

ALL POSSIBLE PATHS

RICHARD FEYNMAN'S CURIOUS LIFE

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Remembering Feynman at One Hundred

First Encounter

In 1966, a Festschrift was organised at Cornell to celebrate the sixtieth birthday of the great Hans Bethe. I arrived late coming from nearby Syracuse University. The auditorium was packed except for a few seats in the front row, where I sat among "much older" men I did not recognise. The first speaker was talking about the stability of matter.

Soon after, a tall older guy with a flaming red mustache comes in and takes the seat next to me. In a *sotto voce* (not so sotto), he proceeds to criticise the talk in vivid and explicit language. This greatly disturbs the lowly graduate student next to him who is desperately striving to listen and understand. As the talk progresses, I am building up courage to ask him to keep quiet. Before I can do so, everyone applauds and the talk is over.

The chair of the session (Bob Marshak) then declares, "... now for our next speaker Richard Feynman", and my noisy red-moustached neighbour climbs onto the stage! I was stunned by this close call; imagine a beginning graduate student almost telling the great Feynman to shut up! Of his talk I only remember one dramatic gesture; cradling his hands together, Feynman declared "I can hear the nuts of strong interactions cracking"!

Needless to say, Feynman did not remember this first encounter.

Damn the Torpedoes

When Feynman was diagnosed with cancer, Bob Walker asked me to take over his field theory course, which Graham Ross and I were attending at the time.

There were no textbooks on the modern developments, and I was soon in the process of writing a book on the subject. Before crediting Dirac for the "Feynman" Path Integral, I asked Feynman, whose office was three doors up from mine. To my relief, he totally agreed with my assignation, and related the following.

At a Princeton party, Herbert Jehle asked Feynman what he was working on. Feynman said he had wanted to formulate quantum mechanics in a Lagrangian setting, and asked if he knew of anyone else who had tried. It so happened that Jehle knew of a conceptual 1933 Dirac paper on that very topic, which he (Jehle) had tried to penetrate without success.

Weeks later, they meet again and Jehle asks if he had found the reference useful. Feynman then casually replies that he had not only found it useful, but used it to derive Schrödinger's equation! Feynman delightedly recalls Jehle's eyes "wide as saucers" in amazement! Dirac had drawn an analogy between the exponential of the action and a matrix element. In his words, Feynman set them equal and went forward, using one of his favourite expressions "damn the torpedoes". The rest is history; when I read Feynman's 1948 article in *Reviews of Modern Physics*, I found no reference to Jehle's role.

Little Steps for Little People

In 1979, Feynman reminisced: "I had realised that the problem with infinities could be neatly solved if fields did not exist. I was very excited at the idea and could not wait to tell my adviser, John Wheeler. When I started blurting out the idea, he slowed me down by saying "little steps for little people". I found it significant that Feynman remembered this so many years later: I bet it was not the advice that Feynman was used to hearing!

Twenty years later, I related Feynman's recollection to Wheeler, who replied "Yes I remember saying that but having no fields was MY idea!"

Impish Genius

Feynman displayed a kind of hissing laugh and twinkling eyes, especially when he had given people the wrong impression.

At a Christmas party, our very young daughters Tanya and Lisa come running, complaining that the world is unfair because they have to look up to people since they are so small! Perplexed, we try to understand what brought that one, and they both point to a mischievously smiling Feynman!

He enjoyed sitting at a party and 'make believe' he was talking in a foreign language he could not speak! He gave me a free demonstration and from a distance he had it right, gesticulations included! He was tickled pink whenever he heard somebody remark that Feynman spoke French or any other language! Feynman loved to speak to groups of students, holding their attention with charisma, brilliance and simple explanations for the most obtuse physics.

After one such event, Feynman leaves, several undergraduates and I linger on. One expresses his amazement that Feynman could "understand so much physics... without knowing any mathematics". Feynman, who had placed first in the 1939 Putnam competition, would have been delighted by this remark.

An incisive description of Feynman's mesmerising effect is Bob Walker's "... after listening to a Feynman lecture, you think you can fly and... that can be dangerous".

At parties, Feynman used to fend off physics groupies by replying to their questions with one of his own like "what is 22 divided by 7". That stopped them cold and by the time they looked up, Feynman had walked away.

Feynman hated when a speaker used a sheet to obscure half the transparency to emphasise a point, berating the speaker into taking away the paper with remarks like "What are you hiding? What are you afraid of?" etc... Caltech's Fred Zachariasen gives a transparency talk and sure enough hides part of his transparency. Predictably, Feynman asks the paper be removed. Fred obliges, revealing a blank transparency. An upstaged Feynman had to join in the ensuing laughter.

Feynman told Rick Field that people (physicists?) fall in two categories, turkeys and others. In the middle of a Lauritsen seminar by an overconfident physicist, Feynman turns to Rick and loudly demands: "Pass the cranberry sauce!"

Intimidating Genius

When I joined Caltech, it took me a year before engaging in conversation with Feynman.

After one summer break, Feynman asks me of new physics breakthroughs. He does not think much of my reply: "No," he says, "I mean something important like the proton-neutron mass difference".

Feynman and Wheeler knock on my door with a 'simple question'. I instantly freeze, although it was indeed a simple question about the renormalisation group and grand unified theories.

Visiting Caltech in the early eighties, I knock on Feynman's door. After a stentorian "enter" (he was in a good mood), Feynman greets me effusively, and asks what physics I am up to; I mention dimensional reduction, and how to make models where some dimensions inflate while others do not.

Feynman is concerned, and pointing to his large armchair utters, "Boy, this is serious! Take a seat. Are you ok? Can I bring you a glass of water...?"

Last Encounters

One of the last times I saw Feynman was at breakfast at the Irvine conference. He spoke about the Hanbury Brown and Twiss effect with his usual enthusiasm. Not yet awake, I became entranced by the constant motion of his expressive hands, and did not remember what he said: the Feynman Effect at work.

Feynman's favourite book on statistical mechanics was Joseph Mayer and Maria Göppert-Mayer's *Statistical Mechanics*. An interesting feature of the book is the diagrammatic cluster expansion for evaluating the partition function of a classical gas.

Feynman remembered a Sunday morning when in his pajamas he was drawing (Feynman) diagrams like crazy and wondering if they would be of any use! I wish I could ask him if the Mayer-Mayer expansion gave him the idea to devise a similar method to quantum field theory.

A mere shepherd on Mount Olympus, I was fortunate to meet some of the Gods of Physics, and Feynman was one of them.

When I learned of Feynman's death, I found myself tearing up.

Such was the Feynman Effect.

