

THE TALE OF AN ENGINEER TEACHER



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The steamer was jam-packed. Starting from Chandpur it was going to Goalanda, a small river-port on the other side of the Meghna river. The river was very wide at that point, looked like almost a sea. I, along with my parents, a younger brother and a sister were migrating from our house in Comilla town (in erstwhile East Pakistan) to the newly independent India. For a boy of slightly above five years of age, it was quite a traumatic experience.

I was so fond of our house in Comilla. It was a bungalow with gardens all around. My father, with the help of a domestic hand, planted a number of saplings, of mango, jamun and jackfruit. He used to tell my mother that we will have to wait for at least two to three years before we can eat the first fruit from those trees. My mother used to have a small vegetable garden, close to the kitchen. In one of the rooms I had a small desk and chair of my own in one corner, close to a big window. That was my study. There were no play-schools or kindergartens in those days, and so I studied at home. Of course, most of the time during the day, I was playing on my own, as there were hardly any other children of my age in the neighborhood and my siblings were too small. The road in front of our house led to the Ishwar Pathshala, a high school, a few hundred yards away. I later came to know from my father that this was a very renowned school in undivided Bengal. Every morning after breakfast I used to cross the road to the other side and sit down below a big jamun tree to run my own school with invisible students, till the time my mother called me home for lunch. What a wonderful time it was!

We had to leave all our possessions behind and my father could bring only two big suitcases, filled with mostly our clothes and my mother's little jewelry, on board the steamer. At that time, I did not know the reason for our leaving the house so suddenly, but later when we were somewhat settled in independent India my parents gave me sufficient hint to make me understand that we were indeed very lucky to cross over to India alive, which many of our near and dear ones could not make. I became aware of the partition in a very rude way.

After living in two or three different locations on this side of the border for a little over two years, we finally settled down at Howrah, a satellite town of Calcutta, but on the other side of the Ganges. My schooling began here in the Howrah Zilla School, a Government school which started as early as 1845. I passed my School Final examination in 1958, standing 3rd in merit in the West Bengal School Board. When I look back, those were possibly the best years of my life. We had excellent teachers, who not only taught us various subjects, but shaped our character too. I would like to pay my respectful homage to all my teachers through this article. My eyes are filled with tears when I think of how much they gave us for so little they got from society. Where are those teachers now-a-days!

I was the eldest of the five siblings and both my parents used to keep a close eye on how I was progressing with my studies. They always used to tell me that if I were good in studies, my younger brothers and sisters would follow suit. I myself also became quite aware that financially we were not that well off as

in Comilla, and life had suddenly become rather tough and difficult. The only way we could improve our lot was by studying really hard. I think that was the motivation that made me a hard-working person throughout my life. I would like to convey to my late parents, through this article, how much indebted to them I am for guiding me through all the trials and tribulations of my life.

My father, who was in Government service, cherished the ambition that his eldest son should work hard to be a member of the Indian Administrative Services. When I was in the seventh standard in school, he called me one day and told me how the administration was run in government departments and what a useful and honorable job the IAS officers performed. He even introduced me to his departmental Secretary, Mr. Ashok Mitra, who later became the Secretary in the Ministry of Information and broadcasting under Mrs. Indira Gandhi. My father's influence worked on me and I started making up my mind to try to become an administrative officer when I grew up. My ideas, however, started changing after I joined the Presidency College in Calcutta to do my Intermediate Science course (equivalent to the Higher Secondary course these days). It was while in Presidency College that I started realizing that administration was really not my cup of tea. Rather, I was drawn to the study of Physics and wondered if it would be a better idea to take up teaching and research in Physics as a career. A chance visit to the Bengal Engineering College (now IEST Shibpur) on my way to the Indian Botanic Gardens, also kindled in me a possible career option in engineering. I mustered enough courage to tell my father that I was not interested in IAS, rather I would like to pursue a career in either science or engineering. He was a little bit sad, but told me that I was free to choose my profession. Since the family was going through economic hardship for obvious reasons, I decided that I would like to pursue a career in engineering, which came with more or less assured jobs those days.

