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clearly the experimental status, and the subtleties of the data interpretation for detecting the class of particles that constitute the presently best motivated and most popular dark-matter candidates. *The Cosmic Cocktail* also treats dark energy. That discussion is informative and covers the basics, but it is nowhere near as detailed as the presentation on dark-matter detection. Throughout the book, Freese appropriately integrates her own contributions and those of others.

The topics covered in the book are timely, even though some are inadequately discussed and others do not contribute to the title's "cosmic cocktail." For example, Freese narrates the relevance and discovery of the Higgs boson and even includes construction details of the Large Hadron Collider's four detectors. But the topic of inflation gets just two sentences in the text and two more in an endnote. She covers the OPERA anomaly of faster-than-light neutrinos—including the joke about the neutrino entering a bar. But her statement that faster-than-light travel implies violations of causality will confuse readers not familiar with special relativity. Also, she does not even name the Tully-Fisher relation, and she dedicates only half a sentence to baryon acoustic oscillations.

Freese's writing style interweaves anecdotes from her personal life with the scientific explanations. Some anecdotes document academic life, others seem to serve no purpose other than to break up the text. In the first chapters, occasional abrupt changes of narrative direction take some getting used to; the later chapters are smoother. The book comes with a light dose of humor that shows mostly in the figures, such as a skull to illustrate the "Death of MACHOs" (massive compact halo objects), a penguin postcard from Antarctica, and a blurry photo of a potted plant.

Freese follows the common advice to first say what you want to tell them, then tell them, then tell them what you just told them. She regularly reminds the reader of what was explained in earlier chapters, and repeats explanations frequently throughout the book. Although that repeating material makes it easy to follow the explanations, the alert reader might find the assumed inattention somewhat annoying. The electron volt, for example, is explained at least four times. Several phrases are repeated almost verbatim in various places—for example, "eventually galaxies formed ... these galaxies then merged to make clusters and super-

clusters" (page 31) reappears as "eventually this merger led to the formation of galaxies and clusters of galaxies" (page 51).

The book contains some factual errors: 3 kilometers is not 5 miles (5 kilometers is 3 miles); the radius of the Sun is not 10 000 kilometers (it's closer to 700 000); and the High Energy Spectroscopic System for measuring gamma rays is not in Europe (it's in Namibia). Some explanations and comments are vague or even misleading, such as the statement that "only with a flat geometry can the universe grow old enough to create the conditions for life to exist." One has to read carefully, including the endnotes, to find out that Freese means the *spatial* geometry has to be *almost* flat. And, although redshift at a black hole horizon is usually illustrated with somebody sending light signals while falling through the horizon, Freese instead uses sound waves; that adds confusion because sound needs a medium in which to travel. These are minor shortcomings, but they will cause readers with no knowledge of cosmology and particle physics to stumble.

We live in exciting times for cosmology and astroparticle physics—*The Cosmic Cocktail* mentions that word, "exciting," more than a dozen times. Especially on the topic of dark-matter detection, the book provides a valuable, nontechnical, and up-to-date overview.

Sabine Hossenfelder

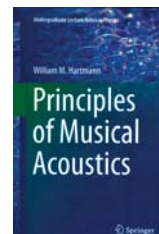
*Nordic Institute for Theoretical Physics
Stockholm, Sweden*

Principles of Musical Acoustics

William M. Hartmann
Springer, 2013. \$59.99 paper
(348 pp.). ISBN 978-1-4614-6785-4

Musical acoustics is a rich, multidisciplinary subject that provides an interesting context for teaching physics concepts in an algebra-based course. Many undergraduates love music and are curious to know how instruments and sound recording and reproduction devices work. Central topics usually include vibrations and waves, analog and digital electronics, elements of musical structure, and the physiological and psychological aspects of human hearing.

Principles of Musical Acoustics by William Hartmann is part of the Springer series Undergraduate Lecture Notes in



Physics, and it reads very much like a set of lectures honed over many years of teaching. Hartmann has taught musical acoustics at Michigan State University since 1974 and is known for his text *Signals, Sound, and Sensation* (Springer, 1998). His new book consists of 27 short chapters that cover the same basic topics as the classic text *The Science of Sound* (3rd edition, Addison-Wesley, 2002) by Thomas Rossing, F. Richard Moore, and Paul Wheeler—but in about half as many pages.

