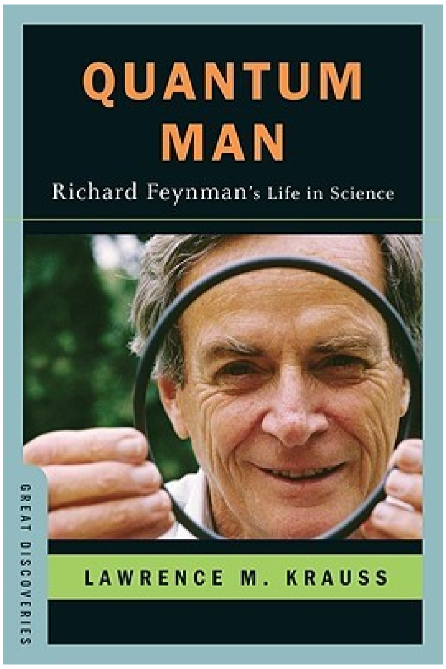


# Quantum Man: Richard Feynman's Life in Science

*Lawrence M. Krauss*

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**Quantum Man: Richard Feynman's Life in Science** Lawrence M. Krauss
Perhaps the greatest physicist of the second half of the twentieth century, Richard Feynman changed the way we think about quantum mechanics, the most perplexing of all physical theories. Here Lawrence M. Krauss, himself a theoretical physicist and best-selling author, offers a unique scientific biography: a rollicking narrative coupled with clear and novel expositions of science at the limits. An immensely colorful persona in and out of the office, Feynman revolutionized our understanding of nature amid a turbulent life. Krauss presents that life—from the death of Feynman's childhood sweetheart during the Manhattan Project to his reluctant rise as a scientific icon—as seen through the science, providing a new understanding of the legacy of a man who has fascinated millions. An accessible reflection on the issues that drive physics today, *Quantum Man* captures the story of a man who was willing to break all the rules to tame a theory that broke all the rules.

## Quantum Man: Richard Feynman's Life in Science Details

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| ISBN | : | 9780393064711 |
| Author | : | Lawrence M. Krauss |
| Format | : | Hardcover 368 pages |
| Genre | : | Science, Biography, Physics, Nonfiction, History |

# From Reader Review Quantum Man: Richard Feynman's Life in Science for online ebook

## Bryan Higgs says

I enjoyed reading this book. I had already read the very good biography of Feynman, Genius: The Life and Science of Richard Feynman, but some time ago. This book goes into Feynman's physics in more detail, and with more context, than "Genius", which, from my perspective as a Ph.D. in Physics and one who has read fairly widely about Physics since retiring from a job that took me away from Physics for more than 30 years, is a good thing. However, I can understand how some others with less of a physics background might have found this a little tough going (although I don't think the book contains a single equation).

When I was an undergraduate in Physics, one of the recommended books was Feynman's classic The Feynman Lectures on Physics, which I found quite readable. Interestingly, it was never an assigned book in any of our courses. The more I learned about Feynman, the more interesting a character he became in my mind. In fact, when I applied to graduate schools, I wrote to him in the hope that I could become one of his graduate students (ah, the innocence of a callow youth!). Therein lies another story that I won't bore you with in this review. Suffice it to say that Feynman was then, and still is, a hero of mine.

In the intervening years I have learned more about Feynman, and have come to the conclusion that I probably would not have enjoyed being one of his graduate students, because I would not have been of sufficient caliber, and because he was not known for his support of graduate students.

This book gave a little more insight to his non-conformist genius, and made me aware of how influential he was in so many areas other than those for which he was awarded his Nobel Prize. I knew he had been in at the very beginning of nanotechnology, and this book filled in some of those details.

Overall, I highly recommend this book, as long as you are prepared to read and try to understand the physics parts.

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## Javier Santaolalla says

Muy buena introducción a la vida y obra de Richard Feynman, uno de los mayores genios de la historia. En esta biografía el profesor Krauss indaga no solo en sus avatares, su frenética vida, sino que profundiza en su obra. Se analizan sus logros científicos con detalle y precisión, poniendo en relieve la originalidad e importancia científica de su obra.
Muy buen libro, una de mis principales fuentes para el vídeo sobre la vida de Feynman:
https://www.youtube.com/watch?v=K5l5r...