I sat for the West Bengal JEE and also IIT JEE (there was just one IIT then, the one in Kharagpur) and made it to the list of successful candidates in both. It was a friend of my father, Late Professor SS Boral, Professor of Physics and Tele-Communication Engineering at BE College, who had advised me to opt for Metallurgical Engineering as the desired course of study. He told me, after I had a long discussion with him, that in this branch science and engineering are so inter-mixed that my passion for science and engineering will be satisfied simultaneously. He cited the case of Late Professor GP Chatterjee (once upon a time, Head of Metallurgy Department in BE College) who did two Ph.Ds simultaneously, in Physics and in Metallurgy, from the University of Pittsburgh, USA. At the same time, Professor Boral assured my father that I should get a very good job after graduating in Metallurgy since Hindustan Steel (now SAIL) was putting up a number of integrated steel plants throughout the country and that there were only a very few metallurgists available, since this discipline was rather new in India. I opted for the Metallurgy course in BE College, which was then more than 100 years old, rather than going to the very new IIT Kharagpur.

BE College in those days was a first-rate technical institution with a team of highly qualified and competent teachers. The college was a partner with eleven other American universities under the Technical Co-operation Mission (TCM) program. Under this scheme, eminent American Professors used to visit BE College for limited periods of time to teach and to help in guiding research. As a reciprocal measure, BE College teachers of high caliber could visit those American universities to pursue higher degrees. I spent a wonderful four-year period in the Metallurgy Department, first learning the basic sciences and elements of the engineering profession in the first two years, followed by specialized Metallurgy courses in the remaining period. By the time I was in the fourth and final year of study, I knew perfectly what I would like to do for a job, once I finished my studies. I wanted to become a teacher and researcher in Metallurgical Engineering, for sure. It was while executing my Bachelor of Engineering thesis, I had a first-hand experience of what research was like. My teacher and thesis advisor, Late Professor AK Seal was very much instrumental to introduce me to the wonderful world of research. One

day he called me to his office to tell me that he considered that I could be a good teacher and researcher in Metallurgy, and asked me to apply for a fellowship under the Technical Teachers' Training (TTT) program of the Ministry of Education, Govt. of India. According to this scheme, those who could qualify under the TTT program, would be allowed to enroll themselves for the Master's degree in an institution of their choice, and at the same time would be acting somewhat like a teaching assistant in US universities. On completion of the three-year program, a lecturer's job in a good academic institution was assured. Accordingly, after my training period was over, I joined as a Lecturer of Metallurgy in my alma mater, BE College. I completed my Master of Engineering and then got enrolled for my Ph.D. under the Calcutta University with Professor Seal as my Guide in both the cases. The topic of my Ph.D. dissertation was the development of Fe-Mn-Ni based maraging steels. By the time the experimental part of my research work was complete, I was selected for a Commonwealth Scholarship to pursue Ph.D. in the University of Birmingham (UK) under the guidance of Professor RE Smallman, the renowned Physical Metallurgist. Since Professor Smallman, who was also the departmental head, could not give me sufficient time, Dr. WB Hutchinson, a bright young lecturer in the department, was made my co-supervisor. Professor Smallman told me that the University received a substantial grant from the Science and Engineering Research Council (SERC) of the UK Government for procuring an AEI-EM7 High Voltage Electron Microscope (HVEM) for the department (Department of Physical Metallurgy and Science of Materials). This 1000 KV microscope had a reasonably large specimen chamber suitable for in-microscope experiments. Further, the much higher penetration of the electron beam would allow use of substantially thicker metal foils than was possible with the existing 100 KV electron microscopes. Thus, for the first time, it was possible, for example, to carry out in microscope heating experiments on heavily cold-worked and rather thick metal foils to study their recrystallization behavior. The use of thicker foils meant that the results obtained would be comparable to those from bulk samples. Previously quite a few attempts were made to study the recrystallization phenomena in-situ in conventional 100 KV electron microscopes. However, the very fact that the foils that could be used in such microscopes had to be rather thin, and therefore not many deformed cells could be enclosed within the space between the top and the bottom surfaces of the foils, those experiments were total failures. I was quite fascinated with the idea that I could possibly be the first person to carry out in microscope recrystallization experiments in a HVEM. Therefore, I volunteered to take up a project on recrystallization studies on heavily cold rolled copper and copper alloys, using an HVEM, for my Ph.D. work. The results of these studies were beyond our expectations. The work was highly acclaimed by the scientific community. The impact of this basic work can be gauged from the following sentence. "Perhaps the clearest confirmation of the fact that the nuclei come from subgrains present in the deformed matrix is Ray et. al.'s [R. K. Ray, W. B. Hutchinson and B. J. Duggan :Acta Met. 23 (1975) 831] direct observation by HVEM of nucleation in heavily rolled copper....., the first time apparently that nucleation events comparable to those occurring in the bulk have been observed in such detail." [Ref. R. D. Doherty in "Recrystallization in Metallic Materials, Ed. F. Haessner, Dr. Riederer Verlag GmbH, Stuttgart, 2nd Edition (1978) 23-61]. After spending a year and a half in Birmingham, I took leave of about six weeks to come back to BE College. I wrote down the entire thesis of my Indian Ph.D. within that period and submitted the same before returning to Birmingham. I finally came back to India after completing my British Ph.D. in April 1973 and was immediately promoted to Assistant Professorship in BE College. Within a few days I sat for the oral examination for my Indian Ph.D. and therefore I received two Ph.Ds in the same year. The next year was a very important year in my life, since in January 1974 I tied the knot with my wife, Chhabi. I have no hesitation in confessing that whatever I have achieved in life is to a very great extent due to the fantastic support and understanding I received all throughout from my dear wife.

