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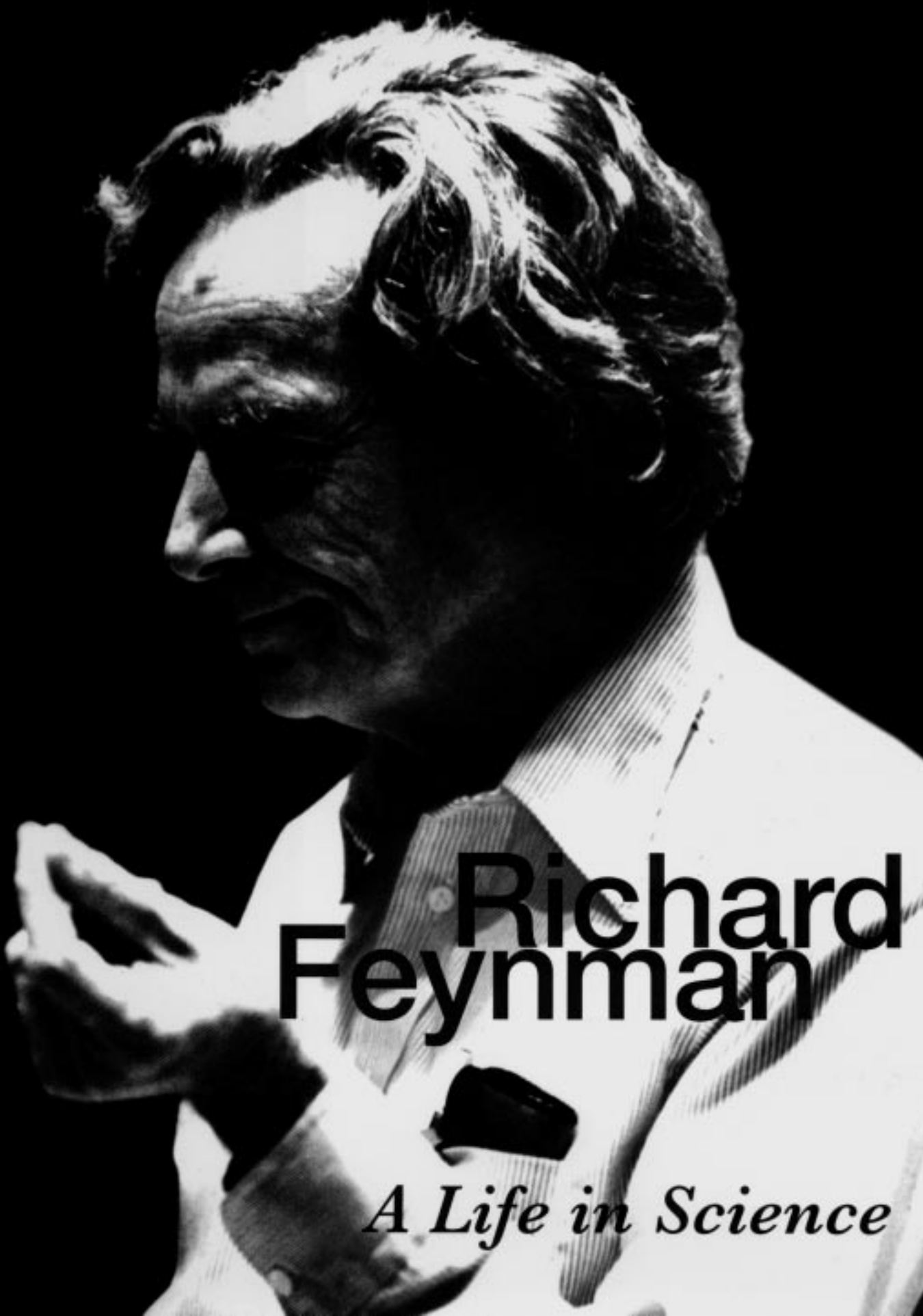

