Great Teachers who have taught me

– J. V. Narlikar

Introduction

At the outset, I congratulate NAAC for organizing this meeting in which teachers come together and share their problem on the same forum. I come here not as an expert, but to use this opportunity to pay my tributes to some great teachers from whom I learnt a lot...not only at the research level but right from my early school days.

I begin with a story by Munshi Prem Chand, a distinguished writer in Hindi. The story centers around a school teacher who is dedicated to his job and ideals but whose earnings are quite modest compared to those of his close friends who are in the police department and in the taxation department. Once his friends and their families set off for piligrimage and somewhat patronizingly ask him to join them. While they manifestly liked to show their 'money power', there came the occasion when reaching their destination, they found that no accommodation was available in any hotel or dharmashala in the town despite offer of money. While they were resigned to sleeping on the railway platform, a railway official recognized the teacher as one who had taught him in his childhood. "Sir, I have never forgotten the contribution made to my life... please allow me to play host to you and your friends in my home", said he. It was then brought home to the teacher's friends what impact a good teacher can have on his students, how they value him way above any monetary assessment.

Time and again I came across a demonstration of this myself, when I encountered the old students of my father, from all over India who remembered their days as his pupil in the Banaras Hindu University. But let me now turn to an account of my own education starting from my school days and leading to research at Cambridge and recall some teachers to whom I owe as an unrepayable debt.

School days

In my school in the campus of Banaras Hindu University, the number of students was small, there being no more than 40 students per class and normally only one section per class. We did not have the rat race of completing an overstuffed syllabus that today's children have to face. Thus teachers had time to explain what they were teaching and also deal with student queries that went beyond our syllabus. For example, our maths teacher, one Mr. Pande would spend time discussing rider in geometry that were of this kind.

Another maths teacher who really belonged to the primary school was once sent to our class of Std 9 as our regular teacher was absent that day. We boys were in a somewhat derisory mood, thinking, what new will this man from primary classes tell us. But we were in for a surprise. The teacher posed three arithmetical questions for us to solve. They looked rather strange and we thought of using our 'superior' knowledge of algebra to solve them. However, we got entangled in mazes of equations and finally had to confess that we did not have a proper solution. He then demonstrated elegant arithmetic techniques to solve them...it was like using a short cut to reach one's destination where the normal route is long and winding.

While in the 8th standard, I was fortunate that my maternal uncle Morumama came to stay in our house since he had enrolled himself for the M.Sc. mathematics course at the BHU. He had been high on the merit list of Bombay Uinversity B.Sc. examination and combined a sharp intellect with marvelous wit. He noticed that our father had provided us (me and my younger brother) with two wall blackboards. We normally used these for drawing pictures, geography maps or for writing occasional trexts. Morumama found another use: he wrote a mathematical puzzle on one board under the title: 'Challenge Problem for JVN'. What began as a matter of fun soon got into a standing practice, with him writing such a challenge problem and I trying to solve it. The problem would remember on the board mocking me till I got the better of it. Or, on a few occasions I had to confess defeat and Morumama would then reveal the solution. On some occasions I took the challenge to my school class for a joint effort at a solution.

Challenge is enough of a motivation for a bright students and a good teacher is able to spot it and use it towards training him. I was unaware that through

such challenges my uncle had taken me at least three to four years ahead of my class.

The second motivating factor is sheer enjoyment of the subject. It is not easy and it takes a top class teacher to convey the enjoyability of a subject to his pupil. Every subject has its enjoyable parts as well as dull ones. The former excite the pupil and make him want to learn more; the later ensures that his interest in the subject dies down. Prof. Bose was a motivating Physics teacher in my intermediate (modern day XII standard) college at Kamachha in Varanasi. He made Physics a likeable subject wherein interesting questions can be asked and answered quantitatively. The use of mathematics in answering Physics questions demonstrated to me the advantage of cross-fertilization of two fields.

Cambridge teaching

The B.Sc degree at BHU was a stepping-stone for me to go to Cambridge for higher education, which was to begin with negotiating the formidable Mathematical Tripos reputedly the most comprehensive and difficult mathematics examination. Although I had secured nearly cent percent marks in maths in the B.Sc exams at the BHU, I had been warned that in Cambridge it would be like bathing on a very different (and unfriendly) pitch. The Tripos questions are seldom repeated; the advantage of practicing with the previous years' papers is just to get the knack of solving tricky problems. There is no guarantee...rather it is almost certain that none of those questions are going to reappear this year. Moreover, the lecturer went at a terrific speed, covering what would be covered in BHU in one year, in a short term of 8 weeks. So taking it easy for a few days meant being left far behind.

It was under such circumstances, that I was lucky in having Mr. Murphy as a supervisor in my first year. A supervisor is a person you see once a week to go over your lectures and to see if you had any difficulties. Murphy had a down to Earth approach to the problems I brought....an approach that showed that provided one understood the contents of the coursework, the apparently tricky looking problems could be solved. My good performance in the first year exams owes a lot to him.

