REVIEW: Chemical Reactor Theory

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index at the end.

The book is produced by photostat of the typed manuscripts; this has kept both the price within bounds, and the production relatively error-free.

Finally, the editors are to be congratulated on performing the herculean task of carrying this work through to print. It is tragic that Leon Lapidus met his untimely death just before the volume actually appeared in print—this is a work he would be rightly very proud of. □

THEORETICAL RHEOLOGY THERMOCHEMICAL KINETICS, 2nd EDITION

By Sidney W. Benson, John Wiley, New York, 1976 ($22.50).

Reviewed by Robert D. Tanner,
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The rate constants for 7 out of the 19 most important reactions proposed to model the destruction of ozone in the stratosphere were not accurately known in 1976. [1] The first direct measurement of the reaction rate of nitric oxide with the hydroperoxyl radical, a critical reaction in the chemistry of ozone in the upper atmosphere, was not reported until the next year. [2] That report, of a rate 10 to 40 times faster than had been estimated, led to the conclusion that chloroflurocarbon aerosols may by 35% more destructive of the earth's ozone layer than had been previously predicted, while supersonic aircraft may be only half as destructive. [2] Since understanding the estimation techniques for such important gas-phase reactions are timely, it is appropriate to examine the general status of estimating rate constants in Benson's revised book on *Thermochemical Kinetics*. How accurate for example, are the most recent developments of the classical transition-state theory and collision theory in predicting rate constants, a priori, from thermochemical data? Can we tell beforehand, as Levenspiel [3] states, whether the predicted rate will "match the experiment by a factor of two" or will be off by a factor of 10^6? Unhappily, as the hydroperoxyl radical example illustrates, the most recent estimation methods still deviate by more than a factor of two, and Benson's text doesn't help us deal with this problem.

What seems to be needed, after recognizing that the collision theory may generally be used to estimate the upper reaction rate bound, [3] is a lower bound estimate. When information is available to apply the transition state theory, the predicted rates are generally closer to experimental rates than that predicted by the collision theory. [3] Nevertheless, the transition state predicted rate does not provide the desired lower bound. We therefore need to simultaneously develop definite upper and lower bounds for predicting rates of specified reactions, and sharpen the predicting tools for each bound, thereby reducing the predicted maximum errors.

A recent review by Rossini [4] aptly covers the topics in the five chapters of Benson's book and, thus, will not be repeated here. What seems to be important in Benson's book, from an engineering point of view, is its potential to help us predict the behavior of such reactions as pyrolysis, cracking, hydrogenation, oxidation, and polymerization in new processes, such as those being developed for coal gasification. Extensions of the predictive methods covered by Benson to the condensed phases (liquids) are beyond the scope of his text, but are presently under development. It is hoped that Benson's book will be the inspiration for one which will eventually cover methods, for not only predicting liquid phase reaction rates, but for those of reactions governed by both homogeneous and heterogeneous catalysts. □

REFERENCES

1. Maugh, T. H., II, **Science**, (October 8, 1976), 170.
2. **C & EN**, (June 13, 1977), 16.
3. Levenspiel, O., **Chemical Reaction Engineering**, 2nd ed., Wiley, New York (1972), 23-29.
4. Rossini, F. D., **Chem. Engin.**, (May 9, 1977), 12.

PATTERNS OF PROBLEM SOLVING

By Moshe F. Rubenstein, Englewood Cliffs, N. J. Prentice Hall, Inc., 1975

Reviewed by Richard M. Cyert,
Carnegie-Mellon University

This book is, in one sense, misnamed. I looked forward to reading it because I thought from the title that it would be an application of some of the recent research in psychology. In fact, only the first chapter attempts that type of approach. The rest of the book could best be described as an introduction to operations research. Nevertheless, the book is an interesting one for the person who wants a quick introduction to such diverse topics as Boolean algebra, Bayesian analysis, the central limit theorem, random walk, utility theory, linear programming and sequential analysis. The book is a potpourri of techniques.