chanical Properties (Ward) without reference to the more complete discussion in Macromolecular Dynamics (Klein). [The latter is missing a reference to either edition of Bird et al. (1976, 1987).]

Finally, I want to reiterate that this is a production of high quality, which will be of considerable use to the technical community. It is also a source of fun for the browser, as any encyclopedia should be. I recommend articles on Fine Arts (De Witte) and History of Polymer Science (Morawitz) as places to start.

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Dynamics of Polymeric Liquids
Volume 1: Fluid Mechanics

By R. Byron Bird, Robert C. Armstrong, and Ole Hassager, Eds. John Wiley & Sons, Inc., New York, 2nd Ed., 1987.

Much has been said and written about the lack of incentives for scholars to devote time to the writing of books. Book writing is tedious business. If, upon completion of a major manuscript, the author does not feel drained, either he or she has not alloted sufficient energy to the task to do it well, or the author belongs to a cadre of persons with a gift seldom bestowed to mortals. What can happen when an author, or in this case three authors, perceive a need to write a book, know much about the subject, are patient, and expend themselves on the project, is shown here. The book is a superb contribution with value well worth the authors' efforts.

Such an introduction may seem out of place for a book that is a second edition. The first edition of Volume 1 of *Dynamics of Polymeric Liquids* was published in 1977, but the second edition is far from a cut-and-paste (a mode of editing soon to become obsolete) revision with a brief additional preface containing words such as, ". . . in order to include results of recent research appearing in the years since the initial publication of. . . ." On the contrary, it is clear that every page of the first edition has come under careful scrutiny, and the book has been essentially rewritten. Much of the first edition has been retained, but only if, in the eyes of the authors, it served their purposes better than another alternative. An example of the level of inspection lavished on their earlier writing is found as early as the second sentence of the Preface. The words of the first edition, which read, "Although untold man-years of research have been devoted to the study of fluids. . ." have been converted to "Although many years of research have been devoted. . . ." Similar attention to detail occurs, sentence-by-sentence, throughout the book.

The above is an example of change at the microscopic level. There are also important changes at the macroscopic level. Changes in the number of pages (approximate) devoted to various topics reflect some of these changes:

First Edition	Second Edition
500 pages	650 pages
9 chapters, 2 appendices	4 parts with a total of 10 chapters, 3 appendices
General subject of material functions	
70 pages	70 pages
Generalized Newtonian fluid	
70 pages	80 pages
Linear viscoelasticity	
30 pages	40 pages
110 pages on *corotational models*	170 pages on *nonlinear models*
50 pages on *codeformational models*	30 pages on *continuum mechanics*
	40 pages on *rheometry*

Thus, both the structure and the content have been significantly altered. Probably the largest change in content was the nearly total exclusion of corotational derivatives in constitutive equations. This change is described in the prefatory material as a "major change in viewpoint" by the authors.

Those familiar with publications by these authors will find the familiar hallmarks: meticulous annotation of sources, copious tables and flow charts in which codification of a bewildering jargon of time derivatives, constitutive models, and other paraphernalia of rheology is attempted. *The attempts are often successful.*

Part I is a presentation of principles of fluid (and some continuum) mechanics considered to be the irreducible minimum requisite for subsequent material of Volumes 1 and 2. Readers will not be surprised to find that the sign convention for stress continues to be the opposite of that generally used by authors of works on fluid, solid, and continuum mechanics. The stream function is introduced in a manner which suppresses its physical content; when low Reynolds number hydrodynamics is discussed, one finds no emphasis on the use of singular solutions to obtain, very efficiently, forces and torques on bodies. Good examples and problems appear regularly. Part I continues, and expands, an excellent motivational chapter of the first edition by adding to the examples and confirming the authors' claim that, "a fluid that's macromolecular is really quite weird. . ."

In Chapter 3 a division is introduced which, although mentioned in the first edition, has been elevated in the second edition to one of the major themes of the book. This is the classification of prototype flows into "shear flows" ($v = (ky, 0, 0)$) and "shearfree flows," [an example being $v = (kx, -ky, 0)$]. The latter terminology is a break with customary usage. Such changes are warranted if the new name offers a clear advantage to the prior art. I believe that the adjective "shearfree" is destined to be confusing, not only because it is not widely used (and there are other alternatives that are) but because the flow is "shearfree" only for some coordinate systems. A 45-degree rotation of coordinates turns the flow into (a variant of) a "shear flow." It is the presence or absence of vorticity that is the true distinguishing feature of the two flows in question, but this point is not made clear. In a later section (Section 3.7) some of the confusion is eliminated by discussing the two types of flows in terms of material lines. This might have been profitably blended with the initial discussion of the two types of flows.

