Remembaring Two Giants: SNG & AKR

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When we joined Presidency College in 1965, I was not even seventeen. It was an impressionable age and it seemed as if the doors of a new world were opened unto us. To paraphrase someone else, "those were the best of times; those were the worst of times". The tumultuous sixties overcame us and one whole year was lost but memories of our college days are still glittering–partly because of our fellow students and partly because of our teachers. I am sure that nobody would object if I said that Physics was one of the departments that stood out. Perhaps English Literature and Economics were two of the other departments with similar reputations.

The Physics teachers most talked about in those days were Samarendra Nath Ghoshal (SNG), Shyamal Sengupta (SS) and Amal Kumar Raychaudhuri (AKR). It was, of course, usual to refer to teachers by their initials. There were other very good teachers such as Dr. Rajendra Lal Sengupta (later to become the Principal and then the DPI), Hemendra Nath Mukherjee, Rashbehari Chakrabarti, Pratip Chaudhuri and the late-lamented Subrata Dutta but the first three were stellar figures. Any one of them would have meant an outstanding faculty but we were fortunate to have all three for some time. After we joined, AKR came back from the University of Maryland (where he had spent a year) and SS was transferred to Maulana Azad College. We were thus to miss thermodynamics taught by SS but were privileged to have it taught by AKR instead.

Our adulations were thus restricted to SNG and AKR. We then thought them ancient but now I find that they were in their early forties. I was stunned to find out recently that both were born in the same year (1923). What an amazing coincidence! Apart from being outstanding teachers and being well-known in academic circles throughout the world, there appeared to be little in common between them. SNG was built big and carried an aura of authority around him. He was always immaculately dressed in white shirts and trousers in

summer and in light suits in winter. In contrast, AKR looked almost frail. We had expected a "pucca suited-booted sahib" but, much to our surprise, he was invariably clad in dhoti and kurta. We used to speculate over whether he wore the same Bengali dress in US winters. SNG was a formidable figure–he seemed difficult to approach but, once the defence was breached, he was surprisingly easy to talk to. Once, during the height of Naxalite violence, Aditi Nath Sarkar, a PCSO leader, was being beaten up severely by some goons, mostly outsiders. In such matters, no one interfered those days. SNG heard the furore from his room, walked out calmly and rescued Aditi. Apparently his assailants were also taken aback. AKR appeared a little ephemeral, living in a world of his own. Once we encountered him on the main staircase of the Baker Laboratory and one of us said 'namaskar' to him–our usual mode of address to teachers. He walked down, turned suddenly and leapt up the stairs, demanding to know why he was so greeted. If we were taken aback, it seemed that so was he! I think that he was jolted out of his quantum-relativistic world by this mundane address. Nevertheless, he was human enough to attend a humble Science Society meeting, organized by one of his students. We came to know later that SNG came from Scottish Church College while AKR was a Presidencian. Also, AKR came from Barisal, though his accent was very slight (If anything, he leant towards the Teutonic mode of pronunciation, being meticulous in his pronunciation of German names), while SNG was a 'ghoti' with a straight English accent. These issues did not seem to matter in the least.

What did we learn from them? In BSc Physics Honours, SNG traditionally taught Paper V (Modern Physics) but, for our batch, AKR taught that paper. From the next batch onwards, SNG taught thermodynamics but, for us, it was AKR. So we never really had SNG during our Physics Honours days, except for brief interactions during practical classes and more mundane interactions on administrative matters, when he was Head of the Department. During MSc of course, SNG taught us Nuclear Physics (his forte) and AKR taught us Classical Mechanics, apart from taking some special classes on the Special Theory of Relativity (where we had bamboozled our assigned teacher). It was a pleasure walking down from the University College of Science to our own college to attend classes with the giants and colleagues from other colleges were also awe-struck. Both were outstanding teachers and were able to inculcate in their students a love of the subject beyond the ordinary. Even while teaching, their methods were quite at contrast. SNG was always

meticulously prepared and was able to reproduce on the blackboard elaborate equations and formulae without any apparent effort. I still recall that he reproduced the Bethe-Weizsacker mass formula (which had very large numerical coefficients which we found difficult to memorise) nonchalantly on the blackboard. Later, I found out that he carried small slips of paper with the equations in his pocket, in case he needed help. To the best of my knowledge, he never did. AKR, on the other hand, never prepared like that and proceeded to derive everything from first principles on the board. Once I recall his having stumbled, after solving myriads of equations on the blackboard. Class was long over but the problem remained intractable. He acknowledged defeat temporarily and went off, only to reappear and solve the entire problem faultlessly at great length. Never mind that it was someone else's class and he was watching helplessly from the sideline. That was the AKR we knew!

