The Bioengineer's Bookshelf

Basic Hemodynamics and Its Role in Disease Processes, by D. J. PATEL and R. N. VAISHNAV, 504 pp, $57.50, University Park Press, Baltimore, Md., 1980.

This new book deals with hemodynamics and arterial wall, with emphasis on artherogenesis. It contains not only chapters by the two principal authors, but also chapters written by Bülent Atabek, Victor J. Ferrans, Donald L. Fry, Joseph C. Greenfield, and their co-authors Philip A. McHale, Judith C. Rembert, and Lewis J. Thomas. It is an excellent textbook, as well as an excellent up-to-date summary of the many years of research by these authors. The authors pay tribute to Dr. Donald Fry, in whose laboratory most of the original work cited in this book was performed. Dr. Fry has a unique insight into biophysical phenomena; he has made important, lasting contributions to many aspects of physiology. His influence on hemodynamics is evident throughout this book. This book could be a Festschrift for Dr. Fry.

The scope of the book can be seen from the chapter headings:

1 Mathematical Preliminaries
2 Some Elementary Hemodynamic Concepts
3 Vascular Structure (by Victor J. Ferrans)
4 General Mechanical Properties of the Vascular Wall
5 Rheology of Vessel Wall – Theoretical and Experimental Considerations
6 Local Rheology of the Vascular Intima
7 Blood Flow and Pulse Propagation in Arteries (by Bülent Atabek)
8 Measurement and Significance of Pressure-Flow Relationship in Man (by P.A. McHale, J. C. Rembert, and J. C. Greenfield)
9 Flow in Collapsible Tubes (by D. L. Fry, L. J. Thomas, and J.C. Greenfield)
10 Mass Transport in the Arterial Wall (by D. L. Fry and R. N. Vaishnav)

Chapters 1 and 2 contain introductory material. Chapter 3 is a superior outline of the vascular structure. Many of the illustrations are excellent. Chapters 4 and 5 draw upon the well-known analysis and results of Patel and Vaishnav. Chapter 6 is brand new; in it the local rheologic properties of the intimal layer is discussed. Two methods were used: a microindentation technique that studies point-to-point changes in the local compliance of the intima and its supporting structures, and the saline jet technique which estimates the local yield strength of the vascular endothelium. The nonuniformity of rheological properties over the intimal surface revealed by these methods is very interesting.

Atebek's chapter on blood flow begins at the very beginning at a very elementary level, and proceeds to a summary of the most complex nonlinear theory of flow and pulse propagation. It is a masterful presentation. The sections on comparison between theory and experiment are particularly useful and can only be written by an author who is personally involved in this kind of research over a long period of time.

Fry, et al.'s chapter on flow in collapsible tube is also good, but seems to be a bit oversimplified. This subject is currently attracting a lot of attention. The reviewer counted no less than 37 new articles published within the last three years in professional journals.

The last chapter by Fry and Vaishnav is aimed at "developing an explicit hypothesis in the form of a mathematical model that may then be tested by experiment." The authors consider the arterial wall as a porous medium. Some specific properties of the pores are described in mathematical terms. Field equations are derived and examples of solution are given.

This book is a valuable addition to the biomechanics literature, and belongs on every bioengineer's bookself.

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Brottmekanik, by J. CARLSSON, 287 pp, Ingenjorsforlaget AB, Stockholm, 1976, (in Swedish).

This is a remarkable book on fracture mechanics. I was given a copy by the author when I visited his laboratory at the Institute of Technology in Stockholm on October 29, 1980. That lab is one of the best laboratories on fracture mechanics in the world. Experiments are done on large and small specimens. Some large ones are half-inch thick plates. Usually a notch or a slit is machined in a specimen, which is then subjected to repeated loading until fatigue crack appears at the site of stress concentration. The propagation of the crack and fracture is then measured and compared with theoretical analysis. Auxiliary machines determine the normal mechanical properties of the material in the same laboratory. Altogether one sees a systematic approach, from theory to experiment, to practical applications. This same aproach is evident in this book. The book is sufficiently mathematical and graphical that I feel I understand a large part of it, although I do not read Swedish. I am not qualified to review fracture mechanics, but I recognize the importance of fracture mechanics to bioengineering. Bones fracture. Tissues fracture. Surgeons introduce and control fractures. I have not seen a book on fracture mechanics specifically written for bioengineering. If a bioengineer wants to learn something about fracture, this book can be recommended.

The book is attractively printed and abundantly illustrated by line drawings and photographs. It starts by discussing stability and fracture in general, stress and deformation of elastic and plastic solids, and proceeds to linear and nonlinear fracture mechanics, dynamics of fracture propagation, and microfracture; it ends with a series of appendices on mathematical problems and numerical results. I would like to see the author put out an English version of this book for the benefit of American readers.

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Mekanik 1980, ed. by L. KARLSSON, 240 pp, Ingenjorsforlaget AB, Stockholm, 1980.

This is a book of collected papers presented at the Swedish Mechanics Day held at the University of Lulea, Lulea, Sweden on October 24–25, 1980. At this Swedish National meeting, all aspects of mechanics research were represented, and 77 papers were presented, 11 of which are collected here in this volume. The book opens with a paper by Folke K. G. Odqvist on the development of theoretical and applied mechanics in Sweden to the year 1980, followed by a paper by Jan Hult on the same subject looking forward to the year 2000. Then there are papers by Y. C. Fung (of USA) on