ChE book reviews

INTRODUCTION TO AEROSOL SCIENCE

by P. C. Reist, Macmillan Publishing Co., New York, ISBN 0-02-949600-4, 1983

Reviewed by
Alex E. S. Green
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This book is an introduction to aerosol science and is intended for practitioners in air pollution, public health, and industrial hygiene. It is timely in that aerosol science, which was at the forefront of 19th century science, has fallen somewhat into the gap between physics and physical chemistry. However, because of its importance to health and to environmental sciences it is beginning to receive the attention it deserves.

This book is an attempt to present introductory information on aerosol properties and behavior in a rigorous but illustrative manner. The text evolved from long experience of the author in teaching an introductory course on aerosol science at the first year graduate level. The numerous and helpful illustrative problems reflect this valuable experience.

The breadth of the book is very impressive and the author attempts to introduce every topic in a simple fashion, yet in forms immediately useful. The major topical headings after an introductory chapter are: 2. Particle Size Distributions; 3. Fluid Properties; 4. Macroscopic Fluid Properties; 5. Viscous Motion; 6. Particle Kinetics: setting, acceleration, deceleration; 7. Particle Kinetics Impaction, Respirable Sampling, Isokinetic Sampling; 8. Brownian Motion; 9. Particle Diffusion; 10. Aerosol Charging Mechanisms; 11. Electrostatic Controlled Aerosol Kinetics; 12. Condensation and Evaporation Phenomena; 3. Evaporation and Growth; 14. Optical Properties: extinction; 15. Optical Properties: angular scattering; 16. Coagulation of Particles. The author pays meticulous attention to his reader and each chapter starts with an introduction, definitions or historical review and ends with a problem set. There are also seven appendices containing useful information.

The reference list is not very extensive and appears to be only updated to 1979. A guide to the current aerosol literature also appears lacking. Despite this relatively minor weakness the reviewer highly recommends the book as a comprehensive and well organized introduction to aerosol science. This reviewer was particularly impressed with the author's efforts to achieve clarity, as evidenced by numerous solved practical problems and graphical and tabular illustrations. □

THEORY OF MOLECULAR FLUIDS, VOLUME 1: FUNDAMENTALS

By C. G. Gray and K. E. Gubbins
Clarendon Press, Oxford, $79.00 (1985)

Reviewed by
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John Prausnitz said that for today's generation statistical mechanics is an esoteric luxury, but for tomorrow's generation it will become a vital necessity. It was stated a number of years ago, so that the new generation has already ar-

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vanced degrees in today's market. The advanced degree—MS, MBA, or PhD—will open up some new doors. John Mulroney, a vice president of Rohm and Haas, said it very well recently [5]. "The PhD degree in chemical engineering seems much more relevant to the current needs of specialty chemical companies than it did ten or fifteen years ago. Probably the greater scientific content of the doctoral education is more valuable today."

Third is the opportunity to change fields easily. Some chemical engineers find their first job isn't as satisfactory as they had hoped. They want to get into a new, growing, area or shift to a new location. Going back to graduate school is a good way to make a clean break from one job and start fresh elsewhere.

Fourth is the experience of graduate school and graduate level education itself. It's a great life, much different from undergraduate education. J. L. Duda described it very well [6]. There are unlimited opportunities for pursuing knowledge at the very edge of what is known. The work can be tough, but it is also exciting and challenging.

Last, there are a number of extraneous factors, ones which apply to one or a few people due to special circumstances. For instance, the spouse, or spouse-to-be, is still in school. The company is willing to pay the bill, plus pay full or part salary. The kids are in school and it's boring sitting at home; it's time for a refresher course before getting back into the job market. It's a good place to look for a girlfriend or boyfriend. It sure beats 8:00 to 5:00 hours—or shift work.

There are many things to consider in deciding whether to go to graduate school. Consider them all. Contrary to popular belief, the economics of getting advanced degrees in chemical engineering are favorable.

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5. Mulroney, J. P., "Divergent Pathways: Chemical Engineering and the Industry," *Chemical Engineering Progress*, Vol. 80, No. 12, p. 29, 1984.
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In Memoriam

CHARLES PEIFFER

Charles Calvin Peiffer, 55, associate professor of chemical engineering at the Pennsylvania State University, passed away on June 18, 1985. He conducted research in the Penn State Petroleum Laboratory and was well known for his studies on co-current absorption and vapor-liquid equilibrium. For many years he was an outstanding advisor to the Student Chapter of AIChE at Penn State and in 1980 he received the Outstanding Advising Award for AIChE. He was an exceptional instructor and received several teaching awards. The unit operations laboratory in chemical engineering at Penn State will be modernized and renamed the Charles C. Peiffer Unit Operations Laboratory. He is survived by his wife, Norma, and two children, Charles and Elizabeth.

