

## Haridas Banerjee: A self-taught physicist

### Introduction

*The Indian Journal of Physics* brought out a special felicitation volume, 1996, A70, No. 3, on the occasion of the 60th birthday of Professor Haridas Banerjee who retired from the Saha Institute of Nuclear Physics in May 1995, and joined the S.N. Bose National Centre for Basic Sciences as INSA senior scientist. This volume contains an accurate biographical sketch by Samir Mallik, a complete list of the 45 publications of Banerjee and a set of research articles in tribute.

When Ramaseshan requested me to write an article about Haridas Banerjee, the immediate problem was – what could I write that is not already in the felicitation volume? I decided to include his reminiscences told to me which might be of interest to the young student starting out in research. The material opportunities for research are decidedly better today due to the enormous increase in instantaneous communication of research results worldwide. On the other hand, the career opportunities for a research physicist in comparison with other emergent avenues are still such that some dedication to science is involved in making the choice. On balance, the human dimensions of the choice are not very different from what it was 40 years ago.

### Why research?

Born on 1 May 1935 at Mymensingh, Bangladesh, Haridas Banerjee faced the choice in 1955 after an M Sc in Applied Mathematics from Calcutta University. Research was not on his list of priorities. He wanted to be an actuary (insurance) and his parents wanted him to be a civil servant (IAS). Things started changing as he came either under the spell or in the proximity of great teachers and scientists which included among others, men like Satyen Bose and Maghnad Saha. But he could not marshal enough courage to take the plunge in research. Research, he thought, could not be done on an empty stomach – one needed adequate financial cushion to get enough time for serious thinking. He had, before him the examples of some of his teachers, who even at a ripe

old age were lecturers at Science College earning only Rs 250 p.m. So, in February 1956, when he was given a standing offer of a Senior Research Fellowship at IIT, Kharagpur he did not accept it. Instead, he followed the wishes of his parents and started preparing for the competitive examination for IAS. In retrospect, he finds the wishes of his parents quite natural. Theirs was a refugee family uprooted from their homes in East Bengal in 1948. What better security could there be for his parents than having him installed as a Magistrate in some district?

Things changed rapidly in June 1956. First, he discovered that lecturers in IIT, Kharagpur had the same salary scale as that of a beginner IAS bureaucrat. So, he was assured that one need not do research on an 'empty stomach'. Second, his old friend and room-mate in the Hindu Hostel of Presidency College, Sukhomoy Chakraborty, who was doing research in economics at ISI, Calcutta, virtually chastized him. His words were 'What nonsense: why should you care to become a civil servant in independent India?'

Thus, in August 1956 Haridas landed in IIT, Karagpur to claim the Senior Research Fellowship offered six months earlier. For his parents this was a setback, but he was determined.

### The challenge

It now appears truly remarkable that Haridas, without any training in theoretical physics was never daunted by the fact that, leave alone quantum field theory, even quantum mechanics was for him a totally unknown territory. He just took the plunge. Perhaps, the shining examples of the illustrious alumni Saha and Bose were still fresh in his mind. The assurance of some of his teachers that he should be quite capable of taking up on his own any new area in theoretical physics, provided the moral support.

### Early successes

It took him about a year to teach himself basic quantum mechanics and then quantum field theory. The book *Theory of Photons and Electrons* by Jauch and

Rohrlich was just out and he found it extremely helpful. By August 1957 he was ready to embark on research proper. Parity violation in weak interactions had just been discovered and experimentalists were eager to measure the polarization of beta particles. For this they badly needed the formulae for polarized cross-sections for processes involving electrons and positrons. In quick succession of a series of papers Haridas presented the required formulae for Bremsstrahlung, Mott scattering and photo-electric effect. His paper on Bremsstrahlung and that of Christian Fronsdaal and H. Uberall of UCLA with identical results appeared simultaneously in *Physical Review*. Ugo Fano and his collaborator sent a paper on polarization effects in photo-electric phenomenon for publication in *Physical Review* without realizing that his paper on the same subject had been published in *Nuovo Cimento* about six months earlier. Their paper finally appeared after Fano incorporated extensive modifications on the basis of feedbacks from Haridas. By the time Haridas submitted his Ph D thesis in June 1959, his papers were well known among workers in the subject, both experimental and theoretical.