Theoretical concepts are an important part of the exposition throughout the book, but the authors have gone to extraordinary lengths to include tabular and graphical representations of data. For example, the chapter on material functions is 67 pages long and contains approximately 58 different graphs of data taken from the literature!

In Part II the reader is introduced to the difficult subject of constitutive equations by an exposition of inelastic and linear viscoelastic fluid models. The treatment is thorough and readable.

Part III, in which nonlinear viscoelastic constitutive equations are treated, is surely the greatest challenge to the authors and readers alike. Any honest exposition of this material will be heavy going for the newcomer. The authors have used Chapters 6, 7 and 8 to cover retarded motion expansions, differential models, and single integral models, respectively. Of necessity, considerable artillery is employed from the arsenal of continuum mechanics, a subject which is not systematically developed until Chapter 9. Because of this organizational format it is necessary in Part III to present a number of results in an *ad hoc* manner. The reader is repeatedly told that rationales will be forthcoming in Chapter 9 and in Volume 2, in which molecular models are presented to form a basis for much that is in Part III of Volume 1. This choice of ordering may make holding a reader's attention difficult through the presentation of the various convected time derivatives and some comparisons of results from models of, for example, "FENE Dumbbells," "Multibead Rods," and "Freely-Jointed Bead-Rod Chains."

When one does arrive at Chapter 9 there is a 32-page introduction to continuum mechanics in which most of the concepts important for Volumes 1 and 2 are developed very successfully. The subject of convected coordinates is handled effectively with a number of helpful diagrams.

It is curious that the concept of material frame indifference receives scant explicit treatment. The index to the first edition contains several entries associated with material\objectivity. In the present edition three separate pages are found under the entry "admissibility," but I was unable to find anything under the usual keywords for this subject. That is puzzling, especially in view of the very clever example problem on the subject (p. 283). In the first edition, the same example was used to show the consequences of nonobjective rheological models. In the second edition no connection with objectivity is made at that point. There is a short, but revealing, hint at the problems associated with requirements of "admissibility" on pp. 482–483. A modest expansion would have been welcome.

Part IV concludes with an excellent chapter on rheometry.

Although the organization and the content of the book have been substantially changed, the intended function of it has not. This is not a book about polymer processing or about numerical methods for solving problems in non-Newtonian fluid mechanics, although the subject matter of the book is certainly relevant to those endeavors. At the end of each of the major topics, the authors give a realistic assessment of how the results can be used to solve problems of engineering interest. One must conclude that in most realistic cases only small extrapolations from known to unknown flow situations or from known to unknown rheological responses are warranted. First and foremost, this is a teaching book that will be rewarding to the serious teacher and the committed student. The book has been written and produced at a high level too seldom achieved in our current "quick-fix" environment. The student who persists through Volume 1 (and presumably Volume 2) will have a profound knowledge of polymer fluid dynamics. The constitutive equations he or she will have learned will have some, but limited, practical value. That, however, is a matter of secondary importance. The authors express their own view on the choice of presentation very clearly on p. 294. "In future years new constitutive equations will undoubtedly be developed, but it is hoped that the methodology taught in these chapters will prevail." I believe that is a well-founded hope.

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A review of Volume II will appear in a subsequent issue.

Transport Processes in Chemically Reacting Flow Systems

By Daniel E. Rosner, Butterworth Publishers, Stoneham, MA, 1986, 540+xxvii pp., $52.95

Chemical engineers are supposed to be experts at dealing with chemical systems, but that ability is not obvious from a perusal of the standard textbooks on transport phenomena. The text by Rosner is a belated attempt to fill some of that void, and for that reason alone it should be considered an important work. Some may criticize the book for its emphasis on combustion, at the expense of other kinds of reacting flows, but that emphasis merely reflects the interest of the author; because it really is a book on transport processes, however, and not combustion, it is not a substitute for the more complete works on combustion by Williams, Toong, and Strehlow.

The book is aimed at advanced undergraduate and beginning graduate students in chemical engineering or related fields. It consists of eight chapters which fall into three groups: The first three chapters consist of an introduction and then development of the conservation laws and constitutive equations for transport in multicomponent systems. The fixed-control volume approach is used for presentation of the conservation laws, which leaves open the question of how to define internal energy in an open multicomponent system (cf. Slattery's treatment with a mass-averaged material volume). The next three chapters deal with