Richard Feynman

A Life in Science

JOHN GRIBBIN & MARY GRIBBIN

VIKING

Another physicist, Richard Sherman, saw just how tremendous Feynman could be in this problem solving role, when Sherman was halfway through his first year as a graduate student at Caltech, doing research on superconductivity. He was in Feynman's office, writing up equations on the blackboard, and Feynman was analysing the work almost as quickly as Sherman could write. Then, the telephone rang. The caller had a question about a problem in high-energy physics. Feynman immediately switched into a discussion of the complicated problem involved, talked for about 10 minutes and resolved the caller's difficulty. He hung up the phone, switched back to superconductivity and carried on exactly where he had left off, until the phone rang again. Somebody else had a problem, involving solid state physics. Feynman solved it, and went back to superconductivity again. 'This sort of thing went on for about three hours – different sorts of technical telephone calls, each time in a completely different field, and involving different types of calculation. [It] made a tremendous impression on me. It was staggering. I have never seen that kind of thing again.'[15]

Another Caltech graduate student, who was supervised by Murray Gell-Mann in the 1960s, unconsciously echoed Marc Kac's comments about the nature of genius (which he was unaware of at the time) when he told us that 'Murray was clever, but you always had the feeling that if you weren't so lazy and worked really hard, you could be just as clever as him. Nobody ever felt that way about Dick.'[16] Feynman may not have built up a large school of graduate students under his direct supervision, but he was a father figure and inspiration to all the graduate students in physics at Caltech during his time there, even the ones supervised by Gell-Mann!

Hagen Kleinert, who now works at the Institute for Theoretical Physics in Berlin, visited Caltech as a young professor in 1972. 'I had actually been hired by Gell-Mann,' he told us, 'but he was very hard to learn from since he always pretended to know everything from pure intuition without any ditch work.'[17] The person Kleinert learned most from during his visit was Feynman, who gave a weekly seminar on the path integral approach to the young postdoctoral researchers. During the course of these seminars, Feynman explained that he had stopped teaching path integrals at a less advanced level, because he had never derived a complete path

integral description of the hydrogen atom, and was embarrassed by this failure. The path integral idea provided a superb mental picture to give a physical feel for what is going on, but the calculations had proved intractable. Actually, this was no real disgrace. The standard approach to quantum mechanics, using Schrödinger's wave equation, was not much better, since even the Schrödinger equation could only be solved to give an exact description of hydrogen, the simplest atom of them all.

The idea stuck in Kleinert's head, and several years later he not only solved the problem (much to Feynman's delight), but wrote a major textbook on the path integral approach, re-establishing path integrals as a research tool, not only conceptually useful but now capable of solving problems as easily as using the Schrödinger equation.

In 1982, Kleinert was back in California (this time based at Santa Barbara), and visited Caltech several times. 'Feynman knew of my work on the path integral of the hydrogen atom by then, and was very friendly to me and open to discussion.' The friendship extended to some joint work, updating some of Feynman's earlier ideas with the aid of a Sinclair home computer, one of the first computers available to the public, that Kleinert had just bought at Woolworth's for $15.00. At first, the work seemed of only minor importance. But in the 1990s Kleinert and his colleagues have developed the technique, known as the variational principle, into a powerful tool which makes it possible to use path integrals to solve increasingly difficult problems in the quantum world. And it all stems from Feynman's continuing active involvement in fundamental science, as a father figure pointing the way for younger researchers, well into the 1980s.

Feynman was also a father figure to the undergraduates. In the 1974 commencement address, which we mentioned in Chapter 10, he provided them with words of wisdom about science which were also words of wisdom about life in general, just the sort of thing a father ought to pass on to his children before they go out into the world. Shooting down the widespread public acceptance of what he regarded as pseudosciences like astrology and spoonbending[18] (and, one of his eternal bugbears, psychology), he explained what it was that real science had that these pseudosciences did not: