

All of Klein's manuscripts demonstrate an efficient use of words. Much information is contained on each page, yet the writing is thoroughly lucid, and delightful to the reader. Compactness is achieved, though not at the expense of a brief literary gem to introduce each chapter and an apparently easy style of writing throughout. The author makes no attempt to minimize his feelings or to hide his innate wit when he describes overzealous regulatory activities of the government or callous disregard for civilized ethics by municipal or industrial polluters. The result is most enjoyable.

This book is, of course, British, which is particularly apparent in Klein's historical introduction and his review of legal aspects of river pollution. These two chapters are of relatively minor use to an American seeking quick answers to a technical question, but are excellent reading for anyone who will relax long enough to appreciate them. The remaining chapters are more tightly packed with technical information on pollution.

The nature and effects of pollution are carefully outlined and described as to sources, chemical types, physical types, physiological aspects, and biological effects. Industrial wastes are included in all of these phases, and are more specifically covered in the succeeding chapter, in parallel with sewage, as a cause of river pollution. Some of the aspects of industrial pollution are typically British, but nevertheless of interest in American practice.

The uses of river water are explored, including brief sections on conservation and possible substitute sources of water. Standards are discussed for the quality of water for drinking, groundwater recharge, industrial uses including boiler water and cooling water as well as a number of specific industries, agricultural and fishery use, waste transport, navigation, and recreation.

The second half of this volume covers more specifically the biochemical and physicochemical aspects of pollution, and biological aspects including separate chapters on fish and on other aquatic life forms. Klein has called upon coauthors for these subjects, each an expert in his field; the result is an exhaustive survey of current information. Toxic materials are well covered, as are other aspects of the aquatic environment.

Klein's book is well documented with literature citations throughout. Probably not suitable for a beginner's text, it is an excellent reference work for anyone who wishes more than a casual knowledge of stream pollution.

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**Elements of Chemical Reactor Design and Operation**, H. Kramers and K. R. Westerterp, Academic Press, Inc. (1963). 245 pages. \$10.00.

This new text on reactor design merits the attention of both educators and those in industrial practice for its catholicity of coverage and its attention to those problems which are, at the same time, important for the student and indicative of current practice and application for the design engineer. It is most pleasing to note the successful combination of much of the recent and significant work in chemical-reaction engineering with a continuing sense of the importance of those practical and economic considerations involved in its effective utilization.

The subject material of the book includes analysis of batch, tubular flow, and stirred-tank reactors, and their operation. The discussion is extended to include reactor cascades, the cross-flow reactor model, and some applications to fixed-bed reactors. Non-isothermal and mixing effects in reactor design are treated in detail. A separate section is devoted to the topic of reactor optimization, including isothermal and nonisothermal systems, through discussion of some individual cases; applications of mathematical methods of optimization such as dynamic programming are introduced at the end of this section.

The authors are to be commended for their treatment of all these topics. Presentation throughout is clear and well organized; the subject material chosen for presentation from this large and rapidly developing field is well considered. The value of the book as a text is considerably enhanced by numerous illustrative examples, which are presented after almost every topic, and by the extensive citation of the literature of the field, including most papers of importance in reactor design and analysis.

The text is, thus, very well presented in general; a sole criticism is the omission of a subject index. An overall evaluation, however, must include some questions concerning material which is not presented. It is perhaps unfair to comment on the scope of a work such as this except when the scope is so limited that the material which is presented is adversely affected, or when the presentation is very well carried out and one desires to see the same authors discuss additional, advanced material. The latter comment applies here. The fluidized-bed reactor, for example, is not discussed in detail, and the recent work developing computational models of fixed-bed, catalytic reactors by means of stirred-tank networks is not mentioned at all. The

important question of experimental reactors and the problems involved in obtaining reliable kinetic data suffers from condensation; this is unfortunate in the sense that inclusion of a topic in an appendix, as this is, may relegate it to secondary importance in the mind of a student. There are a number of additional points of this nature which might be included here, all dealing with various items which could be extended in scope of discussion. It may be the feeling of the authors that many of these systems, such as fluidized reactors, are not yet well enough characterized to allow treatment in the same manner as material which is presented. In view of the excellence of this book, one may only regret this decision.

The authors have succeeded in their stated attempt to bring forth some type of structure or system by which the problems of reactor design and operation may be treated through the use of methods which possess some generality.

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**Liquid-Liquid Equilibria**, Alfred W. Francis, Interscience Publishers, New York (1963). 298 pages.

This excellent little book provides a concentrated treatment of the characteristics of liquid-liquid equilibria in binary, ternary, and quaternary systems. The emphasis is on the manner in which these systems illustrate the principles governing the relationships between regions of solubility and insolubility, the shapes of miscibility gaps and solubility curves, the characteristics of equilibrium tie lines, and other properties. Francis himself has been responsible for developing much of what is known of the properties of these systems, and the book is profusely illustrated with examples, many of which are taken from the author's own extensive researches. Great care is taken to avoid using "typical" systems, no examples of which are known, to demonstrate the principles, and much of the text is devoted to correcting the misinformation which has developed from imaginative use by others of such "typical" systems rather than from direct knowledge.

The book will be most useful for students and chemists working with liquid-liquid systems and for engineers who must apply this information in the practice of liquid extraction. The author's long association with the petroleum industry is revealed on occasions, as when he lists as the principal commercial solvents only those

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