master, Milford Haven Conservancy Board) with an excellent statistical summary of the oil pollution history associated with the port's rapid growth.

The bulk of the biological material is the work of Jenifer M. Baker and Geoffrey B. Crapp who between them either authored or coauthored 17 of the 22 papers in the book. Miss Baker's timely work on the effects of oil pollution on plant life is particularly significant. The complexity of the oil pollution problem is shown in her findings which include the following:

1. Although the reasons for it are not clear, oil pollution produces statistically significant growth stimulation for some marsh grasses.
2. Extremely low concentrations of oil in refinery effluent cause damage to plants due to successive coverage with an oil film. The damage apparently is not due to soil contamination.
3. Successive spillages are damaging, but the recovery of marsh flora from up to four spills appears good; a single spillage does not cause long-term damage.
4. Differences in the properties of the polluting oil are very important; the low boiling fractions of crude oil are the most toxic. The undiluted emulsifiers tested were more toxic than fresh Kuwait crude, but concentrations of less than 10% caused no permanent damage.

Mr. Crapp's papers concern the littoral fauna, and they complement those of Miss Baker. They support and extend previous work of others who have dealt with the effects of oil pollution on animal life.

A strong point of the book is its Discussion sections in which the symposium attendees critically discuss and supplement the presented papers. Several noted experts in the oil pollution field attended and their discussion substantiates the credibility and findings of the authors.

The book contains valuable reference information and is recommended to chemical engineers who are actively engaged in correcting oil spill pollution problems.

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Analytical Methods in Conduction Heat Transfer, Glen E. Myers, McGraw-Hill Book Company, New York (1971). 508 pages. $19.50.

This is an excellent introductory textbook to the advanced treatment of heat conduction problems. The physical problems are well formulated into mathematical ones for which the solutions are developed clearly, often followed by the physical interpretations of the results.

The book consists essentially of two parts: analytical and numerical methods. In the analytical approaches, the methods of Frobenius, separation of variables, superposition or Duhamel's theorem, complex combination for sustained periodic solutions, and Laplace transforms are discussed. The mathematical treatments are given, in general, first for simple geometries with fewer variables and then extended to more complex situations. These subjects may be found in various mathematical textbooks on advanced calculus but they are treated here with particular reference to conduction heat transfer problems. Noteworthy is a method of splitting complex nonhomogeneous problems into a set of simpler subproblems for which the solutions may be obtained with relative ease.

In view of the ever-increasing need for the computer-oriented solutions, emphasis is placed on the numerical methods of finite differences and finite elements. In fact, one-half the book is devoted to this subject matter. The finite difference method has been used extensively since the dawn of the computer age; however, the method of finite elements has been relatively recently introduced in association with the need to provide thermal information for thermal-stress evaluations even though the variational calculus on which the finite element method is based had been developed quite some time before. The presentation in developing these numerical schemes is excellent with reasonable treatment on numerical instabilities associated with explicit, implicit, and combined explicit-implicit formulations of transient problems. The use of the matrix, system is shown to simplify the mathematical treatments considerably and systematize the inputs to computer applications.

The usefulness of normalization or non-dimensionalization is also demonstrated, and ample exercise problems with prepared answers enhance the value of the book.

The shortcomings of the book may be the sparse treatment of three dimensional or spherical coordinate systems (only one simple case is considered), and the complete absence of the use of Green's functions, transformation methods other than Laplace transform, problems involving phase changes, and complex variable conformal mapping for two-dimensional steady state temperatures. In the numerical treatments, systems involving flowing media in which the fluid temperature is space- and time-dependent as a result of the heat transfer with the surrounding structures are not considered at all. This is one of the most frequently confronted conduction problems in the transient thermal processes in chemical and nuclear piping and heat exchangers for which the computer-aided solutions are almost essential. The major problem here is a difficulty in selecting a proper computation time from a numerical instability standpoint because the stability criterion is also dependent upon the flow velocity.

In spite of the shortcomings mentioned above, the book is of a high quality—well-written and easily understood. Although it is addressed primarily to the first-year graduate student, it may serve as an excellent reference book for those who, at times, need to refresh themselves on the analytical and numerical approaches of conduction heat transfer. A thorough understanding of the analytical methods shown in the book will help a reader advance to the more complex books such as Carslaw and Jaeger's treatise on Conduction of Heat in Solids.