REVIEW: Molecular Fluids

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rived. While the vast majority of existing books on statistical mechanics is limited to atomic fluids, this comprehensive monograph treats molecular fluids with an emphasis on anisotropic forces. It requires an undergraduate knowledge of statistical mechanics, thermodynamics, electromagnetic theory, vector analysis, and quantum mechanics, and is aimed at graduate students and researchers in chemistry, physics, and engineering.

The chapter on intermolecular forces reviews thoroughly many advances that have occurred since 1970, especially for small relatively rigid molecules, for example N_2, HCl, CO_2, CH_4 and H_2O. Given the complicated nature of anisotropic intermolecular interactions, it is not surprising that the appendices account for over one-third of the book. The fourth chapter develops statistical mechanical perturbation theories which are powerful tools in chemical engineering thermodynamics. The effects of various short and long range forces are included conveniently in an expansion about a spherical reference fluid. The theories are tested systematically using computer simulation data. Throughout the book, symmetry and invariance

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arguments play a key role. The calculations are simplified using the rotational transformation properties of tensors.

The second volume discusses applications, including the thermodynamics of mixtures, surface properties, dielectric properties, and spectroscopic properties. These two volumes provide a comprehensive description of the types of theories of equilibrium fluids which eventually will become dominant in chemical engineering practice. □

REVIEW: Momentum,Heat,Mass

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and considers the unit operations as applications. Under fluid dynamics various concepts are first introduced, including a brief presentation on rheological models. In the next three chapters the conservation of mass, energy and momentum principles are formulated for a macroscopic control volume. An immediate application is provided by techniques for flow measurements in Chapter 6. The differential mass, energy and momentum balance equations are then derived and some examples showing the use of Navier-Stokes equations are presented. Chapters 11 and 12 deal with boundary layer flow and turbulent flow. The complexities in their analytical treatment lead into the approach of dimensional analysis in Chapter 13. The design equations are presented in terms of non-dimensional groups for flow in closed conduits and for flow around solid objects in Chapter 14. The section closes with a discussion of filtration as a unit operation. The emphasis throughout is on incompressible fluids.

The section on heat transfer starts by introducing the various mechanisms of heat transmission. Steady and unsteady state heat conduction are then discussed and the student is introduced briefly to the role of numerical, graphical and analog techniques for solving conduction heat transfer problems. The convection heat transfer under laminar and turbulent flow conditions is considered in Chapters 22 and 23, followed by a review of correlations in terms of dimensionless groups for the convective heat transfer coefficients. Heat transfer accompanied by phase change during boiling and condensation is considered in a separate chapter. Chapter 26 provides a concise introduction to the radiant mode of heat transfer. The application of heat transport theory to the design of heat exchange equipment concludes the section on heat transfer.

The last section on mass transfer follows along similar lines. The section begins with an introduction to molecular diffusion and diffusivity. Molecular diffusion in binary mixtures is then described. Convective mass transfer under laminar and turbulent flow conditions is considered in Chapters 32 and 33. Relevant design equations for mass transfer coefficients are detailed in the following three chapters. The remaining six chapters are devoted to mass transfer operations. They are organized as follows: continuous contacting of immiscible phases; simultaneous mass, momentum and energy transfer; equilibrium stage separations; contacting of partially miscible phases; distillation of binary mixtures; and multicomponent separations.

The material is organized in all three sections in such a way as to make the connection between transport theory and unit operations more visible. This connection is demonstrated with different degrees of success in fluid dynamics, heat transfer and mass transfer. The emphasis of a first course in transfer operations is on the macroscopic approach. At the same time, it is desirable to introduce the student (at least in a limited way) to the differential approach. Such a goal is achieved by this book. The solutions to various problems require the use of a variety of correlations. The separate chapter on dimensional analysis and the chapters on design equations in each of the three sections allow the student to appreciate how the correlations are developed on a rational basis and how they can be meaningfully used. Since the aim of the book is to expose the student to transport theory and to present the three transfer operations in a unified way, the book had to limit the extent of details presented on various unit operations, particularly in mass transfer. I do not consider this to be a disadvantage because this is a conscious choice an instructor has to make if he or she subscribes to the outlook of this book.

From the point of view of students, I would have liked to see some "real" changes in the Third Edition, especially relating to example and exercise problems. First, the number of example problems solved in the text should have been increased. This is especially needed for the chapters on differential balances. While the rheological models are briefly introduced in Chapter 2, their integration into the equation of motion is not