BE College used to be a state government-run institution those days. For the number of students enrolled every year, the number of teachers was abysmally few. Because of the total apathy, insensitivity and ignorance of the state politicians and the mandarins in the Writers' Buildings, the secretariat, the

infrastructure, both for teaching and research in BE College, deteriorated very fast and most of it became rather obsolete within the span of a few years. Thus, BE College, which once enjoyed the reputation of a premier academic institution in the country, soon became like a local college, both with respect to infrastructure and talent. As I found out that it was impossible to carry out any meaningful research in BE College, I started nurturing the idea of leaving BE College and join one of the newly created Indian Institutes of Technology in the near future. A few visits to IIT Kharagpur and IIT Kanpur convinced me that for doing good teaching and research, IITs would be the ideal places for me.

I was so determined to leave BE College that against all advice from my parents and well-wishers I joined IIT Kanpur, not with a promotion but at the same level as an Assistant Professor, in 1977. I could immediately see the gulf of difference between an IIT and a state government run engineering college, both teaching and research-wise. That difference only increased over the years and I could see the highly deplorable condition BE College fell into. The more I thought about it more I got convinced that in India if we want to produce first grade engineers, all engineering and technical institutions should be brought under the care of the central government. That will ensure that both teachers and students will come from different states of the country. This cosmopolitan fabric will not allow the local political goons to hijack the control of such important institutions, and at the same time will allow their healthy growth.

IIT Kanpur, during those days used to be a fantastic institution. I was highly impressed with the tremendous freedom and flexibility offered by the institute, in terms of academic curricula and courses, and research and teaching programs, which was quite unthinkable even in other IITs. Another very important aspect was the complete absence of hierarchy within the departments and in the institute. These were the attributes which made IIT Kanpur a completely different kind of academic institution in the country. I started getting, at a slow but steady rate, a number of brilliant M.Tech. and Ph.D. students, some of whom later distinguished themselves in their chosen careers. I am glad to mention here that a few of my former Ph.Ds turned out to be excellent teachers and researchers in some of the prestigious institutions in the country and abroad. While doing Ph.D. in Birmingham I learnt that crystallographic texture of materials, like their microstructure, affect the properties significantly. In fact, during those days, techniques of texture measurement were being developed and perfected in a select number of academic institutions and research organizations in several countries of Europe, a few organizations in the USA and in Japan. There was not a single institution in India where any serious research activity took place in the areas of crystallographic textures of materials. With my limited knowledge in textures I wanted to make a beginning in research in this area at IIT Kanpur. I started working with a primitive texture goniometer existing in the Advanced Centre for Materials Science in the institute. The operation of this equipment was totally manual and collection of texture data from one sample used to take almost a full day. I was still very happy that at least I could do some work in the textures area, using this equipment. I was awarded a Humboldt research fellowship in 1981 to work with Professor K. Luecke, Director of the Institute for Physical Metallurgy and Metal Physics in the Technical University of Aachen, in Germany. Professor Luecke was one of the two pillars of modern texture research, the other being Professor HJ Bunge of Clausthal University in Germany. My two years' stay in Aachen has been extremely useful to me in learning the techniques and applications of crystallographic texture. After coming back to IIT Kanpur I built up a small facility for undertaking texture-related research (but still without a modern texture equipment). Using my wide network in Germany as well as in DMRL, Hyderabad I could manage to carry out critical texture measurements for my students' theses. Thus, possibly for the first time, meaningful texture research started in India in a moderate way. In 1997 I wanted to hold the first national seminar on textures in materials, to take stock of the pool of scientists and engineers in the country with active interest to work in this area. My idea did not get any response either at the departmental or at the institute level in IIT Kanpur, for some inexplicable reasons. Since my request to hold this meeting in IIT Kanpur was summarily turned down, I started looking for other

