BOOKS

Quantum Theory of Matter, Second Edition, John C. Slater, McGraw-Hill, New York (1968).

If you would like to own one book on quantum mechanics which is authorative and encyclopedic, you might very well consider purchasing John C. Slater's second edition of the **Quantum Theory of Matter.** It is intended to serve as a text for a one year course for graduate students in physics. However, much of the text is devoted to molecular structure and it is equally well suited to a course for chemistry graduate students. In either case, the professor would have a great deal of freedom in selecting the subject matter from the thirty-three chapters in this book. At the end of each chapter there is a set of problems illustrating the significant features and the range of applicability of the theory.

It is truly amazing how many of the techniques considered were discovered or developed by Slater. He has tackled a wide variety of problems and each time he has persisted until he has found a workable solution. Slater is very intense, forthright, and systematic. His writing is very clear and he tries to explain his derivations point by point so that, with sufficient effort, you will agree with his conclusions.

This book bears no relation to the first edition of **Quantum Theory of Matter** published in 1951. Instead, it is essentially a condensation of the five books which Slater has written since 1960: two volumes on atomic structure and three volumes on the structure of molecules and solids. The first few chapters are similar to the usual *elementary quantum mechancial texts.* The next group of chapters present a very thorough treatment of atomic structure and the theory of multiplets in complex spectra. Chemists will be particularly interested in Chapters 13 to 15 which give a clear treatment of the interaction of radiation and matter which explains the emission and absorption of light, the breadth of spectral lines, and the nature of spin-orbit interactions. Chapters 18 to 29 give a very thorough discussion of most of the recent developments in molecular structure including the Gaussian orbital calculations of the structure of the ethylene and benzene molecules. Slater does an excellent job of explaining the electron correlations and the nature of the chemical bonds. Indeed Chapters 18 to 29 might very well serve as the basis for a second semester course in quantum chemistry. Chapters 30 to 33 are concerned with the structure and properties of crystals. Since big molecules have many of the properties of crystals, these last chapters should not be ingored by chemists.

This is truly a great book written by a great scientist. You won't find it easy reading, but you will be well repaid for your efforts.

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Handbook of Fuel Cell Technology, Carl Berger, Editor, Prentice-Hall, Englewood Cliffs, N. J. (1968). 607 pages. $18.50.

I can highly recommend this volume to any engineer looking for a good introduction to fuel cells. The first two hundred page chapter by L. G. Austin presents the electrochemical theory of fuel cells. It is written in a textbook, teaching style. A set of numerical examples (which not only give relevant orders of magnitude but make one think about the subject) more than compensate for other minor shortcomings, such as no list of notations and references to past 1965 work. This section can serve as an excellent supplement to Bird, Stewart, and Lightfoot's book on transport phenomena.

The second chapter by Suparmanian Srinivasan and Elizear Gileadi gives a welcome survey of electrochemical techniques and continuation of the discussion of the porous electrode models. Unfortunately, too little space is devoted to the more recent and more realistic models, such as the intersecting micro-macro pore model. The next chapter is devoted to the technology of a fuel cell with carbon electrodes by K. V. Kordesch of Union Carbide.

The fourth chapter deals with an ion exchange fuel cell and is by H. J. R. Maget. In addition to the presentation of problems special to these cells, this chapter summarizes the results of a first-rate study on sectioned electrodes. Unfortunately the presentation is not without blemishes. The heading of Section 3.61 is *Natural Convection.* However, the infinite series solution for the current given by equations (50) or (51) in this section is for the case of no bulk motion at all. It was obtained, as presented in a preprint by Maget and Oster, by solving a Laplace equation for concentration in two dimensions. In this section and the next, there are also a number of typographical errors. One possible error that does not appear to be typographical occurs in Equation (54). A Leveque type solution for convective diffusion with a first-order reaction is presented. Unfortunately, as the rate constant becomes large, the concentration at the wall becomes negative rather than nearly zero.

The last chapter deals with fuel cell economics and commercial applications. It is written by J. Verstraete, D. Lefevre, R. Lefort and J. Henry, all from Belgium.

Although this book is a worthy addition to any personal library, I let the reader judge for himself whether it rates the title of *Handbook* in view of such an unrepresentative contribution from major fuel cell developers.

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Thermodynamics, Second Edition, William C. Reynolds, McGraw-Hill, New York (1968). 496 pages. $11.50.

In this book, written as a first course text for engineers, microscopic arguments are used to provide an intuitive basis for macroscopic postulates. This is done in an understandable way that should be acceptable to the third year student in engineering.

There are fourteen chapters that contain material for one whole year of work, which is more time than can be alloted in our curriculum to general thermodynamics.

Fortunately, a class could stop after Chapter Eleven and still cover all subject matter that is important to the third year engineering student. The last three chapters on Statistical Thermodynamics, Molecular Kinetics, and Irreversible Thermodynamics can be left out of the undergraduate course.

The treatment of nonreacting mixtures in Chapter Ten does not include any mention of fugacity or activity, without which the Chemical Engineer could not handle problems in vapor-liquid equilibria.

In Chapter Eight, the Van der Waals and Beattie-Bridgeman Equations of State are discussed. No mention is made of the Redlich-Kwong and the Benedict-Webb-Rubin Equations of

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INFORMATION RETRIEVAL

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A theory of laminar flow stability, Hanks, Richard W., **AIChE Journal, 15,** p. 25 (January, 1969).

