explain it all in dry scientific terms. Yet a small band of musical acousticians has found this a fascinating problem to tackle.

With the notable exception of the saxophone, most musical instruments are not the result of a single deliberate creative act. Rather, they have very complex parentage, with many (and sometimes inadvertent) inventions along the way contributing to the evolution of the trumpet or the guitar that we play today. The skilled artisans who build these magnificent devices may well look a bit askance at the physicist as a latecomer who generally provides an explanation only after the fact for why the instruments work the way they do. These explanations have so far had only a modest impact on further developments in instrument design, but their effect is likely to increase in the future.

This is because the depth of our understanding has advanced significantly over the last 30 years. Developments in electronic technology have made possible much more accurate and detailed measurements of what actually goes on inside an instrument, and fast Fourier transforms have enabled us to relate this information more effectively to our mathematical models of the vibrational motions. There is now a great deal of solid information beyond the veiled glimpse afforded by the typical textbook for a no-prerequisite course on musical acoustics of the sort that became rather popular in the 1970s.

The time is right for a monograph that can bridge the gap between those nontechnical surveys and a research literature that has grown beyond the easy grasp of any one person. So the present book is most welcome, especially because its authors are two of the leading contributors to that literature (Rossing on percussion and Fletcher on wind instruments) and both are highly regarded for the clarity of their articles. The book will be an indispensable summary (including extensive references) for anyone working in this field, particularly for aspiring researchers, who will find many clues to problems needing further attention. But it will probably find its greatest number of readers among those who specialize elsewhere and simply enjoy feeding their curiosity, especially about the workings of instruments they play themselves.

The book is not designed to be read straight through like a novel. I would recommend that the reader simply browse around in chapters 9 through 21, each of which looks carefully at a particular family of string, wind, or percussion instruments. According to the depth of interest, one may then use the first eight chapters as supplementary reference material. There the basic physics of vibrating objects and sound waves is laid out in a review that will be fully appreciated only by one who has previously studied acoustics at some length but will provide useful insight to other courageous readers as well. This organization makes it possible to concentrate the more mathematical and idealized aspects of the theory in those first chapters so that the discussion of real instruments in later chapters can remain primarily physical. Extensively studied instruments such as the violin and clarinet naturally receive the most detailed treatment. But briefer comments also offer interesting insights into everything else from the zither to the didjeridu—a little fun for everyone!

DONALD E. HALL
*Department of Physics and Astronomy,
California State University,
Sacramento, CA 95819–6041*

Combustion Science

Combustion. A Study in Theory, Fact, and Application. JERZY CHOMIAK. Abacus (Gordon and Breach), New York, 1990. xviii, 464 pp., illus. $118; paper, $75. Engineering and Science Series.

In this book Chomiak provides a remarkably broad and concise description of current knowledge regarding combustion processes. The book opens with a discussion of gas-phase combustion that does not differ greatly from that found in most general treatises on combustion. For the most part, the simplest theories that show reasonable agreement with experiment are presented. Though such results provide a good introduction to the physical phenomena involved, in some cases (the effect of stretch on laminar flamespeed, for example) recent developments that have substantially improved our ability to make quantitative predictions are left out. Turbulent combustion is the author's specialty, and the coverage of this area is both more detailed and more clearly presented than in most works on combustion. The dynamics of the transition from deflagration to detonation are also treated in considerably more detail than is usual, as are three-dimensional effects such as pulsating and spinning detonations.

The second part of the book, on the combustion of condensed-phase fuels (droplets and sprays, coal, and mass burning applications such as forest, fixed-bed, and pool fires) provides a good illustration of the critical role played by radiative heat transfer in many practical applications, a subject that is often treated superficially or ignored altogether. The treatment of combustion within the solid phase, including detonation of explosives, burning of solid propellants, and deflagration-based material synthesis methods, is another area of strength. Discussion of the environmental aspects of combustion includes a summary of the formation mechanisms of the primary flame-generated pollutants. Control strategies are discussed, but I found the treatment somewhat dated, with no mention of such recently developed methods for nitric oxide control as the suppression of NO_x emissions by post-flame injection of ammonia (thermal de-NO_x) or cyanuric acid (RAPRENO_x).

Though most of the book is devoted to flame modeling, the last two chapters discuss the experimental methods used to characterize flame structure and some of the most widespread practical applications of combustion, such as internal combustion and turbine engines and utility boilers. The chapter on methods provides a useful introduction and guide to the literature for the nonspecialist. That on applications focuses on equipment design, featuring recent innovations that have led to improved performance, particularly in the emissions area.

This book should prove to be a popular reference work with scientists and engineers familiar with some aspect or aspects of combustion. It covers the field unusually thoroughly, summarizing and adequately referencing the most useful theoretical approaches and their results in a wide variety of subdisciplines. In those areas where substantially different approaches are available and clear distinctions cannot be made as to which is most useful (as in turbulent flame theory, for example), the alternatives are described and compared. Although numerical models (as opposed to analytical models) are not emphasized, the most useful public domain codes are usually mentioned and referenced. I found the book to be somewhat less easy to read than others on the subject, but for those who are familiar with one or more aspects of combustion and need to become familiar with another aspect, it would be a good starting point.

OWEN I. SMITH
*Department of Chemical Engineering,
University of California,
Los Angeles, CA 90024*

Books Received

Carbon Monoxide Poisoning. K. K. Jain. Green, St. Louis, MO, 1990. x, 177 pp., illus. Paper, $37.50.

Classic Experiments in Modern Biology. Melvin H. Green. Freeman, New York, 1991. xii, 208 pp., illus. Paper, $15.95.

Conscious and Unconscious. Freud's Dynamic Distinction Reconsidered. Patricia S. Herzog. International Universities Press, Madison, CT, 1991. x, 117 pp., illus. $27.50. Psychological Issues, monograph 58.