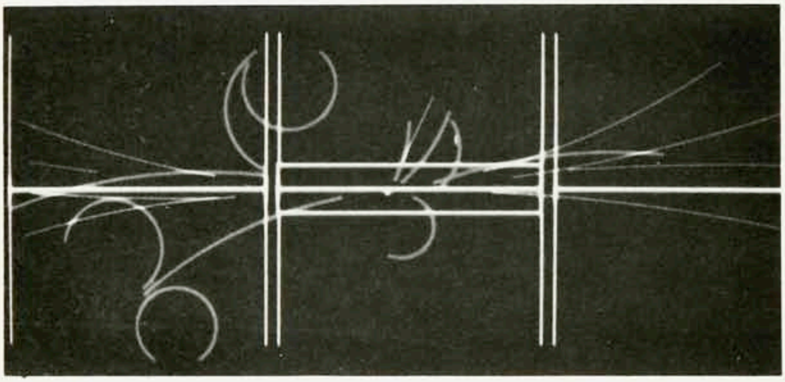
but had few opportunities for pursuing science. There were some academic jobs in normal schools and seminaries, but women physicists depended on women's colleges for employment. Teaching duties were heavy, and not even the elite schools had adequate facilities for research. Only Bryn Mawr had a graduate school. Rossiter reports that by the 1930s the women's colleges were increasingly replacing women faculty by men. For this she blames mainly a growing stress on "the antifeminist concept of 'prestige.'" One may argue the merits, but in fact the colleges gave higher priority to the perceived good of the students than to the hiring of women in preference over men, who were more able both in teaching and in research. The problem is a thorny one. Just as with the employment of blacks and other minorities, there is, in addition to prejudice, the danger that standards are too low (only routine) or too high (demands for proved genius). This remains true today, in almost every kind of employment.

But the letter of the law has changed, if not yet the practice. No longer would Princeton mathematicians need to appeal to Bryn Mawr to find a place for Emmy Noether, already a famous mathematician. And no longer would Robert Millikan feel free to advise the president of Duke University against hiring Hertha Sponer—or any other woman, for that matter. "I might change this opinion if I knew of other women who had the accomplishments and attained to the eminence of Fraulein Meitner." (This was as late as 1936.) Inadequate as the improvement may seem, many advances for women in science have been made since 1940, when the present volume breaks off. One can look forward to a continuation of this readable and scholarly account.



One of five intermediate vector boson events detected in January by the UA1 detector group at the proton–antiproton collider at CERN. These events fulfilled a prediction of the Glashow–Salam–Weinberg gauge theory, discussed in the book review below.

An Introduction to Gauge Theories and the "New Physics"

E. Leader, E. Predazzi
498 pp. Cambridge U.P., New York, 1982. $65.00 cloth, $27.50 paper

An Informal Introduction to Gauge Field Theories

I. J. R. Aitchison
174 pp. Cambridge U.P., New York, 1982. $22.50

Application of non-Abelian gauge theories to both the strong and the electroweak interactions is now almost universally accepted. Gauge theories of the non-Abelian type are apparently here to stay, along with the Abelian prototype of quantum electrodynamics from which they were generalized. Gauge field theory, now synonymous with high-energy theory, forms the essential part of the graduate education of particle physicists, both experimental and theoretical.

Those teaching and studying particle physics, therefore, need good books on gauge field theories. I recall that for graduate students in 1965 several excellent texts covered quantum electrodynamics: *The Theory of Photons and Electrons* (1955) by Josef Jauch and Fritz Rohrlich, *An Introduction to Relativistic Quantum Field Theory* (1961) by Silvan Schweber, *Relativistic Quantum Mechanics* (1964) and *Relativistic Quantum Fields* (1965) by James Bjorken and Sidney Drell. By studying one or more of these books and occasionally going back to the original literature they cited, one could acquire a good working understanding of quantum electrodynamics.

I am hoping to find a comparable book on non-Abelian gauge theory, one that would not devote half its pages to quantum electrodynamics or to the canonical quantization of scalar field theory. This "ideal" book would discuss as formalism: the general rules of constructing classical Lagrangians with local non-Abelian gauge invariance, both exact and spontaneously broken; the quantization of gauge fields using path integrals and the resultant graphical rules, including the important fictitious particles named for Ludwig Faddeev and Viktor Popov; the systematic proof of renormalizability preserving gauge invariance and, for the spontaneously broken case, the use of the gauges introduced by Gerard 't Hooft. This formalism could then be illustrated by the standard electroweak theory developed by Sheldon Glashow, Abdus Salam and Steven Weinberg.

The formalism of the renormalization group is also needed, to explain the asymptotic freedom of quantum chromodynamics (QCD) and the possible unification of strong and electroweak interactions. Finally, for QCD, some discussion of nonperturbative techniques, including the lattice approach, is desirable.

One should mention several reviews and books previously written. Ernest Abers's and Benjamin Lee's *Gauge Theories* (1973) educated a generation, but its treatment of renormalization is now obsolete; John C. Taylor's *Gauge Theories of Weak Interactions* (1976) is excellent but somewhat too cryptic; Claude Itzykson's and Jean-Bernard Zuber's *Quantum Field Theory* (1981) is useful and scholarly but unfortunately only the last fifth is dedicated to non-Abelian gauge theory. All three are worth owning; none fits the "ideal" outlined above.

The first of the two books under review is *An Introduction to Gauge Theories and the "New Physics"* by Elliot Leader and Enrico Predazzi. "New physics" is, of course, strongly time-dependent. In this case it means the discovery of new elementary particle phenomena such as the charm and beauty quantum numbers, the τ lepton, and jets. The authors present a great deal of experimental information along with some tricks necessary to calculate observed quantities. These might have proven useful to a student experimentalist; however, in these sections the authors seem more intent to describe the history of high-energy physics in the seventies than to provide a pedagogic exposition of the experimental results obtained during that time. Because of this reportorial approach, these chapters now have limited interest. The book's coverage of experimental topics does not compare with the excellent exposition given in *Introduction to High Energy Physics* by Donald Perkins (Second Edition, 1982).

Leader and Predazzi also devote considerable space to gauge theory formalism. Their discussion of constructing the classical Lagrangian is adequate, but their treatment of quantization is too sketchy. For instance, they do not

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

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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 infor-