efit of nuclear power; the relative radioactivity risks of coal and nuclear (coal is about equal to nuclear over 10 000 years and higher for the first 500 years); cogeneration of electricity and energy efficiency (they are in favor); forecasts for 2050 and beyond (they advise "a certain humility"); and the California electricity crisis of 2000–2001. They are critical of error and exaggeration by both proponents and opponents of nuclear power. While the authors seem to favor nuclear power (in my opinion), their emphasis on objective analysis provides the necessary data for readers to make their own calculations about the relative risks of nuclear and coal power plants.

Both authors are familiar with nuclear weapons, and Garwin has worked on and advised on them since the Manhattan Project. The authors present the basics of a nuclear weapon and stress the critical importance of the choice of the fissionable material. They discuss the need to restrict access to plutonium that is separated during reprocessing of spent reactor fuel, since such plutonium can be used to make an adequate nuclear weapon. The authors cover an increasingly important issue: how to dispose of the large amounts of weapons-grade plutonium becoming available from the START treaties' reduction in nuclear weapons.

Readers interested in understanding the current debates about mixed oxide (MOX) fuel and the Rubbia energy amplifier will find those topics well covered. Since the current US administration has decided to continue supporting programs to safeguard and dispose of Russian weapons material, *Megawatts and Megatons* provides the necessary background to understand the issues involved. (Many in the government could use this book.)

Other topics covered include the subtleties of nuclear strategy; the nuclear arms race ("mutual assured destruction," "sufficiency"), arms control debates, the Strategic Defense Initiative (also known as Star Wars); the Comprehensive Nuclear Test Ban Treaty, and the authors' recommendations on significant reductions in nuclear arms.

Both Garwin and Charpak have been advisers at the highest levels of their governments and bring to this book the insights gained from decades of such service. They support the use of experts as advisers—if independent (both financially and ideologically) and competent—but for providing advice, not making decisions.

The authors' goal is to develop the level of understanding required to make reasoned judgments about nuclear power and nuclear weapons. While some books listed by the authors as further reading have more details on some of the subjects covered here, I know of no one book that provides the breadth and depth that this one does on both nuclear power and nuclear weapons. *Megawatts and Megatons* is a valuable text for anyone interested in becoming informed on two crucial technology areas.

JOHN F. AHEARNE
Chapel Hill, North Carolina

Things a Computer Scientist Rarely Talks About

Donald E. Knuth
CSLI Publications, Stanford, Calif., 2001. $35.00 (257 pp.). ISBN 1-57586-327-8

Many physicists know Donald Knuth as the creator of TeX, which has revolutionized the way we communicate scientific results. Some will know that he is a distinguished computer scientist, one of the giants of the field. But few will know that he is also a devout Lutheran, who has thought deeply about how his academic discipline informs his religious beliefs.

Very few highly regarded scientists are religious, in the sense of believing in a personal God, even though surveys show that close to 90% of the US population believes in God. In a random sample of scientists, roughly 40% say they believe, a percentage that has remained unchanged for over 80 years. But only 7% of members of the National Academy of Sciences profess such a belief. (See E.J. Larson and L. Witham, *Nature* **394**, 313 [1998]). While a number of conclusions might be drawn from these figures, the relevant one in this case is that Knuth is not typical of scientists as eminent as he is.

In 1999, Knuth gave a series of six lectures at MIT as part of the "God and Computers" project. *Things a Computer Scientist Rarely Talks About* is a written version of those lectures and includes the questions and answers that followed each lecture. Knuth's tone throughout is modest. He does not claim to have ". . . solutions to problems that have challenged and baffled the best human minds for thousands of years." Rather, he describes various projects and analyses he has carried out to expand his religious understanding, projects only a computer scientist would undertake. For example, to deepen his understanding of the Bible, Knuth employed statistical sampling. Rather than start at Genesis and see how far he could get, he analyzed in depth chapter 3, verse 16 of each book of the Bible. This allowed him to get a pretty good idea of the Bible's scope without a lifetime of study. From Knuth's book, you can learn how to make your own translation of the Bible even if you don't know any Hebrew or Greek. You probably won't have the clout to commission world-famous calligraphers to prepare beautiful renditions of each of your verse translations, as he did, but you can read about that project here too. (Aesthetics has played an important role in Knuth's work, especially his work on typesetting. Unfortunately, however, the small black-and-white images of the calligraphy in this book are rather disappointing.)

