



My Life with Einstein

N. David Mermin

On 25 March 1935, the *Physical Review* received a paper from Albert Einstein, Boris Podolsky, and Nathan Rosen, with the title “Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?” A few days later, on 30 March 1935, I was born. My life with Einstein was off to a promising start.

Some would call it an inauspicious start. Abraham Pais, for example, says in his otherwise admirable biography of Einstein¹ that “the only part of this article that will ultimately survive, I believe, is this last phrase [*No reasonable definition of reality could be expected to permit this*], which so poignantly summarizes Einstein’s views on quantum mechanics in his later years.” But today, in this centenary of the Einstein annus mirabilis, as the EPR paper and I both turn 70, it is, in fact, the most cited of all Einstein’s papers.² The debate over its conceptual implications rages hotter than ever, and for the first time, practical (well, for the moment still *gedanken* practical) applications of the EPR effect have emerged in cryptography and in other areas of quantum information processing.

Being only five weeks old, I was unprepared to pay attention to the article that appeared in the *New York Times* on 4 May 1935 under an elaborate set of headlines and subheads:

EINSTEIN ATTACKS QUANTUM THEORY

Scientist and Two Colleagues
Find It Is Not ‘Complete’
Even Though ‘Correct’

SEE FULLER ONE POSSIBLE

Believe a Whole Description of
‘the Physical Reality’ Can Be
Provided Eventually.

And I was completely oblivious to the stern rebuke from Einstein himself, published three days later in the *Times*, which declared that “any information upon which the article . . . is based was given to you without my authority. It is my invariable practice to discuss scientific matters only in the appropriate forum and I deprecate advance publication of any announcement in regard to such matters in the secular press.”

Apparently Podolsky had tipped off the *Times* to the article, which did not appear in the sacred press until the 15 May issue of *Physical Review*. It is not clear that Einstein ever forgave him, and I wish I had been old enough to send Podolsky a cross letter myself.

Anyone growing up in America in the 1940s knew that the preeminent genius of our age, and perhaps of any other, lived in Princeton, New Jersey, had a predilection for baggy sweaters, and was always badly in need of a haircut—as far ahead of his time in dress and grooming as he was ahead in science during his 1905 annus mirabilis. Because I had no trouble learning algebra, during the early years of my adolescence I was widely addressed by my peers as “Einstein,” as were bright schoolchildren across the nation. Although it was not entirely a term of praise, having definite connotations of “get a life,” it never really bothered me. I think this had to do with growing up Jewish and first becoming aware of world news at the time when the Nazi program to murder us was in high gear. I took great pride in the fact that Einstein was Jewish—talk about role models!—and tended to think of him as a kind of distant uncle whom, alas, I had somehow never actually met.

So I was naturally drawn to reading semi-popular books about relativity in junior high school and was under the illusion that I knew quite a bit about it by the time I reached my first physics class in high school. I did not endear myself to the teacher—a retired World War I colonel—when I raised my hand to question his assertion that mass was conserved. To my disappointment he knew even less about relativity than I did. He made

it clear that the subject would not and should not ever be mentioned in the class again.

Still under the illusion that I understood special relativity, I submitted a nonsensical derivation of the Lorentz–Fitzgerald contraction to the Westinghouse Science Talent Search, and was invited up to MIT as a regional semifinalist to present my project. At that point I learned that the semifinalists were selected entirely on the basis of a science “aptitude test,” and I realized that my derivation was rubbish. So I spent an embarrassing couple of days hobnobbing with MIT faculty and fellow high-school students who did know what they were talking about, and emerged more committed than ever to learning relativity.

This didn’t happen until 12 years later when, as a beginning assistant professor at Cornell, I offered a course in relativity to high-school science teachers in a quixotic effort to spare other kids my disappointing encounter with the Colonel. I had to think my way beyond the elaborate formalism I had learned in graduate school to what the subject was really about, putting myself into the shoes of Einstein in 1905 and experiencing for myself the fun he must have had figuring it all out.

After writing a little book based on my course for the high-school teachers,³ I found my life with Einstein expanding in quite unrelated directions. My appointment at Cornell was in a laboratory of atomic and solid-state physics, which made me nervous, since I didn’t know anything about solid-state physics. Harvard had relegated the subject to the distant realm of applied physics at the time I was there as a student. So I started to learn it by the time-honored method of writing a book, in indispensable collaboration with my more knowledgeable friend Neil Ashcroft.

And there was Uncle Einstein again, presiding over the birth of the

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quantum theory of solids in 1907 by pointing out that Max Planck's extraordinary explanation for the high-frequency cutoff in the blackbody spectrum also accounted for the anomalous drop in the heat capacity of solids at low temperatures.⁴ A man who had scaled the heights of pure thought to understand that the solution to a problem in electromagnetism lay in the realization that "time was suspect" was also willing to busy himself with a dreary problem in applied physics. This was a marvelous antidote to my Harvard education. That Einstein solved the problem using a method that most of his distinguished colleagues still viewed with deep suspicion made it all the more delicious.

