on many of the topics in the text; his experience is reflected in the interesting and cohesive perspectives related to the different subjects discussed and in the adaptation of calculations from his own work to new, substantial, and intriguing problems.

Each chapter has two short introductions: one to outline its contents and the other to discuss the exercises at the end of the chapter. The introductions are most useful for providing context, and they help the flow of the presentation. The one choice made by the author with which I disagree is that he did not provide literature recommendations when he did not cover a topic in depth.

A highlight of the book is the broad array of thoughtful exercises; an answer key to most of them is available to instructors on request. That sensible policy is a tremendous boon to time-crunched instructors who want to make up problem sets that take an appropriate amount of time for students to complete. Sethna asks that instructors do not post the answers to the exercises on the Web or distribute them electronically. The exercises include a substantial number of computational problems; software for several of them can be downloaded from the author's website. Some of the software is prewritten so that students can easily download and run simulations. When I was writing this review, some of the canned exercises did not work on Macintosh OS X. I hope the problem is remedied by the time this review is published.

Some of the exercises in the book guide students to write their own simulations. They are encouraged to program in Python, a computer language that runs on all standard platforms and is relatively easy to learn. Some of the exercises would take a long time to grade, so it is best to assign them in a course only when the class is small or considerable grading assistance is available.

Sethna's book provides an important service to students who want to learn modern statistical mechanics. The text teaches students how to work out problems by guiding them through the exercises rather than by presenting them with worked-out examples. Overall, *Statistical Mechanics* is probably more appropriate as a textbook than a self-study guide. Instructors can point out to students which material is core and central to understanding following chapters, and which is cultural and not required to comprehend later topics.

Susan Coppersmith
University of Wisconsin–Madison

Many Worlds in One

The Search for Other Universes

Alex Vilenkin
Hill and Wang, New York, 2006. $24.00 (235 pp.).
ISBN 978-0-8090-9523-0

Alexander Vilenkin's *Many Worlds in One: The Search for Other Universes* is a beautifully written story of a new worldview that has developed during the past 25 years. Cosmologists associate this view with the concept of an eternally inflating multiverse. String theorists, who joined in on the discussions a few years ago, call it the string theory landscape. The new paradigm replaces the idea of a single uniform universe with that of a multiverse consisting of many different universes with different properties.

Another recently published book on multiverse theory is *The Cosmic Landscape: String Theory and the Illusion of Intelligent Design* by Leonard Susskind (Little, Brown and Co, 2006). If you are interested in the string theory perspective, the best introduction can be found in *The Cosmic Landscape* (see the review of Susskind's book by Paul Langacker in PHYSICS TODAY, June 2006, page 61). If you are interested in the theory of the inflationary multiverse, Vilenkin's book should be your first choice. But why not read both?

Susskind is a brilliant and prolific scientist, an expert on string theory and cosmology who coined the term string theory landscape. Vilenkin is one of the world's leading theoretical cosmologists. He is the inventor of the theory of cosmic strings, the author of several influential works on quantum creation of the universe, and one of the architects of the theory of eternal inflation. Both Susskind's and Vilenkin's books are wonderful.

Cosmological observations tell us that the universe looks the same everywhere and that the physical laws in all of its parts are the same as they are in the vicinity of our solar system. In the early 1980s when inflationary cosmology was first proposed, one of its main goals was to explain the uniformity of the universe. Inflation is a stage of an exponentially fast expansion of the early universe. Inflation stretches all previously existing inhomogeneities and makes our part of the universe perfectly uniform, except for the small quantum fluctuations amplified during inflation. Those quantum fluctuations later give rise to galaxies.

However, a few years after the invention of inflationary theory, cosmologists realized that the theory may have some unforeseen consequences. Like water, which can be either solid or liquid in different parts of the ocean, vacuum may have different properties in different parts of the universe. Inflation makes each of those parts uniform and exponentially large, so by looking at any of those parts, one would think, incorrectly, that the whole universe looks the same everywhere.

The next important step was made in the mid-1980s with the discovery of the eternal chaotic inflation scenario. The scenario emphasized that even if the universe began its evolution in one particular vacuum state, quantum fluctuations produced during inflation would exponentially divide the universe into many large parts corresponding to all possible vacuum states. From a local observer's point of view, this means the universe would divide into many universes with different laws of low-energy physics operating in each (see my article in PHYSICS TODAY, September 1987, page 61).

