For example, the Navier–Stokes equations could be presented, and the force balances, scaling and analytical results that apply in different limits could be derived.

Undergraduates at any level should be able to follow the book if they have a background in high school physics and elementary calculus. Dimensionless numbers, such as the Reynolds number, Froude number and Rossby number, are defined for the reader, and quantities such as the Coriolis force and potential temperature are carefully explained.

I have used this book successfully as a reference for an undergraduate class in geological and environmental fluid mechanics. Because of the interesting applications and the absence of advanced math and physics, this book might even be useful as a guide for a freshman seminar.

In summary, this book is well written and thoughtfully motivated and has clear explanations. Its great strength is in the physical insight it provides into many commonly occurring flows and phenomena. As a testimony to the contagion of Simpson's fascination with gravity currents, I now seem to notice these phenomena everywhere and appreciate the physical processes they represent, such as the spreading of syrup on my pancakes, a low Reynolds number current spreading on a porous surface.

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Signals, Sound, and Sensation

William M. Hartmann
AIP, Woodbury, N.Y., 1997.
647 pp. $80.00 hc
ISBN 1-56396-283-7

Psychophysics is the study of the relationship between the magnitude of a stimulus measured in conventional units and the magnitude of the sensation as perceived by the brain. In *Signals, Sound, and Sensation*, William Hartmann provides a comprehensive treatment of the theory and methods used by psychophysicists to study the perception of sound, and he introduces the reader to the quantitative methods of psychoacoustics.

The story begins with an explanation of the importance of a pure tone and the use of decibels to quantify measurements of power and intensity. The reader is assumed to know basic calculus and is provided with other mathematical tools as needed. The connection to psychoacoustics is firmly established in chapter 4 with a discussion of the relationship between intensity and loudness. The chapters on signal theory present topics such as Fourier analysis and filters in the same systematic manner that you would expect to find in an engineering text, although the style is somewhat friendlier. Key concepts and results from psychophysics are interspersed throughout, at appropriate places.

The cochlea's fundamental role as a frequency analyzer is discussed primarily in terms of auditory filters. There is very little discussion of auditory physiology here. Auditory filters in psychoacoustics are idealized as having rectangular, "roex" and "gammatone" shapes. The critical band, described as the "single most dominant concept in auditory theory," is a channel for processing auditory information, and its bandwidth is measured by psychoacoustic methods. Tones separated in frequency by less than a critical band interact with each other much more than do tones that are further separated.

The chapter on music theory covers mainly the mathematics of musical intervals. This is followed by a discussion of the psychoacoustics of pitch perception. More advanced topics in the book include correlation, probability density functions, modulation, nonlinear distortion, noise and signal-detection theory. Signal-detection theory has become the hallmark of modern psychophysics. For the most part, variables describing perceived quantities are best thought of as random variables.

Hartmann's many years of teaching acoustics and physics are evident in the confident manner in which he presents this material. He covers a wide range of topics in a clear, authoritative and easy-to-read style. The material is most appropriate for the student who has an interest in the science of hearing and who wishes to acquire familiarity with acoustics and signal theory.

Signals, Sound, and Sensation is intended to be used as a text for a second course in psychoacoustics. For this purpose, the coverage of relevant topics is very thorough. The exercises at the end of each chapter are generally easy to do and are used to introduce additional material. The book would also be a useful reference for anyone interested in the study of auditory perception. Readers who already have an acquaintance with signal theory may appreciate the sensible style of the discussions of such psychoacoustic topics as loudness and pitch perception. Numerous references to the journal literature are included for those seeking further details.

As a hearing-research scientist with a background in physics and electrical engineering, I appreciated the direct, accessible style of Hartmann's book and found it a pleasure to read. It should be considered by anyone wanting to teach signal theory to students with an interest in psychoacoustics.

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The Dancing Universe: From Creation Myths to the Big Bang

Marcelo Gleiser
Dutton (Penguin), New York, 1997. 352 pp. $25.95 hc
ISBN 0-525-94112-6

The publication of books about the relationships among myth, religion and science is a booming cottage industry. Physicists and cosmologists are particularly eager to explain their esoteric attempts to understand creation and to tie them to other belief systems. Some cosmologists even believe that they have pushed science right up to the edge of faith.

Much of modern cosmology, when simplified for presentation to the lay public, reads much like a creation myth. Even the big-bang and steady-state universes, and closed vs. open universes, have parallels in ancient belief systems.

Consider the Maori myth of the Creation:

From Nothing, the begetting
From nothing, the increase
From nothing, the abundance
The power of increasing the
living breath.

It dwelt with the empty space,
And produced the atmosphere
which is above us,
The atmosphere which floats
above the Earth;
The great firmament above us
dwelt with the early dawn,
And the Moon sprang forth.
The atmosphere above us dwelt
with the heat.

There is no Being behind this creation; things appear from nothing, simply due to an inexorable urge to be. Does this sound familiar? The Roman poet Ovid wrote in 8 AD, in *Metamorphoses:*

Before the Ocean was, or Earth,
or Heaven,
Nature was all alike, a
shapelessness,
Chaos, so-called, all rude and

lumpy matter,
Nothing but bulk, inert, in whose confusion
Discordant atoms warred; there was no Sun
To light the Universe; there was no Moon
With slendy silver crescents filling slowly;
No Earth hung balanced in surrounding air.

