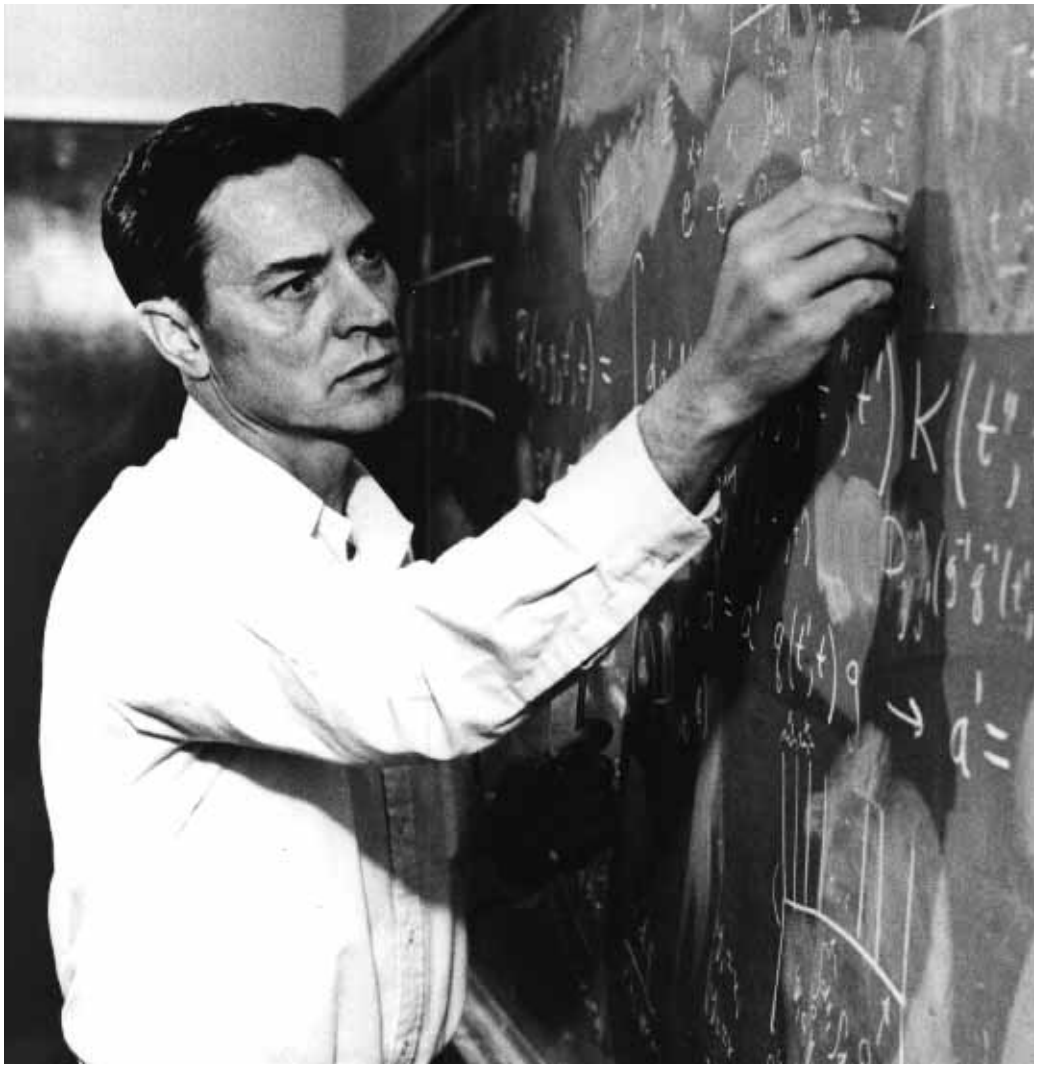
Opposite: Physicists attending the 1966 International Conference on High Energy Physics at Berkeley, California. (Courtesy Lawrence Berkeley National Laboratory)

Right: Geoffrey Chew in the 1960s. (Courtesy Lawrence Berkeley National Laboratory and AIP Emilio Segrè Visual Archives)



seeds within seeds—and no minimal parts—the quark advocates had to face the challenge of "nuclear democracy." Berkeley, it turned out, was the hotbed of an opposing point of view: that there were no fundamental constituents, that all the composite "elementary" particles were somehow made out of each other in an intricate interplay called the bootstrap. Gell-Mann deflected this challenge by repeatedly stressing that quarks didn't have to be real to be useful and that if the mesons and baryons were made up of "mathematical quarks," then the quark model might perfectly well be compatible with the bootstrap hypothesis.

Courtesy C. Quigg

The author in 1970, as a fresh Ph.D. and research associate in the Institute for Theoretical Physics at the State University of New York, Stony Brook.

There was also the question of how to deal with interactions, with theorists divided into sects promoting "*S*-matrix theory," or "field theory," or "Lagrangian field theory," or "abstract field theory." Gell-Mann urged the partisans to stop wasting their breath on sectarian quarrels and to pool their energies to campaign for a higher-energy accelerator that would enable us to really learn more about the basic structure of matter. That accelerator sweeps across the prairie outside my office window.

QUARKS IN BERKELEY?

Berkeley was indeed the Mother Church of the *S*-matrix bootstrap denomination. I don't think quarks were ever mentioned in Geoff Chew's course on the dynamics of strong interactions. Even in Dave Jackson's more catholic version of the course, quarks appeared only once, on a list of term-paper topics at the end of the year. But that was only part of the story. Learning about other approaches to particles and interactions was not only encouraged, it was obligatory. Berkeley graduate students were expected to follow two year-long courses in field theory. The Rad Lab was a center of hadron spectroscopy where the quark model was discussed as a classification tool. In the spring of 1968, George Zweig flew up from Caltech every Friday to teach a graduate seminar on the quark model. George was one of the inventors of quarks. He also knew everything about resonance spectra and decays, and he gleefully showed us how much a simple quark model could explain.

Courtesy G. Zweig

George Zweig in 1965.

What the quark model couldn't explain was itself: "How could this be true?" was the question everyone had to ask. Until the interactions of quarks could be understood, the rules