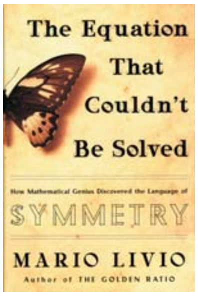

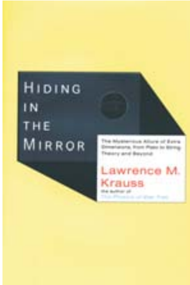

Both volumes introduce sophisticated technical topics to the general public, but their aims and expository styles diverge. Livio, an astrophysicist and also author of *The Golden Ratio: The Story of Phi, the World's Most Astonishing Number* (Broadway Books, 2002), attempts to make the abstract topics of algebraic equations, symmetry, and group theory appealing and relevant to readers who have no mathematical background. His varied and detailed examples are well calculated to engage such readers and make them feel capable of following his narrative of mathematical challenges and progress. Capsule biographies of mathematicians woven throughout the story depict mathematics as a fundamentally human endeavor, while puzzles in the appendices urge active engagement.

Krauss, a professor of physics at Case Western Reserve University in Cleveland, Ohio, and also author of *Atom: An Odyssey from the Big Bang to Life on Earth* (Little, Brown and Co, 2001), examines theories of extra spatial dimensions, an idea with which many readers will have a superficial acquaintance. He tries to remove pervasive misconceptions, display connections to modern physics, and reveal how speculative those extradimensional theories remain after decades of study. The author's ability to convey, with minimal detail, the essence of a scientific idea allows him to show the links among strands of thought in science, philosophy, and science fiction. He pulls the reader into contemplating the relative values of beautiful and useful theories.

In the first seven chapters of *The Equation That Couldn't Be Solved*, Livio masterfully develops the broad theme of symmetry through a suite of vignettes, just as medieval tapestries or classical Chinese scrolls display an epic as a mosaic of smaller scenes. He first introduces the concept of symmetry as encountered in art, music, science, and mathematics and then begins the central story by tracing the origins of algebraic equations, from early Babylonian land records through 16th-century European mathematical competitions. The sadly short lives of Niels Henrik Abel and Évariste Galois provide background for an exploration of attempts first to solve the general quintic equation and then to prove it could not be solved in closed form. Livio takes the reader carefully through the essence of Galois's development of group theory and its consequences; it was disappointing that he did not include a similar exposition of Abel's accomplishments.

The story closes with a whirlwind tour of symmetry's crucial role in various topics in modern physics. Apart from a few oddities—for example, Livio asks the reader to imagine the inverse of a deformation of a piece of Play-Doh (page 164) and alludes to Dan Brown's description of CERN in *Angels and Demons* (Pocket Books, 2000) as though it were serious rather than parody (page 219)—his narrative of mathematical progress through symmetry is quite satisfying.

In contrast, the final two chapters of Livio's book are rather frustrating. Without the underpinning of a dramatic story line, the author's style becomes a liability, making the chapters seem like a jumble of barely related facts, assertions, and surmises. In particular, the discussions of the role of symmetry in evolutionary psychology and the nature of creativity feel superficial and unconvincing.

Hiding in the Mirror smoothly recounts the history of extra dimensions as an element or even a driving factor in scientific and humanistic explorations of the nature of the universe. Much of the book is devoted to an engrossing overview of theories of gravity, particle physics, cosmology, and string theory. It also contains significant discussion of developments in science fiction, art, and spiritualism in which extra dimensions have taken a role. Krauss plays these parallel histories against one another, specifically contrasting the types of extra dimensions most prevalent in science and science fiction, and noting the common impulse by scientists and humanists to employ new spacetime geometries as a tool for opening the mind to new insights. In the closing chapters, he reminds the reader that, in the past, data have falsified seemingly plausible scientific invocations of extra dimensions. He argues that current incarnations of extra dimensions within string theory remain physically speculative, albeit mathematically beautiful, because no firm connection with our physical universe has been established.

Krauss uses humor and a broad palette of cultural references—from Passover to the *X-Files*—to engage the reader and carry the narrative forward. The colloquialism softens his precise physics descriptions and gives the reader a welcoming sense of chatting with a colleague rather than listening to an expert. A few of Krauss's allusions, however, might make some readers feel like baffled outsiders. For example, on page 182, the sequence of puns about the heterotic string is undermined by his not defining heterosis or giving any hint to the lay reader about why "kinky" might be a pun in this context. Likewise, the remark on page 132 that "$1 + 2 + 3 + 4 + 5 + \ldots$ can be shown to equal not infinity, but rather $-1/12$" prompts readers to wonder whether they are being subtly mocked, which is a shame because the remark follows a very accessible account of Hilbert's Hotel and the pitfalls of infinities.

I recommend both books to a general audience seeking a mix of entertainment and education. *The Equation That Couldn't Be Solved* is perhaps best read in short chunks, leaving aside time to digest the mathematical details or solve the puzzles in the appendices. Readers of *Hiding in the Mirror* may profit from more sustained reading sessions to appreciate the full arc of each chapter. Each publisher should consider embellishing its book with accompanying websites that offer interactive puzzles and resources for interested readers.

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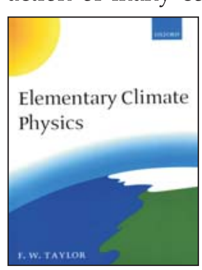
Elementary Climate Physics

F. W. Taylor
Oxford U. Press, New York, 2005. $94.50, $47.50 paper (212 pp.).
ISBN 0-19-856733-2,
ISBN 0-19-856734-0 paper

Fredric Taylor's *Elementary Climate Physics* is an easy-to-read and useful introduction for undergraduate and graduate students who are interested in this increasingly important area of physics. The science involves the interaction of many components, and Taylor, a professor of physics in the department of atmospheric, oceanic, and planetary physics at the University of Oxford, discusses them in broad, elementary terms.



