derive graphical rules, which are listed in an appendix. In these formal parts, the style is again journalistic rather than scholarly. Because it is so long—500 pages—this book is not for casual perusal. Yet its style makes it unsuitable for use as a text.

An Informal Introduction to Gauge Field Theories by Ian Aitchison is a slim volume that gives a good summary of the ideas underlying the standard electroweak model and QCD. I enjoyed reading it. Aitchison introduces the key theoretical concepts, such as local gauge invariance, hidden symmetry and renormalization, in a beautiful physical and intuitive way. As the title implies, he makes no attempt to discuss the complete formalism. A graduate course would require much more on renormalizability and the renormalization group as well as on QCD and grand unification. The book, nevertheless, introduces its subject excellently and I whole-heartedly recommend it as reading prior to a graduate course on gauge field theory. I was annoyed only by the misspellings of several names, for example, Weisberger (page 95), Georgi (page 124), Veltman (page 127); but this is nit-picking. I know of no better book at the same level.

Despite these favorable remarks, there still remains a gap to be filled with a book on non-Abelian gauge theory as comprehensive as those mentioned above on quantum electrodynamics.

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Tabibito (The Traveler): A Physicist's Memoir

H. Yukawa
218 pp. World Scientific, Singapore, 1982. (US dist. Heyden, Philadelphia). $28.00 cloth, $12.00 paper

Asahi Shinbun, a major newspaper in Japan, persuaded Hideki Yukawa to write his autobiography to commemorate his 50th birthday. Back in 1957, when it began to appear, readers of the daily paper eagerly awaited for the next day's episode. Since *Kadokawa Bunko* published the autobiography as a book, it has gone through at least 36 printings.

In 1949, Yukawa was awarded the Nobel prize at the age of 42. He instantly became a living legend, a symbol of Japanese intellectual ability. What was his childhood like? How was he educated? These questions were not only of passing interest but were and still are of major concern to typical Japanese parents.

Hideki was one of four sons born to Takuji, a geologist, and Koyuki Owaga. From the beginning, the four sons were raised to be scholars. Hideki spent most of his childhood reading Chinese, Japanese and European classics. His fear of his father, making him timid and quiet, was reinforced as he was drawn to books. He was, however, quite open to his mother, who poured all of her energy into raising her children. At class reunions, most of Hideki's primary school classmates expressed surprise because they had expected him to go into literature.

Hideki's interest in mathematics grew in his middle-school years. The same cannot be said for his interest in physics: He could not understand this subject from basic principles. Hideki remembers Albert Einstein's visit to Japan in 1922. Unlike some of his classmates, he did not attend the Einstein lectures in Kyoto. "Why was I so thoughtless? In a few words, not only was I [indifferent to] what was happening outside of my own little world, I did not even know who I was, and what changes were occurring within myself."

Hideki's interest in physics and solving physics problems began to sprout in his high-school years. He quickly found books such as *Quantum Theory* by Fritz Reiche and *Theoretical Physics* by Max Planck more interesting than any novel he had read. Here he found his destination for his *tabi* (travel). His long journey required of him first to catch up with the rapidly advancing fields of quantum mechanics, atomic physics and nuclear physics, second to find his own problems, and third to contribute to these exciting fields. His anxiety grew as he approached the ages of 23 and 24, at which age outstanding scientists—Werner Heisenberg, Paul Dirac, Wolfgang Pauli and Enrico Fermi—had attained major achievements.

Around this time the marriage between Hideki Ogawa and Sumi Yukawa was arranged. Hideki was to marry into the Yukawa family. It is a common practice, in Japan, for a well-to-do family without a son to ask a man to marry into the family. It seems to have been an ideal situation for Hideki, since he was now able to devote himself completely to physics without any financial worries.

Acquiring a companion along the way, he ended his *tabi* with his announcement of the meson theory at the Osaka branch of the Physics-Mathematical Society of Japan. He ends the book: "I felt like a traveler who rests himself at a small tea shop at the top of a mountain slope. At that time I was not thinking about whether there were any more mountains ahead."

In this book, the reader is treated to an inside story of a great man. There are many poems, essays and notes written when Yukawa was a boy. It is fortunate that Yukawa's records were

kept in Kyoto where, because of the temples, they were spared from US bombardments during the Second World War.

The present translation, by Laurie M. Brown and Rirutaro Yoshida, loses none of the intricate feelings of a delicate person. Because the original autobiography was intended for lay readers, it lacks technical details that might interest physicists. In the English version, Brown's introduction and the inclusion of Yukawa's 1934 paper on meson theory provide more scientific material.

The book is rich in many helpful hints for educating a child, in details of Japanese culture of the early 1900s as seen by an upper-middle-class Japanese boy, and in poetry.

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Radiation and Human Health

J. W. Gofman
908 pp, Sierra Club, San Francisco, 1981. $29.95

In many respects, this book is the first of its kind. A compendium of the effects of ionizing radiation on humans, it reviews and evaluates the vast collections of data that have been accumulated on somatic, genetic, and teratogenic damage. Gofman presents the information in a manner that can be understood and put to use both by the specialist and the lay reader. He goes into great detail and provides many examples to clarify the points he wishes to emphasize. While this approach is especially helpful to the student or novice in the subject, at times it is a bit tiresome to the radiobiologist or biophysicist who can grasp the points without detailed explanations.