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## Carl Rollyson says

Nearly anyone writing about Richard Feynman is bound to seem staid compared with the man himself. The physicist, who won a Nobel Prize for explaining the interaction between electrons and protons in terms of quantum mechanics, was among the century's most celebrated popularizers of scientific thinking. His public talks were transformed into entertaining books like "Surely You're Joking, Mr. Feynman!" (1985), and he was known for stunningly simple explanations, such as when he explained the disintegration of the space shuttle Challenger using a glass of ice water and one of the rocket booster's defective carbon o-rings. He was also famous for his quirky interests outside of physics—dancing, drawing, bongo playing, a devotion to strip clubs.

Lawrence M. Krauss is a physicist, and "Quantum Man" is part of a series dedicated to lives in science, meaning that much of the book consists of technical explanations that will be challenging for general readers. Mr. Krauss often seems to be addressing physics students. While it is undoubtedly important for readers to grasp Feynman's scientific work, Mr. Krauss rarely uses the sort of crystal-clear language with which Feynman himself used to enlighten listeners. Here, for example, is Feynman's introduction to physics for undergraduate students as recorded in the "The Feynman Lectures on Physics: The New Millennium Edition" (2010):

"If, in some cataclysm, all of scientific knowledge were to be destroyed, and only one sentence passed on to the next generations of creatures, what statement would contain the most information in the fewest words? I believe it is the atomic hypothesis (or the atomic fact, or whatever you wish to call it) that all things are made of atoms—little particles that move around in perpetual motion, attracting each other when they are a little distance apart, but repelling upon being squeezed into one another.

It would be misleading to imply that Feynman's lectures are always as lucid as his one-sentence definition of the atomic hypothesis. But in many cases Mr. Krauss could have simply availed himself of his subject's own words.

Furthermore, even in a biography devoted to a man of science, the man has to emerge in situ, and such is rarely the case in Mr. Krauss's book. Perhaps because so much has already been written by and about Feynman, Mr. Krauss takes his subject's personality for granted. As Feynman himself liked to counsel young scientists: Never rely on the experiments of others. A biographer of Feynman should approach this most unusual genius by doing something fresh.

Mr. Krauss certainly finds room to discuss Feynman's offbeat personality, but he refuses to speculate on how it might have influenced his science. To be sure, Feynman disparaged the notion that his interests outside of science had anything to do with his physics. But such denial should serve to challenge the biographer: Feynman never worried about looking like a fool—as he said countless times to anyone who would listen—and neither should his biographer.

Take Feynman's desire to understand how electrons can behave as particles, as waves and as both, all at the same time—and can even be in two different places at once. Such behavior is not possible according to classical physics, but quantum mechanics suggest that it is. Feynman may have understood such logic—at least in part—because he retained a child-like quality, a sense of play, throughout his life. In a child's world you can be here and elsewhere at the same time—in Kansas and with the Wizard of Oz.

Linkages of these sorts can in fact be forged by reading Mr. Krauss alongside Feynman's own posthumous publications, such as "The Meaning of It All: Thoughts of a Citizen Scientist" (1998) and "The Pleasure of Finding Things Out" (1999), in which Feynman discourses about himself and his intellectual adventures. Usually the biographer serves as a kind of check on a subject like Feynman, who, it is presumed, mythologized himself as most autobiographers do. But in this curious case, Feynman has to be consulted to make sense of his biographer's narrative.

James Gleick's "Genius: The Life and Science of Richard Feynman" (1992) is a more supple treatment of the same basic material. To pick just one example, Mr. Krauss does not mention until page 210 that Feynman's sister, Joan, was also a physicist, while from Mr. Gleick we learn that she served as his lab assistant early in his career. Even so, neither volume quite gives readers the sense that they have penetrated beneath the flamboyant physicist's public pose—if that's what it was. Could Feynman really have been as genial and entertaining a fellow as he seemed? After all, Mr. Gleick notes that many of the justly famous Feynman sayings that seemed so spontaneous in his lectures and interviews were in fact labored over in private.

Yet consulting his selected letters, "Perfectly Reasonable Deviations From the Beaten Track" (2005), reveals the same amusing, shrewd character, evident on every page. This correspondence demonstrates that Feynman was not only a great monologist but a good teacher and interlocutor. One of the best letters is Feynman's reply to a publisher complaining that physics professors were selling complimentary copies of textbooks sent to them. Feynman argues that the very sending of the books accomplishes the publisher's purpose: advertising his wares. If the re-selling of promotional copies prevented the publisher from making a decent profit, Feynman advised, he should stop sending them. As for himself, Feynman concluded, he returned unsolicited books—but now, come to think of it, the publisher had given him a new idea about what to do with them.