The most engaging parts of the book are the fascinating tidbits you encounter along the way. Here are some examples:

▷ The reason Knuth is listed in the *Guinness Book of World Records*.

▷ Why Knuth thinks users of the Emacs editor have more free will than users of Microsoft Word.

▷ The proposal to Knuth by computer scientist Edsger Dijkstra that the SLAC accelerator should run for only an hour at a time; it should then be shut down so one could think about the results for a year before restarting the machine.

▷ The appropriate scorn Knuth heaps on people who claim to have found hidden messages in the numerology of biblical texts. He points out that applying similar techniques to the license agreement for the Microsoft Access Developers Tool Kit has yielded equally dramatic prophesies.

▷ Knuth's years of frustration at reading popular accounts of quantum mechanics, after which all became clear when he read P. A. M. Dirac and discovered that, "Apparently, when physicists talk to physicists, they talk about linear transformations of generalized Hilbert spaces over the complex numbers."

Knuth has an interesting take on the question of whether God is finite or infinite. Knuth is perfectly happy with a finite God. Being finite isn't much of a limitation, given an appreciation of the immense size of finite numbers, such as Super K, that Knuth discusses.

Despite many enjoyable passages, the book ultimately disappoints. While I can imagine that the lectures might have been wonderful to listen

to, their verbatim transcription to the printed page does not always work well. A large fraction of the lectures centered around Knuth's study of selected verses from the Bible, but the written version comes across as repetitious, with many uninteresting details. Knuth's analysis of the verses is not deep and not particularly informed by a scientific sensibility. And too many of the questions in the question-and-answer sessions were superficial and could have been edited.

Things a Computer Scientist Rarely Talks About is a unique book. Ultimately its charm lies in the author's approach to the subject rather than what he actually finds in the end. As Knuth himself writes, in discussing the purpose of life, "The important thing to me . . . is not the destination, but the journey."

SAUL A. TEUKOLSKY
Cornell University
Ithaca, New York

Helium Three

E. R. Dobbs
Oxford U. Press, New York, 2000. $165.00 (1057 pp.). ISBN 0-19-850640-6

In the preface to *Helium Three*, E. R. Dobbs says that his aim was "to provide a book, in the spirit of [John] Wilks' monograph, covering all known properties of ^{3}He at low temperatures." In this Dobbs has succeeded in superb fashion. In the book's foreword, Olli Lounasmaa, author of *Experimental Principles and Methods below 1K* (Academic Press, 1974), calls *Helium Three* "a monumental piece of work." It is hard to imagine that anyone would choose to disagree with that assessment. Wilks's *The Properties of Liquid and Solid Helium* (Oxford U. Press, 1967) and William Keller's *Helium-3 and Helium-4* (Plenum Press, 1969) provided the most comprehensive coverage of helium since Willem Hendrik Keesom's *Helium* (Elsevier, 1942) and, to some extent, Kenneth Atkins's *Liquid Helium* (Cambridge U. Press, 1959). As Keesom's and Atkins's wonderful books had been to an early generation, the books by Wilks and Keller became the bibles to a more recent generation of physicists interested in the helium gases, liquids, and solids—books to which all would turn for orientation to the literature. Clearly *Helium Three* will have a similar legacy for the current generation of readers with interests in ^{3}He and, to some extent, ^{3}He-^{4}He mixtures. It is a remarkable compendium and detailed guide to the literature of ^{3}He.

Dobbs's book begins with a brief introduction that provides an overview and an orientation to the subject of ^{3}He. Four major parts follow: Liquid Helium 3, Mixtures of ^{3}He and ^{4}He, Superfluid Helium 3, and Solid Helium 3. Together these take up nearly 1000 pages. Dobbs cites roughly 1500 original research publications, review articles, and books. As large as this number is, Dobbs did not try to cite all of the literature, only that extensive collection of works he considered the most important or most relevant. A few references that others might have included are missing, for example, the extensive review of ^{3}He on graphite by Henri Godrin and Hans Lauter in *Progress in Low Temperature Physics, Vol. XIV*, William Halperin ed. (Elsevier, 1995), but the citations are remarkably exhaustive. The author index is excellent and the subject index is extensive.