Gofman aims to demystify a field currently dominated around the world by a small circle of prominent experts. Their expertise will probably be questioned by persevering readers who study the entire text. Gofman, examining the data obtained by these experts, in a number of cases provides strong evidence that the risks of exposure to low-level ionizing radiation are considerably greater than the assessments reached by those who carried out the studies of exposed human populations.

Gofman rightly cautions that his book is not bedtime reading but a reference work designed to answer numerous practical questions. The book is conveniently indexed and arranged so that it can serve as a valuable reference to many topics of current interest: One can review quickly a particular type of cancer—leukemia, skin cancer, thyroid carcinoma—or the history and principal findings of studies of persons exposed to radium-226, plutonium-239 and so forth, or such topics as the effects of x-ray exposure to the fetus, genetically inherited disorders, the cancer incidence among survivors of the atomic bombings of Hiroshima and Nagasaki or malignancies among radiation workers at the Hanford atomic energy facility, without having to wade through more than a few pages.

One does not have to be a geneticist to understand and profit from the sections on chromosomal aberrations, Down's syndrome, X-linked disorders, chromosomal diseases, and mental retardation. The lay reader need not be a mathematician, physicist, or radiobiologist to understand and follow most of the arguments in the text. This effort of Gofman not to lose anyone in his audience of readers, however, may cause some scientists to glance-read portions of the text and concentrate on the vast amount of data given in the tables.

The text is particularly valuable for its many tables of cancer incidence resulting from radiation exposure. One gives the cancer coefficient, that is, person rads per cancer (or the inverse of this) as a function of age at the time of exposure for males and females from ages 0 to 55. From these tables one finds, for example, that there is a sharp decrease in cancer risk between ages 40 and 48. In this eight-year period the cancers per person rem decrease from 1.9×10^{-3} to 2.0×10^{-4} for males and from 1.6×10^{-3} to 1.3×10^{-4} for females. The cancer risk at birth, 1.6×10^{-2} and 1.5×10^{-2} for males and females, respectively, is a continuation of the well-known high risk from *in utero* exposure. The cancer risk is greater for males than for females at all ages in spite of the high specific risk of breast cancer in women. Another table indicates that, of the 46 countries listed, the age-adjusted cancer death rate (excepting leukemia) is lowest in Honduras for males and in Thailand for females. Gofman indicates that for males cancers of the respiratory organs (1.9×10^{-3} cancers per person rem) and of the digestive organs (1.3×10^{-3}) rank highest and for females the highest are cancer of the digestive tract (1.1×10^{-3}), breast cancer (7.9×10^{-4}) and cancer of the respiratory tract (6.1×10^{-4}). Three chapters of the text are directed to the question of plutonium exposure. The reader may be shocked at the conclusion that 950 000 persons worldwide have been committed to a death from lung cancer from plutonium particulates. This is one of the many challenges Gofman presents to the claims of leaders in the nuclear industry, who will have to come up with some specific data if they are to meet these challenges—general criticisms will not suffice.

While many scientists will disagree with Gofman's very large risk estimates from low-level exposure to ionizing radiation, in most cases they will have difficulty in finding serious flaws in his arguments. The scientific community is sharply divided on this issue. The polarization was emphasized in the BEIR-III (1980) report of the National Research Council: Four committee members expressed dissenting opinions about the cancer coefficients given in the report. This book, however, should be read by proponents of all sides of this issue because it will bring into clearer perspective many concepts and controversies and is certain to help objective scientists understand better the reasons for agreement or disagreement on how the data should be interpreted.

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A New Prosperity: Building a Sustainable Energy Future (The SERI Solar Conservation Study)

H. Kelly, K. Gawell

Brick House, Andover, Mass., 1981. $39.50 cloth, $19.95 paper

Energy: The Conservation Revolution

J. H. Gibbons, W. U. Chandler

Plenum, New York, 1981. $17.50

Our Energy: Regaining Control

M. H. Ross, H. Williams

McGraw-Hill, New York, 1981. $16.95

Energy conservation, once derided as a one-shot spitball against the Goliath of dwindling resources, is now seen to be cost-effective, environmentally benign, and good for the country's balance of trade. It is, unfortunately, still boring. This is not the fault of John Gibbons and William Chandler, authors of *Energy—The Conservation Resolution*, nor of Marc Ross and Robert Williams, who wrote *Our Energy: Regaining Control*, nor even of the multitudinous producers (including Williams and Ross) of *A New Prosperity*, who, coordinated by Henry Kelly and Karl Gawell, turned out this massive SERI Solar Conservation study that met official rejection by the Reagan administration. All of these authors have labored diligently to produce books that will not only convey the good news but will also educate the reader in the art of doing energy analysis. To a large extent they have succeeded. The problem lies in the nature of the subject and in the predeliction of physicists.

Let's face it: People become physicists because they like big ideas, expressed concisely. General relativity, Maxwell's equations—these are the kinds of things that draw us to physics even if we end up doing experimental work in amorphous semiconductors or, heaven forfend, energy analysis. Take nuclear power. There was a big idea—strong forces revealed on a macroscopic level providing limitless energy—and a simple idea, too, as all really big ideas are. Take, even, solar energy: the biosphere as an energy-transfer system. Meet human needs through minor redirection of what is already happening, and be assured that our impact on the Earth will be small and