The Science of Sound supports two semesters worth of material that can be divided into courses on musical acoustics and the physics of electronic sound. In *Principles of Musical Acoustics*, Hartmann provides a more compact volume with about a semester's worth of material while still including both instrument acoustics and audio electronics. It is a logical approach, given that live and recorded demonstrations are both useful pedagogical tools.

Although the book is not broken into formal sections, its chapters are evidently organized into groups. The first 17 focus on foundations of musical acoustics: vibrations and waves and the human dimensions of hearing physiology and psychology. They include a discussion of the essential instrumentation of an acoustics lab, including oscilloscopes, spectrum analyzers, transducers, frequency counters, and function generators. Other topics covered are Fourier analysis and sound intensity. Students mastering those foundational chapters will have a basic understanding of sound production, propagation, and perception. They will also find tips on how to use relevant lab instrumentation. The remainder of the book breaks into two sets of chapters on the auditory system and psychoacoustics.

Writing in an informal, flowing style, Hartmann effectively uses analogies to explain concepts. He does not, however, provide chapter summaries or lists of important terms and concepts, such as those included in other texts like Donald Hall's popular *Musical Acoustics* (3rd edition, Brooks/Cole, 2002). Each chapter features useful drawings, diagrams, and graphs. Some diagrams include multiple parts to illustrate, for example, the oscillations of a standing wave and the interference of two waves traversing different path lengths. The text does not suggest it, but computer animations and simulations could complement those diagrams to give a sense of the dynamics in slow motion. Equations peppered through-

out support quantitative work—for instance, calculations of the modes of vibrations of musically relevant structures or of wave disturbances in space and time. Example calculations set aside from the main text in boxes are pertinent and clear.

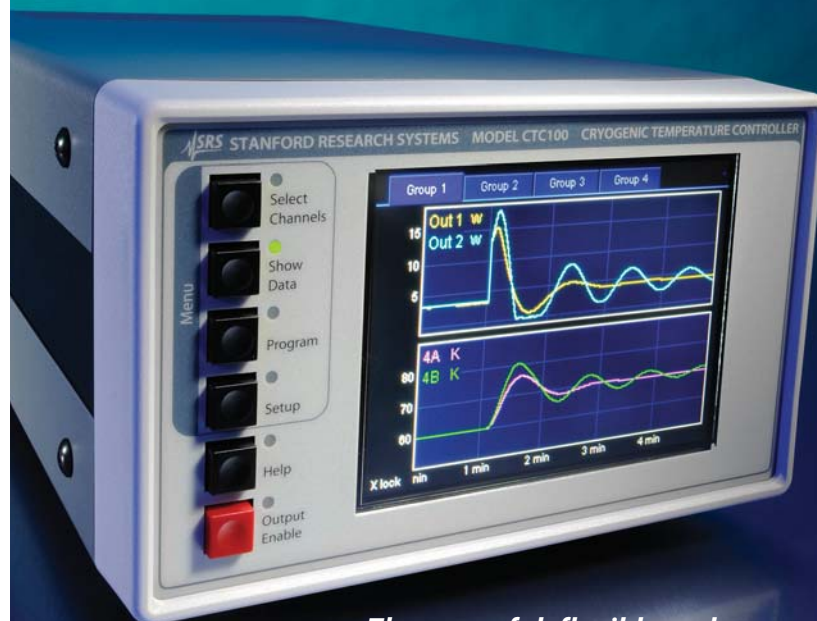
Exercises appear at the end of each chapter. Some are straightforward applications involving a short calculation or restatement of a concept. Others provide more of a challenge, encouraging students to integrate different ideas, think of implications not previously stated, or draw on their own auditory

experience. Unlike many texts that provide brief answers to selected questions, this book gives solutions, including calculations and full explanations, to most of the exercises. Those solved problems provide an opportunity for self-study that could potentially stimulate cross-disciplinary dialog between colleagues in physics, music, and psychology departments.

