TABLE 3. DEVIATIONS* FROM SMOOTHED EXPERIMENTAL VALUES

Method	Overall			Vapor region			Liquid region			Critical region		
	No. pts.	Avg.	Bias	No. pts.	Avg.	Bias	No. pts.	Avg.	Bias	No. pts.	Avg.	Bias
Curl-Pitzer (Kay)	702	10.3	9.7	330	5.0	4.1	319	14.8	14.4	53	16.6	16.3
Curl-Pitzer (SBV)	702	7.8	7.1	330	4.0	3.0	318	10.5	10.2	54	14.3	14.0
Lee-Erbar-Edmister	707	9.3	7.6	329	5.4	5.2	325	10.4	7.5	53	26.5	23.7
Soave	707	4.5	2.4	329	2.7	0.9	325	5.1	2.4	53	12.2	12.2
Starling	707	4.8	1.9	330	2.4	1.1	324	6.7	2.0	53	7.6	6.0
Lee-Kesler	707	3.6	1.6	327	2.3	0.1	324	4.7	3.1	56	4.4	1.6

* All deviations in kiloJoules per kilogram.

relations from which rapid desk calculations can be made. With these tables one would most likely use a linear interpolation and simplified pseudocritical rules, resulting in some loss in accuracy. The results will, however, still be quite good.

CONCLUSIONS

All the six methods evaluated in this study can be expected to give fairly reliable estimates of enthalpies of hydrocarbon mixtures. The methods of Starling and Lee-Kesler, however, have been found to be significantly superior to the others. The Lee-Kesler method is the most reliable of the six methods for the prediction of enthalpies for a wide range of hydrocarbons.

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BOOKS

Handbook of Enzyme Biotechnology, Alan Wiseman, editor. Ellis Horwood, Publisher. Chichester, Great Britain (Distributed by Wiley). 275 pages. $45.00.

The intentions of the editor are much more restricted than might be indicated by the title. The book's objective is to describe the industrial practice of large-scale enzyme production and utilization and to develop those aspects of theory directly coupled with present enzyme technology. The potential industrial use of immobilized enzymes and their preparation are discussed.

To achieve this objective the book adopts a novel approach to organization. The book is divided into two parts; the first is concerned with establishing principles while the second part provides the data for the industrial application of these principles. The author (or authors) of a chapter in part 1 write the corresponding chapter in part 2. The book achieves a cohesiveness by utilizing such a follow-up structure.

This integration of material, unfortunately, does not overcome several weaknesses in topics discussed. These problems result from an apparent attempt to appeal to a very diverse audience. A minimal knowledge of biochemistry and engineering is assumed. Most topics in part 1 are not treated in depth while several others are virtually ignored. Specifically, quantitative relationships, except for oxygen transfer, have been completely neglected, and design engineering aspects are inadequately treated. Sufficient (but not exhaustive) references are presented, however, for the enterprising reader to initiate a literature search or to enhance materials sparsely introduced. Part 2 should have included examples of actual fermentation data, as well as more information on enzyme recovery and purification operations.

The book's strongest points occur in

part 2. The chapter on enzyme data is good; concise but relatively complete information is given on most industrial enzyme preparations. Having this information compiled into one source should be particularly useful.

Chemical engineers with a limited background in biochemistry and an interest in enzyme manufacture and use may benefit from the book. The data presented is of potential use to all biochemical engineers. For those teaching courses in biochemical engineering the book provides some interesting examples of actual practice and these could be used to spice up some lectures.

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Models for Flow Systems and Chemical Reactors, C. Y. Wen and L. T. Fan, Marcel Dekker, Inc., New York, 581 pages. $29.75.

Classmates at National Taiwan University, the authors of this book have followed similar and successful career patterns since coming to the United States in 1951. Readers familiar with their research will recognize this monograph, with its superbly worded title, as a natural eventuation. The book appears to have been offset printed from photographically reduced typewritten masters. This approach has led to a low number of typographical errors, a large number of omitted articles, and mixed singular and plural grammatical forms. The expectation that such a publication procedure would be inexpensive is not borne out by the purchase price of the book.

