reader is referred to specialized texts where needed. Material is up to date, and references to the original articles are included. The main shortcoming of the presentation is the absence of problems with which students can test their understanding of the material; one hopes that an accompanying problem booklet is forthcoming.

Longair's first volume concluded with an introduction to the terrestrial and heliospheric environment, including a discussion of shock waves in solar wind plasma. The second volume explores the relevance of the observations described in the first (and that of other experimental studies), to the life history of stars, the structure of our galaxy, the role of the interstellar medium in star formation and the importance of the cosmic-ray gas. The thread from which the fabric of this book is woven is the evolution of stars, from birth to death, with particular reference to our Galaxy.

The book treats such current topics as the solar neutrino problem and helioseismology. The author discusses various scenarios of mass transfer, stellar winds and accretion discs with respect to such diverse systems as x-ray binaries, cataclysmic variables, novae and supernovae of type I, to mention a few. A rather complete, though elementary, discussion covers the structures of white dwarfs and neutron stars and the formation and properties of radio pulsars and black holes. To encourage understanding of the birth of stars, Longair gives a detailed description of the interstellar medium, including current views on star-formation regions in giant molecular clouds.

He presents characteristics of radio emission of the Galaxy, after a comprehensive discussion of synchrotron radiation theory. He develops the distribution of low-energy gamma rays in the Galaxy, and their relation to the distribution of high-energy electrons is developed and includes a presentation of recent radio emission contours from various galaxies related to synchrotron radio emission. Finally, he gives an excellent summary on the origin, acceleration and propagation of electron and nuclear components of cosmic rays in the Galaxy. This includes a reasonably detailed outline of current models for shock acceleration of cosmic rays in various scenarios.

This is an exciting and timely book in a rapidly expanding field, and it should provide an excellent teaching text for high-energy astrophysics.

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The Cosmological Milkshake: A Semi-Serious Look at the Size of Things

Robert E. Ehrlich
Rutgers U. P., New Brunswick, N.J., 1994. 259 pp. $24.95 hc
ISBN 0-8135-2045-2

The Cosmological Milkshake takes its title from the essay "How big are the bubbles in the cosmological milkshake?", which discusses the observation that the galaxies that make up the universe seem to be distributed along surfaces resembling numerous connected bubbles. This is but one of the book's 135 relatively short (500- to 600-word) essays on physics aimed at a general audience. The whimsical essays on, as the subtitle says, "The Size of Things," are divided into five sections on how big or far, how heavy or massive, how hot or cold, how fast and how old. What could be better than a lively book about mass, length, time, velocity and temperature?

In appealing to nonscience majors in college (and to young children), excellent questions can be and often are asked by simply extending the range. For example, it is quite natural to go from the size of our planet to the Solar System to the Galaxy to the edge of the universe. Conversely, one can ask what is inside the atom, then the nucleus, then the proton and then the quarks.

A great, Zen-like triumph of 20th-century physics is that the basic understanding of the fundamentals of particle physics is necessary for understanding the origins and evolution of the universe. Starting with almost any essay in *The Cosmological Milkshake*, the reader is naturally led to the next level up or down. Thus, as the author suggests and I agree, the 135 essays can be read in almost any order. It would be an interesting experiment to hand out a copy of the table of contents in a classroom of nonscience majors and, based on their interests, use chapter topics as the spine for a course. (The preface notes that teachers who assign the book to their classes can obtain kits of problem sets and answers, illustrations and review questions.)

In any book that attempts to explain basic ideas of physics in short, topical essays, there remains a constant tension—in a sense a complementarity—between clarity and correctness. The clearer one tries to be to a nonscientific audience, often the less accurate and detailed the explanation. In Ehrlich's collection, the approach works best for such simple ideas as equating the national debt to the height of a pile of dollar bills. It works less well with the complex, sense-defying, nondemonstrable laws of special relativity or quantum mechanics.

There are a few minor typos (liquid nitrogen at 72 K), and perhaps some "clairvoyance" when Ehrlich reports that the record high temperature reached for superconductors at the time of publication (1994) is 164 K (the number for a sample under high pressure). Very occasionally the physics is not quite accurate, as in the statement, "at room temperature, the electrons in a wire have an average speed of 118 km/s," in the essay on "how fast does electricity travel in wires?" (The author neglects to take into account the fermion nature of electrons.)

