amorphous polymers, to polymers analyzed above their glass-transition temperatures, and to semicrystalline polymers. The final five chapters discuss special topics, including the study of polymer conformations, chain dynamics, orientation, and morphology.

The book has a number of attractive features. Foremost among these is its thoroughness in reviewing published work and the range of subjects covered. Several hundred references have been provided by the authors of the individual chapters. Most classes of polymer systems are discussed in detail: elastomers, glasses, semicrystalline polymers, and oriented materials. Separate treatment of these classes is useful, since both the applied spectroscopic techniques and the resultant information can vary substantially among the different systems.

With regard to the NMR methods, the final two chapters of the book, dealing with proton multiple-pulse spectroscopy and deuterium wideline studies, broaden the scope beyond the carbon-13 investigations. These two areas will be less familiar to many readers, but they can be uniquely informative with respect to polymer morphology and mobility. Another attractive aspect of the book is that the chapters can be read independently. One who is interested primarily in the study of amorphous elastomers can proceed directly to that section of the book without penalty. Despite this independence, the chapters have been cross-referenced well, and relevant figures and discussions which appear in different chapters are identified.

The book's primary deficiency is a shortage of practical information concerning the experiments. A number of specific points come to mind. First, for one without experience in solid-state NMR, it may be difficult to extract the instrumental requirements for studying each class of polymer system. A brief section concerning such requirements would be a welcome addition to several of the chapters. (The deuterium NMR chapter has a section dealing with aspects of both hardware and software.) Second, since quantitative data are required for many applications, an explicit section on this subject would also be useful. Information concerning quantitative results is scattered throughout the chapters, but there is no concise discussion of how to record quantitative spectra with both cross polarization and single-pulse excitation. Temperature and contact time should be emphasized as useful parameters in quantifying results. Third, with the increasing ubiquity of high-field spectrometers, further experimental details concerning both the elimination and the exploitation of spinning sidebands would be helpful. Finally, a brief section dealing with carbon-13 spin diffusion would highlight an important, but sometimes overlooked, feature of many of the NMR experiments conducted on rigid solids.

For scientists interested in characterizing the behavior of bulk polymers, this book is recommended reading. The versatility of the high-resolution techniques will quickly become apparent, and the reader is likely to recognize areas in his own research or development where the NMR techniques would prove useful. Both academic and industrial scientists should gain an appreciation for information available through solid-state NMR which is difficult to obtain by other means—e.g., structural analysis of thermosets, site-specific motional information, and noncrystalline chain orientation. The book would also serve admirably as the text for a special topics course in graduate school. The structure of the book makes it amenable to a wide range of courses, since most of the chapters can stand alone and since the writing style throughout the chapters is uniformly clear.

John Havens
Raychem Corporation
300 Constitution Drive
Menlo Park, CA 94025

Corrosion Mechanisms

By Florian Mansfeld, Marcel Dekker, Inc., 1987, 455 pp., $89.75

This book discusses mechanisms that have been proposed for major categories of corrosion phenomena. Because the authors present the pros and cons of various competing mechanisms, the volume succeeds in providing an excellent summary in this area. Amply referenced, the nine chapters contain 841 citations, 20% of which are from papers published in the 1980s. While the more recent scientific advances are included, the book serves mainly as a tutorial for readers who are interested in the corrosion field with a modest background in physics, chemistry, materials science, or engineering.

Each of the nine chapters is written by well-known experts. Topics include dissolution of pure metals (Fe, Co, Ni) and alloys, corrosion inhibition, coatings, atmospheric corrosion, pitting corrosion, effect of hydrogen on metals, corrosion fatigue, and high-temperature oxidation. Each of these topics has a long history of past research, much of which consists of case studies and attempts at identifying key parameters by observing phenomena. Corrosion is an old problem but a relatively young field of science. The way the literature of the field is indexed in this volume indicates that there has been the transition from case studies (reporting of diverse observations) to underlying fundamental phenomena (thermodynamic, kinetic, or transport behavior). Such transformation will, in due time, make it increasingly easy for scientists and engineers having specialized training to enter the corrosion field and make useful contributions. The chapters on dissolution of pure metals and localized (pitting) corrosion are particularly strong in this respect.

Most corrosion processes are of an electrochemical nature. The phenomena include events in the metal phase, at the interface, in surface films, and in the electrolyte phase. In such systems it is difficult to carry out controlled experiments, to vary parameters one by one, or to make experimental observations at high resolution of chemical or spatial detail. Therefore, a critical evaluation of mechanisms as presented here represents a significant contribution. In many types of corrosion, the behavior of surface films is critical. In those cases where detailed experiments are described, it is evident that the local chemical environment is the critical factor that influences the properties of the surface film. Thus the volume provides a stimulating list of research opportunities: in probing surface chemistry at liquid-solid surfaces; for studying transport and reaction to interfaces and within surface films; and for developing mathematical models for predicting behavior. For these reasons, the book deserves careful attention by the chemical engineering community.

The topics are covered well. Two important areas not treated are stress corrosion cracking (and its close neighbor, crevice corrosion), and velocity-dependent phenomena (such as erosion, cavitation, and impingement corrosion). While some chapters touch on these areas (corrosion fatigue and hydrogen embrittlement), their emphasis is more on the metal-phase phenomena, such as dislocations and fracture mechanics, than on the entire interfacial region. The shortcomings of the

volume are only that it had to stop somewhere. What is provided will surely serve to stimulate advances in fundamental aspects of corrosion and its allied fields of science and engineering.

