plex industrial process is brought out in this discussion. This work is, of course, the essential basis of any subsequent simulation of a process such as the catalytic reforming of naphtha. Some of the various reactions of catalytic reforming take place on the metal sites and some on the acid sites of the usual bifunctional catalyst used for this process. The interpretation of a large quantity of experimental data so that the kinetics of individual reactions may be obtained is well described in this part of the book. The work of Weisz, who showed that the typical dehydrogenation and isomerization reactions can be obtained over a finely divided mixture of platinum catalyst and silica-alumina catalyst as well as over the usual bifunctional mixture, plays an important role in the analysis. After the various individual reactions have been isolated from the overall reforming process, an interesting discussion is given of the kinetic data for each of these reactions. These data have often been obtained by studying the reactions of the pure individual hydrocarbons and are interpreted by the conventional concepts of adsorption, surface complex formation, degree of surface coverage, poisoning by adsorbed products, and other familiar ideas. In this way a rational picture of the overall process is obtained, so that a practical use can be made of the many kinetic studies described.

The succeeding article, "Heat Conduction or Diffusion with Change of Phase," by S. G. Bankoff of Northwestern University, is a detailed review of the solution of a class of partial differential equations. These problems are characterized by a requirement such as phase equilibrium at a moving boundary. This article is twice as long as either of the preceding ones and includes more than three hundred equations. In spite of the details given, this discussion is probably not self-contained for readers who are not already competent in this special field. The interested general reader will probably need to study the mathematics related to the transformation of variables in a less concentrated form before being able to profit from this chapter. The review appears to be relatively complete and covers exact solutions, analytical approximation methods, and analog and digital computer solutions.

Professor G. D. Fulford of the University of Birmingham, England, has written a review, "The Flow of Fluids in Thin Films." The flow of such films is usually classified as smooth laminar, wavy laminar, or wavy turbulent. The waves may arise because of gravity effects or capillary effects. Most of the treatment of smooth laminar flow is limited to two dimensions, but some consideration is included on end effects, which require a three dimensional treatment. The criteria of stability with respect to the formation of waves or turbulence are presented. Much of the analysis of turbulent flow is given in terms of velocity distributions based on methods analogous to those of von Kármán and Deissler. A good review of the experimental work in the field is given. As an appendix there is a chronological list of papers on film flow and related topics, and I found this an appealing innovation. Only brief treatments were given in the text of the effect of the flow of an adjacent gas stream, and horizontal films were not covered.

The final article of the book is "Segregation in Liquid-Liquid Dispersions and its Effect on Chemical Reactions," by Professor K. Rietema of the Department of Chemical Engineering of the Technical University of Eindhoven, Netherlands. This interesting section begins with an introduction to the idea of segregation in reactors and its relation to residence time distribution. Reactors are characterized by a strong degree of segregation of two phases or by the strong interaction of the phases. The interaction can occur by a mechanism of diffusion or by a mechanism of coalescence and redispersion. After the basic concepts have been formulated, the principles are applied to reactors of various types for reactions of various orders. Continuous stirred-tank reactors are emphasized. Segregation can have an influence not only on conversion but on selectivity when competing reactions are involved. Also considered were a number of interesting models of drop formation and circulation and the effect of dead spaces. Some experimental measurements involving segregation and interaction have been attempted in both physical and chemical systems, but confirmation of the theory in reacting systems is missing so far. In spite of the lack of much present practical applicability of the theories discussed in this article, it does seem that the phenomena discussed are important and will receive more study in the future.

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Distillation, E. S. Perry and A. Weissberger, Editors, Wiley, New York (1965). 2 ed., 838 pages, $24.00.

This book on "Distillation" is Volume 4 of an eleven-volume general treatise termed "Technique of Organic Chemistry" concerned with the tools and techniques used in the laboratory

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Enthalpy determinations on the helium-nitrogen system, Mage, David T., and Donald L. Katz, **A.I.Ch.E. Journal, 12,** No. 1, p. 137 (January, 1966).

Key Words: A. Determining-8, Measuring-10,8, Calculating-10,8,4, Diagramming-10,8,4, Enthalpy-9,2,7,8, Thermodynamic Data-9,2,8, Heat of Mixing-9,2, Heat Capacity-9,1, Latent Heat-9,1, Joule-Thomson Coefficients-9,1,7, Specific Heat-9,1, Temperature-1,9, Pressure-6,1, Composition-6, Diagrams-4,8, Mixtures-9, Helium-9, Nitrogen-9.

Abstract: Experimental isobaric heat capacity and different latent heat measurements have been made on the helium-nitrogen system. Compositions studied were nominal 5, 25, 50, and 100% helium in nitrogen over the range 0 to 2,000 lb./sq.in.abs. and —250° to 50°F. These data, combined with the previously reported work on nitrogen and the Joule-Thomson coefficients of Roebuck, are used to construct the complete pressure-enthalpy-composition network over the investigated limits of pressure and temperature. The enthalpies obtained from experimental heat capacity and Joule-Thomson data are compared with enthalpies computed from PVT data.

