Diffusion resistances in alumina and silica catalysts, Rao, M. Raja, and J. M. Smith, **A.I.Ch.E. Journal, 9,** No. 4, p. 485 (July, 1963).

Key Words: Ortho Hydrogen-1, Hydrogen-1, Para Hydrogen-2, Nickel Oxide-4, Alumina-5, Silica-5, Liquid Nitrogen-5, Particle Diameter-6, Pore Resistance-6, Diffusion Resistance-6, Effectiveness Factor-7, Reaction Rate-7, Pore Diffusion-8, Para Hydrogen-9, Fixed Bed Reactor-10, Catalysts-10, Reactors-10.

Abstract: Reaction rate measurements were made for the ortho-para hydrogen conversion at —196°C. and 1 atm. pressure with nickel oxide catalysts using alumina and silica gel as carriers. Data were obtained for fine particles and for larger particles and pellets where pore diffusion resistances were significant. From these data experimental effectiveness factors were evaluated.

Theoretical effectiveness factors were predicted from measured properties of the pores in the catalysts and a previously developed theory. Comparison between experimental and theoretical results indicated good agreement.

A high resolution resistivity probe for determination of local void properties in gas-liquid flow, Neal, L. G., and S. G. Bankoff, **A.I.Ch.E. Journal, 9,** No. 4, p. 490 (July, 1963).

Key Words: Gas-Liquid Flow-8, Void fraction-7, Liquid Metal-5, Resistivity Probe-10, Gas Flow Rate-6, Bubble Frequency-7, Bubble Size Distribution-7.

Abstract: An electrical resistivity probe has been developed which permits high-order resolution of local void fraction, bubble frequency, and bubble size distribution function in gas-liquid flow. Illustrative results are reported for a co-current mercury-nitrogen upward flow system, which is particularly advantageous because of the fast break from the probe, owing to high mercury surface energy. The resistivity probe and a newly developed impact probe have permitted a detailed exploration of mercury-nitrogen flow structure which will be reported elsewhere.

Diffusion in ion exchange resins, Hering, Burton, and Harding Bliss, **A.I.Ch.E. Journal, 9,** No. 4, p. 495 (July, 1963).

Key Words: Dowex-1, Ion Exchange-8, Solid Diffusion-8, Diffusivity-8, Diffusion Coefficients-8, Resins-1, Cross-Linkage-6, Fick's Law-10, Nernst-Planck-10, Sodium-1, Zinc-1, Silver-1, Aluminum-1, Cerium-1, Copper-1.

Abstract: Measurements of the rates of exchange in Dowex 50W under conditions assuring that solid diffusion was the governing phenomenon are reported for the six pairs of ions: sodium-zinc, sodium-silver, silver-aluminum, zinc-copper, zinc-aluminum, and aluminum-cerium (trivalent).

Interpretation with a Fick's law model yielded diffusion coefficients greatly dependent on the direction of exchange.

Interpretation with a Nernst-Planck model was made possible by numerical solution of the flux equations for valence ratios of 1/3, 2/3, 3, and 3/2, each with three diffusivity ratios. Resulting values of diffusivities for each ion were dependent on the nature of the second ion in most cases.

Activation energies were 4 to 6 kcal. Increasing resin cross-linkage from 4 to 12% decreased the diffusion values by about 80%.

An analysis of slug flow heat transfer in an eccentric annulus, Snyder, William T., **A.I.Ch.E. Journal, 9,** No. 4, p. 503 (July, 1963).

Key Words: Annulus-6, Eccentric-6, Slug Flow-10, Temperature-7, Heat Transfer-7, Nusselt Number-7, Liquid Metal-9, Heat Transfer Coefficient-7.

Abstract: A solution is presented for the temperature distribution in a fluid flowing in an eccentric annulus formed with circular cylinders under the assumption of slug flow. The flow is assumed to be fully developed thermally with constant thermophysical properties. The outer surface is assumed to be adiabatic and the inner surface temperature is assumed to be independent of circumferential position. General expressions and numerical results for a typical set of conditions are presented for the quantities, local heat flux, local heat transfer coefficient, adiabatic surface temperature distribution, and average Nusselt number. The application of the present results to the prediction of turbulent heat transfer to liquid metals is indicated, and a comparison with other liquid metal heat transfer analyses is presented.

theory and elementary statistical mechanics; he feels that much more emphasis needs be placed on the physical significance of the "molecular models" and their consequences.

