the book. There is a wanting to come to some sort of generalized conclusion in Chapter III, and Chapter IV comes over as being rather tedious with difficulty in coming to any generalized set of tools.

Chapter V addresses thermodynamics of chemical reactions and is a rather typical presentation as used in most textbooks. Chapter VI on energy balances is weak. The energy balances are initiated with the first law of thermodynamics and all the material is generalized throughout. There are no specific illustrative examples. Actually, Chapter VI could be combined with Chapter VII that does contain more of the applications part.

Chapter VIII is given to the fundamentals of heterogeneous catalysis. It is qualitative rather than quantitative in nature and is a rather cursory introduction to the topic. However, not much more can be covered in the typical one-semester course on the topic.

BILLY L. CRYNES
School of Chemical Engineering
Oklahoma State University

The Scientific Basis of Flocculation, NATO Advanced Study Institute Series E: Applied Science—No. 27, edited by K. J. Ives, Sijthoff and Noordhoff International Publishers B.V., Alphen van den Rijn, The Netherlands (1978) 369 pp., ($33.50).

As outlined by Ives in the introduction, the aim of these proceedings is to provide the reader with a scientific basis of flocculation in liquids without any attempt to present the principles of practical design. The text comprises twelve chapters (excluding the introduction), each the result of a lecture presented by well-known participants at the NATO Advanced Study Institute on the Scientific Basis of Flocculation at Christ's College, Cambridge, U.K. held July 3-15, 1977.

The usual reservations and criticisms for multiauthored proceedings regarding continuity, style, symbols, and overlap prevail. The text does however cover a wide variety of subjects associated with flocculation of colloids in liquids. It should be useful to those readers desiring an updated review of the fundamentals of surface chemistry of colloids, kinetic theories, hydrodynamics, and the influence of inorganic salts and polymers on colloidal stability. The text also covers experimental methods for destabilization from concentrated and dilute suspensions, and several applications including water and wastewater treatment, sludge dewatering and mineral processing.

For students of Environmental Engineering this book should be especially timely since its theoretical bias complements the emphasis on design evident in a spate of new books devoted to Water and Wastewater Treatment. After all, understanding why (mechanism) in addition to how (design) elevates training to education.

GEORGES BELFORT
Department of Chemical and Environmental Engineering
Rensselaer Polytechnic Institute
Troy, New York 12181

Fault Detection and Diagnosis in Chemical and Petrochemical Processes, by D. M. Himmelblau, Scientific Publishing Co., 1978, 414 pages, $59.50.

The size, system characteristics, economics and hazards of large chemical and petrochemical plants are now such that the penalties of inefficient operation due to fault conditions of plant downtime and of sudden failure are often serious. As a result there is considerable interest and activity in the development of improved methods of dealing with fault conditions, including the detection of incipient malfunctions. The important area of condition monitoring of process machinery has recently been described in *Mechanical Fault Diagnosis* by R. M. Collacott. The present volume is timely in presenting an overview of the whole field of fault detection and diagnosis with particular emphasis on the processing of the information obtained from detection and diagnostic systems. The successive chapters deal with the overall approach; with basic statistics, including error propagation, interval estimation and hypothesis testing; with process models, both deterministic and stochastic, continuous and discrete, including models based on physico-chemical principles, population balance models and empirical models; with process control charts, including Schewhart charts, cumulative sum charts and multivariable charts; with fault detection by state and parameter estimation using algebraic equations, ordinary and partial differential equations, difference equations, transfer functions, frequency response, time series and residence time distributions; with pattern recognition methods based either on template fitting or feature extraction and classification, including fault dictionaries and cluster analysis; and with information flow methods, including hazard and operability studies, failure modes and effects analysis, fault trees and cause-consequence diagrams. The treatment covers fault detection and diagnosis both by the process control system, i.e. process operator and process computer, and by trouble-shooting teams and deals both with design faults which become apparent during operation and with operational faults. The material is illustrated by synthetic or simulated and real-life examples, including reactors, distillation columns, liquid-liquid extraction columns, reboilers, heat exchangers and instrumentation. The book is intended to present analytical background and practical techniques; it is not a student textbook and does not contain tutorial problems. The chapters on statistics, modelling and estimation are fairly heavy mathematically. Essentially the book is a source book of ideas and techniques. It is valuable also as indicating practical applications of mathematical techniques. It does not deal with one of the central problems in this field, namely the overall design of the fault detection and diagnosis system. There is a large and increasing number of techniques available, but they all cost money. There is need for the development of criteria to guide the selection of individual techniques and the design of the system as a whole. This is not a criticism of the book, however; the work has not as yet been done. Current developments in algorithms for fault tree generation and, more generally, fault propagation are mentioned only briefly. Some particular aspects of fault detection and diagnosis not dealt with in any detail include pressure vessel inspection, nondestructive testing and acceptance standards; event trees; and Weibull analysis. These are comments, however, rather than criticisms. The author is to be congratulated on a most useful contribution to an important but somewhat neglected field.

F. P. LEES
Department of Chemical Engineering
Loughborough University
of Technology
England

Measurement of Two Phase Flow Parameters, by G. F. Hewitt, Academic Press, Dec. 1978, $22.25; 287 pages.

The most useful travel guides are those written by travelers who have themselves experienced most of the trip. Hewitt's "guide to the world of gas-liquid flow measurement" is offered by an experienced traveler in that world. Few laboratories have provided as much experimental data in two phase flow as the Harwell group under Hewitt's leadership. Many modern two phase flow measuring methods originated in those laboratories and innumerable methods developed by others were evaluated and improved there. So this is a book by an investigator

with extensive first-hand experience in the creation, development and evaluation of measuring methods for gas-liquid flow and it reflects the personal touch of that experience. Even the best of the travel guides draw on the experience of others to present a well-rounded picture. When Harwell did not create, evaluate or improve on a measuring method, Hewitt draws on the encyclopedic collection of two phase flow literature in the Harwell files to tell you who did.

