is also a highly interesting discussion of the phrase lag between minimum radius and maximum luminosity, based on the work of John Castor.

Relatively little is said about the nonlinear theory of radial oscillations. In fact much of the basic physics can be understood in terms of the much simpler linear theory. Furthermore, the detailed nonlinear calculations that have been made involve numerical complications that are probably beyond the scope of a book of this nature. Nevertheless a discussion of some of the results of such calculations, or indeed of the results of the linear calculations, would have been valuable as illustrations of the theory presented. These could perhaps have been included at the expense of the treatment of one of the simplified models for nonlinear oscillation. Still, Cox gives ample references to such detailed calculations.

A major problem in the theory of stellar stability involves the treatment of convection. It is normally assumed that the increase in the efficiency of convection causes the return to stability at the low-temperature edge of the Cepheid instability strip. This conjecture receives some support from the—so far few—calculations that have attempted to take convection into account. These problems perhaps merit a somewhat more extensive treatment than given here. Cox barely mentions that Wasaburo Unno and Douglas Gough have generalized the commonly employed mixing length theory to oscillating stars; yet in my opinion such an approach offers greater promise for an understanding of this difficult subject than the severely truncated nonlinear calculations by Robert Deupree that Cox apparently prefers.

Part III, on nonradial oscillations, is not quite on the same high level as the preceding parts, partly because of the rapid development of this field in recent years and probably also because Cox has participated only little in the study of nonradial oscillations. Nevertheless he gives a good introduction to the subject. A Japanese group that made a major contribution to the development of this field recently published a monograph dealing only with nonradial oscillations (W. Unno, Y. Osaki, H. Ando and H. Shibahashi: *Non-radial Oscillations of Stars*, University of Tokyo Press, 1979) that gives a more up-to-date and much more detailed treatment of the subject than the present book. However, Cox is often more successful in describing the basic physics in simple terms.

A few minor criticisms may be made. On page 222 it could have been pointed out that toroidal modes, here introduced as a mathematical concept, in fact just correspond to infinitely slow rotations of spherical shells; such motion is clearly possible in a spherically symmetric star with no rigidity. Similarly it would have been instructive to note on page 237 that the solenoidal mode with $l = 1$ is a uniform displacement of the entire star. It should perhaps have been made clearer that the properties presented as characteristic for g modes only strictly apply to high-order modes; in particular the quotation on page 236 from T. G. Cowling's important paper is presented as referring to g modes in general, rather than to modes "of very long period."

The book would have profited from stricter editing. The discussion of the energy integral, somewhat repetitive, could probably have been presented more concisely. Furthermore the notation is at times slightly confusing. Although in a work as wide-ranging as this it is probably impossible to keep a completely consistent and unified notation, a little more care would have yielded more clarity.

The book requires a knowledge about basic mathematical techniques in differential equations and vector analysis, but is otherwise largely self-contained. However the reader would profit from having some background in the theory of stellar structure. It would be very useful as a text for a graduate course on stellar pulsations, provided the instructor ensures that the students go though the details of the derivations (in fact this might partly make up for the lack of exercises) and supplements it by including a few well-chosen research papers giving more detail about results of numerical work, or perhaps sections of the book by Unno *et al.*

The critical remarks presented above must not overshadow the book's obvious merits. It represents a very valuable addition to the astrophysical literature and is warmly recommended to anyone interested in stellar oscillations or stellar structure. By reading it one should acquire a thorough basic understanding of the processes responsible for stellar pulsations.

* * *

J. Christensen-Dalsgaard, a postdoctoral fellow at the National Center for Atmospheric Research, is working on the theory of stellar, in particular solar, structure and pulsations, with special emphasis on the seismological aspect of the pulsations.

Knowledge and Wonder. The Natural World as Man Knows It. Second Edition

V. F. Weisskopf

290 pp., MIT P., Cambridge, Mass., 1979. $5.95

This book began as a series of lectures that Victor F. Weisskopf, then head of the world's largest physics department (at MIT), gave to the students at the Buckingham School in Cambridge, Massachusetts. Its first edition, in 1963, was a tremendous success—and justly so. Sixteen years later, he has revised the original edition, devoting special attention to the sections on particle physics, on chemistry and on the biochemistry of life.

The title comes from Francis Bacon's remark that, "all knowledge and wonder (which is the seed of knowledge) is an impression of pleasure in itself. . . ." Weisskopf obviously derived enormous pleasure from writing this book; so also will any reader—with or without any background in physical science. Originally written for those with no special grounding in science, the book is also a treasure chest for professional scientists, who time after time will be brought up short by a gem of simplicity or explanation.

Weisskopf undertakes to understand, in an essentially qualitative way, why Nature is the way she is: Why are mountains the height they are? Why are bacteria the size they are? How did our universe evolve and how did life originate? He is remarkably successful.

Perhaps his greatest success is instilling in his readers some of that sense of wonder that shines within all great scientists. At each step along the way—from the infinitely small to the infinitely large—he catches the reader's attention with a commonplace example or analogy that leaves the nonscientist thinking, "I understand *that*, so maybe I really can understand the rest," and the scientist thinking, "Why didn't *I* think of that?"

Weisskopf begins with a remarkably complete overview of the basic concepts of science, the natural forces, the structure of matter and the fundamental unity of science, passes on to the wondrous structures of life, the giant biological molecules and the evolution of life and of human beings.

At a time when this nation desperately needs better secondary-level education in science—both to give rise to a better-informed public and to encourage a larger fraction of our most talented youth to undertake careers in science and to prepare them for those careers—this little book should be required reading for every US secondary-school student, and, I should add, for every US secondary-school science teacher. I know of no other book that is as successful in making accessible, to a general audience, the truly astonishing breadth and scope of modern science.

None of his many friends will be in the least surprised by the lucidity of Weisskopf's book. From his days at Los Alamos, the University of Rochester, MIT, and CERN, Weisskopf has always been able to make the most abstruse and arcane accessible and, in a very special sense, almost obvious. Much better than that, he has helped an entire generation to see and understand that Nature is truly wonderful and, in the deepest sense, beautiful.

Having read the first edition with pleasure in 1964 and having shamelessly cribbed marvelous examples, comparisons and insights from it on frequent occasions since then, I was delighted to find that this second edition seemed just as fresh and up-to-date as I found the original.

D. ALLAN BROMLEY
Yale University

The Physics of Deformation and Flow

E. W. Billington, A. Tate
626 pp. McGraw-Hill, New York, 1981. $59.00

From the preface one gathers that this book is directed to "material scientists and engineers." It is not clear what use these substantial individuals—leave aside their immaterial colleagues—are supposed to make of it. It does not seem suitable to be a textbook, although at least ten of fourteen chapters comprise an exposition of well-established, one might say classical, theories. Likewise it would not serve as a handbook: The other chapters consist of surveys of more specific and up-to-date topics, with good bibliographies, but neither the surveys nor the bibliographies are sufficiently detailed for such use.

In a sentence, the book is too detailed for novices, as the authors, seemingly anxious to avoid the minor sin of incompleteness, include telegraphic discussions of every concept and model, useful or not useful, of which they are aware, while it is too sparse for experts, as the authors exclude both explanations of why these concepts and models are useful or not and histories of their applications.

The first nine chapters, aside from a remarkably short one on statistical mechanics, comprise an introduction to continuum mechanics. By and large it is a poor exposition of Clifford Truesdell's and Walter Noll's *The Non-Linear Field Theories of Mechanics*. One can admit that the latter truly is difficult to read and occasionally obscure. However, the authors of the current book suffer from the common but inexplicable delusion that the difficulty and obscurity may be relieved by replacing good mathematics by bad. If this judgment seems harsh, I recommend to the reader section 5-1, culminating in the constitutive equation (5-1-9), as an example of how it is possible to obscure the elegant and precise discussion by Truesdell and Noll (section 26).

The dust jacket suggests that the main objective of the book is to attempt "some integration of the microscopic and macroscopic viewpoints." Each chapter involving classical constitutive models accordingly has at least a section devoted to an atomic or molecular model. It is a measure of how far we are from such an integration that these sections connect to the remainder of the chapter only peripherally; these sections are interesting and help explain the response of the particular material, but one can only remain convinced that such models will continue for the foreseeable future to enter as *a posteriori* illustrations of old, rather than as generators of new, continuous models. The sections of these chapters that discuss experimental results also provide useful and interesting explications of the models.

As one reads the last several chapters, dealing with equilibrium and dynamic plasticity, impact and fracture, one has the feeling that finally the authors are where they want to be. The discussion is focused, interesting, useful and up-to-date. Indeed, if the authors had chosen to expand these