85

At the interface

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As a child I travelled widely because of my father's transferable job. This had an interesting effect, as I did not have to grow up in the midst of strict social norms of any one particular place. After my father's untimely death, we, a family of three women, settled down at Santiniketan, which is known for its artistic and literary environment. I had the privilege of spending most of my formative years in this place, where the community encouraged academic pursuits over monetary gains, and nature-based cultural celebrations were part of the social fabric in which children grew up. I also was lucky to go to a school there, which was based on Tagore's ideals of the free mind.

My mother told us, her two daughters, that whatever we studied we had to do well and earn scholarships to continue. I liked the logical approach in science and did well in science. So with my teachers' encouragement I chose science in high school. Reading about scientists like the Curies, who dedicated their lives to solving scientific problems despite many obstacles, inspired me greatly.

I had no second thoughts about pursuing an undergraduate, and then a postgraduate course in physics after obtaining the top rank in school. We faced social and economic challenges, and

lived very simply. The National Science Talent Scholarship (NSTS) went a long way to help me with my studies. My mother must have shielded us from many assaults, like well-meaning relative's suggestion that "guardian less" daughters be married off early. This was possible only because of continued support from my teachers and the community. I remember that I never had new books in school; they came from seniors, who were happy to help. The book grant that was part of the scholarship was of great help. A loner in college, I spent all my time trying to excel in examinations, and read a lot of science magazines and books borrowed from teachers and the library.

While a student, I wrote a few articles for Bengali science magazines, as I felt that science could reach a wider audience if available in their native language. I could attend only two summer camps of the NSTS, and made lifelong friends there, some of who are now renowned physicists. Since I came from a small town, the camps gave me a chance to see how I compared with other physics students from all over India. They also exposed me to some excellent institutes of learning, great teachers and a research environment. The only thing I was denied by my mother was going to college in Kolkata. That certainly was a defining decision, which changed my life completely. It was a time of social turmoil in Bengal. There was unrest all over the world, with student uprisings in universities in France and the U.S. and political wars in China, Cuba, and Vietnam.

The 1970's and 80's were very interesting times in science. Walls between different scientific disciplines were increasingly being knocked down. Studying physics, I came across more and more physicists looking at the world and wondering how nature weaves such beautiful patterns. I loved the intricacies of the cosmic dance of the elementary particles and their fields, which were understood only in terms of mathematical equations and logic. But at the same time I looked around and was amazed at the shapes and arrangements of the leaves and flowers, the symmetry in the body plan of organisms, and above all the endless robust elaboration of all these over and over in time.

I crossed over from studying elementary particles to

macroscopic biological objects – albeit theoretically – after completing my M.Sc. I took this decision on my own, based on my understanding of the nature of science of that time and the time to come. I chose to join a newly started course in Theoretical and Environmental Sciences at Jawaharlal Nehru University in New Delhi over Physics at an I.I.T, for graduate studies. This was my first step towards the interface between physics and biology. Nobody really had a clear idea at that time as to what theoretical biology meant, and I wandered around trying to understand what I wanted to do. I wrote to those whose papers I had read, and then travelled to the Centre for Theoretical Studies at the Indian Institute of Science, Bangalore. Shuttling between J.N.U. and I.I.Sc. several times in the space of two years, reading many papers, having lots of discussions with teachers and friends, both from biological and theoretical sciences, slowly guided me to develop some ideas. I finally stayed at J.N.U. and carried on a programme to study developmental processes in Hydra, using both mathematical and experimental tools. The highly academic environment of I.I.Sc. and the high quality socio-political environment of J.N.U. influenced my life and way of working. I learnt a lot from both places.

Though I had worked on models of circadian rhythms (at I.I.Sc.) and pattern formation during development in Hydra (at J.N.U.) for my thesis, I developed a general interest in biological processes. On seeing the advertisement in Employment News, out of sheer curiosity I applied for a position in a newly formed institute in Hyderabad, the Centre for Cellular and Molecular Biology and I joined in 1983. One of the first institutes to start a programme on theoretical biology, CCMB had a highly developed work culture, strong emphasis on originality and imaginative thinking, and a very active group of young faculty along with strong leadership. I was encouraged to work at the interface of theory and biology. Though I learnt a lot of biology from my colleagues here, it has mostly been a lonely journey. The area was new and it has been a continuous struggle to be accepted by the community, as I was neither a trained biologist nor a card–carrying physicist. But I continued alone, with determination to do what seemed to me a

worthwhile endeavour, although few recognized its importance then.

It is only during the past ten years, with the surge of activities in genomics/bioinformatics in one hand, and evolution of a new sub-discipline called soft condensed matter in physics on the other, that many more theorists are getting interested in biological problems, and biologists are becoming more and more aware of computational studies. For example, some of my work published in 1988 on biochemical pathway modelling has suddenly been noticed during the past two years by people in the field. What helped me sustain my objective to work in this interdisciplinary area is the sheer wonder of the intricate designs in biological systems at all levels of organization. Will we ever learn how all this comes about?

I am glad that I lived in times that were interesting both scientifically and socio-politically. I am so grateful to my family, friends and teachers for having encouraged me to choose and continue in basic science, especially physics, as my field of enquiry. The tremendous surge of interest in understanding nature by using all possible approaches – experimental and theoretical – makes the pursuit of science very exciting now. Sometimes I wish that I could start my life in science now, so that I could study physics again and try to understand the codes of life using physical principles.