alternatives. Fortunately for me, Professor Dipankar Banerjee, the then Director of DMRL Hyderabad, agreed to provide me all help for holding the National Seminar on the Application of Textures in Materials Research (NASAT) there. The seminar was a great success and was attended by about twelve overseas experts on textures, including Professor HJ Bunge, fondly known as the father of modern texture research. In addition, about thirty-five delegates from within India also participated. The proceedings of this seminar were published as a volume entitled Textures in Materials Research. This event singularly helped to put India firmly on the Texture map of the world. For pioneering texture research in India, I was made a member of the International Committee on Textures of Materials in 1999, the first and the only member from India. It was after the successful meet during NASAT-97, I started thinking about establishing a National Centre for texture studies in India. In fact, a number of prominent metallurgists in the country assured me of all help in this effort. However, it soon became apparent to me that, both in the departmental and in the institute level at IIT Kanpur, this proposition would be rather unwelcome. I therefore stopped nurturing this idea. I felt extremely happy when, after a few years, a national facility was indeed set up in the Materials Engineering Department of IIT Bombay with a grant from the DST, under young and energetic Professor Indradev Samajdar. By the time I retired from IIT Kanpur in 2005, texture research in India picked up in a big way and a large number of scientists and researchers, in academic institutions, national research laboratories and in the R&D laboratories in a number of industries, were engaging themselves routinely in texture studies on various materials. Thus, what I started single handedly about forty years ago, has now developed to such an extent that India is considered as one of the few countries in the world where high quality and meaningful research on crystallographic texture is being carried out on a regular basis. I must admit that this is the biggest source happiness and pride in my professional life. During the 15th International conference on Textures of Materials, held in 2008, I voluntarily relinquished my membership from the International committee, in favor of my younger professional colleague, Professor Samajdar, who was later inducted into the committee. In the same meeting I could convince the remaining members to choose Bombay as the venue of the next (16th) International texture conference in 2011, the first time this conference was held in India.

Although when I had joined IIT Kanpur, it was a fantastic institution of learning, over the years I noticed a steady and continuous decline in the academic culture of the institute. In the IIT system, a faculty member does not have to take many classes, as in case of other engineering colleges and universities. The faculty members are encouraged to put in sufficient time and effort in doing high quality research work, for which they have ample time. I must confess that going from a small state engineering college to IIT Kanpur, I had some kind of inferiority complex to begin with. I thought I was rather small in comparison to many of the faculty members there. However, I soon realized that excepting about some 40% faculty members, most of the others were really not that great. There were quite a few who neither taught well, nor did any worthwhile research. This kind of a situation is very fertile to breed dirty politics. As an elected member of the Board of Governors in IIT Kanpur for two years, I had ample opportunity of observing the working of the institute from close quarters. I was appalled at the extent of politics in almost all spheres, and this peaked during selection and promotion of faculty members. No wonder that the IITs do not figure within the top 100 academic institutions in the world. It is time to strictly implement a system so that only the most qualified and competent academicians are selected and promoted. There should be another system to monitor the academic and administrative output of every faculty member on at least a yearly basis. To start with, for the purpose of promotion to higher positions, the method followed in the Indian Institute of Science, Bangalore may be adopted. Again, the total contribution of a faculty member should be evaluated, on the basis of his/her teaching, research and administrative performances. Once it is ensured that only the good and deserving people can go to the top, all other problems of the institute will automatically vanish.

