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A woman scientist in a field dominated by men

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Looking back at the time when I decided to take up physics as my profession, I find it rather hard to figure out what prompted me to do so, since no one in my family, until then, had studied the pure sciences.

Having migrated to Delhi from Lahore at the time of the partition of India, I got admission in a government school which did not offer science as an option. Consequently, I was an arts student in High School. However, mathematics was my favourite subject. My father was a gold medalist in (M.A.) mathematics from Punjab University, although he became a lawyer. Since I had done the matriculation examination, not the Higher Secondary, I had to take a one-year course at Delhi University before I could get admission into B.Sc. (Hons.). At this stage I opted for the physics, chemistry, mathematics combination rather than biology for the simple reason that I was scared of cutting open frogs, maybe because I am a vegetarian. My sister's husband, a medical doctor, tried hard to persuade me to study medicine, but my father encouraged me to pursue the career of my choice. I did not enjoy chemistry but did like physics, probably because of my interest in applied mathematics. I considered going into engineering but for

that I would have had to go out of Delhi. Neither my family nor I liked this idea. This, probably, was the reason I chose Physics (Hons.) at Delhi University.

After B.Sc. (Hons.) and M.Sc. Physics from Delhi University, for my Ph.D. I went to the University of Chicago, where I was privileged to work with Nobel Laureate Prof. S. Chandrasekhar. Besides my father who molded me during my early years, it was my Guru Chandra (Prof. Chandrasekhar was addressed as Chandra by his students, colleagues and friends) whose training had an indelible effect on my professional life later on. The virtues instilled in me in childhood, like self-reliance, the confidence to face all kinds of situations and the courage not to bow to unjust pressure, were strengthened by my association with Chandra. I always spoke my mind fearlessly, and most of my seniors did not like this. I suffered professionally both because of this and because of gender bias. But I have no regrets.

For the sake of my profession, right from the beginning, I had decided not to marry. I took this decision because of my habit of doing full justice to my work, and tirelessly pursuing every task I took on. Marriage would have meant not doing full justice either to my family or to my profession. Being single, I was free to focus on my professional commitments.

Prof. Chandrasekhar had worked in many diverse fields. He would work in one field and after doing a thorough job in it, he would write a book and then move on to a different field. At the time I joined him, his field of interest was magneto-hydrodynamics and plasma physics. I had specialized in plasma physics. For my thesis, I worked on relativistic plasmas. My way of working has been to first develop a general model and then apply it to problems of my interest in space, astrophysical as well as laboratory plasmas. Using the techniques of nonlinear dynamics, I interpreted many observed phenomena in terms of nonlinear, turbulent and chaotic plasma processes.

After my Ph.D. from Chicago, I returned to India and taught at my Alma Mater, Delhi University, for two years. I then decided to go back to the US to work as a Resident Research Associate of the National Academy of Sciences, at the Goddard Space

Flight Center, NASA. There I was associated with the Theoretical Division headed by a brilliant plasma physicist T. G. Northrop. Life there was very different from my student life at Chicago but my tenure (over two years) was very fruitful and enjoyable.

I next worked at the Department of Physics, Indian Institute of Technology (IIT), Delhi, as a Senior Scientific Officer. It is during this period that Chandra was invited by then Prime Minister Indira Gandhi to deliver the Nehru Memorial Lecture. After the lecture, Mrs. Gandhi organized a banquet in Chandra's honour and as a Chandra's student, I was also invited to this dinner party. I was a small fry at this gathering that included dignitaries like Vikram Sarabhai, D.S. Kothari and the President of Indian National Science Academy (INSA). I met Prof. Sarabhai for the first time. Right then and there, he invited me to work at the Physical Research Laboratory (PRL) of which he was Director. This is how I joined PRL and spent twenty-three years of my professional life as Associate Professor, Professor, Senior Professor and Dean of Faculty there. The research atmosphere at PRL was quite different from that at IIT and Delhi University. Sarabhai did not believe in vertical hierarchy, and he gave full freedom and responsibilities to the scientists. We managed to establish a very strong group in plasma physics, both theoretical and experimental, at PRL. I initiated and founded the Plasma Science Society of India whose registered office is still at PRL. I am really proud that all my students, who are settled in India and in America, are doing very well professionally and otherwise.

While at PRL, I had opportunities to visit and work at other NASA centers, like the Ames Research Center and the Jet Propulsion Laboratory (JPL), California, for longer durations. Besides visiting NASA Centers, I worked at the University of California, Los Angeles, from 1986 to 1987. In the capacity of Director of Plasma Physics at the International Centre for Theoretical Physics (ICTP), Trieste, Italy, from 1985 to 2003, I had many opportunities to interact with a large number of scientists from many developing and developed countries. I had to spend quite a bit of time organizing Plasma Physics Colleges at ICTP every alternate year for participants from developing countries, but I think

it was worth it since the colleges gave participants an opportunity to come into contact with a number of leading plasma physicists who came to lecture at these colleges.

I was fortunate enough to be elected an INSA Fellow, the National Academy of Sciences (NAS), the American Physical Society (APS) and The Academy of Sciences of the Developing World (TWAS) in 1990 when TWAS had only a handful of Indian Fellows. I was the first Indian woman Fellow of TWAS and the first Indian woman Physicist Fellow of INSA. I have used the word 'fortunate' for the simple reason that one has to be nominated for any worthwhile award and for the Fellowship of the Science Academy, and it was almost impossible for me, a woman scientist in a man-dominated field, to get nominated for prestigious awards like the Bhatnagar award. Another incident of differential gender treatment was apparent when the Director of PRL was to be chosen in the mid-1980s. Invariably, I had to face the jealousy of my male colleagues.

It may sound strange but it is true that one's scientific work is appreciated much more abroad than it is in one's own country. In spite of gender differential treatment from the scientific community in India, I got the Vikram Sarabhai Award for Planetary Sciences, 1977, the Jawaharlal Nehru Birth Centenary Lectureship award, 1993, the Vainu Bappu International Award in Astrophysics, 1994, and the Lifetime Achievement award of the University of Chicago in 1996.

After my official retirement from PRL, I again spent four years at the Jet Propulsion Laboratory (NASA), California Institute of Technology. Now I am settled in Delhi, continuing my research and also doing some social work through the Buti Foundation (www.butifoundation.org), which I founded in 2003. To my great satisfaction, the Foundation is progressing very well.