This encounter with Einstein in solid-state physics marked the beginning of a trend. Whenever I moved to a new area of investigation, Einstein greeted me. When I became interested in phase transitions, there he was with a 1910 paper, refining Marian Smoluchowski's observation that density fluctuations at the critical point were the source of critical opalescence.⁵ When certain discoveries of my Cornell colleagues Bob Richardson and Dave Lee with their student Doug Osheroff distracted me into the study of superfluids, there was Einstein again with his 1924 discovery that Satyendra Bose's quantum theory of a gas of identical particles led to a curious condensation phenomenon at low temperatures.⁶

Einstein was also an inspiration to me as a writer, having produced some of the finest pieces of scientific exposition I have ever come across. I remember vividly his explanation of why there is a place on the beach between the water and the dry sand where it is easiest to walk. (I have been unable to track down this explanation even with the help of Google—can you, dear reader, supply me with a reference?) What makes the sand firm, Einstein noted, is water that partially covers adjacent grains. Surface tension draws the grains together to minimize the water's interface with the air. If the sand is only a little wet, there are only a few necks of water bridging each pair of nearby grains, and the sand is loose, soft, and difficult to walk on. And if the sand is quite wet there are only a few necks of air, and it is again difficult to walk. But when the sand is neither too wet nor too dry, then there is a lot of air–water interface working to pull nearby grains together and the sand becomes firm and easy to traverse!

To some, "Einstein on the beach" may evoke the Philip Glass opera, but

to me it means how to find the easiest place to walk along the shoreline and understanding, thanks to Einstein's lucid explanation, why the method works. I love to walk along the beach. And Einstein is always with me when I do.

His pre-teabag explanation of why tea leaves collect in the center of the bottom of the cup when you stir vigorously, even though the leaves are obviously heavier than the water, is another masterpiece of scientific writing.⁷

And when I was in college, during the dark and dreary depths of the McCarthy period, Einstein's forthright and eloquent statements were an inspiration and are not without resonance today.⁸

Every intellectual who is called before one of the committees ought to refuse to testify, i.e., he must be prepared for jail and economic ruin. . . . This refusal to testify must not be based on the well-known subterfuge of invoking the Fifth Amendment against possible self-incrimination, but on the assertion that it is shameful for a blameless citizen to submit to such an inquisition and that this kind of inquisition violates the spirit of the Constitution. If enough people are ready to take this grave step they will be successful. If not, then the intellectuals of this country deserve nothing better than the slavery which is intended for them.

Einstein could be just as outspoken on scientific matters. In 1928, just three years after the birth of quantum mechanics, he wrote to Erwin Schrödinger:⁹

The Heisenberg–Bohr tranquilizing philosophy—or religion?—is so delicately contrived that, for the time being, it provides a gentle pillow for the true believer from which he cannot very easily be aroused. So let him lie there.

Although my sympathy for this assessment of the Copenhagen interpretation of quantum mechanics waxes and wanes (it is currently waning), this is as eloquent a polemical statement about science by a scientist as I have ever seen.

So I was amazed and delighted when I again felt the presence of Einstein in the pages of the *New York Times* on 24 June 1985. An advertisement announced a sale at Lord and Taylor's department store: "50% off every size—soft-flowered sheets and

our own Quantum pillows!" Particularly recommended were "medium support" Quantum pillows, presumably for those who did not rely totally on Niels Bohr and Werner Heisenberg for their peace of mind, but were capable of a little independent thought of their own.

The latest chapter in my life with Einstein has just concluded with the appearance of a new book on special relativity for the general reader.¹⁰ In the course of 37 years I came to realize that in many respects I preferred Einstein's 1905 approach to relativity to my own 1968 effort. But I flatter myself that he would have enjoyed a few of the new wrinkles I bring to the subject, inspired in my expository efforts by his beautiful reading of the tea leaves.

That Einstein will be in my future life is assured. For these days, I work in the quantum-information field, where "Einstein locality" is all the rage, and what it means and whether or not quantum mechanics violates it is, in my opinion, still up for grabs. It's strange, though on the whole a good thing, that 2005 has been celebrated as the 100th anniversary of his annus mirabilis, rather than consecrated as the 50th anniversary of his death. Since he'd be 126 years old today, one can't really mourn his absence from the playing fields of quantum information theory, but surely some aspects of that particular game would have given Einstein considerable pleasure, not to mention the unimaginable pleasure we would have had trying out our ideas on him.

References

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