is a need for information respecting fire-induced convection to be pulled together in the literature. As the sole attempt to do so, Murgai's effort to do so constitutes a valuable resource for the aspiring or practicing fire scientist. But it falls seriously short of this need in some important respects.

Literature coverage effectively terminates at 1970. By then, understanding of convection induced by open fires fairly approximated its present state. But, since 1970, so much has been done on enclosure fires that these volumes are useful only as an introduction.

The writing is at the level of a specialist in applied mechanics and this reviewer judges the material, as presented, inaccessible to most engineers. Even for the specialist, the organization causes considerable frustration. There is considerable cross-referencing, and extensive and sometimes redundant development of methods of approach. Little space is devoted to comparative evaluation of alternate approaches or to critical discussion of the diverse modeling concepts covered.

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V. RADCENCO, **Optimization Criteria for Irreversible Thermal Processes (Criterii de Optimizare a Proceselor Termice Ireversibile)**, Editura Tehnica, Bucharest (1977) 468p.

THIS book treats the subject of thermal process design, relying heavily on the concept of irreversibility production and its engineering implications. As such, it is a courageous attempt to summarize for the reader a new and important trend in thermal engineering, namely, the infusion of second law concepts into a field traditionally dominated by first law considerations. For this reason, Dr. Radcenco's book deserves serious attention.

The book is addressed to engineers with an undergraduate knowledge of classical thermodynamics, heat transfer, and fluid mechanics. Its main objective is to convey a design optimization philosophy which takes into account the fact that the irreversibility associated with any thermal process results in lost useful work. The material is grouped into eleven chapters which discuss, in order, the engineering consequences of the second law of thermodynamics, the optimization of processes in piston expanders, one- and two-stage compressors, internal combustion engines, gas turbine engines, turbojet engines and vapor-compression refrigeration plants.

The most useful and instructive part of the book is the first chapter, in which the author develops the known second law result whereby the useful mechanical power lost in a steady-state, steady-flow process is equal to the total rate of entropy generation (internal and external to the process) times the absolute temperature of the surroundings [see, for example, G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, 2nd Edition, Wiley, New York (1973), pp. 271–277]. Dr. Radcenco calls this result the "Gouy-Stodola Theorem". Next, the associated concepts of exergy, exergy accounting and exergy efficiency are presented. The author makes a special and very appropriate effort to expose the parallel existing between the new name "exergy" and older terms such as "availability" and "useful energy".

The remainder of the first chapter is devoted to analyzing a number of elementary processes which are responsible for the production of irreversibility in practical thermal processes. This list includes filling and discharging, mixing, throttling, heat transfer processes and combustion. However, the subject of irreversibility production through heat transfer is considered much too briefly; as an example, the author analyzes the irreversibility of a two-fluid parallel flow heat exchanger with zero pressure drop.

The rest of the book contains the case-by-case design optimization of work transfer devices, such as reciprocating and rotating expanders and compressors. The relative imbalance in the treatment of heat transfer versus work transfer components may be explained in terms of the author's own research interest. From the reader's point of view, however, this imbalance weakens the book considerably. As a treatment of all irreversible thermal processes, the book is incomplete. For the study of irreversibility production and minimization in heat exchangers, the reader should consult other sources, such as the article, A. Bejan, The concept of irreversibility in heat exchanger design: counterflow heat exchangers for gas-to-gas applications, *J. Heat Transfer* **99**, 374–380.

Despite its limitations, the book is an excellent reference text, particularly with regard to second law analysis and the optimization of work transfer components. It contains a total of 103 references, most of which are drawn from local sources, some published in Russian and Romanian. The book is written in Romanian, which makes its table of contents and structure, at least, accessible to readers acquainted with any other Romance language.

For its uniqueness, Dr. Radcenco's book is recommended highly to researchers active in the area of irreversibility analysis and minimization in thermal engineering. The first chapter is a very good exposition of the position occupied by the second law of thermodynamics in thermal design.

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