# Book Reviews

**Advances In Heat Transfer,** Volume 4, J. P. Hartnett and T. F. Irvine, Jr., Ed., Academic Press, New York (1967) 458 pages $19.00

Those who specialize in heat transfer will recognize this volume as the fourth issue of what has become a welcome yearly event. The editors have maintained their practice of publishing select authoritative review articles that develop each topic from basic principles in a concise yet straight forward manner. It is my opinion that this volume is generally successful in meeting these objectives, although the five topics: "Advances in Free Convection," "Heat Transfer in Biotechnology," "Effects of Reduced Gravity on Heat Transfer," "Advances in Plasma Heat Transfer," "Exact Similar Solutions of the Laminar Boundary Layer Equations," span a range in quality that is as broad as the subject matter.

Clearly, the best treatments are given in the chapters on free convection by A. J. Ede, and plasma heat transfer by E. R. G. Eckert and E. Pfender. Ede's examination of free convection illustrates the essential details of evolving theoretical descriptions of laminar and turbulent flow over vertical plane and circular surfaces. Selected experimental data on heat transfer coefficient, temperature and velocity profiles are included. There are 111 references at the end of this chapter on the fundamentals of free convection.

Although many chemical engineers may never encounter fluids with temperatures from 4,000 to 40,000°K, the article on plasma heat transfer is nevertheless highly recommended. Beginning with a definition of the plasma state as a mixture of neutral particles, ions and electrons, the authors consider the particle and radiant energy transfer mechanisms needed to describe thermal and chemical spatial equilibrium. Readers are then introduced to the thermodynamic and transport properties of plasmas, followed by discussion of applications to the space vehicle reentry problem. Since plasmas are studied principally with electric arc facilities, a discussion of heat transfer in the presence of electric and magnetic fields is included to complete this quite informative article.

The chapter "Heat Transfer in Biotechnology" is doubly interesting, as it relates to items of personal interest and presents heat transfer from the viewpoint of the natural sciences. Although the definition of heat transfer coefficient in units of the 'clo' (5.55 kcal./sq. m.hr°C, or the equivalent conductance of ordinary business clothing) is unique, the philosophy that "useful approximations can be achieved even in the most complicated situations" is not unfamiliar to the engineer. In particular, the author considers those thermal problems encountered by humans in underwater, earth-surface and space environments. Special experimental devices, such as the *pan-radiometer* are described, as well as design criteria for human enclosures for each environment. The chapter is concluded with a treatment of the thermal functions and limitations of the human skin.

The chapter on similarity solutions to the laminar boundary layer equations will prove of interest primarily to those specializing in this area. Eighty pages of computer generated similarity constants allow prediction of heat, mass, and momentum transfer through the boundary layer for varying leading edge sweep angles, mass transfer rates, pressure gradients, wall temperatures and fluid properties. The chapter on reduced gravity effects should be useful for its compilation of 118 references and its discussion of experimental techniques and results with free convection, boiling, condensation and, briefly, combustion.

In conclusion, it seems to this reviewer that **Advances in Heat Transfer,** Vol. 4, will be a broadening, yet basic, addition to the heat transfer specialist's library. If for no other reason, the book is recommended for its absorbing presentation of currently scattered information on Natural Convection and Plasma Heat Transfer, and for an enlightening introduction to the sometimes neglected area of natural and human science, for those of us who deal in physical science.

EARL QUANDT
NAVAL SHIP RESEARCH
AND DEVELOPMENT
CENTER
ANNAPOLIS, MD.

**The Variational Method in Engineering,** R. S. Schechter, McGraw-Hill, Inc., New York (1967), 287 pages, $13.50.

This book, written for engineering students, is a useful introduction to variational methods. It is clearly written and covers a wide range of applications in engineering. Each of the methods treated is developed with care, and is thoroughly demonstrated with examples and problems.

The book is divided into two parts. The first part (Chapters 1 and 2) deals with natural problems, that is, those which are naturally stated in variational form. These problems are treated by solving the appropriate Euler-Lagrange equations. Several excellent examples are analyzed, including optimal designs for a thermoelectric generator, a cooling fin, and various simple reactor systems. Pontryagin's maximum principle is derived and used in the reactor examples.

The second part of the book (Chapters 3 to 7) deals with synthetic problems, that is, problems that one chooses to rewrite as variational statements. Chapter 3 discusses approximate solutions obtained by direct and partial integration methods. Chapter 4 discusses the formulation of the equations of change as variational statements by using the local potential proposed by Glansdorff and Prigogine, and Chapter 5 gives several detailed examples solved by this approach. In Chapter 6 the Galerkin method is given, as well as some additional variational formulations of the equations of change. Chapter 7 contains a local potential formulation for hydrodynamic stability problems.

(*Continued on page 521*)

# INFORMATION RETRIEVAL*

**Pool boiling heat transfer to cryogenic liquids, parts I, II, & III,** Kosky, P. G., and D. N. Lyon, **AIChE Journal, 14,** No. 3, p. 372 (May, 1968).

