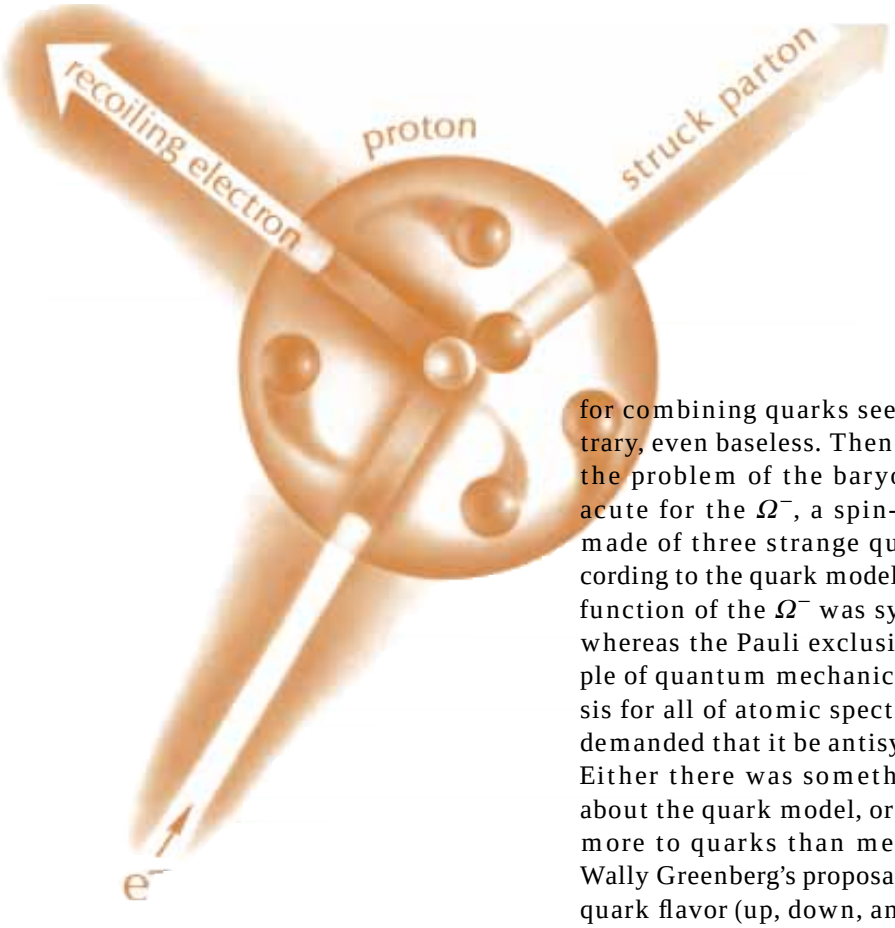
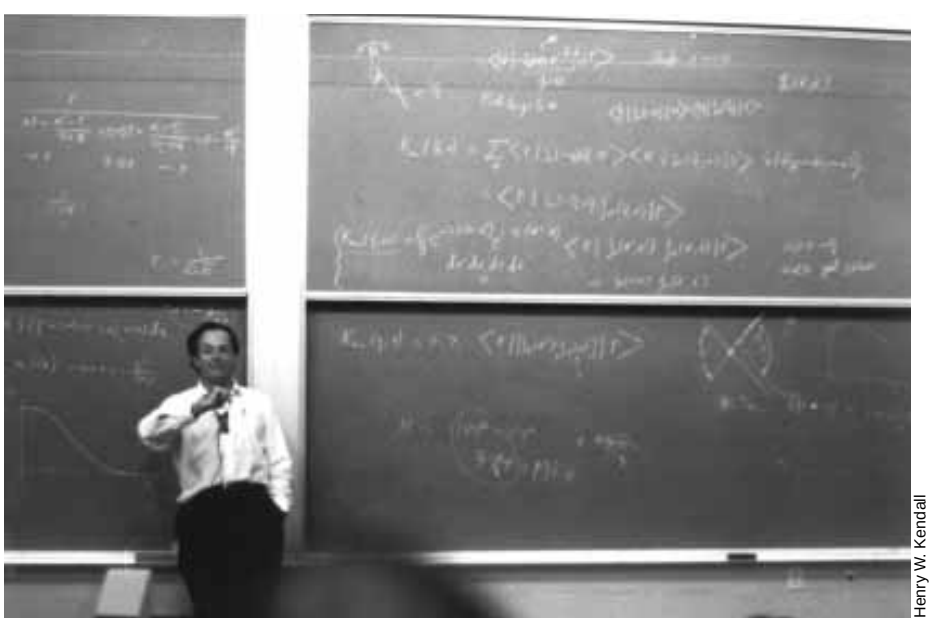


for combining quarks seemed arbitrary, even baseless. Then there was the problem of the baryons, most acute for the Ω^-, a spin-$\frac{3}{2}$ particle made of three strange quarks. According to the quark model, the wave function of the Ω^- was symmetric, whereas the Pauli exclusion principle of quantum mechanics—the basis for all of atomic spectroscopy—demanded that it be antisymmetric. Either there was something dicey about the quark model, or there was more to quarks than met the eye. Wally Greenberg's proposal that each quark flavor (up, down, and strange) came in three distinguishable "colors," and that antisymmetry in color brought the quark model into conformance with the exclusion principle, seemed to many like invoking the tooth fairy. But in one of those delicious ironies that make research so interesting, when we learned to measure the number of colors of each quark species, it really was three. And color would turn out to be the key to explaining how the quark model could be true.

The other evidence that drew attention to quarks arose from the MIT-SLAC experiments in which Jerry Friedman, Henry Kendall, Dick Taylor, and their colleagues studied the structure of the proton. To the prepared mind, the high rate of inelastic collisions they observed showed that there were within the proton tiny charged bodies. No mind was more prepared to take the leap than Feynman's. Feynman presented his interpretation at a SLAC colloquium that occasioned my first pilgrimage across the Bay. The colloquium was then held in the evening after what has been described to me as a vintner's dinner. Whatever the reason, I remember both speaker and audience as extremely exuberant. If an electron scattered from one of the hypothetical tiny charged bodies, not the whole proton, it was easy to understand why the inelastic cross section was so large. Instead of measuring the delicacy of the proton, the MIT and SLAC experimenters were measuring the hardness of the little bits. Feynman wasn't prepared to say what the tiny charged parts of the proton were, so he called them "partons." Everyone in the room must have thought, "Quarks?"

Before long, Bj Bjorken and Manny Paschos had worked out the consequences of the quark-parton model for electron scattering and neutrino scattering. The success of their predictions added to a gathering crisis. If the quark-partons acted as if they

Richard Feynman lecturing on his parton model at SLAC in October 1968.



Henry W. Kendall