The first seven chapters (Introduction, Residence Time Distribution in Flow Reactors, General Mathematical Background, Velocity Profile Model, Dispersion Models, Combined Model, and Compartments Model) deal with research results which have now achieved almost classic form. Wen and Fan deal with these subjects with exceptional thoroughness. They provide 335 categorized literature citations which serve as a guide to all of the original theoretical literature. For example, they deal at length (Would you believe 17 pages?) with the continuing question of the proper boundary conditions for a steady state plug flow model with axial dispersion. Excellent use is made of graphical and tabular techniques to provide the reader with comprehensive understanding. Typical among these are a graphical summary of applicable regions of various approximate solutions to the velocity profile model for laminar flow of a Newtonian fluid; also a 6 page table summarizing details of 79 diverse tracer experiments to study residence time distributions for gas, liquid, and two phase flows in tubes, tanks, packed beds, fluidized beds, and extraction columns. The treatment in this portion of the book is so comprehensive and definitive that these chapters might be thought of as the "Crank" or "Carslaw and Jaeger" of reactor and flow system modeling.

The authors provide generalizations where possible. For example, in the chapter on Velocity Profile Models all developments are for power law fluids with reduction to Newtonian cases indicated from time to time. The Compartments Model chapter is a generalization of much of what has preceded it. In contrast to these generalizations, the chapter on Combined Models restricts its attention largely to first order kinetics.

The remaining four chapters (Gamma Distribution Model, Progression Models, Heterogeneous Models, and Models of Micromixing) are much more a reflection of the authors' personal research effort in these areas. As such, they provide mainly perspective and elaboration on the earlier materials, some illustrative examples and 135 more references. The last 33 pages are almost a modeling orgy containing ten model descriptions and five model examples of micromixing.

Before opening the book this reviewer had hoped for more real-life flavor, such as consideration of industrial practice, emphasis on pitfalls and model inadequacies, the severe difficulties in making the proper assumptions and model simplifications a priori, and the problem of poor data. The authors are aware of such matters and take notice of them. Indeed they have been diligent about identifying what experimental data exist and pointing up computational hazards. Nevertheless, this book, like previous treatments of residence time distribution, mixing, and reactor modeling, comes across as very analytical and loaded with the familiar parametric curves (61 of 87 graphs contain no data). There are no homework problems and rather few examples that really reach out to the reader and force his involvement. Accordingly, this monograph is more likely to find use as a reference work than as a textbook. That is, you must have a reason of your own to undertake study in it. It is easy to visualize teachers deriving lectures from this book, perhaps even using it as a mystery text. Researchers and practitioners to whom flow system modeling methodology is of pervasive interest will find the book to be of great value. Already two of my colleagues have asked to borrow it when I complete this review.

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Mixing—Principles and Applications, by Shinji Nagata, published by Halsted Press, 458 pages, $32.50.

I have had a personal interest in this text as Professor Nagata and I discussed his plans for a book on mixing when I visited Japan in 1972. The first nine chapters were prepared by Professor Nagata and his associates in Japan. Although they were written in English, every effort was made to preserve the flavor of Professor Nagata's thought and method of expressing concepts. Unfortunately, Professor Nagata passed away before this task was completed. However, his two associates, Mr. Nishikawa and Mr. Yamamoto, assumed the job of final editing and manuscript preparation.

The book is exceptionally detailed in its treatment of mixing phenomena. It also contains references to many works published in Japanese literature and not readily available to practitioners elsewhere. To appreciate the material, a reader should possess a good background in mixing theory as well as fluid mechanics.

To illustrate the material covered, the first chapter presents a very thorough review of power requirements for mixing impellers. It even discusses those errors inherent in various kinds of dynamometers. The chapter on heat transfer is equally thorough. When flow patterns are described one is given an excellent view of fluid-shear rates, turbulence and energy dissipation which summarizes the work of Professor Nagata and others.

In Chapter Four there is a discussion of the basic problem in blending, that of choosing suitable criteria. The difference between scale and intensity of blending is defined and experimental results are presented to illustrate a variety of blending systems. The chapter on continuous mixing is good but it could have drawn more on the work of McMillan and Weber to give residence time distributions for well-mixed systems.

Solid suspensions is one of the most common mixing applications. Unfortunately, most of the experimental data available are for a single size particle. The vast number of publications in the field are well summarized by Professor Nagata, and his own extensive work in this field is documented.