prejudices and expertise of this reviewer are similar to those of most nuclear engineers who have been in the business for a decade or more. Usually, we start out with the conviction that the Boltzmann transport equation is the summation of most of the knowledge we will ever require and then find out to our surprise that most of the nuclear power plant problems actually lie in the thermal-hydraulics area. Thermal hydraulics is thus a subject we must learn largely on our own. This necessity colors our evaluation of the texts and the reference books we have assembled on our bookshelves. The main question that I address in reviewing R. P. Benedict's *Fundamentals of Pipe Flow* is how well it meets these rather special needs.

But first an attempt at a general overview.

This is a text and a handbook covering precisely what the title promises—flow of fluids in pipes. Benedict not only knows but evidently also loves his subject. This is illustrated by his concern for the historical development of hydraulics. The historical dimension adds depth and interest to the subject and at times also contributes to the insight that can be gained. Thus, for example, the first hydraulic engineer mentioned is Hero of Alexandria, and Leonardo de Vinci is represented by a well-chosen quotation describing the law of continuity. All through the text historical development is noted and precedence cited. The names mentioned include the familiar like Bernouli, Reynolds, and Fanno, and the not so familiar ones of Regnault, Rouse, and Hagen. At times, this adds color, at other times real information. After all, historical development to a degree mirrors the sequential steps by which an individual can best acquire knowledge in the subject. A good example of this is Benedict's presentation of boundary layer theory (Chap. 4). In an economical ten pages, he first describes the gulf that developed in the nineteenth century between the elegant yet unsolvable equations of Navier and Stokes and the entirely empirical relationships of Darcy-Weisbach. Placed in this context, the deceptively simple yet subtle concepts of boundary layer theory proposed by Prandtl, which succeeded in bridging the gulf, acquire a new significance.

This is not to suggest that the book is overly theoretical. Actually, the balance between theory and application is decidedly shifted toward the application side. It is foremost an engineering book and includes numerous worked out numerical examples of pipe flow problems. The examples are solved in a clear stepwise manner and all the equations used are flagged right in the solution process. This will be appreciated by engineers who use the book as an occasional reference. Further features enhancing its reference character are an extensive chapter on loss coefficients and several brief but informative chapters on flow measurement techniques.

And now back to the nuclear engineer's point of view. From this vantage point, the book has several serious shortcomings and can be recommended at best as a special supplemental reference text covering steady-state flow of single-phase fluids. A number of hydraulic problems of primary importance to nuclear engineers are not covered at all or are covered incompletely. An example of the later is two-phase flow. Although there is a chapter on the subject, it completely ignores the large experimental and theoretical contributions that have been made in this area by reactor-safety-related work. Thus the only Moody noted is L. F. (the one of the Moody diagram), and there is no recognition of the important influence that thermal nonequilibrium conditions can have on critical two-phase flow. The extensive experimental data produced by facilities as the loss-of-fluid test and Semiscale is ignored. Even more limiting is the fact that the book deals only with steady-state flow. Probably because of this restriction, no notice is taken of the large advances that have been made in the application of finite difference methods to the solution of hydraulics problems. Even the basic standby computer codes as RELAP, COMPARE, and their simpler predecessors are not mentioned.

Maybe it's not fair to complain that some subjects are missing that are not really promised in the title. The title indeed states "pipe flow." Thus there is no information about the behavior of fluids after they have left the pipes. For nuclear engineers this constitutes an important omission. A large class of reactor-safety-related hydraulics problems deals with the behavior and impingement of fluid jets after they have left a pipe break. A related class of problems deals with the dynamic forces imposed on piping systems by the occurrence of a break.

A final disadvantage of the book is that it adheres exclusively to the British units. However, this seems to be consistent with its general tone. It is a solid, single purpose engineering text, thorough, but somewhat old fashioned in its approach. Nuclear engineers will find its applicability to be limited.

K. Almenas is an associate professor of nuclear engineering at the University of Maryland. He obtained his PhD degree in 1968 from the University of Warsaw and has worked at the Argonne National Laboratory. His research papers have been mostly concerned with thermal-hydraulic aspects of the light water reactor safety field, particularly containment design.

Modern Physics

Authors	Robert L. Sproull and W. Andrew Phillips
Publisher	John Wiley & Sons, Inc., Somerset, New Jersey (1980)
Pages	682
Price	$27.95
Reviewer	J. N. Anno

I first encountered one of the coauthors, Dr. Robert L. Sproull, in 1958 when I read from cover to cover his then relatively new book, *Modern Physics (A Textbook for Engineers)*. Frankly, at that time I was not impressed; in my opinion that book lacked a depth of treatment of even the survey of the topics it covered. However, in this new book, *Modern Physics* (third ed.), Dr. Sproull and Dr. W. Andrew Phillips have completely eliminated my earlier objection. In one magnificent volume they do indeed cover the world of modern physics in the proper depth to make this work a valuable text (and reference book) to those working in peripheral areas of nuclear science and technology. To such members of the American Nuclear Society (ANS), I recommend this book most highly. It has, in my opinion, at least one other appeal to certain ANS members, namely those who have specialized in "narrow" fields. For example, if one has limited knowledge of molecular physics (as has this reviewer) or semiconductors, this book offers a good, quick introduction and survey of the subject(s). On this positive note, let me briefly skim the highlights of *Modern Physics*.

