This section features conversations with personalities related to science, highlighting the factors and circumstances that guided them in making the career choice to be a scientist.

Tinker, Builder, Physicist, and Teacher !

Melissa Franklin talks to Prajval Shastri *

Melissa Franklin is a particle physicist and the Mallinckrodt Professor of Physics at Harvard University. Franklin was part of the collaboration that discovered the top quark, which was the one missing particle of particle-physics orthodoxy. They used collisions of protons with their anti-particles at very high energies (1.8 tera electron Volts centre-of-mass energy) at the Fermi Laboratory Tevatron accelerator in Chicago to make the discovery. Franklin led the Harvard component of the team, which was involved in 3 of the 10 detectors of the experiment. She is also part of the ATLAS and CMS collaborations that discovered the Higgs Boson.

Franklin was born in Edmonton, Canada, schooled in Toronto, and went to college at the University of Toronto. She got her PhD in particle physics from Stanford University, working at the Stanford Linear Accelerator Centre, supervised by Martin Perl and Gary Feldman. There she grew to love the process of building particle smashers with a distant 'fundamental physics' goal as the backdrop. After being a post-doctoral fellow at the Lawrence Berkeley Lab, and faculty at the University of Illinois, she joined Harvard as a Junior Fellow (Society of Fellows) in 1987, and as a physics faculty member in 1989. Franklin is known to bring 'learning by doing' strongly into her teaching. She appears on the *Quirks & Quarks* show of the Canadian Broadcasting Corporation. Incidentally, Franklin was the first woman faculty at Harvard to get tenure in the physics department (in 1992).

P Shastri

PS: I recall from reading about your life that you decided to quit school when you were 13, because of a discontent with your learning environment. You were then in an alternative learning environment. Did that seem like quite the normal thing to do? Were your parents not worried about you being out of school? And how did you find a peer group?

*in a face-to-face interview over Skype.

MF: Yes, I did quit conventional school. I did not have the capacity to sit still for even 40 minutes, so the school was not a good learning environment for me. Then that summer, I was riding around on my bike, and I found a bunch of teenagers in a park who were reading aloud - it was *Finnegan's Wake* by James Joyce. I had found my peer group! It turned out that they were starting an alternate school, and it did get recognition by the authorities. My parents were not worried – in the late 60s and early 70s people were not so worried about things. The new environment was good for me because we physically moved around a lot (rather than sitting still in a classroom). Even now, I tend to not lecture too much – its not a great way for most people to learn.

PS: So you just did whatever you wanted, play, do maths, read, play music?

MF: The whole idea was to get people from the community to come in and teach us. We got a physics professor from the university to come in; an urban planner called Jane Jacob taught us about urban planning, a Greek professor taught us Greek... There were a couple 'real' teachers associated with this school, but we pretty much did whatever we wanted.

PS: So you created your own Summerhill [1]?

MF: Like it, yes. And so I do not have a high school degree.

PS: At what age did you get interested in physics, and how did that happen?

MF: I got bored and so I went to London. I had to enrol in a school there because I was only 15. After three months, the school told me that I really needed to focus on something because I had to take the A-level exams soon. I chose physics for no particular reason, but when I started reading about it, especially quantum mechanics, I got really interested in it!

PS: So you were just reading physics on your own?

MF: Yes, I was reading Heisenberg, about his life and times, and so on. I had also been reading a lot of philosophy, and those days quantum physicists were interested in philosophy and wrote on both topics. So it was a way for me to get from one to the other.

PS: Later you did go to a conventional college, the University of Toronto? [Yes] Did you have the 'good grades' to get in?

MF: No! It took me talking to them for 34 consecutive days, begging them to take me in because I did not have the requirements. The initial semesters were rough because I did not have the background to cope, but there were some very supportive professors who looked out

[1] Summerhill School is a British school founded in 1921 based on the idea that the school should be made to fit the child, and is run as a democratic community.

for me. So eventually I caught up, and learnt how to work, and got good grades.

PS: By the time you went to Stanford for a PhD, the feminist movement had quite an influence on academia in the United States. Did you feel its influence on your environment in physics?

MF: Stanford did want to bring more women into their PhD programme (there were very few) which was an effect of the feminist movement. But clearly, the professors were not that impacted by the movement, nor had they thought about those issues, and their behaviour with the women students clearly reflected that. There was a group of women graduate students, though, in various branches of physics, who were very supportive. And I noticed that at least a couple of them stayed in physics and even got into leadership positions in their (top) universities.

PS: Your research involves large collaborations and working over long periods of time during which there may not be tangible outcomes. Does that call for a different science culture?

MF: In my field, there is no way to do experiments except in large collaborations. We have a sort of flat democratic structure which is amazing. In fact, there are people studying the structure of the collaboration! I think the students who persist in my field are those who remember the science goal, but on a day-to-day basis enjoy doing the little things. It is not about being smart or not smart. There just are those who love tinkering and debugging, when they have a larger science goal, like discovery of the Higgs boson! So I try to make the little things fun by approaching each day, and each week as a sort of mini-experiment. And that seems to work. The biggest problem down the line then is not sustaining interest, but the lack of jobs!

PS: When you became faculty at Harvard, were you made to feel that your gender was salient?

MF: My first year was odd for them. A faculty member told me that I should not talk so much in meetings, but have them get used to me slowly! Physicists are not the most evolved; nor educated on broader issues. Unfortunately, we do not have any consciousness-raising groups.

Also, the culture in physics is aggressive – just being aggressive is what people think is smart. Critiquing, while essential, is not done in a nice way. Many young women do not like that.

But I am hopeful!

I am also hopeful that we can teach better. I do active learning-teaching.

PS: Do you think learning by doing is a better way of teaching the scientific method?

MF: Yes. I intersperse my talking with the students doing. So that helps students who are like me, who cannot sit in one place for long periods of time! I also feel strongly about including in physics education a lot of hands-on things and lots of skills, making it real for them early, and making physics less scary. That way we will get a lot more people understanding science.