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The Doctoral Students of Richard Feynman

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Abstract

I document 31 students who graduated to receive PhDs under Feynman’s supervision. I provide links to their doctoral dissertations.

Introduction

An ordinary genius is an ordinary fellow ... There is no mystery as to how his mind works. ... It is different with the magicians ... Even after we understand what they have done, the process by which they have done it is completely dark. *They seldom, if ever, have students* ... Richard Feynman is a magician of the highest caliber.

— Mark Kac [1]

As the centennial of Richard Feynman’s birth approaches, I attempt in this letter to dispel a minor myth about him. The myth is embodied in the words of Mark Kac that I have emphasized above, and in the following statement attributed to one of Feynman’s students, Philip Platzman [2]: “The reason why Feynman did not have many students was because he was very difficult with them, because he didn’t really worry about students. ... He had a few students, but not many.”

Thus a prevailing belief in the scientific community seems to be [3] *Feynman had very few doctoral students who completed theses under his supervision*. It may be surprising to most people to learn this is *not* true.

The number of Feynman’s doctoral students is actually 31 ± 3 , with the uncertainty intended to take into account some unavailable documents as well as possible subjectivity on my part [4]. The lineup of students who completed their PhD research under Feynman’s discerning gaze began with Michel Baranger, Laurie Brown, and Giovanni Lomanitz at Cornell in 1951, and concluded with Ted Barnes and Thomas Curtright at Caltech in 1977. In addition, two years after Feynman’s death he was listed as a co-advisor in Sandip Trivedi’s thesis, completed in 1990.

While **31** is not an extremely large number of doctoral students to have mentored during a lifetime as an academic (e.g. compared to the 70+ dissertations supervised by Julian Schwinger during five decades), nonetheless, **31** does amount on average to three PhDs for every four years of Feynman’s time as a professor. Moreover, were it not for illness during the last several years of his career, Feynman might have supervised several more students.

Among Feynman’s doctoral students the most recognized physicist is undoubtedly George Zweig, who was also mentored by Murray Gell-Mann, and who graduated from Caltech in 1964. Soon thereafter Zweig had a major impact on elementary particle physics through his independent invention of the “quark model” of hadrons. However, in my opinion, the research of Feynman’s other students has also had significant impact and continues to influence several areas of physics.

The Students

There are PhDs and then there are Feynman PhDs. — Richard Sherman [2]

From theses and PhD dissertation examination documents wherein it was either explicitly stated or otherwise clear that Feynman was the advisor* or co-advisor**, I find the 31 doctoral students listed here, the first three at Cornell, the others at Caltech:

Michel Baranger** (1951) Relativistic Corrections to the Lamb Shift
Laurie Brown* (1951) Radiative corrections to the Klein-Nishina formula
Giovanni Lomanitz* (1951) Second order effects in the electron-electron interaction
Albert Hibbs* (1955) The growth of water waves due to the action of the wind
William Karzas** (1955) The effects of atomic electrons on nuclear radiation
Koichi Mano* (1955) The self-energy of the scalar nucleon
Gerald Speisman* (1955) The neutron-proton mass difference
Truman Woodruff** (1955) On the orthogonalized plane wave method for calculating ...
Michael Cohen* (1956) The energy spectrum of the excitations in liquid helium
Samuel Berman* (1959) Radiative corrections to muon and neutron decay
Frank Vernon* (1959) The theory of a general quantum system interacting ... dissipative system
Willard Wells* (1959) Quantum theory of coupled systems having application to masers
Henry Hilton** (1960) Comparison of the beta-spectra of boron 12 and nitrogen 12
Carl Iddings* (1960) Nuclear size corrections to the hyperfine structure of hydrogen
Philip Platzman** (1960) Meson theoretical origins of the non-static two nucleon potential
Marvin Chester** (1961) Some experimental and theoretical observations on ... EMF
Elisha Huggins* (1962) Quantum mechanics of the interaction of gravity ...
Harold Yura* (1962) The quantum electrodynamics of a medium
Michael Levine** (1963) Neutrino processes of significance in stars
George Zweig** (1964) Two topics in elementary particle physics ...
James Bardeen** (1965) Stability and dynamics of spherically symmetric masses ...
Howard Kabakow** (1969) A perturbation procedure for nonlinear oscillations ...
Robert Carlitz** (1970) Elimination of parity doubled states from Regge amplitudes [5]
Mark Kislinger** (1970) Elimination of parity doublets in Regge amplitudes
Finn Ravndal** (1971) A relativistic quark model with harmonic dynamics [6]
Richard Sherman* (1971) Surface impedance theory for superconductors in ... magnetic fields
Arturo Cisneros** (1973) I. Baryon-Antibaryon phase transition ... II. ... the Parton Model
Steven Kauffmann* (1973) Ortho-positronium annihilation ... first order radiative corrections
Frank (Ted) Barnes** (1977) Quarks, gluons, bags, and hadrons
Thomas Curtright* (1977) Stability and Supersymmetry
Sandip Trivedi** (1990) Topics in quantum gravity

From documents where Feynman was *not* described as an advisor or co-advisor, but was a member of the PhD examination committee although not the committee chairman, and/or was acknowledged in the thesis for moderate influence and general advice, I find in addition:

Fredrik Zachariasen (1956) Photodisintegration of the deuteron
Paul Craig (1959) Observations of perfect potential flow and critical velocities in superfluid ...
James Mercereau (1959) Diffraction of Thermal Waves in Liquid Helium II
Kenneth Wilson (1961) An investigation of the Low ... and the Chew-Mandelstam equations
John Andelin (1966) Superfluid drag in helium II
Karvel Thornber (1966) I. Electronic Processes ... II. Polaron Motion ...