But why would any theory have many different vacua? A possible answer is found in the context of string theory. According to the theory, our space has many dimensions, but some of them are extremely small, or "compactified"; therefore, we perceive our spacetime as four dimensional. The first commonly accepted solution to ensure the stability of compactified dimensions was the KKLT (Kallosh-Kachru-Linde-Trivedi) mechanism, proposed in 2003. Researchers soon realized that this mechanism allows an enormously large number of ways to stabilize the vacuum. String theory admits 10^{100}, or maybe even 10^{1000}, different vacuum solutions. Each solution appears in the context of the same fundamental theory, but the laws of interaction of elementary particles in each of these vacua look completely different. Combining this scenario with the theory of eternal inflation leads to a picture of an inflationary multiverse consisting of 10^{1000} different types of exponentially large universes, the string-theory landscape.

If that picture is correct, then it is insufficient to find the fundamental theory. One must also determine in which of the 10^{1000} possible universes we live. Some people like this newly revealed freedom of choice; some people hate it, calling it metaphysics and theology and saying that it kills their dreams of a final theory. But in his 2005 paper, "Living in the Multiverse," Steven Weinberg compared the recent developments with the revolution in physics that happened with the invention of the special theory of relativity: "Now we may be at a new turning point, a radical change in what we accept as a legitimate foundation for a physical theory."

Perhaps the most emotional response is related to the anthropic implications of multiverse theory, which are actually quite trivial and, I believe, trivially correct: We can live and make our observations only in those parts of the inflationary multiverse where we can live.

Vilenkin's book contains only 200 pages, which is nearly optimal. The first part of the book includes a description of the Big Bang theory and inflationary cosmology. Years ago inflationary theory looked like an exciting piece of science fiction, but it is gradually becoming a widely accepted cosmological paradigm, and many of its predictions have been confirmed by observational data. The rest of the book is devoted to the theory of eternal inflation, creation of the universe "from nothing," the anthropic principle, the cosmological constant problem, and the string theory landscape. Many of the problems related to those theories are still unsettled, but the book conveys the sense of wonder and excitement that is known to those who take the risk to work on some of the most fundamental problems of modern physics.

It is impossible to write about inflationary theory and quantum cosmology without introducing some of the technical details. In less experienced hands, this could easily make such a book dry and intimidating. Fortunately, because of his deep understanding of the subject, Vilenkin successfully presents even the most complicated parts of the theory in a simple and intuitive way, and he does it without making any parts of his discussion vague or inaccurate—a real achievement.

Vilenkin also offers personal recollections and a well-balanced narrative of the history of the most interesting cosmological ideas of the 20th century. I found his discussion of the work of Russian cosmologists refreshing, particularly concerning Alexei Starobinsky and Viatcheslav Mukhanov, whose seminal contribution to the development of inflationary cosmology is underappreciated by the English-reading audience.

But what I like most about *Many Worlds in One* is its combination of Vilenkin's seriousness, intellectual honesty, and good sense of humor. When I opened the book, I did not expect that it would be so much fun to read. If you are not sure whether this book is for you, I recommend doing something that goes against the grain: First read the prologue, then the epilogue, and then, if you are intrigued, the rest of the book. If you are among those who want to learn about the emerging worldview and enjoy intellectual challenges, you are in for a real treat.

Andrei Linde
Stanford University
Stanford, California

Experimental Techniques for Low-Temperature Measurements

Cryostat Design, Material Properties, and Superconductor Critical-Current Testing

Jack W. Ekin
Oxford U. Press, New York, 2006. $125.00 (673 pp.). ISBN 978-0-19-857054-7

At last a new book, not a collection of technical papers, has been published on the techniques of low-temperature measurements. Jack Ekin's *Experimental Techniques for Low-Temperature Measurements: Cryostat Design, Material Properties, and Superconductor Critical-Current Testing* is an encyclopedia of techniques, dos and don'ts for anyone starting measurements in the low-temperature field. The text is also a useful reference for old hands at the profession; its appendix provides a current list of suppliers and services and an up-to-date list of cryogenic materials and material properties. The information in the book's more than 650 pages is confined to temperatures between 1 K and room temperature because, according to Ekin, it is written "with special emphasis on superconductor critical-current measurements."

Ekin does not cover such topics as adiabatic demagnetization, dilution refrigeration, and helium-3 coexistence-curve pressure cooling. Those techniques are treated in Olli V. Lounasmaa's *Experimental Principles and Methods Below 1K* (Academic Press, 1974). And Ekin's book would require another 600 pages or more for those topics. Guy K. White's *Experimental*