Journal of Applied Mechanics

Book Reviews

The Physics of Deformation and Flow. By E. W. Billington and A. Tate. McGraw-Hill, New York, 1981. pp. xx–626. Price $59.00.

REVIEWED BY DANIEL C. DRUCKER[1]

This is a most unusual book of great value to those entering the field or changing the direction of their research. It is unusual because of its broad coverage from advanced mathematics to simple experiments, from linear and nonlinear fluids, and linear and nonlinear elastic solids to plastic solids, and because of its aim to bring together, in a meaningful way and at a high level, both macroscopic and microscopic physical behavior within a broad set of current continuum mechanics approaches. A remarkable compartmentalization of approach is employed without comment in a most successful innovation. Each major section is written primarily from the viewpoint of those who developed that specific area in its present form. The authors exercise judgment in the choices they make of inclusion or omission but then carefully display the mathematics and the physical arguments to represent the school of thought (as of June 1979) without the distraction of contrary viewpoints. Consequently there is much with which each expert will disagree but much more that will prove helpful in achieving greater understanding. Ample reference is made to the relevant literature needed to follow up on the background presented.

The work of Truesdell, Toupin, and Noll, to which extensive credit is given, is preceded by a mathematical introduction to scalars, vectors, and tensors. Yet this approach sits side by side with other sections from other points of view including both those that are primarily physically based and those that are reminiscent of Love and Lamb in their detailed writing of scalar equations. Appropriate sections are interspersed that give descriptions of electronic, atomic, and interatomic structure and forces, dislocations and dislocation structure of solids, molecular structure of fluids, statistical mechanics, and the results of basic continuum experiments. A full chapter is devoted to crystal plasticity between two chapters on continuum plasticity. Impact, dynamic plasticity, and shock waves receive the attention to be expected from the great interest of the authors in these fields, but the writing here is just as concise and effective as in the closing chapter on fracture, and throughout the book. The authors certainly have done well to provide the continuum mechanics background that would be of great help to materials scientists and engineers as well as the "useful reminder to those involved in continuum mechanics that the ultimate test of abstract theories lies in the laboratory."

[1] Dean, College of Engineering, University of Illinois at Urbana-Champaign, Urbana, Ill. 61801.

Biomechanics. Mechanical Properties of Living Tissues. By Y. C. Fung. Springer-Verlag, New York, Heidelberg, Berlin, 1981. 433 pages. Price $23.85.

REVIEWED BY RICHARD SKALAK[2]

Biomechanics has grown rapidly in the last decade and it is a pleasure to report that in this book an acknowledged leader in the field has set down a connected account of much of the progress that has been made in recent years. The book includes a good bit of anatomy, physiology, and analysis of systems, such as blood flow in tubes and muscle contraction, which entails more than just physical properties in the usual sense. The balance of materials presented serves the purposes of the book very well. It will be especially appreciated by students of biomechanics. It can be expected that physiologists will also find it of interest. Established workers in other branches of theoretical and applied mechanics who wish to have an authoritative and collected introduction to biomechanics will also find the book valuable. It will be a welcome textbook in courses in biomechanics.

This book has a number of features that make it especially pleasurable to read. First is the open style and the alternation of biological background and analytical representation that gives a degree of integration which has been often lacking in both the mechanical and biological literatures. Second, there is a most interesting historical introduction in Chapter 1 which points out that biomechanics is a fairly old subject. Although biomechanics is a relatively new word, which means the application of mechanics to biology, it turns out that the word mechanics is somewhat older than the word biology.

Third, the exercises given in small print at the end of each chapter are unique in the biomechanical literature. In many cases they add to the content of the book by the ideas they suggest and the impetus to have the reader work out some of the details. Finally, as befits the subject, it may be seen from the reference lists in each chapter that a large fraction of the literature cited has been written in the last decade. Professor Fung is one of the few people who has kept up with the development of biomechanics on so many different fronts in the last decade and could single-handedly write this book for us.

There are some items in this book that probably deserve special mention as they are distinct contributions to the literature. One of these is the discussion of extreme values in relation to red blood cell sizes. Another is the consideration of the mechanics and thermodynamics of biological tissues in a single format. The discussion of inversion of stress-strain relations is an original and interesting contribution.

[2] James Kip Finch Professor of Engineering Mechanics, Director, Bioengineering Institute, Department of Civil Engineering and Engineering Mechanics, Columbia University, New York, N. Y.. 10027.