Cambridge can be an awe-inspiring place for any student. To see Nobel Laureates walking or cycling along the Cambridge Streets was a common

sight. One saw physicists like Paul Dirac, G.P.Thomson, John Cockcroft, and biologists Kendrew and Perutz, and learnt to take them in one's stride. But I was fortnate in having Dirac deliver the quantum mechanics course based on his own classic book. The subject had derived a lot more clarity and logical consistency from what Dirac had put in it. From a set of arbitrary working rules it had progressed to a discipline that required Hilbert space algebra to quantify its details. Dirac was by no means flamboyant, rather the reverse. He had a sedate style, which simply called a spade a spade. Yet often his 'punch lines' became that much more effective because he delivered them in his usual matter of fact way; like when he said: "I shall begin with an action principle, because nature follows an action principle". A profound assumption was thus stated as a straightforward fact!

By contrast, the most flamboyant teacher I have ever had the pleasure of listening to was Richard Feynman at Caltech. Gestures, up-and-down motion across the stage, raising or lowering of voice, jokes and brickbats all were employed to get the subject across. But despite their sharply contrasting styles, Dirac and Feynman shared two things in common, their understanding of the subject and their love and excitement of it. A student is generally able to gauge his teacher on these counts and the effectiveness of the teacher vis-à-vis the student depends on how high is he rated on these scales.

Research supervisor

I was equally lucky to have an inspiring research supervisor who loved his subject and understood it thoroughly. Fred Hoyle had taught me in the Tripos and to a large extent his teaching had been responsible for my opting for astronomy and astrophysics as my field of research. I have yet to come across a scientist as original in his approach as Fred Hoyle. Although many of his ideas became textbook material, he himself was far from conventional. Instead of looking for things that fit a theory, he was on the look out for anomalies, for it is here that he felt that nature was trying to tell us something new. Most scientists believe that he was wrongly passed over in the award of Nobel prizes in 1983.

What was it like working with a highly original man? First, one learnt to be scientifically more critical; don't accept an idea just because the majority goes for it. He felt that if a popular paradigm despite being extensively worked

upon, failed to produce satisfactory explanation of a phenomenon, then one should not hesitate in abandoning it. Indeed, he himself did not work within the popular framework because he felt that"....if it were correct, then one of the multitudes of brainy scientists presently working on it would have solved it...." How did he treat his student?

When in June 1960, I went to work under him as his student; he suggested several problems for may consideration. Noting that he had omitted one important topic, I asked him: "Sir, why don't you like me to work on the steady state cosmology?" This was his own theory of the universe for which he was known worldwide. His reply was; "I do not wish a new research student to get involved in controversy. It is best if he experiences and learns the research techniques through a non-controversial problem." I recall being disappointed by this reply but could understand the logic behind it.

Neverthless, subsequent events worked the other way! I completed one of the alternative problems that we chose that day, within six months. I was waiting for another problem to tackle when the Ryle-Hoyle controversy erupted. Briefly, Martin Ryle, the leading radio astronomer at Cambridge had been conducting a survey of radio sources in distant universe lying beyond our milky way Galaxy. On the basis of his findings he announced in mid-January 1961, that these disproved the steady state cosmology proposed by Herman Bondi, Tommy Gold and Fred Hoyle. This was therefore a challenge to Hoyle. Did this theory stand disproved? Not so, through Hoyle, and he sought my help in working out a detailed model with in the steady state cosmology that is consistent with Ryle's findings. We worked for around ten days and I recall doing some number crunching on very primitive calculators and the EDSAC computer that had to be fed data through paper tape. We were against time, since Ryle's results were to be presented at Royal Astronomical Society in its February meeting. We had been given ten minutes to present our point of view.

It was when we had completed our task that Fred released his bombshell on me! Because of a prior engagement that day, he could not attend the RAS meeting I could present our results instead. I was shaken to the core...how could I, a raw research student stand up and confront an established and seasoned scientist like Ryle's? However, Hoyle was reassuring. If I had confidence in the accuracy of my calculations then I had nothing to fear. All I must ensure was that I speak and present our point of view with the necessary

slides, within eight minutes, to allow for any interruptions, queries etc. He went over my presentation several times to ensure that I presented the crucial arguments within those eight minutes.

I did follow that plan at the actual meeting and am glad to say that all went well. There were many who later came and said that they could see our point of view. For me what was the most important plus point was that of self-confidence in being able to present my point of view against any adversary.

In retrospect, I take that 'ordeal through fire' as an example of what a good teacher can do; to delegate responsibility of presenting joint work to the student and thereby build up his self-confidence. I have myself followed that practice with my students too.

Concluding remarks

These autobiographical narrations have allowed me to present my perceptions of what a good teacher can do to motivate his student, to get him interested in the subject, to encourage his creativity and above all to build up his self-confidence. Such teachers are sources of inspiration to a whole generation of students and as such are the most valuable asset of an educational institution. I consider myself fortunate in having had the right teachers at the right times of my career.