Unfortunately, they had no books published by then. We knew their greatness by their performances in class and from their class notes (nothing dictated, but copied by us meticulously). Later, I found that SNG had written a textbook on *Atomic and Nuclear Physics* (S Chand & Co) and another on *Introductory Quantum Mechanics* (Calcutta Book House). No doubt, they were found useful by future generations of students. I found that these were recommended texts in the current Physics Honours curriculum of the Calcutta University. He had already written a textbook on Atomic and Nuclear Physics in Bengali. In 1980, when I attended Cornell University as a Hubert Humphrey Fellow, I found out that AKR's *Theoretical Cosmology* (Clarendon Press and Oxford University Press, 1979) was a recommended textbook and stocked in the Campus Book Store. This cheered me no end and I was able to boast to my fellow students about my dhoti-clad, humble teacher from Presidency College. I must have handled that book lovingly a hundred times but, unfortunately, by then, I was no longer able to grasp the significance of most of what was written. The dust jacket, however, proclaimed: "Current understandings and unresolved questions in the field of theoretical big bang cosmology are discussed". Later, two of his textbooks on *Classical Mechanics* and *Classical Electrodynamics* came out and I understand that his students had helped out by contributing his class-notes. This made me rue the fact that we had not made more constructive use of his notes on thermodynamics. Though he generally followed Fermi, some of his treatments were original and this could have made an excellent book. His first and last love was, however, Cosmology and General Theory of Relativity

and his last book *General Relativity, Astrophysics and Cosmology* (co-authored with S Banerji and A Banerjee, presumably his students) came out in 2003. The publisher was Springer Verlag and any one remotely connected with scientific texts would be aware of the elaborate system of referring the draft to competent referees before publication. This, I presume, was his magnum opus and was finally published when he was 80. These works would live on and carry their memories for some time, at least.

When we were students, these books were not there but we were privileged to read about their research work. Internationally acclaimed research work by teachers was rare then (and, I presume, rare even now). Dr Ghoshal's name stood out, as his pioneering work - the Ghoshal Experiment–was quoted in most textbooks of Nuclear Physics. This was really the verification of Niels Bohr's theory of the Compound Nucleus, which was one of the hottest topics in Nuclear Physics those days. He had joined the Science College for research in 1945 but proceeded to the University of California at Berkeley in mid-1946 on a Government of India fellowship. His celebrated work was done in the Berkeley Radiation Laboratory in 1950 and his supervisor was the great Emilio Segre, Nobel Laureate (1959), though the experimental approach emerged after discussions with the famous nuclear physicist Victor Weisskopf (who was the author of one of our best textbooks). This path-breaking paper was published in the Physical Review (Phys Rev 80, 939-942, 1950) and is still quoted in countless research papers. He created the compound nucleus Zn64 by bombarding Ni60 by alpha particles and Cu63 by protons and compared cross-sections of certain reactions with theoretical calculations. This earned him his Ph.D and what a way to earn it! In the last couple of years, I had occasion to visit the Lawrence Berkeley Lab a couple of times on work and could not help being thrilled by the work done by my great teacher 60 years back. On completion of his doctorate, Dr Ghoshal returned to India in 1950 and, after an initial stint at Lucknow University Institute of Nuclear Physics, he joined Presidency College. Experimental work in nuclear physics was hard to pursue at home but he did not give up on research, though his forte was teaching. He set up a Mass Spectrometer and carried out research in nuclear scattering. A cursory search through the internet revealed a couple of papers with Dr, B B Baliga and Dr A N Saxena, both of Saha Institute of Nuclear Physics, which were published in Proceedings of the Physical Society. There were probably some more but, more and more, he came to be known as the archetypal professor

rather than a researcher. What was a loss to the world of research turned out to be a gain for us, his students, many of whom made names for themselves as scientists. After we left college, he was dragged into administrative assignments and later joined Calcutta University, as Khaira Professor of Physics.

