# BOOKS

**Quasilinear Hyperbolic Systems and Waves,** Alan Jeffrey, Pitman Publishing, London, 230 pages, £ 6.90.

Until quite recently books suitable for the chemical engineering audience on systems of first order partial differential equations did not exist. Those who desired to inquire about this fascinating field were frustrated by the older books of Goursat and Caratheodory and were only somewhat more satisfied with Courant and Fredrichs or Courant and Hilbert which, indeed, were heavy going for most of us, although it is all there. First order systems of equations are the natural starting blocks for many problems in mathematical modelling because of their simplicity and economy and because they elucidate the basic structure of many problems without the concomitant complexity caused by the transport terms now such a fetish in intentionally complicated models. Hyperbolic systems are the natural hunting ground for wave propagation; shocks arise quite naturally. For a variety of problems in chemical engineering, such as, fixed and moving bed reactors, adsorption beds, pebble heaters, and parametric pumps, to name only a few, the beautiful interplay of constant states, simple waves, and the aforementioned shocks not only enriches and enlivens our lives but informs us about the basic pathological character of a problem without the messy and often uninteresting details caused by transport and computers.

Alan Jeffrey has written an admirable book which discusses all of the pertinent topics useful to modern chemical engineers only moderately sophisticated mathematically. It is clearly an excellent book from which to learn about the structure of hyperbolic systems, namely, the anatomy of characteristics, shock waves, Riemann invariants, simple waves, and the propagation of discontinuities. The style of the book is clear and lucid, maybe too mathematical for some, but it has numerous applications, largely to fluid mechanical systems. There are no applications to other things, perhaps more interesting to chemical engineers, but, as we all know, there is another superb book that does exactly that.

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**Biomedical Engineering Principles,** David O. Cooney, Marcel Dekker, New York, 1976, xiv + 458 pages, $36.50.

Written by one of the young successful researchers and educators in the field, this textbook is a very good contribution and a much needed addition to the basic literature of the growing field of biomedical engineering. Since no single book can encompass all aspects of the field, a justifiable subtitle points out the author's concentration to fluid, heat and mass transport processes in the human body.

The reviewers, a practicing pediatrician and former chemical engineer who has been engaged in the teaching of introductory courses in biomedical engineering for the past seven years, and a chemical engineer who is presently involved in related research and has been exposed to the subjects covered by this book, have sensed the necessity for a textbook directed mainly to chemical engineers and they have experienced the unfortuante educational solution of having to use handouts from physiology books and/or engineering review articles.

The author solves this problem efficiently by covering basic anatomy and physiology in an abbreviated but adequate fashion particularly in Chapters 2, 8 and 10; and by presenting the mathematical modeling and engineering aspects in a concentrated by understandable manner in the other chapters. This bias and apparent unbalance is appropriate, moreover, since the text is designed for the engineering student rather than the physician.

We are pleased that the author has included practical examples of disease states such as narrowing of arteries and aneurysms (p. 83) and has not overlooked classical physiological phenomena such as the one-way venous valves (p. 89).

Modeling the body as compartments, sources and streams, is particularly valuable as it relates to the kinetics of drug distribution. The fields of pharmacokinetics, drug design and evaluation are a "natural" for chemical engineers and are becoming increasingly important.

The only addition we would have liked to see included in this book, would be a section covering the "tools of medicine" not included elsewhere; i.e., respiratory, diagnostic and therapeutic equipment, environmental control devices (isolettes, temperature control mechanisms, etc.), and radiation diagnostic and therapeutic implements. We must, however, acknowledge that the areas most often attacked by chemical engineers (artificial kidney and cardio-pulmonary by-pass machines) have been most adequately covered.

The engineering aspects and mathmatical modeling are drawn directly from and backed very efficiently by the original literature citations of the research of Colton, Cooney, Keller, Lightfoot, Merrill, Michael, Middleman, and other chemical engineers who in the last fifteen years have contributed to this area. Consequently, chapters 3, 7, 9 and 11 dealing with blood rheology, transport through membranes, artificial kidneys and oxygenators are very well written. The book is backed by over two hundred carefully selected illustrations, numerous tables and some sixty problems.

We would not hesitate recommending this text for an introductory senior or graduate biomedical engineering

course and we hope to use it in our classes in the Fall of 1977, although for an advanced approach to the engineering aspects the more specialized books of Middleman and Lightfoot are still preferable or at least supplementary to this one.