Key Words: A. Flow Stability-9, Stability Parameter-2, 9, Transition-9, Analysis-8, Angular Momemtum-1, Linear Momentum-1, Drag-1, Turbulence-2.

Abstract: In this paper an analysis of laminar flow stability is presented which leads naturally to the parameter in a much different manner than originally proposed. The stability parameter is seen to represent the coupling ratio between the rate of change of angular momentum of a deforming fluid element and its rate of loss of momentum by frictional drag. At a certain critical value of this coupling ratio, the element becomes unstable to rotational disturbances. If such disturbances are present, the basic nonlinearity of the momentum transfer process guarantees rapid amplification and generation of a turbulent eddy. The consequences of the theory are examined for two special fixed boundary classes of motion. The physical interpretation of the parameter is compared with conventional interpretations of the Reynolds number and found to be more fundamentally sound. The application of the theory to moving boundary flows, such as the Couette viscometer, is also discussed and an important physical difference is pointed out.

Graphical calculation of multiple steady states and effectiveness factors for porous catalysts, Stewart, Warren E., and John V. Villadsen, **AIChE Journal, 15,** p. 28 (January, 1969).

Key Words: A. Calculation-8, Reaction Rates-9, Diffusion-9, Heat Conduction-9, Multiple Steady States-9, Particle Stability-9, Porous Catalysts-5, Effectiveness Factor-7, Particle Size-6, Particle Shape-6, Reaction Kinetics-6, Variable Fluid Properties-6, Asymptotic Solutions-10, Polynomial Approximation-10, Orthogonal Collocation-10, Nonisothermal-0, Nonlinear-0.

Abstract: Simple graphical methods are given for predicting the effectiveness factors of single reactions in particles of various shapes. A collection procedure was used for small particles, and the known asymptotic solution was used for large particles. Multiple steady states and variable fluid properties can be handled directly. Examples are given for several nonlinear reaction rate laws.

On the particle size distribution function and the attrition of cracking catalysts, Gwyn, J. E., **AIChE Journal, 15,** p. 35 (January, 1969).

Key Words: A. Attrition-8, Cracking Catalyst-9, 1, Fluidization-10, Elutriation-10, Retention-4, Loss-4, 7, Time-6, Particle Size-6, Attritability-6, Rate-7, Fines-3, Air-5, Gas-5. B. Attrition-8, Cracking Catalyst-9, Particle Size Distribution-9, 1, 2, 6, 7, Mathematical Analyses-10, Loss-7, 4, Integral Rate-2, Fines-3, Primary-0.

Abstract: The rate of attrition of a catalyst sample of a single particle size can be expressed by a simple function of initial diameter and of time. The initial rate is a function of initial diameter, whereas the decrease in attrition rate of a catalyst of a given size as the catalyst ages depends only on time.

The attrition equation for a single size of particles is introduced into the particle size distribution function and, through mathematical analyses, yields a relationship for the attrition of a full size-range catalyst. The form of this relationship, which includes terms for attritability and severity of attrition conditions, is verified by laboratory and commercial attrition data on two full-range catalysts. The size distribution of an attrited sample is not expressible in simple analytical form, but is readily obtained by numerical analysis.

An approximate solution for countercurrent heat exchangers, Tien, Chi, and Seshadri Srinivasan, **AIChE Journal, 15,** p. 39 (January, 1969).

Key Words: A. Heat Exchanger-4, Counter Flow-8, Heat Transfer-8, Multistream Forced Convection-8, Integral Method-10.

Abstract: An approximate solution is presented for the countercurrent parallel plate exchanger with laminar flow. Using the integral method, the problem is reduced to one of solving a pair of first-order differential equations in a straightforward manner. Comparisons between the results of this work and those obtained from a more elaborate orthogonal expansion technique are found to be excellent.

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

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State, which are used rather extensively in preference to others.

It appears that students using this book might acquire a speaking knowledge of microscopic and the macroscopic postulates of thermodynamics but it is doubtful that they will acquire a working knowledge of thermodynamics. Without the latter, the student cannot make the necessary thermodynamic calculations that arise in other engineering problems.

This compromise between statistical and classical thermodynamics is a good book for the library but is not a suitable text for third year students in Chemical Engineering.

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Mass Transfer Operations, Second Edition, Robert E. Treybal, McGraw-Hill, New York (1968). 717 pages. $15.75.

In the thirteen years which have elapsed since the first edition of this excellent text, numerous changes in the training of chemical engineers have taken place. Consequently a revised treatment of this important subject is most welcome.

The general format and arrangement of subject matter has been retained while, at the same time, the design approach so successful in the past, is still emphasized. The number of chapters and chapter headings remain the same. The most significant changes appear in the first five chapters, devoted to the underlying principles of diffusion and mass transfer where the influence of the more recent approach to the theory of the transport processes is apparent. The basic features, for example, of the film, penetration, surface-renewal, and combined film-surface-renewal theories are compactly treated as are also the several transport analogies.

The chapter on gas-liquid contacting equipment has been updated and the list of references reflecting current design practices greatly expanded. The use of enthalpy-concentration methods is now included in the chapter on distillation and quantitative methods for handling multicomponent systems in absorption and distillation are given. Unfortunately, as in the first edition, treatment of phase equilibria, particularly of nonideal systems, is still sketchy. Limitations of space, however, preclude an adequate treatment of this complicated field.

The numerous illustrative problems have been revised and made more comprehensive. They form an integral part of the text. The number of ref-

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