be made better known to chemical engineers whose problems abound in multistage decision processes. **Reaction Kinetics Optimization Using Nonlinear Estimation,** T. I. Peterson. The result of this investigation indicate that several mechanisms may be plausible representations for a given set of experimental data. Such ambiguity may possibly be resolved by further experimentation or through independent information.

Computer Program Abstracts

Readers of the *A.I.Ch.E. Journal* who are interested in programing for machine computation of chemical engineering problems will find in each issue of *Chemical Engineering Progress* abstracts of programs submitted by companies in the chemical process industries. Collected by the Machine Computation Committee of the A.I.Ch.E., these programs will be published as manuals where sufficient interest is indicated. The following abstracts have appeared this year:

CEP (March, 1961), p. 88

A General Equation Solver for Engineering Computations (068)
Traverse Closure and Curve Data Program (072)

CEP (April, 1961), p. 88

Fisher's F-Distribution (071)
Thermodynamic Functions of Monatomic Gases (073)

CEP (May, 1961), p. 78

Computer Program for the Construction of a Table of Temperature vs. Resistance for a Platinum Resistance Thermometer (054)
Computer Program for Evaluation of Free Energy of Formation Temperature Functions (074)

ERRATUM

The captain for Figure 2 appeared under Figure 3 and vice versa for "Extractive Reaction: Batch and Continuous-Flow Chemical Reaction Systems Dilute Case" by Edgar Piret, W. H. Penney, and P. J. Trambouze which appeared on page 394 of the September, 1960, issue of the *A.I.Ch.E. Journal.*

BOOKS

Transport Phenomena, R. B. Bird, W. E. Stewart, and E. N. Lightfoot, John Wiley and Sons, Inc., New York (1960). 780 pages. $11.50.

In the opinion of the reviewer this book is probably one of the most important texts to appear in the field of chemical engineering in many years. Indeed there is little doubt that the consideration of transport phenomena as a distinct engineering subject can and should have a great impact on engineering in general, far beyond its immediate usefulness and application to chemical engineering.

The authors have endeavored to develop from fundamental principles the topics of momentum, energy, and mass transport in a rigorous manner and then, through the use of many problems, to point out the applications of these topics to subjects of engineering interest. Diligent pursuit of the material included in the text leads to a good idea of the meaning of engineering science and the importance of this approach, particularly to those who may be convinced that the term is only a combination of two words sitting in somewhat uneasy proximity to one another.

The text is concerned with molecular and turbulent transport processes, and encompasses both the rigorous developments allowable for molecular transport and the approximations or empiricisms necessary

for development of turbulent transport. The authors' consideration of momentum transport is convenient to use as an illustration of the development of subject material. In this section the concept of viscosity and its definition in terms of momentum flux are presented initially, for both Newtonian and non-Newtonian fluids. Also included is a discussion of the pressure and temperature dependence of viscosity, and some discussion of the theory of viscosity for gases and liquids. The development of momentum balances is then introduced by a discussion of the methods involved in writing shell momentum balances for various systems; this material is useful in itself but also serves as a convenient introduction to the methods involved in the next topic, which is the derivation of the equations of motion and continuity for the viscous flow of fluids. This is perhaps the backbone of the entire method of approach, and the authors have done a commendable job in their presentation. Emphasis is placed on the understanding of the physical significance of these equations and their application (through simplification) to various problems in hydrodynamics in steady state systems. These methods are further applied to more complex situations involving unsteady state or more than one dimension, which leads directly into an excellent discussion of some of the aspects of boundary-layer theory. Next the equations of motion and continuity are applied to the case of turbulent flow; the various approaches required for determination of a mathematical description of the process (that is eddy viscosity, Prandtl mixing length, etc.) are discussed and their limitations are defined. Further consideration of turbulent flow is carried out through presentation of the concept of the friction factor as a method of correlation used in systems of importance where velocity and pressure profiles cannot be calculated readily. The results of the developments for laminar and turbulent flow are then summarized through applications to what that authors term "macroscopic balances." For the case of momentum transport this would involve development and application of the Bernoulli equation, calculation of frictional losses and power requirements in flow systems, and generally various applications to engineering problems in the flow of fluids.

Energy and mass transport are approached in much the same fashion: development of the mechanism of transport; application to shell balances; derivation and application of the equations of change for these transport processes to laminar, turbulent, and unsteady state systems; development of the definitions and methods of correlation required for turbulent systems analysis; and finally the application of all these principles to the solution of problems of heat and mass transfer. This method of presentation is very flexible, since the topics may be introduced in successive fashion, as outlined here, or one may investigate mass, energy, and momentum transport simultaneously.

The description of material given in this review is certainly inadequate to do full justice to the scope of the text. A partial list of other topics includes discussions of non-Newtonian fluid flow, energy transport by radiation, and boundary-layer theory. In addition a valuable section on vector and tensor operations has been included for convenient reference. In this regard it should be pointed out that much of the development and discussion of topics in the text involves mathematical analysis beyond the elementary level. Undergraduate students, in order to secure maximum benefit from the material, should certainly have a sound understanding of the calculus and should have completed (or should be taking simultaneously) a first course in differential equations. In contrast to this however is the fact that the development of more complicated topics involving partial differential equations and their solutions sometimes seems to be oversimplified, if one takes the view that most of these problems are beyond the scope of the normal undergraduate course but are the basis for much of the discussion in advanced courses.

The text as a whole gives a clear concept of the continuity and kinship of momentum, mass, and energy transport processes, and the development is carried out so thoroughly that for many topics the material discussed extends all the way from basic principles to the current areas of research interest. It would seem apparent that the approach used in this book is adaptable enough to serve in a variety of capacities and for a variety of purposes. Most important, though is the unification of material accomplished by the authors, as well as their sound organization and clarity of presentation.

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