Besides entertaining himself, why would Feynman spend so much time on such trivial correspondence? (The letter to the publisher is by no means atypical.) This question Mr. Krauss, for one, never asks. When he observes behavior in Feynman that he does not understand, he simply calls it "paradoxical." Perhaps the point about Feynman's character that this reveals is that nothing—at least potentially—was beneath his notice. Just as Feynman wanted to explore the constituents of the atom, he wanted to fathom other minds and would happily engage, say, a member of the John Birch Society in a discussion of the U. S. Constitution rather than simply dismiss extremist views—or even ridiculous ones. There is a lesson there about curiosity that his biographers would do well to heed.

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### Jason says

This book is an interesting combination of biography and introductory physics. The life of Richard Feynman is intertwined with discussions of physics. While it might make for slow going for some, I quickly came to see that, to understand Feynman's life and work, one needs to have even a minor grasp upon and understanding of the questions with which he grappled throughout his life. Krauss does a fairly good job of keeping the physics at the level of the general reader, though I thought there were times where the discussion became bogged down in details and asides.

I have not read other biographies of Feynman, so I cannot comment on how this compares to them. As a basic introduction to Feynman and the physics questions of the twentieth century, it's pretty decent.

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### M says

This book is about theoretical physicist Richard Feynman and is written by Lawrence Krauss, who is also a theoretical physicist. Krauss says his book is "accessible," but I strongly disagree. To me accessible means that the content could be read by a lot of different people and still be appreciated. I think that even people who are knowledgeable in physics would have trouble following this book. I listened as a an audio book, which probably made it even harder to follow. The central focus of the book is Feynman's major scientific achievements and the processes by which he arrived at his conclusions (or lack thereof). It also talks a little bit about his personal life, his work on the Manhattan Project and his interactions with others in the scientific community. But mostly the book returns again and again (I think) to Feynman's attempt to remove the infinities from an equation that describes the number of possible pathways that an electron can take between point A and B. This is called the sum-over-paths equation (or the path-integral formulation of quantum mechanics). If you don't know what this is, this book might not be too fun for you. Despite some training in physics, much of the book was incomprehensible to me. But what I did find interesting was Feynman's admirable tenacity to chase down an idea. You learn a lot about the scientific process, competition, politics and drama in academia. But what might be most important is just to remember that there are many ways to go from point A to B, we just don't know if that number is infinite or finite, yet. Or maybe we do know. I don't know. If you are interested in a book about Richard Feynman that is accessible, I would suggest, "Surely you're joking Mr. Feynman" that Feynman wrote himself and is highly accessible.

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### Ahmed Fawzy says

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### Ibrahim Majed says

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### Will says

This is a really good book but I can see why it got so many relatively poor reviews. Krauss explains Feynmann's work very well, and provides an arresting and insightful account of how his thinking developed over the decades. But it is about physics, not just the man and those aspects of Feynmann's life that made him an internationally-recognized name. I heard Feynmann lecture a couple of times myself and it's true, he was as dynamic and awe-inspiring as Krauss makes clear; on the other hand I have to admit I didn't fully understand the lectures either.
But it is such a joy to read a biography that isn't written by a popularizer who doesn't understand the subject matter enough to be other than an uncritical booster, that it really is worth the effort to read this bio.

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### Michael says

I found this book very good at explaining Feynman’s contributions to physics from the context of the history of the science and ideas. It was a great complement to Glieck’s wonderful “Genius”, a biography which focused on the special qualities of his mind and personality. Krauss is a physicist himself, so the advantage here is his ability to convey the science as much as possible (without resorting to equations), and in the process he elucidates the paradoxical blend of individual genius, collaboration, and competition that drives progress. I came away with a deep respect for how Feymann’s ideas fueled not only his own successes with a theory of the electromagenetic force but seminal influences on work of others on all the other fundamental forces (strong and weak nuclear forces and gravity). Also, I understand better his pioneering work on superfluidity (which led to big advances by others in superconducters), foundational thinking about nanotechnology, and advances in computations science and prospects for quantum computing.

Like many ordinary citizens of the world, there is only so far I can get toward truly understanding the science of quantum physics. I was a biology major required to take physics in college in the 70’s, and I struggled through with a C in a standard intro course. But for a make-up class, I wrangled permission to take an intro to quantum mechanics and somehow took to it enough to garner an ”A”. I succeeded in imbibing the basics accepted at that time for accounting for the electromagnetic force and the yawning gap in attaining Einstein’s dream of a unified theory encompassing the other forces with a coherent scheme. I admired the innovation of “Feynmann diagram” which allowed one to visualize an interaction between particles in collision with tracking of exchange of photons to mediate the forces leading to changes in trajectories before and after. His diagrams combined with his path integral approach was seen by Feynmann as mathematical tricks that served to bypass (“normalize”) a lot of infinities that Dirac discovered as spoiling the success of the Copenhagen school model when one applies probability wave descriptions to situations beyond a simple hydrogen atom hanging out (in my dim understanding). But Krauss seems to favor the school of thought that the tools themselves, once found to be essential for the theories of the weak and strong nuclear forces, somehow represent a fundamental theoretical capturing of how reality works.