Lorin Vant-Hull (1967) Verification of long range quantum phase coherence ...
William Press (1973) Applications of black-hole perturbation techniques
Robert Wang (1976) A Study of Some Two-Dimensional Field Theory Models
Don Page (1976) Accretion into and emission from black holes
Stephen Wolfram (1980) Some topics in theoretical high-energy physics

All of these were Caltech students. Originally I included Platzman in this second list. But upon looking at other documents I became convinced that his thesis was effectively co-supervised by Feynman to the extent that he belonged in the first list. (Indeed, as I document later, Platzman's personal listing in the Mathematics Genealogy Project states that Feynman was a co-advisor.) Similar remarks apply for Robert Carlitz [5] and Finn Ravndal [6]. If so, that would justify my head count of **31** "Feynman PhDs" to be a lower bound.

Finally, I find several less compelling cases where Feynman was only a member of the dissertation examination committee at Caltech and was not particularly influential for the research, so far as I can tell. I suspect there are many more such cases that I have not found, since on this point documentation is quite often incomplete and all committee members are not listed. For example:

Lipes, Richard Gwin (1969) I. Application of multi-Regge theory ... II. High energy model
Hill, Christopher Thaddeus (1977) Higgs scalars and the nonleptonic weak interactions.
Dally, William J. (1986) A VLSI architecture for concurrent data structures. (restricted)
Wawrzynek, John (1987) VLSI concurrent computation for music synthesis. (restricted)

For the last two cases given above, I cannot access the theses to see if Feynman was acknowledged for significant influence.

Sources

At the time of this writing, wikipedia lists only six students to have officially received PhDs with Feynman as the advisor, in alphabetical order: James M. Bardeen, Laurie Mark Brown, Thomas Curtright, Al Hibbs, Giovanni Rossi Lomanitz, and George Zweig. However, this list is obviously far from complete, as documented by the Math Genealogy Project (MGP) and by the Caltech library archives.

According to the MGP, also at the time of this writing, there were at least thirteen other doctoral degrees completed under Feynman's supervision in addition to those listed in wikipedia — one more at Cornell and twelve more at Caltech. In particular, Philip Platzman is in the MGP list but not in wikipedia. I suppose that is because he requested MGP to classify him as a doctoral student of Feynman. Platzman's personal listing in MGP supports my supposition. By way of comparison, and as a measure of the completeness of their database, Schwinger has only 22 of his students listed by the MGP.

In any case, the mother lode of information about Feynman's doctoral students can be found at the Caltech library. A direct search of their online database produces a list of 25 PhD theses where Feynman is described as the advisor or co-advisor, at the time of this writing. By way of comparison, a direct search for Gell-Mann as advisor turns up 16 theses in the Caltech library database. Among these, Hilton, Levine, and Zweig are shown to be co-advised by Feynman and Gell-Mann.

Beyond these publicly accessible sources, the largest amount of documentation that is available to me concerns Thomas Curtright, who has provided this succinctly amusing excerpt from his thesis examination committee papers [3]:

IV. Result of Examination

1. The candidate was examined in the following manner: Orelly

2. The result was: Passed

Signed R. P. Feynman (Chairman)

Summary

From looking at many theses and papers by Caltech students, my overall impression is simply this: Feynman played a *major role* through his mentoring and supervision of doctoral students. He exerted tremendous influence on graduate student research conducted at Caltech during his four decades there — perhaps even more than his widely perceived influence on Caltech undergraduate studies. I conclude that it is *not* true Richard Feynman “had a few students, but not many.”

Acknowledgements: I thank Professor Curtright for suggesting that there could very well be a widespread misunderstanding about the extent of Feynman’s mentoring of doctoral students. Finally, I thank Cosmas Zachos for his comments on various drafts of this manuscript.

References

- [1] M Kac, *Enigmas of Chance: An Autobiography*, University of California Press (1987).
- [2] J Mehra, *The Beat of a Different Drum: The Life and Science of Richard Feynman*, Oxford University Press (1994)
- [3] T Curtright, private communication.
- [4] Regarding my subjectivity, see [5, 6].
- [5] Robert Carlitz’s thesis was not available from the Caltech library when I originally compiled a list of Feynman’s doctoral students, but now it is. Therein I see that Carlitz’s advisor was Steven Frautschi and Feynman was not described as a co-advisor. In fact, Carlitz did not acknowledge Feynman for discussions at any point in his thesis — he only cited Feynman for an unpublished 1967 lecture. However, the main points of Carlitz’s thesis involve research that was carried out in collaboration with Mark Kislinger and published jointly with him in two papers. Now, in *his* thesis, Kislinger *does* acknowledge Feynman as his primary advisor. Moreover, in the second of his two papers with Carlitz, Kislinger “thanks R. P. Feynman for suggesting investigating this problem and for numerous helpful discussions.” Therefore, I consider Carlitz to have been co-advised by Feynman.
- [6] Finn Ravndal’s advisor was also Steven Frautschi, officially. Frautschi was the chairman of Ravndal’s dissertation examination committee, while Feynman was only a member of the committee. On the other hand, upon reading the acknowledgements in Ravndal’s thesis and considering what the entire thesis is about, it is clear that Feynman provided considerable guidance to Ravndal (also see [7]). Indeed, much of the research in the thesis was published jointly with Feynman and also Kislinger. In addition, Feynman appears as *the* advisor in Ravndal’s personal listing in the MGP, presumably because Ravndal wanted it so.
- [7] F Ravndal, “How I Got to Work with Feynman on the Covariant Quark Model” *Int. J. Mod. Phys. A30* (2015) 1530009, arXiv:1411.0509 [physics.hist-ph]