Jauch, the examiner of his thesis invited him straightaway to join the Physics Department of Geneva University. Thus, even before he was awarded the Ph D degree in December 1959, he was appointed Chef-de-Travaux in theoretical physics, a tenured position in Geneva University with effect from October, 1960.

### The two great influences

During the earliest spell (1960–61) of his stay in Geneva he came in contact with two great physicists Josef Maria Jauch and Leon Van Hove, whose life and work had an abiding influence in shaping his attitude to research. Jauch used to tell him that our works were like our children and we should avoid doing something which might lead to embarrassment. Haridas' first encounter with Van Hove was rather accidental. Accompanied by Jacques Prentki, Van Hove came to his seminar (early 1961) on the Nambu-Jona Lasinio paper on

spontaneous breaking of chiral symmetry. At the end of the seminar Van Hove came up to Haridas to offer his congratulations and appreciation. From Van Hove, Haridas imbibed the lesson that in research in theoretical physics, experiments are the elixir of life. A theoretical work is lifeless if it cannot be related to experiments.

### Research at home vs research abroad and independence

Haridas never harboured – at least in the early years of his research career – the idea of settling abroad. But before returning to India, he wanted to visit the US. Thus, at the end of the first year at Geneva he told Jauch about his intention to resign. Jauch lamented 'You are leaving me like a hot potato'. Later on when Haridas visited Geneva again in 1969, this time with a one-year assignment at CERN, Jauch told him that had he stayed on in Geneva University, he would have become a Professor there. Haridas went to the US with an assignment at Carnegie Institute of Technology, Pittsburgh in October, 1961 and returned finally to India in October, 1963 to join Delhi University as a Reader in the Physics Department. Half-way during his stay at Carnegie Tech he made a short visit to India to get married to Sunanda, a charming, accomplished woman. From Delhi he moved on to Calcutta in April, 1966 to join Saha Institute of Nuclear Physics where he worked till his retirement in May, 1995.

Apart from socio-cultural alienation, there is something else that dissuaded Haridas from settling abroad. It has been his perception that in important centres like CERN, there is an undercurrent of pressure to follow a set agenda in research. Conformism was at a premium, deviation had a penalty. Haridas however, enjoyed a lay-back style of functioning in research where priorities are set by himself. To quote his student Samir Mallik, Haridas prefers working with others but on problems formulated by himself. Indeed, Haridas is fiercely independent to a fault: he is not a good listener.

### Loss of Sunanda and its impact

The loss of his wife Sunanda in March, 1984 was a devastating experience. 'It was as if I lost one leg and to support myself spiritually I had to depend entirely on the remaining leg, my research. My reflexes and attitude were that of an one-legged disabled person, jumping from one challenge to the next in a constant quest of excitement to fill the spiritual vacuum.' He was prepared to take more risks and address challenging and 'controversial' problems. In his own words, 'my children' of this period will continue to be a source of joy and happiness for years to come.

### The present

Indeed, Haridas continues to be actively involved just now in the problem of

putting fermions on the lattice which, for him, is an entirely new track. As a Fellow of INSA, he takes sincere interest in the activities of INSA and Indian science in general; his particular desire is that more research is done at the Indian Universities. I have known Haridas to be a simple, sincere, serious and hard-working physicist. He is always bubbling with enthusiasm that is infectious and has produced 10 Ph.Ds. He is a fiercely independent physicist who has blazed his own track, always treating basic problems which inspire him, independent of what the prevailing fashions are. The canvass of problems on which he worked is truly wide: polarization effects in quantum electrodynamics, dispersion theory sum rules for hadron-scattering, multiparticle production in electron-positron scattering, the U(1) and CP problems in modern gauge theory. Concerning the last cited problem, Fujikawa remarked in the felicitation volume for Haridas Banerjee: 'H. Banerjee and his collaborators continuously clarified the most fundamental aspects of the problem and suggested a careful reassessment of the path integration quantization of modern gauge theory itself.'

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