*Simplest Feynmann diagram showing a collision between two particles, p, with exchange of momentum k mediated by a photon indicated with a dotted line*

The picture that Krauss paints reveals Feynmann as quite collegial in many ways and driven more by the common enterprise of finding principles than in seeking selfish glory and ownership of original ideas. Yet he was also quite a loner and driven by a form of hubris that didn't trust the work of others unless he could derive their advances in his own way. He often neglected advances with other approaches that might have helped his own progress. By the time he was 15 he had taught himself most branches of mathematics and his own ways of deriving proofs. He is famous for applying so-called path integrals as a mathematical approach to handling all the probability wave dynamics between one point and another, which proved essential for a Nobel-winning breakthrough in the quantum model for the electromagnetic force known as quantum electrodynamics. Krauss cites an early kernel of his methods in his high school fascination with the calculus innovations of Lagrange and Hamilton for describing pathways of motion based on accounting for continual interplay of potential and kinetic energy.

Where I fail in confidence is in my understanding of the status of virtual particles and the energy inherent in a vacuum. Feynmann's modeling made use of brief creation of particle pairs such as a photon and anti-photon, which could then annihilate each other with no violation of conservation laws. The virtual particles can have negative energy, and mathematically an antimatter particle can sometimes be described as like its counterpart running backward in time. What I can grasp is like Dirac's prediction of antimatter and its confirmation by experiment, the application of quantum probability treatment to the nuclear forces by Feynmann's Caltech colleague Gell-Mann predicted a host of particles similarly confirmed in high-energy collider studies. There were a couple of decades where there was a zoo of particles being predicted and discovered, and it all seemed mad. The solution of multiple quarks with properties of charm, color, and spin I now just shake my head over in dumb amazement. The final count I read in Wiki is 61, all elegantly systematized. The take home message I can manage is all forces are conceived as mediation by the quantized energy packets/particles, photons for the electromagnetic force, gluons for the strong nuclear force, and quarks for the weak force now integrated with electromagnetic as a unified electroweak force. Feynmann had his own scheme called partons, but he ultimately acknowledged Gell-Mann's conception of quarks as more comprehensive. He dabbled with parallel quantum field representations of gravity mediated by gravitrons, but no clue to how to experimentally prove of their existence has been developed yet.

The book integrates coverage of his personal development, including his wives, his womanizing, his affinity for drumming, his humor, and his dedication to teaching. But such delving is not a strength of this book. The Glieck biography and his own memoirs (e.g. "Surely You're Joking, Mr. Feynmann") are more satisfying in that regard. If you feel ready to be walked through a lot of physics without the challenge of equations (and thus without hope of attaining a deep appreciation of the subject), or have any interest in how science evolves from individual and collaborative achievements, then I bet you can gain more from this read than you might expect.

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### Nick says

This is not a full biography, but rather one that attempts to explain, for non-physicists, just why Richard Feynman was and is one of the most important scientists of the twentieth century. Krauss succeeds admirably in assessing Feynman's importance and his outsize influence on physical science which has endured for several decades after his death. Krauss argues convincingly that Feynman's importance will continue to grow as our knowledge of physics grows.

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### Ulla Al-Najjar says

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### Bob Nichols says

As in other accounts, Feynman as a person is interesting. In this account of Feynman's life, Krauss does a good job. Krauss lost me quickly, however, in his discussion of Feynman's quantum physics. Acknowledging that particle physics is a tough nut to crack, this is not a book, perhaps, for the general reader.

The best part of this book was toward the end when Krauss describes Feynman's attempt to seam particle physics with gravitation and general relativity, which Feynman called a quantum theory of gravitation. Krauss notes that while general relativity had become “an entirely self-contained field that could be understood apart from almost all of the rest of physics,” Feynman “rightly believed such a separation was artificial.” With gravitational waves, Feynman believed that “general relativity is not that different from the theories describing the other forces of nature. It can be described by the exchange of fundamental particles just like the rest.”

The discussion of Feynman's “quantum cosmology” where the universe is viewed as operating via quantum mechanics was difficult to follow, but was tantalizing, as was the discussion and statement that “the total energy of the entire universe might be precisely zero.” Boiled down, is the cosmos about energy differentials and balance?