For the last ten years or so, all the academic institutions in the country, including the IITs, have been facing the problem of poor attendance in classes by the students. This is a terrible wastage of money, time and manpower for the nation. During the last few years of my stay in IIT Kanpur, I extensively interacted with many students. As per their version, the reasons for their poor attendance are: (1) poor teaching quality, (2) lack of motivation, (3) lure of high salary in the IT sector, for which just the engineering degree is needed, not any education, (4) easy availability of lecture materials through the internet and (5) urge for more freedom to choose the time and pace for learning a subject. Although this appears to be the biggest challenge for engineering education in our country, this can be turned into a very big opportunity. As we are all aware, the engineering education imparted in our country is highly deficient in the sense that here it is mostly bookish knowledge, as a result of which a graduate engineer hardly knows anything about practical engineering aspects. This has time and again been pointed out by the leaders of the various industries also. I would suggest a radical departure from the conventional engineering education as is practiced in India. On every subject high-quality e-learning courses can be produced, through the auspices of NPTEL and/or some other agencies and the students may be given easy access to those courses. The students need not come to formal classrooms for learning, rather they can learn at their own time and pace. There should be a few formal contact hours with the teachers, when a student can clear up the deficiencies he/she may have by discussion with the teacher concerned. This will release a large amount of time for the teachers who can concentrate on research. Everyday a few hours should be set aside when a student will be taught the practical aspects of the relevant engineering course he/she is registered in, especially in modern manufacturing practices and design along with hands-on experience with sophisticated instruments. The marks allotted to these practical courses must have a substantial part based on attendance. This way we should be able to not only solve the problem of students' non-attendance in classes, but will also motivate and equip them better for future employment.

When I was near retirement from IIT Kanpur, I got an invitation to serve as a Visiting Scientist in the R&D Division of Tata Steel, Jamshedpur. My job description was to offer critical technical/scientific input on R&D research programs during the formulation and execution stages, to actively participate in specific projects undertaken by R&D, to hold special lectures on selected topics from time to time, to review the progress of research projects and to guide researchers so that they could write excellent research reports and technical/scientific papers and patents. In addition to these I was also requested to produce an e-learning course on X-ray Diffraction, with technical support from Tata Interactive Systems in Kolkata. After retirement from IIT Kanpur I started my work in Tata Steel full-heartedly. The Chief of R&D and Scientific Services of Tata Steel during that period was Dr. Debashish Bhattacharjee, an excellent technocrat and scientist with impeccable credentials. It was a wonderful time and I got into my task with the same vigor and purposefulness which I had in IIT Kanpur. Things went smoothly for the first few years when I was instrumental in getting a reasonably large number of papers published from the work done by researchers in R&D. I used to spend a lot of time discussing research problems with researchers and helped them in learning various techniques needed in research activities. In fact, I thoroughly enjoyed my job in Tata Steel. Then came a sudden change. The Tata Group bought Corus (a steel company with assets in both UK and the Netherlands) and Dr. Bhattacharjee left for Europe as Group Director of R&D Tata Steel with control over both Tata Steel India and Europe. A steady deterioration in R&D in the Jamshedpur plant started after the departure of Dr. Bhattacharjee, and it continued to become worse and worse. I finally left Tata Steel R&D in 2014. My ten years of service in Tata Steel R&D gave me a rare insight into the working of the top private sector steel plant in India. As a Visiting Scientist I used to send, after every two years, a critical report to the Managing Director, outlining the steps needed to improve things within R&D. I do not know what happened to those reports, however, I started having a feeling that the top management possibly was not that concerned with the health of R&D. They possibly were very happy that they, after all, had an R&D to give them some tax benefit from the Government. Tata Steel R&D those days had an excellent crop of very high-grade