The book has only 212 pages, yet it covers a wide range of topics, as evidenced by its chapter titles: "The Climate System," "Solar Radiation and the Energy Budget of the Earth," "Atmosphere and Climate," "Clouds and Aerosols," "Ocean and Climate," "Radiative Transfer," "Earth's Energy Budget: The 'Greenhouse' Effect," "The Ozone Layer," "Climate Observations by Remote Sensing," "Climate Sensitivity and Change," "Climate Models and Predictions," and "Climate on Other Planets." The author's discussions of other planet's climates are particularly novel.

A distinguishing feature of *Elementary Climate Physics* is that instead of focusing on geophysical fluid dynamics the book covers the thermodynamics, the radiative-energy balance, and the basic principles of how the climate system is observed and modeled. This approach is useful because many texts on climate thermodynamics and radiative-energy balance tend to be aimed at more advanced readers. Even though the text is an introduction to the field, the author provides references to more detailed sources for readers who wish to delve deeper into the subject. Currently, overview texts like Taylor's are rare. Most books on climate physics tend to cover a narrow area of the field and are for a specialized audience. Perhaps it would be useful if the publisher's website featuring the book provided additional resources such as PowerPoint presentations and links to the many online sites that explore the various aspects of climate physics discussed in the book.

Because many of the insights gained in climate physics over the past two decades have been through observation and modeling, it is useful that discussions on climate observations by remote sensing and on models and predictions each have their own chapters. Taylor also covers current Earth-observing systems.

Overall, *Elementary Climate Physics* fills a gap in the literature and is self-contained. Taylor defines and explains relevant terms and units, and he does not assume readers have prior knowledge of climate physics. The book expounds on the basic mechanisms controlling climate and will be particularly helpful to newcomers to the field.

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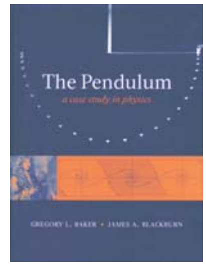
The Pendulum

A Case Study in Physics

Gregory L. Baker and James A. Blackburn
Oxford U. Press, New York, 2005. $99.50 (288 pp.).
ISBN 0-19-856754-5



Oscillatory motion is among the great unifying themes of physics. In fact, one of my graduate-school professors, an experimentalist, would regularly speak disparagingly of theorists as "simple harmonic oscillator reductionists." A well-known example of an oscillation is the mechanical pendulum, which can range from the traditional, simple pendulum to a complex coupled or chaotic pendulum.

Gregory Baker and James Blackburn's *The Pendulum: A Case Study in Physics* surveys different types of pendulums: simple, nonlinear, Foucault, torsion, chaotic, coupled, and quantum. Each case is given its historical or cultural perspective, a mathematical analysis, and applications. The intended audience is the typical undergraduate physics major. The authors assert that the reader should have completed a standard introductory physics course and a mathematics course covering differential equations. But I think that some of the book's material—for example, Lagrangians, elliptic integrals, and Dirac delta functions—would prove difficult for students at that level. Nevertheless, the book includes sufficient information to make it a useful reference for undergraduate students.

The authors propose that the text could form the basis of a new type of "thematic" physics course. Although such courses are rare, they provide the instructor with the opportunity to draw parallels and exploit analogies across traditional boundaries, thereby promoting deeper physics insights than are possible in the usual compartmentalized curriculum. For example, at Oregon State University, where I teach, courses for junior-year physics majors are organized around thematic topics that we call paradigms (see PHYSICS TODAY, September 2003, page 53).

Although Baker and Blackburn's book succeeds in providing a useful and interesting summary of different types of pendulum motion, it unfortunately suffers from inconsistent notation and inadequate editing. The text contains numerous punctuation errors, especially missing or superfluous commas. Placement of parentheses in equations is inconsistent; for instance, the authors use both cos φ and cos (φ). Titles and scientific terms are inconsistently capitalized: For example, one paragraph on page 211 has "oxygen," "Hydrogen," "Helium," and "helium"; George Airy is identified as both the "astronomer royal" and the "Astronomer Royal"; the book discusses both "gaussian" and "Gaussian" distributions and "dc" and "DC" Josephson effects. Schrödinger's name appears throughout most of the book without the umlaut. The authors have adopted, although not uniformly, an unusual convention for citations that dictates that the author and year appear together in parentheses, which leads to such jarring constructions as (See (Einstein 1905)).

The errors and inconsistencies, however, are not limited to punctuation. The authors identify force as the negative derivative of the potential rather than of the potential energy, a common mistake that persists in many physics texts. Grams are abbreviated as "gm" rather than "g"; the temperature is expressed in "degrees kelvin" rather than "kelvin." Some constants, such as the Planck constant and the magnetic flux quantum, are expressed with eight or nine significant figures, but the quoted numerical values are unreferenced and differ from the current values accepted by NIST and the Committee on Data for Science and Technology, or CODATA; the Boltzmann constant, on the other hand, is inexplicably allocated only three significant figures. In addition, the Rosetta stone (which the authors also refer to as the "Rosetta Stone") was discovered in 1799, not 1899; and it was Einstein, not Planck, who first formulated the idea of energy quantization.

Although such inaccuracies were distracting at times, I found some chapters to be informative. For example, chapter 5 on the torsion pendulum begins with the shearing stresses on the fiber. The authors then analyze torsional oscillations, including forced and damped oscillations. A junior-year undergraduate physics major would feel quite comfortable with the mathematics in this chapter. The authors cover Henry Cavendish's and Charles Coulomb's use of the torsion pendulum to explore, respectively, the gravitational and electrostatic forces. How-