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### Richard says

A very good book about Feynman that complements other biographies of him by focusing almost completely on the actual science. Krauss is skilled at explaining that science for the lay reader, but I suspect this book works much better as a reading experience. I was trying it as an audio book, and I think that was a mistake. I found myself having to go back a lot as I kept missing details and losing the thread.

This is definitely a book I'll revisit as a print/e-book, though. I would recommend others try it that way, and give the audio book a pass.

### Vlad says

Excellent scientific biography of Feynman. Going thru the Los Alamos years, improvement on Dirac's interpretation of QED, the rise of anti-particles, the Theory of Positrion 1949, the work on quantum field theory.

Creation of Feynman diagrams.
Vacuum polarization.
Radiation is photons.
Friendship and work with Hans Bethe.
Lamb shift calculations http://en.wikipedia.org/wiki/Lamb_shift
http://en.wikipedia.org/wiki/Shelter_...
Space-time approach to QED

Feynman on Scientific Method: http://youtu.be/EYPapE-3FRw

Improvement on Dirac: how quantum mechanics can be expressed in terms of a Langrangian

Probability amplitudes for paths, weight for probability is expressed in total action; add up all weights for the separate paths

relativity and QM require a theory than can handle a posibility of infinite virtual particles at a given instant

1963 Roger Penrose: past the event horizon falls into a singularity (infinity)

Julian Schwinger approach to QED at the http://en.wikipedia.org/wiki/Pocono_C...
Freeman Dyson's first papers in 1949 using Feynman diagrams: unfies Schqinger, Feynman and Takana
The Slotnick incident
removing infinities from QED
the emergence of masons, condensed physics (low temperatures)
Feynman interested in Bose-Einstein condensation transitions
Murray Gell-Mann: new symmetries, quarks

Alan Guth: originator of inflation

"The game I play is a very interesting one. It's imagination in a tight straigtjacket".

Scanning tunneling microscopes and atomic force microscopes

Tsung-Dao Lee (born November 24, 1926) is a Chinese-born American physicist, well known for his work on parity violation, the Lee Model, particle physics, relativistic heavy ion (RHIC) physics, nontopological solitons and soliton stars.

http://en.wikipedia.org/wiki/Chen_Nin...

weak interaction violates parity, beta decay

http://en.wikipedia.org/wiki/Robert_M... chair of Rochester Conference
In 1957, he and George Sudarshan proposed a V-A ("vector" minus "axial vector") Lagrangian for weak interactions, which was later independently discovered by Richard Feynman and Murray Gell-Mann.

The Feynman Gell-Mann paper on V-A

Feynman and Gell-Mann interrupting young Steven Weinberg who later unified weak interactions with electromagentism

Feynman lectures in 50s at Caltech

The Feynman Lectures on Physics is a 1964 physics textbook by Richard P. Feynman, Robert B. Leighton and Matthew Sands

The NBC interview

The Character of Physical Law book based on the 6 Messengers Lectures

A quantum world and a classical world can never be equivalent.

1985 paper: no quantum computation can be done without loss of heat/energy

Group theory, Gell-Mann, 1961, polyhedra, SU3, rotations, change particles into each other, "8 fold way", Buddha's 8 way, decouplet => new particle called "omega-minus", "nuclear democracy"

Feynman at http://www6.slac.stanford.edu/
Are partons real?

gauge symmetry ensures that the photon is massless

quantum chromodynamics, YangMills
David Gross and Frank Wilcheck -> QCD can explain strong interactions?
=> asymptotic freedom

confinement not fully proved to date

path integral formulation is the only formulation now

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### Louise Silk says

I was not at all familiar with Richard Feynman until reading this very down-to-earth understandable biography that brings out the essence of a true scientific genius in the league of Einstein.

Krauss details Feynman's scientific contributions, their relevance, importance and uniqueness in fairly easy to understand layman's terms. He also delves into Feynman's more publicly known activities, including his bongo playing, nude painting and his famous demonstration of the failure of the O-rings in the Challenger space shuttle disaster.

Feynman's great influence on physics was not just the direct impact of his original ideas but also his compulsive need to work out everything from first principles, understanding it inside out, backwards and forwards and from as many different angles as possible-to think outside the box. He insisted on honesty and truth in science, reporting the negative as well as the positive results.

Richard Feynman was a scientist with striking intellectual originality that allowed him to look at the physical world in wholly unanticipated new ways. The biography does a good job of demonstrating that true success needs fearless determination and an unwavering belief in truth.

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