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Elements of Transport Phenomena, Leighton E. Sissom and Donald R. Pitts, McGraw-Hill Book Company, New York (1972). 813 pages. $18.50.

The stated purpose of this book is to combine the elements of heat, mass, and momentum transfer in such a way that it can be presented to junior-level engineering students with a knowledge of differential equations and an elementary exposure to vector analysis. The authors have attained their goal. However, the text is not suitable for graduate-level instruction in engineering or more helpful than existing texts to the practicing engineer who is familiar with transport phenomena.

The authors begin with definitions and the elementary aspects of thermodynamics and fluid statics. They continue with the classical equations of steady and unsteady state heat transfer, elements of diffusion with and without chemical reaction, and radiative heat transfer.

The basic equations of mass, momentum, and energy are derived and used

with illustrating examples. Definitions necessary to the understanding of fluid dynamics are introduced before derivation and description of the Navier-Stokes Equation. A discussion relating to turbulent flow follows. Convective mass-transfer is considered but not analyzed in depth.

One-dimensional compressible flow is discussed with special application to flow through nozzles. Free convective heat transfer, bubble dynamics, and two-phase flow are next considered. The last part of the text covers the analysis of heat exchangers, open channel flow, and flow through permeable media.

The appendix contains considerable physical properties and functions for use in solution of problems on the above topics. The basic equations are given in selected coordinate systems. At the end of each chapter, numerous problems are given for assignment, half of which have stated solutions. References are given at the end of each chapter for additional study.

The book should be considered by engineering departments for use in their junior-level transport phenomena course. However, as a text for chemical engineering students it lacks adequate depth in mass transfer and the use of chemical reaction kinetics in the basic equations. Practicing engineers will only find this text useful for refresher courses in the elements of heat, mass, and momentum transfer.

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From Electrocatalysis to Fuel Cells, G. Sanstede (ed.), Battelle Seattle Research Center by the University of Washington Press, Seattle and London (1972). 415 pages. $12.50.

From Electrocatalysis to Fuel Cells contains 34 papers that were presented during an international seminar at the Battelle Seattle Research Center. The papers are separated into eight sessions (chapters) covering metallic fuel cell catalysts, nonmetallic fuel cell catalysts, acid fuel cells, alkaline fuel cells, high temperature fuel cells, implantable fuel cells, batteries as related to fuel cells, and development prospects for fuel cells. The separation of the papers into the respective sessions with each session summarized by the session chairman greatly enhances the book's readability.

Generally the papers are outstanding—authored and presented by the leading international authorities on the respective subjects. In several instances, critical commentary is provided by other attendees lending further insight into the matter, as well as some humor.

This material is essential reading for any scientist or engineer presently involved in electrocatalysis, fuel cells, or metal-air batteries. The papers range from highly theoretical mathematical treatments to very practical discussions of hardware design. For those who have been associated with fuel cells for the past decade, this book provides a rather interesting historical perspective. For example, most of the papers dealing with basic research are authored by the European community, reflecting the decreasing research activities in this country. In fact, approximately one-half of the papers were authored by the Europeans. This ratio also suggests decreasing interest in fuel cells in the United States. Also of interest is the lack of presentation of any significant technical breakthrough. Some hope is placed in the pthalocyanines, carbides, and bronzes as replacements for noble metal catalysts. However, these materials are not new and to date have shown little in practical devices. Thus, in perspective one must question whether the fuel cell has failed the test of economic utility and is losing in the quest for government and industry funding.

Three of the papers warrant special comment. C. V. Bocciarelli's paper "Fuel Cells and the Theory of Metals" views the problem of electrocatalysis through the eyes of a solid state physicist and presents a refreshing perspective to the problem. While some aspects of the paper are somewhat naive, the approach is interesting and warrants attention.

K. D. Beccu's discussion of "The Characteristics of Metal-Air Systems" is one of the most comprehensive and current treatments of this subject available.

The final paper in the volume, "Some Basic Aspects of Electrocatalysis," by J. O'M. Bockris is a marvelous summary of the present status of electrocatalysis knowledge as well as the required direction for future electrocatalysis research.

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