Dr Raychaudhuri had a different career pattern altogether. After his MSc in 1944, he joined the Indian Association for the Cultivation of the Sciences as a research fellow. He did not like the experimental work on Xray crystallography at all and wasted 4 years of his life here. He started teaching at Ashutosh College in 1949. He taught himself Riemannian geometry and started taking serious interest in the General Theory of Relativity, almost unimaginable in those days. He did receive some encouragement from Professor N R Sen and produced a couple of papers but started working largely by himself. He joined IACS for a second stint as Research Assistant but again felt bogged down in the study of properties of metals. His own work proceeded and, by 1953, he was able to arrive at what came to be known as the Raychaudhuri Equation. Even before this, he had done some independent work on the Schwarzschild Singularity which attracted attention. His seminal paper on the Raychaudhuri Equation was ultimately published in the Physical Review in 1955 (Relativistic Cosmology I, Phys Rev 90:1123, 1955) and it was appreciated by scientists such as Pascual Jordan and Heckmann. Later, the legendary Russian scientist Lev Landau arrived at the same equation independently and it is often referred to as the Landau-Raychaudhuri Equation. I am now no longer competent to go into the Mathematics (and without Mathematics, it cannot be really appreciated) but the Wikipedia article on the equation reads "The equation is important as a fundamental lemma for the Penrose-Hawking singularity theorems and for the study of exact solutions in general relativity but has independent interest, since it offers a simple and general validation of our intuitive expectation that gravitation should be a universal attractive force between any two bits of mass-energy in general relativity". Now that more than fifty years have passed since the formulation of this equation, it has been said: "In this intervening half-century, it has influenced different types of research, not only in classical GR as well as in still incomplete theories of quantum gravity, but also in string theory and even in hydrodynamics. There is every likelihood that research involving the Raychaudhuri equation will take new directions in future". Singularity, Penrose and Hawking are much talked about these days but it is nice

to know that our great teacher had a hand in the pie. He submitted his thesis for D.Sc which contained two papers on solid state physics as well. The thesis was appreciated by the legendary John Archibald Wheeler, widely acclaimed and he was awarded the D. Sc degree in 1960. In 1961, he joined Presidency College as Professor and the rest, they say, was history. He became known as an iconic teacher, revered by his students, as we can well testify. Of course, his research work did not stop and he kept contributing papers (some with coworkers) which were published in journals such as Annals of Physics, Physical Review, Physical Review Letters, Modern Physics Letters, General Relativity and Quantum Cosmology and so on. He retired in 1986 but continued as UGC Emeritus Fellow, Visiting Professor and fellows of several academic bodies. He was closely associated with the Inter-University Centre for Astronomy and Astrophysics, where several of his students worked. He certainly could have emerged as one of India's top practising research scientists but fate decreed otherwise. He remained a committed teacher, inordinately proud of his students. Such is the stuff of which legends are made!

This was the remarkable duo with whom we came in contact in the 1960's and early 1970's. Both of them gave me outstanding recommendations when I applied to US Universities after the GRE. However, I could not pursue higher studies and joined the civil service in 1972. Thereafter, for a few years, our interactions were confined to stray encounters in departmental reunions. I was fortunate to discover in 1983, when I became Director of School Education, that Dr Ghoshal had been Director of Secondary Education for a couple of years and some of our office files contained pages of handwritten notes in the same familiar neat handwriting. He had applied his analytical mind to working out conditions for approving appointments of secondary school teachers and recognition of 'organized schools' as he had done to nuclear physics problems. I visited him in his house at Ramakrishna Samadhi Road and found his memory as good as ever. Since then we kept in touch except for the last year of his life, when he had been affected by a stroke. He was also unhappy about certain family matters but, when speaking to us, he was the same SNG. I rediscovered AKR in the 1990's almost by chance in PSC interviews where he was the 'expert' and I was the Government nominee for several years. I was amazed to find a new AKR, full of wit and sparkle, well-read in many fields and his cool rational mind was able to analyze

social and political developments in a manner that really surprised me. We interacted easily, discussing many issues. I still remember a rare day when the list of interviewees contained no less than three M.Sc's in Physics. The first two, from North Bengal University and Burdwan University, failed to impress and the third, from our own alma mater, failed to appear. AKR gently leant across and whispered to me with a gleam in his eyes "Well, this fellow has at least upheld our prestige! Since he did not appear, the other members of the interview board will go home thinking that a Presidency man (or woman) could have handled those questions easily". These words still ring in my ears.

The past five years have seen both of them slip away–AKR in 2005 and SNG in 2007.I feel that I was fortunate to attend their memorial meetings in college, saying a few words as homage. In our minds, they are still there, solving esoteric problems and advising students with kindly smiles. The legends live on!

[The author was assisted by a couple of excellent articles on the internet and some comments from a few of his classmates.]

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