Modern Physics presents a study of elementary phenomena in nuclei, atoms, molecules, and solids in the light of quantum mechanics. The first chapter gives a historic overview of experiments and results that led to the discovery of the atom, its structure, mass, and charge, at the same time describing elementary properties of particles composing atoms and nuclei. Chapter 2 deals with the behavior of assemblies of particles, introducing the ideal gas law, the Maxwellian distribution of kinetic energies and velocities of these particles, and the Boltzmann distribution.

Since classical mechanics and electromagnetic theory could not explain all the properties of atoms, it became apparent that particles show some different phenomena in behavior that could only be understood by means of quantum physics. Chapter 3 describes the ways that led to modern theories of quantum physics, starting with the explanation of black body radiation, the photoelectric effect, the discrete nature of atomic spectra, electron diffraction in crystals and other phenomena that all confirmed the dual nature of subatomic particles and electromagnetic radiation. Chapter 4 gives the mathematical background of quantum mechanics. It introduces the Schrodinger equation and shows how it can be applied to describe and explain the different physical phenomena of the world of modern physics. In Chap. 5, the Schrodinger equation is solved for the hydrogen atom and the quantum numbers are introduced. Applying Pauli's principle of exclusion, the electronic structure of atoms is then explained. Chapters 6 and 7 deal with chemical bonds in the light of wave mechanics—the molecular binding and spectra, the ionic bonds, the metallic bonds, and energy bands in solids.

Next, in Chap. 8, the theory of binding and energy bands is used to explain selected properties of solids, such as the electrical conductivity in metals, the thermal conductivity in solids, and the magnetic properties of materials. Chapter 9 explores how imperfections and impurities in crystals affect the physical properties of solids, and the next chapter makes use of the theories that have been introduced to study semiconductors.

The last two chapters are devoted to nuclear physics. The quantum physics explanation of natural radioactivity, nuclear reactions, and nuclear forces is first given, while Chap. 12 deals with the applications of nuclear reactions and radionuclides in practice and with the interactions of radiation with matter.

J. N. Anno received his PhD in physics from The Ohio State University in 1965. Since 1953, when he joined the staff of Battelle Memorial Institute, Columbus Laboratories, he has been involved primarily in nuclear-oriented research and development. He was operating supervisor of the Battelle Research Reactor from 1955 to 1960, then continued later research in the effects of radiation on materials, covering a broad spectrum of topics from secondary electron emission to radiation-induced desorption. In 1970, Dr. Anno joined the nuclear engineering faculty at the University of Cincinnati, where he is now teaching and performing research primarily in the areas of nuclear physics, radiation effects, and fusion. He is also president of Research Dynamics Incorporated, a small research and development corporation.

Thermal Properties of Foods and Agricultural Materials

Author	N. N. Mohsenin
Publisher	Gordon and Breach, Science Publishers, Inc. (1980)
Pages	407
Price	$53.00
Reviewer	Clifford J. Cremers

This book has four major parts: basic heat transfer theory as applicable to problems encountered in dealing with foods and agricultural materials, methods for determining thermophysical properties, applications to food heat transfer problems, and finally a large appendix of property values.

There is nothing particularly profound about the material in this book. It is taken piece by piece from the literature with a stress on the data. Where appropriate, there are also brief descriptions of the original investigator's techniques. Very little space is devoted to critically reviewing the data or the experiments from which they came.

There are some discrepancies in the cited references, and a number of typographical errors and poorly labeled figures are apparent. In the selection of subject matter, it appears odd that there is no space devoted to freeze-dried materials. This type of food processing is energy intensive and design predictions depend heavily on having accurate property values.

Most nuclear engineers would not find this book of much help unless they were directly involved in the food processing industry.

Clifford J. Cremers is presently professor and chairman of the Department of Mechanical Engineering at the University of Kentucky, where he has been since 1966. Previous to that he was on the faculty at the Georgia Institute of Technology, where he went after receiving a PhD from the University of Minnesota in 1964. He teaches courses across the spectrum of the thermal sciences and has published over 60 papers in heat transfer in plasma systems, heat transfer in frost layers, and thermophysical property measurement.

A User's Guide to Vacuum Technology

Author	John F. O'Hanlon
Publisher	Wiley Interscience Publishers, New York (1980)
Pages	402
Price	$24.95
Reviewer	Clifford J. Cremers