Int. J. Heat Mass Transfer. Vol. 20, pp. 183–185. Pergamon Press 1977. Printed in Great Britain

BOOK REVIEWS

P. D. DUNN and D. A. REAY, **Heat Pipes.** Pergamon Press, Oxford (1976), 299 pp. Price $18.00 (£9.00).

THE USEFUL heat-transfer characteristics of heat pipes have been recognised since the publication by G. M. Grover *et al.* of the paper "Structure of very high thermal conductance" in 1964, 22 years after the idea of the heat pipe had been suggested and patented by R. S. Gaugler in 1942. During the last 12 years, the high-thermal-conductance characteristic of the heat pipe has been appreciated, developed and successfully applied to a wide range of problems. Initially, heat pipes were used for satellite isothermalisation; but today they are in general use for (a) separation of heat source and heat sink, (b) temperature flattening, (c) heat flux transformation, (d) temperature control, (e) thermal diodes and switches. The five groups of application listed above correspond to the five basic properties of a heat pipe. The understanding of the heat-transfer and fluid-flow mechanisms of the heat pipe has progressed to the stage where heat-pipe design for specific application can be undertaken with some confidence. This is exemplified by the growing specialist commercial use of heat pipes and the wide range of published material on heat pipe application.

Dunn and Reay state: "This book is intended to provide the background required by those wishing to use or to design heat pipes. The development of the heat pipe is discussed and a wide range of applications described."

The tasks thus defined by the authors have been adequately achieved and the use of their text is enhanced by the extensive working-fluid property data, provided as an Appendix. However, the text suffers from a number of typographical errors, and the use of units other than S.I.; further, Fig. 2.1. on p. 19 is wrong, it should be replaced by the figure below.

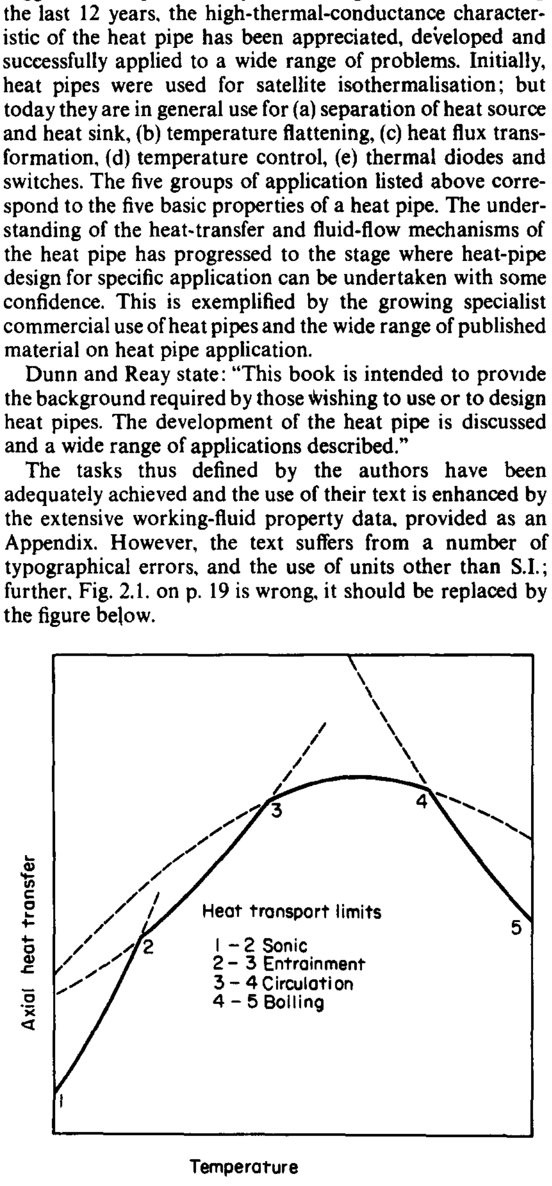

FIG. 2.1.

"Heat Pipes" is well written; and, in a text of 299 pages, it covers the history, theory, design development and application of heat pipes admirably. It is a timely and valuable addition to the literature on heat pipes and should be widely read by designers and users alike.

A. BROWN

A Bibliography of Finite Elements, compiled by J. R. WHITEMAN, Academic Press, New York (1975).

THIS volume contains some two thousand two hundred titles listed by author and by subject on topics such as "classical analysis, functional analysis, approximation theory, fluids, diffusion and aeronautical, civil, mechanical, electrical and nuclear engineering applications. Literature on the solution of systems of linear and non-linear equations" is not included. Entries against specific topics in Applied Mechanics range from 10 to 50 items per subject area. From knowledge of some of the papers listed and examination of titles of others, it would seem that the coverage is very mixed between papers describing new advances or others applying known finite element techniques to specific problems.

This bibliography obviously provides a start to the worker unfamiliar with a particular field, but makes no claim—indeed disclaims—to give comprehensive coverage.

C. E. TURNER

Heat Transfer at Low Temperatures, edited by W. FROST. Plenum Press, New York (1975). Price $35.00. 362 pp.

CRYOGENIC engineering has become an increasingly important subject to many practising engineers and researchers. The recent growth of cryogenic technology has been particularly propelled by large scale uses of cryogenic liquid fuels in space propulsion systems, and of liquefied gas fuels for transport and storage. Rapid expansion in the future is further assured with the advent of superconducting devices and machineries, cryogenic transmission cables, cryopumping, cryosurgery, etc. Naturally, the subject of heat transfer at low temperatures becomes an integral part of this new development. While most of the heat-transfer problems at low temperatures can be resolved through existing heat-transfer theories, many do require special considerations and solutions because some assumptions or approximations commonly employed are no longer valid in this regime. Furthermore, cryogenic applications have often generated new heat-transfer problems that do not exist otherwise. To produce a successful treatise for heat transfer at low temperatures, however, is a formidable task, because of the substantial overlap with general heat-transfer principles as well as the heavy reliance on cryogenic applications.

The present book is the latest addition to the highly acclaimed International Cryogenics Monograph Series under the general editorship of K. Mendelssohn and K. D. Timmerhaus. Judging from the inherent difficulties in treating this subject as mentioned above, this book must be regarded as a successful venture on an overall viewpoint. It contains chapters with the following titles: Introduction, Conductive Heat Transfer, Convective Heat Transfer to Low-Temperature Fluids, Terminology and Physical Description of Two-Phase Flow, Nucleate Pool Boiling, Critical Heat Flux, Film Boiling, Minimum Film Boiling Heat Flux, Vapor–Liquid Condensation on Cryogenic Surfaces, Vapor–Solid Condensation, Pressure Drop and Compressible Flow of Cryogenic Liquid–Vapor Mixtures, Forced Convection Heat Transfer with Two-Phase Flow, Transient Conditions in Boiling and Two-Phase Discharge, Radiative Properties, and Heat Transport in Liquid Helium II

The material was originally presented by various contributors in a short course, and was later expanded and edited into the form of a book. This organizational development is reflected through the rather uneven coverage of different topics as well as the emphasis placed on each topic as expressed by each contributor. Specifically, two-thirds of the book deal with boiling, condensation and two-phase flow (Part II), while the rest is spread very thinly on conduction and convection heat transfer (Part I), and radiation and helium II heat transport (Part III). Partly due to its comprehensive coverage, Part II contains a great deal of valuable and up-to-date information, assembled altogether in a single treatise for the first time. A better overall balance would be achieved, however, if more coverage on low-temperature thermophysical properties and insulation systems were incorporated into the conduction chapter (Chapter 2) and radiation characteristics of metal surfaces at low temperatures were treated in the radiation chapter (Chapter 14). Indeed, the title of radiative properties for Chapter 14 is quite misleading since only the radiative properties and effects of cryodeposit layers are considered.

For readers who are interested in additional reading and information about cryogenic heat transfer, the following monographs are recommended: *Advances in Cryogenic Heat Transfer*, edited by K. J. Bell, AIChE Chemical Engineering Progress Symposium Series, No. 87, Vol. 64, 1968; Cryogenic Heat Transfer by J. A. Clark, *Advances in Heat Transfer*, Vol. 5, 327–517, 1968; and Cryogenic Insulation Heat Transfer by C. L. Tien and G. R. Cunnington, *Advances in Heat Transfer*, Vol. 9, 349–417, 1973.

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JAN F. KREIDER and FRANK KREITH, **Solar Heating and Cooling.** Scripta, Washington D.C. (1975) 342 pp.

THE ENERGY crises has drawn our attention to the fast rate of consumption of primary fuels by mankind. This has stimulated interest for the development of the possibilities of using "flow-energy" supplies, especially solar energy. In the U.S.A. a number of scientists and engineers have been studying the use of solar energy already for a few decades. It is very valuable that two of them have written this practical book on the use of solar energy for heating and cooling.

The authors give the necessary fundamentals on heat transfer and solar radiation followed by an extensive and rather complete discussion on practical methods and system evaluation, including the economic factors.

The book is mainly aimed at the professional engineer, designer and architect who wants to apply solar energy for heating or cooling of buildings. In this respect the book contains many useful diagrams and tables giving practical information for the design of systems. This book is particularly aimed at application by engineers in the U.S.A. This means that SI-units are not used and that extensive solar insolation and weather data give US data only. Also the economic evaluations hold for US conditions. However the general principles are clearly explained and can be easily adapted by the engineers in other countries. It means that some of the conclusions, like on the optimal number of collector covers should be considered for each case separately by a designer.

The book covers all relevant material for solar heating systems. Of course not all aspects could be covered in detail, many useful references help the reader to find more detailed information on special subjects. Attention is given to flat-plate collectors mainly but also optical concentration is touched upon. As an appendix the proposed US standard method of testing and rating of flat plate collectors is included. This is very useful as the engineers should realise that much confusion on the performance of collectors occurs due to different test methods.

The calculation of the heat requirement of a building as well as the possibilities of heat storage are discussed The book brings these parts together in a discussion on system evaluation. Computerised system optimization including the economic factors is well covered. The book also goes into the legal implications of solar energy use.

A chapter on solar cooling of buildings presents the possibilities of solar energy in this field. Necessarily this subject is treated less extensively as the solar heating of buildings. This would have required a too detailed coverage of cooling technology.

A research scientist working in the field of thermal conversion of solar energy will miss a fundamental coverage of radiation properties and heat transfer of solar collectors. New developments like vacuum-collectors, new spectral selective surfaces and honeycombs to suppress convection are not or only slightly discussed. However this book aims at the designer of to-day and for him this is a well organized book giving easy access to all information on solar heating and cooling systems that he may require.

C. J. HOOGENDOORN

Steam and Air Tables in SI Units, edited by THOMAS F. IRVINE JR. and JAMES P. HARTNETT. Hemisphere, Washington, U.S.A. (1975) 120 pp.

APPROXIMATELY two-thirds of this 120-page set of Tables is taken up by the properties of steam. There are also tables on ammonia, Freon 11 and mercury in addition to those on steam and air. Accompanying the Tables is a Mollier chart for steam

Although intended primarily for student use, the steam tables appear to be more detailed than would be necessary for that purpose. The authors state that they have ultimate industrial use also in mind as the United States becomes more committed to SI units. Hence the need for these steam tables in that country presumably arises from the fact that, unlike other countries at the time, only tables in British units were published there following the appearance in 1967 of the internationally agreed IFC Formulation for Industrial Use. The Mollier chart accompanying the Tables was obtained from what is described as an International Edition of Steam Tables published in Germany in 1969; however, those tables did not receive the official international imprimatur that has been accorded by the International Association for the Properties of Steam to the IFC Formulation from which the tabulated values were computed. The sources of other data in the Tables under review are not listed.

In most of the tables, the unit used for tabulation of pressures is the bar. In two of the tables tabulation is in terms of the technical atmosphere, which is not an SI unit, while the conversion tables list the normal atmosphere; a correction slip draws attention to this unfortunate circumstance. The unit symbols used in the Tables are not always in accordance with accepted international standards, while the term "molecular weight" is used where molar mass is listed and the ratio of the specific heat capacities is erroneously described as the "adiabatic exponent"

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