

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<sup>18</sup> (and, one of his eternal bugbears, psychology), he explained what it was that real science had that these pseudosciences did not: