

authors cover the derivation of the equations of motion; the definition of vorticity and a few of the classical theorems; some material on classical potential flow; an introduction to boundary layers (with a glance at matched asymptotic expansions); and one-dimensional gas flow. This material may all be found elsewhere, in books by the likes of George Batchelor, L. M. Milne-Thompson, Hans Liepmann and Anatol Roshko, but nowhere else is it collected in a single volume. Added in this edition are a few pages on stability and bifurcation from a dynamical systems point of view.

In some respects this book would make a good text for one of the introductory graduate-level fluid mechanics courses we teach. However, the authors have also included a section on vortex sheets, a very strange construction of Chorin's in which the boundary layer is replaced by little vortex sheets that appear randomly at the boundary and diffuse outward into the flow. Although this construction produces formal solutions to the equations of motion and may have computational advantages, I object to its inclusion here on the grounds that it creates in the student's mind a very unphysical picture of what is going on in the boundary layer.

There are a few other small things about the book that I did not like. The authors use vector notation throughout, despite the fact that this is a text intended for graduate students in mathematics and that it is not possible in general to write the Navier-Stokes equations unambiguously in vector notation. The fluid dynamics community generally uses Cartesian tensor notation to avoid these problems, and it is a good idea to get students accustomed to this notation as early as possible. I also feel that the authors' terminology sometimes sets a poor example for precision and clarity, and is sometimes wrong.

In another vein, I was pleased to see that the authors use a fixed volume in laboratory coordinates to derive the equation of conservation of mass, but I was disappointed to see that they shied away from such usage for the momentum equation, presumably because they felt more comfortable, or thought the students would feel more comfortable, with Newton's second law in the form commonly used in particle mechanics.

Acheson's book is of quite a different sort. It covers much more: elementary viscous flow, waves, classical airfoil theory, vortex motion, the Navier-Stokes equations, very viscous

flow, boundary layers and instability. However, the main difference is one of tone. Throughout he lovingly describes experiments and presents drawings of the results. There is a large number of other illustrations throughout the text. He includes from time to time a little historical perspective, which I feel makes the topic far more palatable for the interested student. I can vouch for the fact that this historical material is very difficult to come by. In the sciences we seem to present the current state of the subject as a *ding an sich*, as though it had come into being by magical intervention, seldom giving the student a hint of the ups and downs of the professional careers of those responsible.

Acheson's voice is almost conversational. Here he is introducing boundary layers: "The amount of insight packed into this part of Prandtl's paper is staggering." He includes many good exercises (with hints and answers in the back) and uses a mix of vector notation, component notation and some Cartesian tensor notation. His section introducing the stress tensor is self-contained and can be understood by a student who has taken no previous course in tensors. He includes some cute explanations, along with excellent drawings, that should interest students—for example, the Weis-Fogh mechanism for lift generation in insect flight. He goes so far as to discuss at the end of the book the various routes to chaos and Albert Libchaber's experiments.

Acheson is in fact sneakily mathematical without seeming to be; in discussing Rayleigh's jerked-plate problem, he approaches the similarity solution by off-handedly bringing in invariance under affine transformations or Lie groups, but without naming them. I really find this a very attractive book and am happy to recommend it for a first graduate course in fluid mechanics.

JOHN L. LUMLEY
Cornell University

Undulators and Free-Electron Lasers

P. Luchini and H. Motz
Oxford U. P., New York, 1990.
332 pp. \$85.00 hc
ISBN 0-19-852019-0

Synchrotron radiation from relativistic electron beams, extending from the far infrared to the x-ray region, has become an important tool for the study of solid-state and surface physics, chemistry and biology, and has a growing number of applications in

medicine and industry. A reflection of this growing importance is the increasing number of facilities worldwide dedicated to the production of this form of radiation. Free-electron lasers, which also use the radiation from relativistic electrons, enhance the coherence properties and peak power of undulator radiation and are the natural evolutionary next step for synchrotron radiation sources.

Since the early 1950s Hans Motz has been a pioneer in the introduction and development of undulator radiation. This book, written with his younger colleague Paolo Luchini, reflects Motz's historical vision of the development of this field and his understanding of the physics of these devices, as well as a modern view of the field. It is unfortunate that Motz, who died in 1987, could not see the book finished. However, this volume will help remind us of his contributions to this area of physics.

Several recent monographs and a volume of the *Laser Handbook* describe free-electron lasers and synchrotron and undulator radiation. Because to understand and design these systems one needs to draw from particle-beam physics, accelerator technology, laser physics and optics, it is very difficult to cover completely in a monograph both the theoretical and experimental aspects of the subject. Luchini and Motz, after giving an excellent historical introduction to this subject and an overview of its basic physical principles, prefer to concentrate more on the theory, providing a very detailed and accurate description of the spontaneous radiation from a relativistic beam traversing an undulator, with or without a waveguide. This description is then extended to stimulated radiation and free-electron laser theory, which is discussed in the small- and large-gain regime, and includes optical guiding effects and the effects of beam emittance and energy spread.

The part of the book that covers experiments and the descriptions of particle-beam properties and particle accelerators are presented on a more qualitative, introductory level. A reader interested in the experimental aspects of undulators and free-electron lasers will need to supplement his or her reading with material given in some of the references.

The authors have attempted to make the book as self-contained as possible by, for example, including an appendix on Hamiltonian mechanics and discussing in detail the solutions of the Maxwell equations appropriate to these problems. Thus the book can be used as a text for graduate students

and as a reference for the reader who is seriously interested in undulators and free-electron lasers.

CLAUDIO PELLEGRINI
*University of California,
Los Angeles*

The Physics of Musical Instruments

Neville H. Fletcher and
Thomas D. Rossing
*Springer-Verlag, New York,
1991. 620 pp. \$69.00 hc
ISBN 0-387-96947-0*

This is a book for physicists. Its more than 600 pages are organized into five parts, entitled Vibrating Systems, Sound Waves, String Instruments, Wind Instruments and Percussion Instruments; these are in turn divided into a total of 21 chapters. Essentially everything you have ever wanted to know about the physics of musical instruments (whether or not you were afraid to ask) is there, presented on a level that a good college junior can begin to handle, but of which a graduate student or, for that matter, a professional need not be ashamed. The coverage ranges from excellent introductions to such standard topics as the transient response of an oscillator and bending waves in bars, to clear presentations of the dynamics of an air jet (in the context of flutes), the radiation from guitars and violins, the nonlinear interactions in lip-driven brass instruments and the effects of air loading on the normal frequencies of timpani. I also enjoyed the intelligent preface, which places musical acoustics in a larger context.

Inevitably there are small points on which one can remark critically, such as the figure that purports to show Lissajous figures but appears to be in error, or another that sketches progressive stages in the impact of a piano hammer on a string but does not show the slope discontinuity that accounts for the hammer's deceleration. I was also disturbed by the description of equal temperament as something that "modern ears have come to tolerate." In fact, completely apart from anything having to do with modulation, the "quasi-vibrato" introduced into 19th- and late-18th-century music by equal temperament is perceived by most listeners as an integral and necessary part of the musical style; indeed, such chords sound quite intolerable without it.

I would also suggest that when a revised edition is prepared, the authors consider including a fuller discussion of impedance, admittance and mobility. It is unfortunate that these

words tend to be used rather uncritically, so that mobility (or admittance) becomes simply the reciprocal of impedance. To me, the important difference is that "impedance" refers to a situation in which a velocity is imposed at one point of a dynamical system, with all other points kept fixed, whereas in an "admittance" experiment a force is applied at one point, and all other points are left free. The two are equivalent only for a system with one degree of freedom, which is seldom a case of great interest.

These minor criticisms do not change the fact that if someone asked me what musical acoustics book I would most like to see written and published, it would be precisely this one, and precisely by these authors, whose encyclopedic knowledge and seemingly boundless energy have impressed me (and made me envious) on more than one occasion. The text fills a great need for all who are interested in the field, and I recommend it highly.

GABRIEL WEINREICH
University of Michigan

The Physics of Phonons

G. P. Srivastava
*Adam Hilger, Bristol, UK
(US dist. AIP), 1990. 421 pp.
\$80.00 hc ISBN 0-85274-153-7*

The physics of phonons is one of the most important and fast developing areas of solid state physics. This fact makes the reviewed book attractive; the author and publisher deserve high credit for their effort.

The book is a scientific monograph that covers a wide range of topics. It starts out with a description of crystal symmetry, Brillouin zones and related topics (the reciprocal space could be introduced in a less formal way), followed by a discussion of lattice dynamics. In chapter 4 the author pays special attention to the important question of the effects of anharmonicity. I think that the double-well-potential problem also should have been covered in the book.

Among the various phenomena connected with lattice dynamics, lattice thermal conductivity is described in detail. Because it represents one of the most important transport phenomena, this subject fully deserves the attention devoted to it. Furthermore, the author himself has made significant contributions to this field. The detailed discussion of various relaxation mechanisms is full and elegant. It would have been useful to include a description of phonon ther-

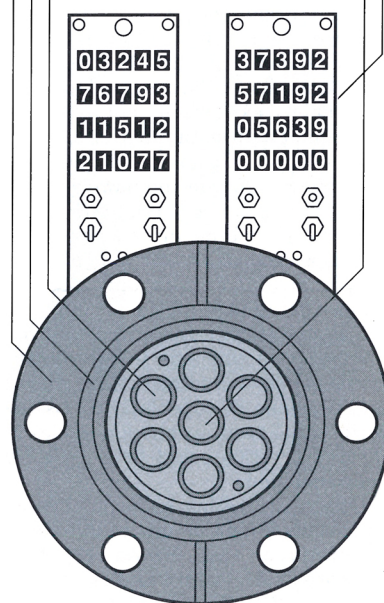
Superior count rate for high intensity applications.

Insensitive to hard radiations for accurate measurement in harsh environments.

Standard 2-3/4" OD (ISO 38 mm) copper seal flange.

Ultra clean UHV operation.

Long term stability for consistent measurements.



More Photons/Sec Than Any Other Diode You Can Buy.

Introducing XUV-007. A carefully crafted, seven channel x-ray diode that provides a spectral survey for UV through hard x-ray photons. XUV-007 is the result of 20 years of research and development in inertial confinement fusion. It is rugged, reliable and available now.

For a comprehensive product information package or for personalized technical information call...

1-800-521-1524

Ext. 680 weekdays 9 AM to 5 PM EST.

Fax: 1-313-769-1775 / Phone: 1-313-769-8500
700 KMS Place / Ann Arbor, MI 48106-1567

X-SI X-RAY AND
SPECIALTY
INSTRUMENTS
A Division of KMS Fusion, Inc.

Circle number 30 on Reader Service Card