researchers, coming from the IITs and the Indian Institute of Science, Bangalore. Compared to many of them, the group heads and the Chief of R&D appeared to be rather ordinary. The result was simple. Due to total apathy of the top brass in R&D these bright young boys and girls started leaving the R&D in large numbers. The vacant positions would be filled by new recruits, fresh from colleges. I brought these facts in my reports to successive MDs since I felt that the persons who left were the “value-added products”, well versed in research and the new recruits were like “raw materials” and therefore no match for those who left. However, to my surprise I found that the Tata Steel bosses firmly believed that nobody was indispensable for the company and therefore no attempt was made to retain good researchers in R&D. This came as a big surprise to me. I was also shocked that Tata Steel R&D, which is the first industrial R&D in the country, and was more than 75 years old, lacked some of the basic equipments for research. Even now they do not have a vacuum induction furnace for melting experimental steels and a laboratory-scale rolling mill. It is high time they go for a total revamping of their facilities, otherwise nothing tangible will come out of that laboratory. As a result of all these, Tata Steel R&D is nowhere in comparison to the R&D departments of the major steel plants in the world, like Arcelor-Mittal, Nippon Steel and the steel companies in South Korea and China.

After my stint with Tata Steel finished in 2014, I joined as a Visiting Professor in my alma mater, BE College which has now become Indian Institute of Engineering Science and Technology (IIST), administered by the central government. Life has turned a full circle for me. I started my career from BE College and now, at the fag end of my life, I am back again in the same institution.

When I look back, I think I am one among a handful of engineers (metallurgists) who worked both in academics and in industry. Surprisingly, I found plenty of similarities in both these types of entities. For example, politics reigns supreme in both, it is of course far dirtier in industry than in academics. A genuinely good and competent person faces lot of opposition from the mediocre (their number is obviously very large) who join in a formidable group and push the good one against the wall. The person concerned either leaves the organization or, if he/she cannot leave due to personal or family reasons, gradually gives up and becomes a member of the mediocre group. As a country we really cannot afford this anymore. The situation can change only when very bright and visionary persons are brought at the helm of affairs everywhere. It is indeed a matter of shame that bright young people who join an organization in India, find it extremely difficult to work and give their best. The same persons, when they go abroad, do wonderful work. The reason is very simple. In our country very small people unfortunately occupy very big chairs. This has to stop forthwith. If the top person is bright and first-grade, he/she will recruit only the first-rate persons. On the other hand, if the top person is second or third grade, he/she will keep on recruiting only the third or fourth grade people.

Our government over the last quite a few years has been emphasizing the need for quality research work in the country, in academic institutions, research laboratories and in the R&D laboratories in the various industries. From my limited experience I have seen how the top brass in an industry gives only lip service, so to say, for advancement in research. They are just bothered about how to maximize the profit of the company during the period of their tenure, and therefore do not want to take any risk. The other most important point is that the top persons in most of the Indian industries are just graduates in engineering with a diploma or degree in business management. Because they have not done any research work during their life-time, they have absolutely no idea about what research is and what is essentially required for undertaking worthwhile research activity. Of course, there are very few exceptions also. But, by and large, this is the existing scenario. That is the reason why no landmark research has ever been carried out in the area of either product or process development, for example, in our steel industry laboratories. The remedy is to appoint very good and competent engineers, with substantial research experience, preferably a Ph.D. at the level of Managing Directors or Presidents of the companies. Our industry can only progress

and become at par with the industries in the West, in China, Korea or Japan only by developing competitive technologies through sustained research. Otherwise, Indian industry will never be a leader in the world and will remain an inefficient follower all along. It is my fervent appeal to the Indian National Academy of Engineering (INAE) that they seriously start considering the measures necessary to improve the quality of engineering education in India, and at the same time start advising the industries on how to improve the quality of research, so that the country can forge ahead with high quality engineering manpower and knowledge (research) based modern engineering enterprises. INAE has to interact with the relevant Government departments, academic and research institutions and industries and roll out, after due deliberations, the way forward.

After spending nearly fifty years of my life in teaching and research, when I ask myself “are you happy?” the answer comes in a flash “yes, of course, because this profession is so fulfilling”. I am a totally satisfied and utterly happy person, with no regrets whatsoever. Yes, it is true that I did not receive many accolades and awards, like many others, but that has nothing to do with my inner self, which is totally at peace and happiness. If I am asked to advise a budding engineer on which profession to choose as a career, I would definitely tell him/her always to consider teaching/research as a worthwhile option, although many will say “R.K. Ray is totally biased”!