A major strength of the book is its presentation of reprints or replicas of figures from the referenced literature. These figures contain a wealth of original data, including many illustrations of experimental apparatus and figures designed to make the description of theory more transparent.

Throughout the text, the discussion is clear, at times paralleling the original literature and at other times summarizing and extracting the most relevant information. Sections, for example those on neutron scattering or spin-polarized solutions, typically begin with a brief development of the relevant concepts and basic techniques and then move quickly to an orderly presentation of various experiments, the data, and their interpretation. In all cases, the treatment is comprehensive and experimental results from various sources are brought to bear on the particular subject or issue at hand. In this regard, the book serves as a valuable guide to the original literature and at the same time as a definitive single source for what one may want to know about almost any subject relevant to liquid, solid, or low-dimensional ^{3}He.

The emphasis in the book is on experimental results and their interpretation and comparison to theoretical predictions. Those interested in a more thorough discussion of the theory of superfluidity in ^{3}He are referred by Dobbs to *The Superfluid Phases of Helium 3,* by Dieter Vollhardt and Peter Wolfle (Taylor and Francis, 1990).

Dobbs's *Helium Three* is a very impressive book, one all researchers working in the subject will want to own, and it will serve as an important reference for anyone who requires thorough one-stop information about ^{3}He. Dobbs thanks many people in the preface; the community should thank him for the dedication required to create for us this remarkable book.

ROBERT B. HALLOCK
University of Massachusetts
Amherst

New Books

Astronomy and Astrophysics

Essays on the Motion of Celestial Bodies. V. V. Beletsky (translated from Russian by A. Iacob). Birkhäuser Verlag, Boston, 2001. $169.00 (372 pp.). ISBN 3-7643-5866-1

Gamma 2001. S. Ritz, N. Gehrels, C. R. Shrader, eds. *AIP Conference Proceedings 587*. Proc symp., Baltimore, Md., Apr. 2001. AIP, Melville, N.Y., 2001. $250.00 (968 pp.). ISBN 0-7354-0027-X

Mining the Sky. A. J. Banday, S. Zaroubi, M. Bartelmann, eds. *ESO Astrophysics Symposia*. Proc. wksp., Garching, Germany, July–Aug. 2000. Springer-Verlag, New York, 2001. $54.95 (705 pp.). ISBN 3-540-42468-7

The Nature of Unidentified Galactic High-Energy Gamma-Ray Sources. A. Carramiñana, O. Reimer, D. J. Thompson, eds. *Astrophysics and Space Science Library 267*. Proc. wksp., Tonantzintla, Mexico, Oct. 2000. Kluwer Academic, Norwell, Mass., 2001. $119.00 (355 pp.). ISBN 1-4020-0010-3

The New Cosmos: An Introduction to Astronomy and Astrophysics. 5th edition. A. Unsöld, B. Baschek (translated from German by W. Brewer). Springer-Verlag, New York, 2001 [1991]. $49.00 (557 pp.). ISBN 3-540-67877-8

The New Science of Astrobiology: From Genesis of the Living Cell to the Evolution of Intelligent Behaviour in the Universe. J. Chela-Flores. *Cellular Origin and Life in Extreme Habitats 3*. Kluwer Academic, Norwell, Mass., 2001. $112.00 (251 pp.). ISBN 0-7923-7125-9

Organizations and Strategies in Astronomy. Vol. 2. A. Heck, ed. *Astrophysics and Space Science Library 266*. Kluwer Academic, Norwell, Mass., 2001. $119.00 (280 pp.). ISBN 0-7923-7172-0

Quasars, AGNs and Related Research across 2000. G. Setti, J.-P. Swings, eds. *ESO Astrophysics Symposia*. Proc. conf., Rome, Italy, May 2000. Springer-Verlag, New York, 2001. $34.95 (220 pp.). ISBN 3-540-42191-2

Relativistic Astrophysics. J. C. Wheeler, H. Martel, eds. *AIP Conference Proceedings 586*. Proc. symp., Austin, Tex., Dec. 2000. AIP, Melville, N.Y., 2001. $260.00 (938 pp.). ISBN 0-7354-0026-1

The Restless Universe: Applications of Gravitational N-Body Dynamics to Planetary, Stellar and Galactic Systems. B. A. Steves, A. J. Maciejewski, eds.