How far have we come since then? Marcelo Gleiser attempts in *The Dancing Universe* to classify cosmogonical myths and cosmogonical models and show that they offer complementary explanations for the origins of the universe. The book is about the history of ideas in cosmogony and the life and work of such scientists as Copernicus, Galileo, Kepler, Newton and Einstein. The author explores the beliefs and inspirations, often religious, behind the scientific creative process. He illustrates how current theories of the origin of the universe have come nearly full circle with some of the oldest mythical and religious stories.

Many books cover this ground. Although Gleiser's explores the relationships between scientific and prescientific belief systems, it is not as blatantly commercial as the recent spate of God-and-physics or physics-and-immortality books. It does not push Zen or Taoism or mysticism. It is not about the end of physics. It is simply a history of science wherein both "history" and "science" are broadly defined. It is written by a physicist, not a philosopher or historian.

There are a few figures, a long glossary and a complete index. For a reasonable investment of time and money, one can learn how creation physicists think and how their ideas may have evolved. After reading the book and becoming impressed with how far we have come and how much we know, one should go back to the beginning and reread the Hindu *Veda*, (from about 1200 BC):

Only He who is its overseer in the highest heaven knows.
He only knows, or perhaps He does not know!

Some of the scientific theories that we have embraced and then abandoned seem, in hindsight, much like some of the more amusing myths. Even some modern ideas seem outrageous to those who are not "members of the faith." How will our current naive theories be viewed from the future? Will they be viewed as amusing myths or misdirected energy? Is science just one of today's religions? It is good to put things into the type of perspective offered in this book.

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Lecture Notes on Atomic and Molecular Physics

Şakir Erkoç and Turgay Uzer
World Scientific, River Edge, N.J., 1996. 310 pp. $48.00 hc
ISBN 981-02-2811-2

Lecture Notes on Atomic and Molecular Physics is a small (310 half-sized pages) book and is, as the title indicates, a setting in print of notes intended to guide students through a one-semester, junior- or senior-level presentation of atomic and molecular physics. The authors, Şakir Erkoç and Turgay Uzer, intend this to be a self-contained guide to the subject. For this reason, the book assumes little or no background in atomic physics or quantum mechanics; it begins from the vantage point of a reader who has taken a traditional calculus-based university physics course and assumes some familiarity with differential equations, including partial differential equations.

Given these assumptions, the book contains a very brief overview of some of the physical phenomena leading up to quantum mechanics (Rutherford, Bohr models of the atom; Franck–Hertz experiment; photoelectric effect; deBroglie waves), followed by an equally brief introduction to elementary quantum theory in one and three dimensions. After a short development of perturbation theory, both time-independent and time-dependent, the text begins the discussion of atomic physics, starting with the one-electron atom, helium atoms, the periodic table, vector models and properties of atoms (radii, ionization potentials, inner-shell transitions à la Moseley, quantum defect formula for outer shells). The discussion of molecular structure includes the Born–Oppenheimer separation, vibrations and rotations, simple linear combination of atomic orbitals, molecular orbitals and level-crossing models. A final section is an introduction to Hartree–Fock theory, C. J. C. Roothan's version of Hartree–Fock, and Otkay Sinanoglu's approach.

This book presents a more comprehensive version of atomic physics than is found in a traditional curriculum, which might present some of this material in a so-called modern physics course and some of it under applications of quantum mechanics. I believe that, in terms of being self-contained, the book does well. It would serve well as a supplementary text in some contexts.

I would have difficulty using this book, however. In teaching a modern physics course, I find the biggest job is getting students to make the connection between physical phenomena and concepts and their newly acquired skills in advanced calculus and differential equations. For many students, neither of these is completely settled, and so they have a hard time making those connections. Their insecurity causes them to avoid risking failure; they do not venture models of their own without much encouragement.

In many cases, this book presents formulas as "the way it is" without indicating how they might have come about. The teaching of physics is an interesting art. There is a fine line between pontificating about "the way it is" and convincing students to struggle to envision a way to formulate a given problem. This book has only minimal words surrounding the presentation of a given formula. A heavily annotated bibliography, carefully referenced in each section of the text to give the student additional guidance, would have been very useful, in my view.

An additional difficulty with this text as I see it is that it would require revamping or replacing a standard modern physics course or reorienting a course on the applications of quantum mechanics. For those students who had not been exposed to modern physics, such a course might serve as a replacement. Some significant part of the material covered here is often included in a full-year quantum mechanics course, however. Coordination is then required.

There is a difference between a pedagogically sound presentation of material, as found in a standard text, and the presentation found in lecture notes. This text provides students with just an outline, which does not answer the questions that arise naturally as they approach this subject matter for the first time. An instructor using this text would have to provide essentially all of the context for the material.

A final comment: I was disappointed to find no discussion of laser interactions, atom and ion cooling and trapping, Bose–Einstein condensates and related developments that have produced so much excitement in the physics community in the last few years. Their inclusion would have made the book much more interesting.

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