Our only serious reservation is the cost of the book, especially considering the form of printing undertaken by this publisher. The price is unacceptable for an undergraduate textbook, although the prepublication announcement that we received earlier this year, stated that "a special discount for adoption orders of five or more copies is available," at the price of $24.50.

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**Thermodynamics for Chemical Engineers,** K. E. Betts, J. S. Rowlinson, and G. Saville. The MIT Press, Cambridge, Massachusetts, 1975, 505 pages. $19.95.

This book provides a thorough introduction to the subject. The first eight chapters develop the relations that are utilized in classical thermodynamics while the final chapter treats the prediction of thermodynamic properties by means of statistical thermodynamics. Although the authors state that the text is used throughout the three years of undergraduate study in England, it could be covered in a two-term junior-level course. The authors introduce numerous exercises throughout the text and these should provide some of the practice that is so necessary in learning the subject. The book utilizes the SI system of units throughout. The cautions and calculation strategies included in this book are particularly helpful. Careful attention to these cautions should enable the reader to avoid some of the common misapplications of the subject.

The book does not contain the property table for any common substance as most thermodynamics texts do. It does provide an extensive bibliography of these charts, however.

This carefully written book could serve not only as an introduction to the subject, but also as a reference for those familiar with the subject.

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**Gas Dynamics,** Vol. I, by M. J. Zucrow and J. D. Hoffman, John Wiley & Sons, 1976, 772 pages. $26.95.

This text has its origin in Zucrow's earlier book *Aircraft and Missile Propulsion,* Vol. I, *Thermodynamics of Fluid Flow and Application to Propulsion Engines,* and represents an updated version of that work based on the extensive classroom experience of Professor Hoffman. Use of numerical methods for solving real gas dynamics problems is emphasized.

The text begins with two chapters covering fundamental principles, and the derivation of the governing equations for compressible flow. Here one finds that modern fluid mechanics has been completely avoided in the presentation of the laws of mechanics, and all of the recent progress in thermodynamics has been ignored. The concepts of kinematics and stress are presented in a superficial, and sometimes incorrect, manner.

After having dispensed with fundamentals, the authors move into home territory with four chapters on one-dimensional flow covering general features, area change, friction, and heat transfer. Virtually every aspect of one-dimensional flow is discussed here, and in these chapters one finds numerous solved example problems. A significant number of these deal with the use of numerical methods for solving various compressible flow problems.

Completion of the material on one-dimensional flow finds one halfway through the text and moving on to shock waves (normal and oblique), expansion waves, and combustion waves. These three chapters are directed toward the analysis of supersonic propulsion systems, and once again there are numerous solved example problems to illustrate the application of various theoretical developments. The material contained in these first nine chapters is presented within the framework of one-dimensional flows, and in Chapter 10 one is introduced to the general features of multi-dimensional flows. This is followed with chapters on acoustics and two-dimensional irrotational supersonic flow. The final chapter takes up the matter of unsteady, one-dimensional, homentropic flows, with much of the chapter devoted to numerical methods.

While one cannot expect to find in this text a rigorous theoretical treatment of gas dynamics, the authors possess a weath of knowledge about compressible flow and they have presented this clearly and in great detail.

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**Order In Polymer Solutions,** edited by K. Solc of Midland Macromolecular Institute (MMI), Gordon and Breach, 1976, 320 pages, $19.50.

This book consists of 13 papers presented at the 1st monotopical symposium held at MMI. All the papers including several authoritative reviews and new theoretical and experimental results deal primarily with the presence of ordered structure, helix formation, solvation and association in both synthetic and biological polymers in solution. Furthermore, since subjects are current and sufficiently integrated with one another so that any chemical engineer who is at all interested in the effects of order on reaction efficiency, mechanism, rates, as well as the properties of such products will find this book a welcome addition to his personal library.

For example, as one who is primarily interested in order in the so-called "amorphous" solid state, I find the evidence described by G. Challa on the stereospecific replica polymerization of methyl methacrylate on stereoregular poly(methyl methacrylate) as a polymer matrix in different types and on their replication efficiency highly interesting. I won't hesitate in recommending this book to my fellow chemical engineers who are interested in polymers.

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