Principles of Musical Acoustics is a welcome addition to the existing selection of undergraduate texts. It does not contain as much material as the texts by Rossing and coauthors or Hall, both of

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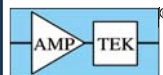
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which I've taught from many times, and it lacks literature references, so it would not be a first choice for researchers. However, the writing is clear and lively, and it would be accessible to its target audience. Coupled with a laboratory component and ample demonstrations and computer visualizations, it could form the basis for a stimulating semester course.

John Smedley
Bates College
Lewiston, Maine

The Physics of War From Arrows to Atoms

Barry Parker
Prometheus Books, 2014. \$25.95
(320 pp.). ISBN 978-1-61614-803-4

If, as Ambrose Bierce probably never said, "War is God's way of teaching Americans geography," then it might serve just as well to teach some basic physics. That seems to be the premise of Barry Parker's *The Physics of War*. Its subtitle, *From Arrows to Atoms*, suggests an ambitious, chronological treatment of the technologies and basic science relevant to warfare throughout recorded history.

Indeed, the coverage is substantial. From the Battle of Kadesh (circa 1274 BC) and its roughly 5000 chariots to the modern Predator drone, the author identifies game-changing weapons from more than a dozen eras and explains the basic principles necessary to understand them. Some rudimentary history of major conflicts, empires, and civilizations provides context for the larger technological discussion.

Parker, a professor of physics emeritus at Idaho State University, presents short historical vignettes on each of the technologies and principles highlighted in the text. Mathematics and quantitative assessments are almost entirely absent from the discussion; when they do appear, they are somewhat extraneous to the storyline. The writing is accessible and the narrative style unassuming; the book is likely geared to a high school audience. For the adult reader, the unbroken chronological structure of the narrative and the simple, repetitive sentence structure result in a dry and often tiresome read.

The Physics of War does not pretend to be a textbook. If you are not already acquainted with basic physics, you will not learn much of it from Parker's treat-

ment. Where opportunities to teach physics present themselves, the scarcity of appropriate figures or diagrams limits the utility of the explanation. Errors in nomenclature are also pervasive and potentially confusing to the layperson. In a section discussing the physics of balloon flight, the buoyant force is introduced in mathematical notation with g identified as "the force of gravity." To a physicist, that might seem a minor editorial error, but it can lead to profound confusion for the careful lay reader wrestling with the distinction between force and acceleration.

Given the cursory treatment of most of the topics covered, the book is also not a historical travelog. If you already know that the Chinese are credited with the invention of gunpowder or that radar played an important role in World War II, you will not learn much to contextualize those discoveries. The title and attempted scope of the book suggest a work like Bill Bryson's *A Short History of Nearly Everything* (Broadway Books, 2003) or Jared Diamond's *Guns, Germs, and Steel: The Fates of Human Societies* (W. W. Norton, 1997); Parker, though, does not pretend to seek the depth or insight of those classics.

For example, in the discussion of the longitude problem, Parker describes the challenge of celestially navigating a ship without an accurate clock. The critical importance of celestial navigation to both trade and military operations throughout the 17th and 18th centuries is noted, but the story of John Harrison's lifetime of work on the longitude problem is summarized only briefly: "In the end, the best solution was an accurate clock for the ship, and it came when the British clockmaker, John Harrison, realized that pendulums could not be used for clocks at sea. He devised a spring-driven clock, and it worked beautifully." That statement is misleading, since at the time, it was well known that pendulum-based clocks were not ideal for the rocking decks and variable temperatures of an ocean-going vessel, and that was not Harrison's insight. But it is also an oversimplification of the challenges that Harrison faced. Isaac Newton himself seemed convinced that consistent mechanical timekeeping was impossible on the open ocean.

Parker provides some good discussions of physics that are accurate and accessible to the layperson. The discussion of the dynamics of a bullet riding the wave of expanding gases in the barrel of a gun is both enlightening and well developed. In the discussion on the