In conclusion, it would seem that this physical chemistry text has less "chemistry" in it than its competitors. This is unfortunate for chemical engineering students, who really need to understand as much as possible about complex chemical systems. The average chemical engineering student would be better off to have a good qualitative understanding of the macroscopic chemical aspects of high polymers, colloids, surfaces, and ionic solutions than to have a faltering introduction to quantum and statistical physics.

R. B. Bird
University of Wisconsin

Entropy, J. D. Fast, McGraw-Hill, New York (1962). 313 pages. $10.75.

This is a fine book, which in my view should admirably fulfill its stated purpose: "to reach all of those students and researchers to whom thermodynamics and statistical mechanics seem a little frightening, although a certain knowledge of these subjects is indispensable to them." J. D. Fast is chief metallurgist at the Philips Research Laboratories and professor at the Technical University at Eindhoven in the Netherlands. The first edition of this book appeared in Dutch in 1947. It is the good fortune of those not fluent in Dutch that the present edition is being published in English, French, German, Spanish, and Polish.

The entropy concept is presented first from the classical point of view. This is done thoroughly and well, though in a completely conventional way. Thus, while the first chapter may serve a useful purpose as an introduction to the subject and as a review, it is not here that the chemical engineer should find the primary benefit from this book.

Chapter 2 is quite another matter. Here the author in forty lucidly written pages lays bare the essence of the statistical concept of entropy. I have long looked in vain for such a chapter. Here the reader is led very slowly and logically from the very beginning, guided firmly from one essential point to the next, so that with relative ease he should come to appreciate the statistical significance of entropy. Professor Fast says exactly what needs to be said. He admits to the sacrifice of absolute rigor, concentrating on the presentation of basic and essential ideas. One does not get lost in jargon or in complex mathematical symbolism. This chapter and the fourth on quantum mechanics and statistics, are well worth the price of the book.

Chapter 3 deals with applications of the entropy concept. The point of view varies from classical to statistical. Since Professor Fast is a metallurgist, it is perhaps not surprising to find emphasis on applications involving solids (including polymeric materials). However, this should not detract in any way from the value of the book, for it is just in these areas where the chemical engineer could well benefit from a broadening of scope.

These first three chapters make up just over half of the book. They are written to stand alone and to provide a basic treatment for those with very limited time for study. Most chemical engineers, however, would be well advised to press on, at least through Chapter 4. As already mentioned, this chapter deals with the principles of quantum mechanics and quantum statistics. The author comments, "This chapter is scarcely more complicated or difficult than the preceding ones." This turns out, surprisingly, to be true. But this does not mean that topics with a reputation for being difficult have been avoided; their treatment is just beautifully done. Here we find the material of "modern" physics—Heisenberg's uncertainty principle, Schrödinger's equation, Bose-Einstein and Fermi-Dirac statistics, etc.

The last two chapters deal rather thoroughly with the entropy calculations for monatomic and diatomic gases. Few with any real interest in the subject of statistical thermodynamics will want to stop short of these chapers, which provide examples of the use of the principles so carefully developed earlier. The treatment is uniformly excellent to the very end.

Those who continue to avoid acquiring a workable knowledge of the statistical concepts in thermodynamics will now have to find an excuse other than the unavailability of a suitable book for self-teaching.

H. C. VAN NESS
RENSSELAER POLYTECHNIC INSTITUTE

New Chemical Engineering Separation Techniques, edited by H. M. Schoen, John Wiley and Son, New York. 439 pages. $14.50.

This book is a collection of separate reviews of 6 separation processes distinguished mainly because chemical engineers are not as familiar with them as with distillation, extraction, etc. All 6 processes have potentialities beyond their present uses, both in the laboratory and in industry; and the purpose of the book is to stimulate their wider use and to inform a wider audience of uses and future possibilities.