The time-optimal control of discrete-time linear systems with bounded controls, Lesser, Herbert A., and Leon Lapidus, **A.I.Ch.E. Journal, 12,** No. 1, p. 143 (January, 1966).

Key Words: A. Control-8, Linear Systems-9, Digital Computer-10, Linear Programming-8.

Abstract: The discrete-time, time-optimal control of high-order, linear systems with bounded controls is formulated as a problem in linear programming. The solution obtained requires a certain minimum number of controls to be on their bounds. Numerical results are obtained for a system with controls bounded on one and both sides and extensions indicated for state variable constraints. The method proves to be extremely fast and simple to solve on a high-speed digital computer.

Dynamics of a tubular reactor with recycle: Part I. Stability of the steady state, Reilly, M. J., and R. A. Schmitz, **A.I.Ch.E. Journal, 12,** No. 1, p. 153 (January, 1966).

Key Words: A. Deriving-8, Equations-2, Difference Equations-2,10, Mathematical Analysis-4,8, Predicting-4,8, Calculating-4,8, Stability-9,8, Steady State-9, Temperature-2, Concentration-2, Dimensionless-0, Tubular Reactor-9, Plug-Flow-0, Recycle-0, Newton-Raphson Iteration-10, Analyzing-4,8.

Abstract: An analysis of the stability of a plug-flow tubular reactor with recycle is presented for a model in which axial dispersion of heat and mass is neglected. A method is developed which permits determination of stability or instability for small disturbances immediately upon attainment of the steady state solution. The method, which is applicable to a large class of recycle processes, is based on a Newton-Raphson iteration technique for steady state solution and on the stability theory of nonlinear difference equations. The feasibility of the method is demonstrated by means of numerical examples.

The finite-difference computation of natural convection in a rectangular enclosure, Wilkes, J. O., and S. W. Churchill, **A.I.Ch.E. Journal, 12,** No. 1, p. 161 (January, 1966).

Key Words: A. Heat Transfer-8, Fluid Flow-8, Convection-8, Natural-0, Momentum Transfer-8, Numerical Methods-8, Rectangular Enclosure-9, Finite Differences-10, Computer-10, IBM 7090-10, Time-6, Position-6, Temperature-7, Velocity-7, Stream Function-7, Vorticity-7, Flow Pattern-4.

Abstract: A study is made of the natural convection of a fluid contained in a long horizontal enclosure of rectangular cross section with one vertical wall heated and the other cooled. Two-dimensional motion is assumed. The governing vorticity and energy transport equations are solved by an implicit alternating direction finite-difference method. Transient and steady state isothermals and streamlines are obtained for Grashof numbers up to 100,000 and for height-to-width ratios of 1, 2, and 3.

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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for synthesis, isolation, and purification of compounds. The volume is the revised edition of "Distillation" which appeared originally in 1951 in 608 pages. It is directed primarily to those who do distillation separations on a bench scale or "within laboratory room" scale.

The general objectives, which the reviewer believes the book meets, are summarized well in this quotation from the general introduction: "The present series is devoted to a comprehensive presentation of techniques—the authors give the theoretical background for an understanding of the various methods and operations and describe the techniques and tools, their modifications, their merits and limitations and their handling—reference is made to some investigations in the field of chemical engineering, so that the results may be of assistance in the laboratory and help the laboratory chemist to understand the problems which arise when his work is stepped up to a larger scale."

The subject matter is divided into eleven chapters, each written by a specialist in the particular field:

1. "Theory" by Arthur and Elizabeth Rose, State College, Pa.; 239 pages, 292 references.
2. "Vapor-Liquid Equilibria" by Carl H. Deal, Shell Development Co.; 59 pages, 42 references.
3. "Ordinary Fractional Distillation" by F. E. Williams, Hercules Powder Co.; 124 pages, 193 references.
4. "Extractive and Azeotropic Distillation" by C. S. Carlson and Joseph Stewart, Esso Research & Engineering Co.; 88 pages, 95 references.
5. "Distillation under Moderate Vacuum" by R. Stuart Tipson, 24 pages, 46 references.
6. "Distillation Under High Vacuum" by E. S. Perry, Eastman Kodak Co.; 64 pages, 72 references.
7. "The Vacuum System" by J. C. Hecker, Distillation Products Industries; 62 pages, 106 references.
8. "Sublimation" by R. Stuart Tipson; 45 pages, 204 references.
9. "Continuous Distillation" by F. E. Williams, Hercules Powder Co.; 22 pages, 11 references.
10. "Pilot Plant Distillation" by D. E. Orgen, Celanese Corp. of America; 35 pages, 27 references.
11. "Automation in Distillation" by T. J. Williams, Monsanto Co.; 60 pages, 67 references.

The chemical engineer will find in this book many things of interest. It can provide a better understanding of laboratory distillation practice, and thus better fit him to judge the adequacy of laboratory data given to him as the basis for larger scale operations. Also, the better understanding should enable him to collaborate more effectively with laboratory people in planning bench work directed to larger scale objectives. The contents of Chapters 2, 7, 10, and 11, relating to the rationalizations of vapor-liquid equilibria, mechanical features and design of high vacuum systems, pilot plants, and automation, probably will have more direct interest to chemical engineers than to chemists.

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