**Key Words:** A. Boiling-8, Nucleate Boiling-8, Pool Boiling-8, Heat Transfer-8, Liquids-9, Cryogenic-0, Low Temperature-0, Nitrogen-9, Oxygen-9, Argon-9, Carbon Tetrafluoride-9, Methane-9, Peak Nucleate Boiling Flux-8. B. Boiling-8, Nucleate Boiling-8, Pool Boiling-8, Nitrogen-9, Oxygen-9, Peak Nucleate Boiling Flux-8, Mixtures-9.

**Abstract:** Pool nucleate boiling heat transfer curves and peak nucleate boiling fluxes for pure nitrogen, argon, oxygen, methane, carbon tetrafluoride and oxygen and nitrogen mixtures were measured. The results were compared with various suggested nucleate boiling correlations.

---

**Solids mixing in fluidized beds,** Woollard, I. N. M., and O. E. Potter, **AIChE Journal, 14,** No. 3, p. 388 (May, 1968).

**Key Words:** A. Fluidized Bed-2, 10, Solids-1, 9, Particle-1, 9, Air-1, 5, Bubble-6, Interface Displacement-7, Tracer-1, 9, Bubble Injection-10, Mixing-8, Bubble Volume-7.

**Abstract:** The volume of bed solids displaced in a fluidized bed held in an incipiently fluidized condition by the passage of a single bubble has been measured using a layered bed of glass spheres over dyed glass spheres. Solids used were glass spheres of 380 $\mu$ in diameter. The profile of displaced solids was also determined and compared with that produced by a sphere moving in an inviscid fluid.

---

**Concentration-dependent time-lag measurements,** Phillips, J. R., and B. F. Dodge, **AIChE Journal, 14,** No. 3, p. 392 (May, 1968).

**Key Words:** A. Diffusion-8, Diffusivity-6, Permeation-7, 8, Time-Lag-7, 8, Gas-9, Metal-5, Hydrogen-9, Stainless Steel-5, Concentration-6, Pressure-6, Temperature-6, Interfacial Resistance-6.

**Abstract:** In gas-metal permeation, diffusion is normally considered to be the rate-controlling step. In addition, the diffusivity is usually taken to be independent of concentration. Under these conditions, the time-lag is found to be independent of the gas pressure applied to the inlet surface of the metal membrane. Further, the time-lag can then be directly related to the diffusivity of the system. In this paper, data on the hydrogen-type 321 stainless steel system are presented which show a pronounced effect of pressure on measured values of the time-lag. A model of the permeation process is presented which is consistent with the time-lag data and an estimate is made of the diffusivity of hydrogen in type 321 stainless steel.

---

**Free tear sheets of the information retrieval entries in this issue may be obtained by writing to the New York office.**

* For details on the use of these Key Words and the AIChE Information Retrieval Program, see **Chem. Eng. Progr.,** Vol. 60, No. 8, p. 88 (August, 1964). A free copy of this article may be obtained by sending a post card, with the words "Key Word Article" and your name and address (please print) to Publications Department, AIChE, 345 East 47 St., N. Y., N. Y., 10017. Price quotations for volume quantities on request.

(*Continued on page 522*)

(*Continued from page 371*)

Chapters 1, 2, and 3 of the book are accessible to senior undergraduate students with some background in partial differential equations. The subsequent chapters are at a higher level and can be useful to research workers.

The strength of the book lies in the variety of examples treated and their close coordination with the development of the theory. This feature will be particularly welcomed by those who read the book on their own. The parts dealing with local potential methods appear to be less useful than the rest, since it is now known that comparable results can be obtained more easily by weighted residual methods (see Finlayson and Scriven, *Applied Mechanics Revue,* Vol. 19, p. 735, and *International Journal of Heat and Mass Transfer,* Vol. 10, p. 799).

W. E. Stewart
University of Wisconsin

**Vapour-Liquid Equilibrium,** Second English Edition, E. Hala, J. Pick, V. Fried, and O. Vilim, Translated by Geo. Standart, Pergamon Press, New York (1968). 599 pages, $24.00.

A second edition of this book was welcomed as I had made considerable use of the first edition and regarded it as the outstanding work in the field. I must confess to a little disappointment in this edition for reasons that will appear as the various chapters are considered.

Like the previous edition the book is divided into three parts; I. "The thermodynamics of solutions," II. "Laboratory technique," and III. "Vapour-liquid equilibrium data." Chapters 1, 2, and 3 of Part I are identical to those of the first edition; they deal with general relations, the ideal solution, and real solutions. One wouldn't expect much revision of chapters 1 and 2; but since considerable development has taken place in the treatment of real solutions some revision of chapter 3 would have been in order. The main treatment of real solutions is in chapter 4 and it is here that I expected to find considerable revision and especially an addition of new material. There have been a few desirable deletions and some relatively small additions but many significant developments of the past 10 years have been omitted. For example the very extensive work on hydrocarbon systems is just mentioned in one short paragraph. There is no mention of Chao and Slader, Edmister, Van Ness, Ibl and Dodge, Kobayashi and Prausnitz;

(*Continued on page 522*)