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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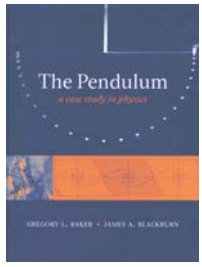
# The Pendulum

## 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 $\varphi$ and cos ($\varphi$). 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-

ever, I wish the book had referenced Jack Soules's 1990 article in the *American Journal of Physics* (volume 58, page 1195), which discusses Coulomb's failure to account for the mobility of the charges on his spheres.

Chapter 5 also includes an explanation of the workings of the ballistic galvanometer, which was the standard for student electronics labs for many years. It concludes with a discussion of modern torsion balances that have been used to measure the gravitational constant and test the equivalence of gravitational and inertial mass, a cornerstone of general relativity. I also found chapter 9 to be especially interesting. The authors exploit the similarities between the treatment of the single and coupled Josephson junctions and that of the single and coupled pendulums. This type of analogy has great pedagogic value and serves as a good example of the authors' assertion concerning the benefits of a course organized around a single common theme.

Other chapters, such as chapter 6 on the chaotic pendulum, are less focused and less satisfying—at least to me. I was disappointed by chapter 8 on the quantum pendulum: The mathematical treatment, especially derivations of the recursion relation for the Hermite polynomials and the uncertainty relationships, did not seem to be as well connected to applications as was the case in other chapters. In addition, the experiments were discussed only superficially.

I suspect few colleges or universities offer thematic courses exclusively devoted to pendulums, courses for which Baker and Blackburn's book could serve as a text. Until such courses become common, a more likely role for the book would be as a supplemental text for an intermediate mechanics course. *The Pendulum* offers interesting and challenging topics that can enhance the level, depth, and breadth of coverage of typical undergraduate mechanics texts.

I know of no mechanics book that couples formalism with practical examples and applications as successfully as this one does. It is written as a text rather than as a monograph, with occasional worked-out examples (not enough, in my opinion), and each chapter has about 10 problems suitable for students—although many of the problems, especially those in the chapter on chaotic motion, seem more appropriate for graduate students. It is disappointing that a student text on oscillatory motion published in 2005 offers problems that are almost exclusively analytical and thus neglect the development of numerical or computational skills. The text contains an extensive and useful bibliography, but the index is inadequate for either a student text or a work that strives toward encyclopedic coverage.

Overall, *The Pendulum* presents insights and unusual approaches that will broaden the experience of undergraduate physics students. I just hope the publisher will provide a new or revised edition that is more carefully edited to remove the errors and inconsistencies that characterize this edition.

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