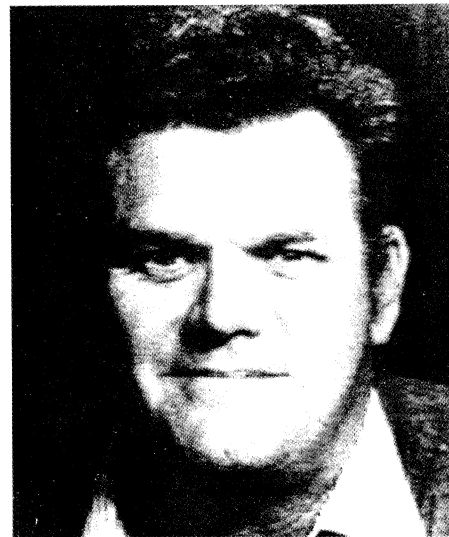


Nobel Prize 1990



The most prestigious award in physics went this year to Jerome I. Friedman and Henry W. Kendall, both of the Massachusetts Institute of Technology (MIT), and Richard E. Taylor of Stanford 'for their pioneering investigations concerning deep inelastic scattering of electrons on protons and bound neutrons, which have been of essential importance for the development of the quark model in particle physics'.

Their experiments, carried out from 1967 at the then new two-mile linac at the Stanford Linear Accelerator Center (SLAC) showed that deep inside the proton there are hard grains, initially called 'partons' by Feynman and later identified with the quarks, mathematical quirks which since 1964 had been known to play an important role in understanding the observed variety of subatomic particles.

These initial forays into high energy electron scattering discovered that a surprisingly large number of the electrons are severely deflected inside the proton targets. Just as the classic alpha particle results of Rutherford earlier this century showed that the atom is largely

1990 Physics Nobel Prize people – left to right, Jerome I. Friedman and Henry W. Kendall of MIT, and Richard Taylor of Stanford.

(Photos Keystone)

empty space with a compact nucleus at its centre, so the SLAC-MIT experiments showed that hard scattering centres lurked deep inside the proton.

Writing on the wall for this year's Nobel Prize was the award last year of the Wolfgang Panofsky Prize (sponsored by the Division of Particles and Fields of the American Physical Society) to the same trio for their leadership in the first deep-inelastic electron scattering experiments to explore the deep interior of nuclear particles.

In the early 1960s when construction of the SLAC linac was getting underway, the 1990 Nobel trio, who had first met in the 1950s as young researchers at Stanford's High Energy Physics Laboratory, came together in a collaboration preparing the detectors and experimental areas to exploit the new high energy electron beams.

The outcome was described in an article (October 1987, page 9)

by Michael Riordan, subsequently a member of the experimental collaboration and now SLAC's Science Information Officer, for the 20th anniversary of SLAC's electron beams.

In October 1967, MIT and SLAC physicists started shaking down their new 20 GeV spectrometer; by mid-December they were logging electron-proton scattering in the so-called deep inelastic region where the electrons probed deep inside the protons. The huge excess of scattered electrons they encountered there - about ten times the expected rate - was later interpreted as evidence for pointlike, fractionally charged objects inside the proton.

The quarks we take for granted today were at best 'mathematical' entities in 1967 - if one allowed them any true existence at all. The majority of physicists did not. Their failure to turn up in a large number of intentional searches had convinced most of us that Murray Gell-Mann's whimsical entities could not possibly be 'real' particles in the usual sense, just as he had insisted from the very first.

