spacecrafts, laser processing, electric arcs, and discharges. The book is a translation of a Russian edition, originally published in 1984, and contains many references to important Russian works in this specialized area of radiation.

In Chapters 1 and 2, the authors discuss briefly the basics of radiation, its relation to other modes of energy transfer, some approaches available in the literature for handling the integration over all wavenumbers, and a few approximate methods of solution. These two chapters are not by any means complete, and the researcher must consult more complete texts such as *Thermal Radiation Heat Transfer* by R. Siegel and J. R. Howell or *Radiative Transfer* by M. N. Ozisik.

Chapters 3–6 present the theory and numerical results of a newly developed treatment of radiation in high-temperature gases, which is the significance of the text. However, the new method is limited to radiation problems in which emission and reflection from bounding surfaces and scattering are negligible. To save important computer times, the method is developed so that it utilizes data stored in the computer's memory. Such data, included in an appendix, cover the necessary information for hydrogen, argon, air, and carbon dixoide for a wide range of temperatures, pressures, and characteristic lengths. Since the data in the appendix cover 171 of the 308 pages in the text, it would have been worthwhile to provide the data on floppy disks. To obtain data for other constituents, it is necessary to perform calculations based on the theory presented in Chapter 4. Inspection of the results given in the text reveals that the new method is sufficiently accurate for most engineering applications.

This text is informative and well written. And credit should be given to R. Goulard, the editor of the English edition. As the integral computational method appears to be a promising approach, the text should serve as a welcome addition to the growing literature on radiative heat transfer in participating gases.

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Heat Transfer and Fluid Flow in Rotating Machinery

Edited by Wen-Jei Yang

New York: Hemisphere Publishing Corp., 1987. Pp. 553. $95.00

This book forms the *Proceedings of the First International Symposium on Transport Phenomena,* held in Honolulu in April/May 1985. It will either be confused with, or seen as a companion volume to, a recent title from the same publisher, *Heat and Mass Transfer in Rotating Machinery* (edited by D. E. Metzger and N. M. Afgan, 1983). Forty-three papers are included, without discussion, ranging from fundamental research likely to be of long-term value to product-specific studies of more ephemeral interest. The authors are predominantly from the United States and Japan, but other countries in the Pacific Basin are represented. A reasonable balance has been achieved between academic and industrial contributions.

Inevitably, many of the papers address phenomena that, although important to the operation of rotating machinery, are either affected by rotation to a negligible or small extent or are sufficiently poorly understood that studies in stationary frames of reference are currently the first priority. Approximately half of the papers are concerned with direct effects of rotation.

The papers are grouped into six sections. The *Blade Cooling* section (nine papers) begins with a valuable review by R. J. Moffat and includes several experimental studies of curvature effects on heat transfer and on film cooling effectiveness, together with work on end-wall heat transfer, mist cooling, and other topics. Visualization techniques and visualizations of secondary flows form a substantial part of the next section, entitled *Flow Visualization and Flow Measurements* (nine papers). The third and fourth sections, *Rotating Tubes, Channels and Heat Pipes* (four papers) and *Rotating Surfaces and Enclosures* (six papers), cover heat transfer and fluid dynamics studies on a variety of configurations, including shaft seals. Grouping of papers has had to be somewhat arbitrary, as subject areas in many cases overlap. A *General Topics* section (seven papers) contains some of the less obvious paper titles, on subjects as diverse as cooling of superconducting generators and numerical solutions for two-phase flow. The final section, *Turbines and Compressors* (eight papers), is equally wide ranging and includes discussions of radial turbomachinery measurements and steam/water flow.

Browsing through the book would have been easier if the subject index has been comprehensive and if all authors had begun their contribution with an abstract. However, the text and figures are generally very clearly printed, from camera-ready copy. The breadth of coverage makes it unlikely that many individual researchers will find it worthwhile owning a copy, but it should prove a useful addition to the library shelves.

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Heat Transfer in High Technology and Power Engineering

Edited by Wen-Jei Yang and Yasuo Mori

New York: Hemisphere Publishing Corp., 1987. Pp. 602. $95.00

This volume is the *Proceedings* of a seminar held in San Diego in September 1985 under the auspices of the U.S. National Science Foundation and the Japan Society for the Promotion of Science. To the potential reader it is important to recognize that the aim of this binational forum is to promote cooperative research between the two countries, and in consequence a number of the papers tend somewhat toward a qualitative review of a particular field. Overall, nearly half of the 39 papers are of this sort, the balance reporting specific research by the authors, with an odd distribution that is commented on below. The impression that lingers is of slightly guarded statements of research strategy from both countries' researchers supported by various presentations to establish technical credibility.

It is noted in the editors' introduction that the subject of the meeting reflects the diminution of interest in energy research and resultant shift toward high technology applications in the space, nuclear, and electronics industries. This is largely borne out by the contents, which are organized into four parts: (1) heat transfer in high technology; (2) high heat-flux technology; (3) high-performance heat exchanger devices; and (4) radiative heat transfer and solar energy utilization. Although some papers, particularly in the final section, have an air of "energy crisis" about them, even these are refreshingly free of the reexamination of economically discarded techniques so prevalent five or so years ago. In the opening review paper on relevant Japanese work, however, Professor Mori makes clear Japan's view that energy conservation research should still be pursued in preparation for expected oil price rises from 1990 onward, in parallel with the growth in high technolgy–related studies.