Each section is independent of the others and is written by people familiar

INFORMATION RETRIEVAL

Determination of constants for the Benedict-Webb-Rubin-Friend equation of state from limited data, Griskey, Richard G., and Harold H. Beyer, **A.I.Ch.E. Journal, 9,** Vol. 4, p. 507 (July, 1963).

Key Words: Benedict-Webb-Rubin-Friend Equation-1, Equation Of State-1, Compressibility Data-2, Critical Data-2, 3 Methylpentane-8, 2, 2 Dimethylbutane-8, 2, 3 Dimethylbutane-8, 2, 2, 4 Trimethylbutane-8.

Abstract: Two techniques have been developed to determine constants of the Benedict-Webb-Rubin-Friend equation of state from limited data. Constants for 3-methylpentane, 2, 2-dimethylbutane, 2, 3-dimethylbutane and 2, 2, 4-trimethylpentane were determined using these techniques. Pressures calculated using these constants deviated by 0.43% on the average from experimental values. Calculated critical pressures differed by 0.33 atm. on the average from observed data.

Effect of sublimation on stagnation-point heat transfer, Short, W. W., and T. A. Dana, **A.I.Ch.E. Journal, 9,** No. 4, p. 509 (July, 1963).

Key Words: Carbon Dioxide-1, Vapor-2, Turbulence-3, Radiation-3, Air Stream-5, Stagnation Point-5, Boundary Layer-5, Reynolds Number-6, Velocity-6, Temperature-6, Nusselt Number-7, Stanton Number-7, Ablation-8, Sublimation-8, Mass Transfer-8, Heat Transfer-8, Transpiration Cooling-8, Convection-8, Wind Tunnel-10, Calorimeter-10.

Abstract: The reduction of heat transfer to carbon dioxide models caused by the subliming solid was measured experimentally. Heat transfer coefficients were obtained for 0.7-cm-diam. copper and carbon dioxide hemisphere cylinders in air at 500° to 800°K. with velocities up to 300 cm./sec. The ratios of the heat transfer coefficients with sublimation to that without sublimation are compared with several theories. At 0.0084 g./sq. cm.-sec., which was the highest mass transfer rate obtained, the stagnation-point heat transfer coefficient was reduced by 65%.

Measurement of diffusivity in a high-viscosity liquid, Hollander, Martin V., and James J. Barker, **A.I.Ch.E. Journal, 9,** No. 4, p. 514 (July, 1963).

Key Words: Diffusivity-7, Sodium Chloride-1, Glycerol-5, Radioactive Isotope-10, Diaphragm Cell-10, Fick's Law-10, Viscosity-6.

Abstract: A technique to measure diffusivity in high-viscosity liquids was investigated using a modified diaphragm cell. The concentration buildup in the cell owing to a gradient in the diaphragm was monitored using a radioactive tracer for times up to 25 hr. The data concurred with the mathematical model. The specific system studied was sodium chloride in glycerol at 32°C., and the resulting diffusivity is reported as $18.36 \pm 0.36 \times 10^{-8}$ sq. cm./sec.

Fluid flow and convective-radiative energy transfer in a parallel plate channel under free-molecule conditions, Sparrow, E. M., and V. K. Jonsson, **A.I.Ch.E. Journal, 9,** No. 4, p. 516 (July, 1963).

Key Words: Duct-5, Heat Transfer-7, Mass Flow-7, Gas-5, Low Density-6, Pressure Level-6, Temperature Level-6, Radiation-6, Convection-6, Molecular Flow-5, Analysis-10.

Abstract: The flow of a highly rarefied gas in a parallel-plate channel and the transfer of heat owing to simultaneous thermal radiation and free-molecule convection has been investigated analytically. The analysis is facilitated by analogies which exist between the processes. The mass throughflow has been determined as a function of the temperatures and pressures of the system and of the channel dimensions. From the heat transfer analysis, it was found that at temperature levels corresponding to room temperature and above, the results for the combined convective-radiative transport differed little from those for a purely radiative transport.