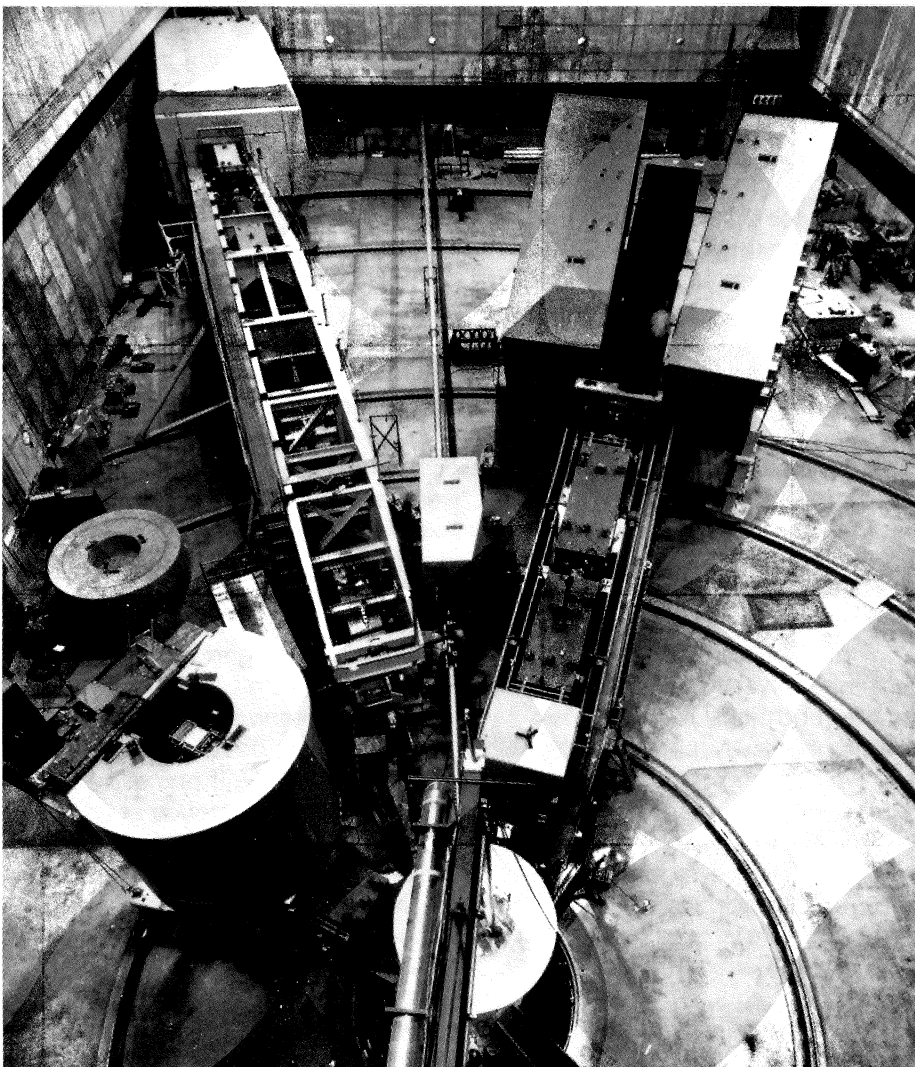
Jerome Friedman, Henry Kendall, Richard Taylor and the other MIT-SLAC physicists were not looking for quarks that year. SLAC Experiment 4B had originally been designed to study the electroproduction of resonances. But the prodings of a young SLAC theorist, James Bjorken, who had been working in current algebra (then an esoteric field none of the experimenters really understood), helped convince them to make additional measurements in the deep inelastic region, too.

Over the next six years, as first the 20 GeV spectrometer and then its 8 GeV counterpart swung out to larger angles and cycled up and down in momentum, mapping out this deep inelastic region in excruciating detail, the new quark-parton picture of a nucleon's innards gradually took a firmer and firmer hold upon the particle physics community. These two massive spectrometers were our principal 'eyes' into the new realm, by far the best ones we had until more powerful muon and neutrino beams became

available at Fermilab and CERN. They were our Geiger and Marsden, reporting back to Rutherford the detailed patterns of ricocheting projectiles. Through their magnetic lenses we 'observed' quarks for the very first time, hard 'pits' inside hadrons.

These two goliaths stood resolutely at the front as a scientific revolution erupted all about them during the late 1960s and early 1970s. The harbingers of a new age in particle physics, they helped pioneer the previously radical idea that leptons, weakly interacting particles, of all things, could be used to plumb the mysteries of the strong force. Who would have guessed, in 1967, that such spindly particles would eventually ferret out their more robust cousins, the quarks? Nobody, except perhaps Bjorken - and he wasn't too sure himself.

(The saga is recounted in every detail in Riordan's book 'The Hunting of the Quark', published by Simon and Schuster.)



1990 Physics Nobel Prize apparatus – the big spectrometers at End Station A of the Stanford Linear Accelerator Center (SLAC) in 1967: right, the 8 GeV spectrometer, and left, its 20 GeV and (extreme left) 1.6 GeV counterparts.