In the section on high technology the primary topics are from the space and electronics areas. In the former area a study on

Marangoni convection in microgravity is supported by a couple of review papers on thermal control, one concentrating on heat pipes and including recent terrestrial applications. Electronics is addressed by four papers, all by industry-based authors and all reviews: one deals with heat transfer in a crystal growth process and the remainder discuss thermal control practice (these are virtually the only industry-source contributions in the volume). There is a contribution on temperature distributions during heat bonding and one on molecular clustering, a phenomenon occurring during phase change, which can produce local material states with widely varying physical properties.

The section on high heat-flux technology is concerned primarily with boiling and condensation, with research reporting, particularly on boiling, being more in evidence than elsewhere within the volume. This is further served by a perceptive review of CHF by Katto and a critical study of boiling enhancement by Fujita and Ohta. In contrast to the latter, a review of condensation by Witte is little better than a set of undergraduate level lecture notes. An excellent presentation of heat transfer in aeropropulsion by Simoneau is notable for its emphasis on the relationship between ultimate applications and research stratregy with some convincing statements of future needs. There is also a contribution on circulating fluid bed combustion, whose relevance to the seminar's subject was somewhat tenuous.

The section on high-performance heat exchange devices covers a wide range of topics, including heat transfer enhancement (both mechanical and electrical), the fouling, vibration, and numerical modeling of shell and tube heat exchangers, compact heat exchanger development for automotive and waste-heat recovery applications, high free-stream turbulence effects on convective heat transfer, and a weighty contribution on turbulent heat flux structures in wall-bounded shear flows from Hishida and Nagano. Again, virtually half of the papers are reviews.

The final section is, with one exception, free of reviews: that is on natural convection in high-technology applications by Lior, and nicely structured it is, too. Two papers address current solar energy work in the United States, and two more consider radiation in heat exchangers and packed spheres. More interesting is a study of plasma fluence–surface interactions in fusion reactors, which explores the thermal shielding effect of material vaporized from the inner wall of a plasma-containing vessel.

The physical presentation of this material is generally good. The volume is in hard covers and well-bound, and although the industrial papers are reproduced directly from authors' submissions with the consequent variations in typeface, the are all clear and commendably error-free.

It is not easy to judge who will find this publication valuable. There is certainly much of interest, but the field it covers is so broad that I suspect most full-time researchers will find little or nothing of novelty in their own specialisation. To this reviewer the most useful feature is the insight it gives into heat transfer research directions of the United States and Japan (albeit two years ago) and the overview of fields outside one's normal activity. It may be that those casting round for new areas of research may particularly welcome this! Most workers will, I suspect, find it sufficient to borrow a library copy.

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Heat Transfer in Turbulent Fluid Flows

By A. Zukauskas and A. Slanciauskas

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This is one of the series of "Experimental and Applied Heat Transfer Guide Books" edited by Professor Zukauskas. It describes research work at the Institute of Problems of Energetics at Kaunas, Lithuania, and is a research monograph rather than what one would normally call a Guidebook or Handbook. The first chapter is a five-page introduction, but it is clearly intended to set the scene for specialists rather than to educate students. Subsequent chapters, although uniformly written and well cross-referenced, could equally well have been published as separate research papers.

Chapters 2 to 7 deal mainly with boundary-layer heat transfer, with special reference to constant-pressure flows ("flat plates"). Chapter 3 gives a detailed description of the experimental techniques used at the authors' Institute. Topics include overall effects of fluid properties and temperature differences on heat transfer rate in gases, water, and oils and more detailed studies of velocity and temperature profiles. The data are clearly presented and extensively discussed.

The problem of boundary-layer heat transfer at high Reynolds numbers can be encapsulated as the problem of finding the behavior of turbulent Prandtl (Pr) number (1) in the viscous or conductive sublayer, $y^+ \mathrm{Pr} < 40$, and (2) in the fully turbulent part of the flow where Pr_t should not depend on the molecular Pr, i.e., on the type of fluid considered. In simple cases the effect of Pr is simply to change the additive constant, c_0 say, in the logarithmic law of the wall for temperature, but since Pr—and of course ν—can be a strong function of absolute temperature one must allow c_0 to be a function of wall temperature T_w and of a heat-transfer parameter that implies the variation of T with y. Unfortunately, the present book does not fully achieve this synthesis—which, of course, is unpleasant to those who believe in completely dimensionless presentation of results. Nevertheless, the book contains a large amount of painstakingly acquired data that appear to be of high quality; it will, therefore, be of use to heat-transfer specialists who are prepared to devote some time to reanalyzing the data in their own preferred forms. The extensive tables of data in the appendix will make this relatively easy.

The book has been competently translated, about the only non-trivial confusion being the description of a sublayer fence skin-friction gauge (typically 0.05 mm high) as a "plank." The translation of the eight-page index, a peculiarly tedious task, has also been done well. Roughly half of the 120 references are to Soviet work: one must be especially careful to avoid saying "Russian" because several of the cited papers are in Lithuanian (whose apparent similarity to Finnish is unlikely to help many readers and is in any case not to be relied on, since they are members of quite distinct philological families).

In summary, this is a book for specialists in heat transfer: it represents a significant contribution by well-respected workers, and will be a useful source of data, especialy for those concerned with variable-property heat transfer.

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