A brief introductory chapter comments on the physical nature of gas-liquid flow and discusses some models for characterizing momentum and heat transfer. The presentation seems intended to lay the framework for a wide variety of measurements discussed in the rest of the book. It is not particularly successful in doing so and a good place to start is in Chapter 2 which outlines a well reasoned classification scheme for the variety of experimental measurements used for gas-liquid systems. There are three broad groups:

- First order parameters; those of direct interest to the designer.
- Second order parameters; steady state measurements of interest to the researcher.
- Third order parameters; measurements which provide information on inherently unsteady or fluctuating quantities and where the character of the fluctuation is indicative of the process.

Measurement methods for steady first order (design) parameters which are discussed include pressure drop, heat and mass transfer coefficients, mean voids content and critical heat flux. For unsteady design parameter measurement, techniques are discussed for determining rapidly varying flow rates, void fractions, momentum flux and pressure, bubble growth and collapse rates, dryout and rewetting conditions. In addition, methods are presented for measuring less central design parameters such as vibration, stability and liquid level.

Perhaps, the most valuable contribution of the book rests in the presentation of the methods for measuring the second order parameters. These include flow pattern, film thickness, void fraction distribution, entrainment, drop and bubble sizes, wall shear stress and residence times. Here the direct experience of the Harwell laboratory adds a special level of authority to the presentation.

The chapter providing information on third order or fluctuating quantities is of only limited usefulness. Included are discussions of the time variation of film thickness, temperature, pressure, velocity, concentration and wall shear. Also briefly discussed are photographic methods for observing these variations. Modern methods for measuring fluctuating quantities (in the frequency range of 2-50 Hz which is of interest in two phase flow) are little different than those for steady flow. The significant difference comes in the methods for analyzing the time series. The presentation deals with this problem only superficially.

It is important to set the expectation for the reader correctly. This is not a manual of measurement methods with full detail. Rather, it is a guide which presents the methods and steers the reader to the location of the details which he needs. To this end there are included over 1200 references.

A. E. Dukler
University of Houston
Houston, Texas

Principles of Photochemistry, by J. A. Barltrop and J. D. Coyle, John Wiley and Sons: Chichester, New York, Brisbane and Toronto, 1979. (214 pages). $12.50.

As recently as twenty years ago, a review of a work that dealt exclusively with photochemistry might have seemed bizarre in these pages; attempts during the 1940s and 1950s to devise photochemically driven processes for the production of bulk chemicals had not been gaudy successes. In the meantime, photochemistry has matured startlingly, aided in no small measure by the invention of the laser which has created new horizons both for scientific and engineering studies and for the chemical industry. As a result the late 1970s find increasing numbers of chemical engineers using photochemical techniques, for example, in investigations of flames and of fuel combustion; in surface studies of catalysts; in attempts to understand and to increase biomass yields; and in campaigns to create new, solar-driven chemical syntheses.

When Baltrop and Coyle's 376 page monograph "Excited Studies in Organic Chemistry" appeared in 1975, it received a warm critical reception. The authors wrote in their preface that they hoped their work would serve both as a reference for practicing photochemists and an instructional text for undergraduate and postgraduate students. Given the price of that volume (now *ca.* $41), my guess is that students have not been rushing to the bookstalls for it. The present work is a different matter. Published in a quality, softbound version at about $13, it comprises the first six chapters of the original. These deal, in an exceptionally lucid manner, with the theoretical foundations of photochemistry.

Since adequate summaries of each of the six chapters have already appeared in reviews of the original version (cf. *Nature 260,* 735, 1976; *Science 193,* 670, 1976), they are eschewed here. Note, however, that this is not a "how to" manual although it does provide enough references to the experimental literature to permit a novice to begin laboratory work.

Missing from the present volume are the final five chapters of the original, which provide an uniquely organized and valuable review of the photochemistry of organic molecules. In their stead is a valuable set of problems with solutions to help students (or other photochemical neophytes) determine if they are mastering the material.

A familiarity with quantum chemistry at the level that now exists in many chemistry and chemical engineering undergraduate curricula would be helpful, if not essential, for anyone approaching photochemistry for the first time. The authors of this book, however, have performed a marvelous hat trick in producing a work from which both novice and expert may learn.

Robert C. Axtmann
Department of Chemical Engineering
Princeton University

Liquids and Their Properties: A Molecular and Macroscopic Treatise With Applications, by H. N. V. Temperley and D. H. Trevena, John Wiley & Sons, Inc., 1978, 274 pages; $37.50.

This book is a useful survey of liquids that combines molecular and macroscopic approaches. It is designed to be of use to students in the pure and applied sciences, and also to research workers in other fields who require a basic knowledge of the liquid phase. As is the case with other recent books on liquid state, this one seems to emphasize new insights into the structure and properties of liquids at the molecular level that have resulted from computer simulations, beginning about 1957, and the parallel developments in theory and experimental methods. It differs from other recent books in that it covers a wider variety of topics, including hydrodynamics, acoustics, liquids under tension, and other specialized or applied topics that are specialties of one or both authors.

Its most serious shortcoming is that it attempts to cover too many topics in too little space, with the result that many sections are so brief as to be of doubtful value. The section on solutions of gases in liquids, for example, consists of five sentences and includes no specific references for further reading.