Richard Alkire
Department of Chemical Engineering
University of Illinois
Urbana, IL 61801

Molecular Connectivity in Structure-Activity Analysis

By L. B. Kier and L. H. Hall, Research Studies Press (a division of John Wiley and Sons), Letchworth, Herefordshire, England.

Kier and Hall have extended and elucidated a different method for correlating the physical and thermodynamic properties of organic substances using the concept of molecular connectivity. In this formalism, the molecule is treated as a mathematical graph whose vertices are the atoms and whose edges are the bonds of the molecule. Connectivity indices, χ, are defined from the number of paths of various lengths (number of bonds) in the molecule, the degree of branching, and the types of atoms. Kier and Hall have shown high correlations among some of these indices and many properties of organic substances such as critical properties, densities, solubility in water, and even the effectiveness of nonspecific anesthetics. An interesting feature of this method is that connectivity indices can be related to structural features of the molecules under consideration.

This book contains nine chapters. Chapter 1, Origins of Molecular Connectivity, gives background information, briefly discusses methods for describing molecular structure, and describes in detail the molecular connectivity method that enables one to calculate connectivity indices. Neither the concept nor the mathematics is difficult at this level, and a computer program for calculating the indices is available from Hall.

Chapter 2, Physical Properties, describes a number of correlations of physical properties such as molar refraction, water solubility, molar volume, heat of vaporization, magnetic susceptibility, and the various molecular connectivity indices for different classes of compounds. For example, the molar volumes of 37 linear and branched chain paraffins from pentane to dotriacotane have been correlated with three connectivity indices, giving a correlation coefficient of 0.9999 and a standard error of 1.17. The actual molar volumes range from about 116 to about 566, so this standard error represents an error of about 1% for the lightest paraffin and about 0.2% for the heaviest. This chapter will be most interesting for chemical engineers concerned with property estimations.

In Chapter 3, Topological Information, the relationships between the molecular connectivity indices and the structural features of molecules are discussed. This chapter illustrates which indices are likely to be significant in correlating various properties.

The relationship of the χ's to electronic structure is treated in Chapter 4, Electronic Information. This includes types of bonding (single, double and triple), electrons in π and lone pair orbitals, and the effects of heteroatoms. Electronegativity and solvent polarity are also discussed.

Chapter 5, Statistical Considerations, is a reasonably simple treatment of many aspects of statistics that are important in developing correlations discussed elsewhere in the book.

Chapter 6, Strategies for the Use of Molecular Connectivity, gives guidelines for using the molecular connectivity method. Topics such as selection of the indices to be used, nonlinear correlating equations, and molecular symmetry are discussed.

Chapter 7 gives several examples of the use of the method in quantitative structure activity relation (QSAR) studies of biologically active substances. Chapter 8 is a bibliography of published studies using molecular connectivity. Chapter 9 contains some thoughts about future directions for molecular connectivity. References are given at the end of each chapter. Author and subject indices are at the end of the book.

This book is well written and quite easy to read. Its main focus is on the correlation and prediction of physical and thermodynamic properties as well as correlating properties with structure. It not only describes the theory behind the method and presents results which have been obtained by using it, but also explains how readers can apply the method to their own problems.

George Thomson
356 Fleetwood Dr.
Bartlesville, OK 74006

Chemical Process Simulation

By Asghar Husain, A Halstead Press Book, John Wiley & Sons, New Delhi, 1986, 376 pp., $34.95.

The author attempts to cover all aspects of simulation as applied to chemical process engineering. The material is divided into four topics: general-purpose steady-state process simulation, specific-purpose simulation, dynamic simulation, and process synthesis. The author states that the book will "be of great interest to students, R&D scientists and practising engineers."

The book is basically an extensive literature survey with over 400 references published up to 1984, which will be of considerable value. Practical applications are inadequate since many systems and techniques described are obsolete. Little guidance is given as to what is current.

The features to be found in general-purpose sequential modular simulators are described and illustrated through reference to ASPEN and the author's program, PROSIM. Unfortunately, little direction is given would-be users on the use of such simulators, particularly the pitfalls which might be encountered. Related chapters cover the simultaneous equations approach, decomposition of networks, convergence promotion, and physical properties.

Specific-purpose simulations, many of which the author has done himself, employ more detailed models (particularly of reactors) than are found in most general-purpose simulators. The examples include many familiar processes and multicomponent distillation. This chapter is the best in the book and of most use to potential users because the process modeling is covered in considerable detail.

The topic of dynamic simulation covers continuous system simulation languages such as CSMP, some of the simulators which have been developed specifically for chemical processes, and the simulation of batch processes and distillation systems. In the chapter on process synthesis, all of the basic problems that have been studied over the years are reviewed: heat-exchanger network synthesis, separation system sequencing, etc. But most of the material in both chapters is a rehash of the literature. Neither is recommended since many important concepts are glossed over or omitted entirely.

L. H. Rinard
City College of New York
New York, NY 10031

Advanced Biochemical Engineering

By H. R. Bungay and Georges Belfort, Eds., John Wiley and Sons, New York, 1987

This book begins with a preface that proclaims its uniqueness with the basis