books

The physics of Feynman

Quantum Man

Richard Feynman's Life in Science

Lawrence M. Krauss
W. W. Norton & Company, New York, 2011. $24.95 (368 pp.).
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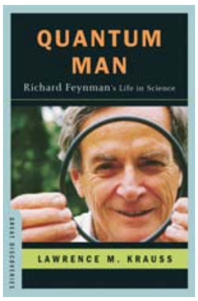
Reviewed by David L. Goodstein

Richard Feynman was my friend and colleague for more than 20 years before he died on 15 February 1988. Knowing him was a thoroughly remarkable experience that informed and illuminated my days.

Nevertheless, the latest biography, *Quantum Man: Richard Feynman's Life in Science*, by theoretical physicist Lawrence Krauss, has greatly improved my understanding of what Feynman did before I met him in 1966. Unlike Krauss's previous popularizations, notably *The Physics of Star Trek* (Basic Books, 2007), *Quantum Man* is about a physicist and for physicists. To be sure, Krauss nobly attempts to make the book accessible to a general audience by including essentially no equations. He says he prepared to write the book by reading all of Feynman's scientific works and much of the secondary literature about him. The book certainly reflects that slant toward science.



Among the many examples of Krauss's writing style is this description of Feynman's path-integral attack on quantum electrodynamics (QED):

> [Feynman] found a way to alter the interactions of electrons and photons at very small scales and very high energies in a manner that was consistent with the requirements of relativity. Pictorially this results from considering the case where the loop in the self-energy diagram becomes very small, and then altering the interactions for all loops that are small and smaller. In this way a provisional result could be derived, which is finite. Moreover, this result could be shown to be independent of the form of the alteration of the interactions for small loops in the limit that the loops become smaller and smaller.

David Goodstein is professor emeritus of physics and applied physics at California Institute of Technology, the creator of the 52-part Public Broadcasting Service series *The Mechanical Universe*, and the author, with his wife Judith Goodstein, of *Feynman's Lost Lecture: The Motion of Planets Around the Sun* (W. W. Norton & Company, 1996).

With descriptions like that, no equations are needed.

Quantum Man introduces John Kosterlitz and David Thouless, who in 1966 were relatively unknown physicists. They produced a theory of two-dimensional phase transitions just like one Feynman independently worked out. I know that to be true because around that time I told Feynman about my work on 2D phase transitions and he was clearly intrigued. A week later he returned to my office with what turned out to be the Kosterlitz–Thouless theory fully formed. Then, just as we were about to write it up, a preprint from Kosterlitz and Thouless arrived in the mail. I tried referring to ours as the Kosterlitz-Thouless-Feynman theory in the literature, but that name didn't stick. Feynman, however, duly gave them full credit.

Krauss says that Feynman didn't produce the Bardeen-Cooper-Shrieffer theory of superconductivity because he didn't follow previous work in the field. In fact Feynman spent a great deal of time and effort trying to explain the phenomenon, but failed because he was using perturbation theory, which can't produce the essential singularity that lies at the heart of superconductivity. He thus failed where BCS succeeded.

Quantum Man paints the broad outlines of Feynman's life: his love for his first wife Arline, his exploits at Los Alamos National Laboratory during World War II, his depressed state at Cornell University after the war, his long battle to understand QED, his trips to Brazil and his sexual conquests there, his marriage to Gweneth Howarth, and his work on *The Feynman Lectures* (Addison Wesley Longman, 1970). All that material is gleaned from secondary sources. Krauss ends with the story of Feynman's struggle with quantum chromodynamics and barely mentions his critical advisory role in the investigations of the *Challenger* disaster. The focus on Feynman's science over his personality or public profile is characteristic of the entire book.

Krauss has written a very good book whose natural audience comprises typical readers of PHYSICS TODAY, not the general public.

Optically Polarized Atoms

Understanding Light–Atom Interactions

Marcis Auzinsh, Dmitry Budker, and Simon M. Rochester
Oxford U. Press, New York, 2010. $79.95 (376 pp.).
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The teaching of atomic structure has undergone something of a metamorphosis in the past decade or so. Traditionally, the subject would be served to third- or fourth-year undergraduate students in a one-semester course—sometimes with a laboratory component as added seasoning—as a means to exercise their recently acquired quantum mechanics skills. The course usually relied on such texts as E. U. Condon and G. H. Shortley's classic *The Theory of Atomic Spectra* (Cambridge University Press, 1935) or B. H. Bransden and C. J. Joachain's compendious *Physics of*