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written for the uninitiated, but is rather flavored primarily to the selective palate of the mathematician and secondarily to that of the physical rheologist.

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Fuel Cells and Fuel Batteries. A Guide to Their Research and Development, H. A. Liebhafsky and E. J. Cairns, John Wiley and Sons, New York (1968). 692 pages. $27.50.

It is perhaps proper that a book summarizing the major fuel cell developments should appear at a time when fuel cells have helped make man's dream of flying to the moon a reality. Liebhafsky and Cairns give a documented historical account of the kind of fuel cells used in the Apollo project as well as of all other important types, including molten carbonate, solid oxide-ion, and ion exchange membrane fuel cells.

An effort is made to develop the pertinent theory, starting with fundamentals. The emphasis is rightly on transport phenomena. For example, an up to date treatment of mass transfer in fuel, oxidant, and free electrolyte chambers is presented. However, the authors' recommendation on page 209 to use flat plate solutions rather than the Leveque solution (linear velocity profile) for estimating Nusselt numbers in the KOH chamber seems strange. The momentum boundary layer thickness of 3.4 cm., calculated by the authors, is larger than the normal distance between the plates. Thus the momentum boundary layer should have developed well before the exit.

Again, as a part of the emphasis on transport phenomena, the authors present an integral reactor analysis of a fuel cell that had previously not made its way into the open literature. It's under the heading of "irreversibility and changing composition" in the body of the book and in the Appendix. Although the example is very good, the presentation does not make it clear that molecular diffusion of hydrogen has been neglected compared with bulk flow. Also, this type of an analysis need not be restricted to the case of constant molar flow or to control by resistive loss in the electrolyte. Usual differential reactor polarization data can be used and the conservation of mass and species equations solved numerically using Runge-Kutta subroutines. If a simple relation is desired, linearization of the Nernst equation permits one to integrate equation 4. 7-6 in closed form and thus obtain polarization curves for high conversion of fuel or oxidant from polarization data at no conversion.

In treating the problem of electrode structure the authors do a good job in discussing the requirements for no bubbling or weeping, but they do not present the important subject of porous electrode models in sufficient detail. Here and in a few other instances they appear to have dismissed or only summarized in words the more mathematical papers available to them. Partial information allows this reviewer to conclude that advanced fuel cell groups in this country and in the Soviet Union have developed reasonably sophisticated electrode models which allow a nearly complete prediction of polarization curves in some cases from basic kinetic, structural, thermodynamic and transport properties. Supporting experimental evidence remains largely confidential, but the published models show in which direction one must go to reduce polarization. The view expressed by Liebhafsky and Cairns on this subject is too pessimistic.

On the whole, this book contains such a wealth of information that it is worth, to anyone seriously interested in fuel cells, the high price charged for it by its publisher.

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Engineering Fluid Mechanics, John E. Plapp, Prentice-Hall, Inc., Englewood Cliffs, N. J. (1968). 654 pages. $11.95.

A book should be judged on the extent to which the author's goals are achieved. In the preface of this book Dr. Plapp states, "As a text, this treatment of fluid mechanics is designed to fit into a basically-oriented curriculum in mechanical, civil or electrical engineering, rather than into one in chemical engineering where the emphasis on transport processes is much stronger than in this volume." Whether the book might succeed as a textbook in these other branches of engineering will have to be determined by reviewers in those fields.

From the point of view of the chemical engineer in industry the book provides a more complete treatment of fluid mechanics than most chemical engineering books and one should find it useful for reviewing and expanding his knowledge of fluid behavior. The treatment is for the most part leisurely, satisfactorily rigorous, and often leads to practical results with which chemical engineers are familiar. The writing is quite good and the typeface and page layout are excellent. Both author and publisher are to be congratulated for a handsome production. About the only surprising feature noted was the short treatment given boundary layer flow. The author makes a point of acknowledging his debt to Schlicting in the preface and then deals with boundary layers rather briefly. Chemical engineers who regard boundary layer theory as the key which unlocks the door to a large part of transport behavior would find this part of the book inadequate.

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Computer Calculations for High-Pressure Vapor-Liquid Equilibria, J. M. Prausnitz and P. L. Chueh, Prentice Hall, Inc., Englewood Cliffs, N. J. (1968). 239 pages. $12.95.

This book will be of the most interest and use to chemical engineers and thermodynamicists working in the field of liquid-vapor equilibrium. In fact, these men will very likely be already familiar with most of this work from the series of articles the authors have published in various engineering periodicals in the last two years. However, not only will the user now find everything conveniently within one binding, but the related computer programs (not previously available) form part of the Appendix. This volume is a sequel to *Computer Calculations for Multicomponent Vapor-Liquid Equilibria* published in 1967 by Professor Prausnitz and co-workers. This new work covers the much more difficult field of high pressures whereas the techniques in the previous book were only applicable to low and moderate pressures.

Turning first to the strong points of the book, the greatest contribution in this reviewer's opinion is the modification of the Redlich-Kwong equation to permit it to represent more adequately the nonideality of the vapor phase in equilibrium work. This modification appears to be far superior to ones previously proposed. It consists of two parts: 1. varying the 0.4287 and 0.0867 constants with each component and 2. providing for the inclusion of a binary interaction constant for each constituent binary in the mixture.

Another major contribution of the authors is related to the critical region of the mixtures. As the authors point out, "the thermodynamic analysis of

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