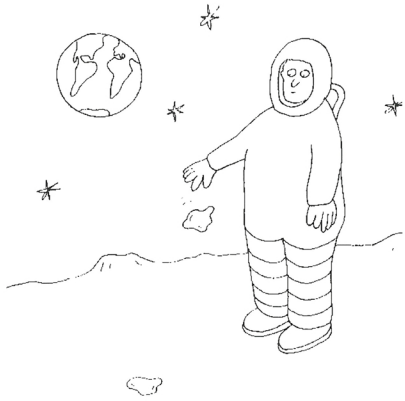

FIGURE 19. In observing that things fall slower on the Moon, Jim concludes that the Moon has stronger levity rather than weaker gravity. (From *The Cosmological Milkshake*, with permission.)

No review of this book would be complete without commenting on the "deliberately weird" cartoons by Gary Ehrlich, the author's son. Each essay has at least one line drawing cartoon that, in a zany manner, plays off an idea in the essay. (In a few of the more complex essays, two figures are associated with the essay, one a zany cartoon, the other a textbook-style illustration of the physics, and in one essay, three figures are presented.) The author states in the preface that some of the cartoons may strike you as "for adults only . . .though tastefully done." True on the "adults only" comment, while the "taste" is in the eye of the reader. Most of the cartoons are quirky enough to entice many nonscience readers. The book contains a very modest bibliography.

(Even in one as short as that given, Ehrlich should have included the Morrisons' book *Powers of Ten*, (Freeman, 1991) based on the fabulous Eames film of the same name.)

The essays are mostly successful. The book should be in the library of any teacher offering a course for non-science majors. It would make a nice gift to a curious person of any age.

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Dynamics: Numerical Explorations

Helena E. Nusse and
James A. Yorke
Springer-Verlag, New York, 1994.
484 pp. $79.00 hc
ISBN 0-387-94254-8

If you learn by example, this is the dynamics book for you. But beware, because *Dynamics: Numerical Explorations* and its accompanying software are addictive. Before you get to the end of the book you may succumb to the allure of dynamical systems. This happened to me several years ago, and I've been working in the field ever since.

Yorke, more than anyone else, understands the importance of a graphical intuition about dynamical systems, and for several years he has circulated his graphics-based software program with the intent of conveying the beauty and intricacies of nonlinear dynamics. Now he and coauthor Helena E. Nusse present the most current investigative tools of nonlinear dynamical systems in a beautifully illustrated book that includes the Dynamics software package.

Tools such as dimensions, Lyapunov exponents, bifurcation diagrams, basins of attraction, straddle trajectories, unstable and stable manifolds and unstable periodic orbits are presented in numerous hands-on examples. All of these tools can be put to use on an extensive list of nonlinear differential equations and maps, including the Henon, cubic, logistic, tent and Ikeda maps and the forced damped pendulum, Lorentz, Lotka–Volterra and Duffing differential equations. The authors also provide excellent instructions, enabling the readers to add their own favorite dynamical systems to the program. This makes Dynamics an excellent research tool, because the included tools and techniques are state of the art.

This is not a conventional textbook. Think of it as an exploratorium of nonlinear dynamics and chaos. Consequently it would serve as an excellent companion volume to a textbook on dynamical systems (such as the excellent *Nonlinear Dynamics and Chaos: with Applications to Physics, Biology, Chemistry, and Engineering* by Steven H. Strogatz (Addison-Wesley, 1994) or as a stand-alone text for a dynamical systems computer lab (all source code in C is provided).

The accompanying Dynamics program runs under the MS-DOS and UNIX operating systems. I found the MS-DOS installation to be quite straightforward. For the UNIX installation I shamelessly procured the help of Hank Roark, a UNIX-savvy undergraduate. He installed the program on several unsuspecting workstations with equal ease.

Lest you think I am in the pay of the authors, I should offer a few critical comments. First, a Macintosh version of the software would be nice. Also, the user interface for Dynamics, while easy to use, looks a bit dated compared to more current Windows-based interfaces. Paradoxically this may also be Dynamics's strength, as the hardware requirements to support the interface are quite modest (PC and VGA graphics) and the source code is very readable. Indeed the authors encourage the use of their excellent routines in the user's own programs (with proper citation of course).

With all the books on chaos and nonlinear dynamics appearing these days, one has to show some discrimination in what to read. I can recommend *Dynamics: Numerical Explorations* as high on the list of required reading for those who are interested not just in reading about but in exploring dynamical systems. But be forewarned: You might be seduced by the beauty of dynamics before you know it.

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A Friendly Guide to Wavelets

Gerald Kaiser
Birkhäuser, Boston, 1994. 300 pp.
$34.50 hc ISBN 0-8176-3711-7

Wavelet transforms have been finding widespread acceptance over the past 10 years, with contributions coming from the mathematics, physics and engineering communities. Wavelets may be thought of as atomic functions that are localized in both time and frequency and whose dilates and translates span some Hilbert space of interest. The field is much richer than one might expect upon casual ob-