

## A conversation with Satyendranath Bose about five decades ago – Some recollections

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Seventy-five years have passed since the epoch-making discovery of Bose statistics. My mind goes back to the memorable meeting I had with Satyen Bose about five decades ago. At that time when I was comparatively young I found meeting 'distinguished scientists' (young or old) in India was by no means an easy or enjoyable task. They were usually very busy, always going from one meeting to another, always wanting to impress, more often than not pompous. I was however extremely keen on meeting Satyen Bose and the meeting proved to be quite easy and was a success. I went prepared to discuss many topics with him.

When I was in the University College, Calcutta, I was told he was in, and that he would be leaving for his home within the next half an hour. I tried my luck and peeped into his room. A visitor was just leaving. Bose welcomed me with a smile. I introduced myself. He asked me whether I wanted to discuss with him any scientific problem. I said 'Not really. Since I am C. V. Raman's student I would like to know whether you have had any interaction with him. I would like to know about the remarkable discovery you have made. I have a big list. For example, now that you are turning your attention to X-ray crystallography and you are a recognized authority in statistics, I would like your views about the Hauptmann and Karle intensity statistics by which the phases of X-ray reflection could be determined'. Bose said: 'The statistics I am familiar with is taught in high schools. You should probably meet P. C. Mahalanobis about this matter. (I said I would.) In any case, I will not like to discuss with you this X-ray statistics problem as I have not read the paper by Hauptmann and Karle. However, I am not surprised that the phases could be determined by intensity measurements only. In fact Kedareshwar Banerjee, I think, and Ott and Avarami also tried this approach but they did not persist with it nor did they go far enough.' I then told him these are really minor matters. Frankly, I had longed to meet him – asked whether I could waste his precious time

just talking and listening to him. Again he flashed his charming smile and said if I wanted to talk to him why not we go to his home and relax. 'I can give you tea, I can play you music, you can see my cats. I hope you are not allergic to them!' So we went to his house and sat in his room which was in a perfectly chaotic state but which strangely had a character of its own. It seemed to be overflowing with cats, every type that T. S. Eliot describes and more.

Tea was brought in (extremely sweet) with some Bengali sweets, which I love, and a couple of arrowroot biscuits. In this brief piece I shall try to present three or four of the many topics we talked about. It is very difficult to convey all that Bose said and implied, the spirit with which he presented everything and the incredible friendliness of the meeting. The words that I put into his mouth are of course not his exact words. I have tried to convey the spirit of what he said.

Knowing that I was Raman's student, Bose commented on Raman's work on the diamond. He was certain, all along, that Raman was not right in his conjecture of the four forms of carbon and that most of the experimental observations made by Raman and his school could well have been explained using some other simpler and not so revolutionary hypothesis as the four forms of carbon. I agreed with him and he said: 'Do not think that committing scientific errors is the monopoly of ordinary scientists. Even the greatest of them, Einstein himself committed a very grave one. As late as 1926 he proposed an experiment to distinguish classical and quantum views of light. If it had been made by a lesser man, one would have called it a foolish proposal. Raman had a very acute mind and it was he who first pointed out the error Einstein had made.'

'Do you think all the work done on diamond in Bangalore was a waste?' I asked. 'Oh no, all errors made, particularly by men of intuition always become useful and even fruitful. Just count the number of techniques which were evolved and results that these experi-

ments yielded. I believe that science was enriched by these studies. I also feel that the later discovery of impurities in diamond was to some extent, provoked by Raman's wrong thesis!!' I was truly surprised that Bose had studied most of Raman's papers so well that he could comment on them with discrimination.

Later on the conversation turned to the Raman Effect. I asked 'As one who had a lot to do with the foundations of quantum mechanics, would you subscribe to Born's statement that Raman's discovery is predicted in its entirety by quantum mechanics and so it could be thought of as a proof for the same'. 'It is in a sense true, but it is very easy for theoreticians to make such statements after the experimental discovery had been made. They do not understand the immense struggle an experimenter has to go through.'

'Raman and I used to meet off and on and discuss some science. Since 1921, I had been continuously thinking about the reality of the light quantum. Raman, of course, was a firm believer in the photon. As he once humourously remarked, "You, I and Einstein were the only three who believed in the light photon in 1921–1922." Raman had an uncanny intuition and he could ask some very penetrating questions. He had read the paper by Kramers and Heisenberg on the dispersion theory, within a week of the arrival of the journal *Z-fur Physik* in Calcutta. Later when I had just read the paper, he said that he feels that Kramers and Heisenberg imply that there is another type of quantum scattering quite different from the classical one. "Am I right?", he asked. At that time, I could not give him a definite and precise answer. Later after 4 years, when he had discovered the Raman Effect I realized that his question clearly showed that he had hit the nail right on the head. In fact, at the time the Kramers–Heisenberg paper appeared, few of us understood its full implications. I was quite vague about it and I also realized that it would have been difficult for an experimenter to envisage the type of experiment to be

done to verify the implication of what they said.'

'I must say the discovery of the Raman Effect did come to me as a surprise. I am also convinced that it was a surprise to most including the great Einstein himself as is indicated by what he said. (I quote – says Einstein, "C. V. Raman was the first to *recognise* and to *demonstrate* that the energy of the photon can undergo partial transformation in matter. I still recall the deep impression that this discovery made on all of us.") Raman had stated that while from his light scattering experiments he did expect to discover a quantum effect he did not realize how useful his discovery would be to chemistry, physics and engineering.'

'I was staggered that such an important quantum effect could come out of such simple scattering experiments. Actually thinking deeply I should not have been surprised as most major advances in physics since the turn of the century, i.e. in nuclear physics (Rutherford–Geiger experiment) in quantum physics (the Compton effect) and recently in particle physics – have come out of scattering experiments. Yes, Raman had a tremendous horse sense. I can say that it shows the uncanny or inspired intuition Raman had. No wonder he persisted in light scattering experiments over 7 years till he discovered the quantum effect. In fact, it is obvious that he had a prescience of it as he mentioned it clearly in the monograph which he published as early as 1922.'

'In fact, I was so impressed with the discovery that when we both went on a walk along the Hooghly I told him near the Prinsep Ghat "Prof. Raman, you have made a great discovery. You will surely get the Nobel Prize for it".'

After discussing a few other topics, he suddenly asked me, 'Can you deliver a scientific lecture in your mother tongue?' I shook my head and gave him a sheepish grin. Again after flashing a charming smile he said very seriously 'You should be ashamed of yourself. Did you know that K. S. Krishnan could'. He then talked about the work he and many others were doing to teach science in Bengali. 'I feel it is unnatural and immoral to try to teach science to children in a foreign language. They will know facts but they will miss the spirit. People forget that science is culture, a child must learn from science many things; a true scientific attitude not only engenders objectivity but also spiri-

tual values. We MUST teach science in the mother tongue. Otherwise science will become a highbrow activity. It will not be an activity in which all people can participate. It will not percolate into the heart or blood of our people.' He spoke with great intensity and verve. He then read out some of his writings in Bengali. His reading was so sonorous – and it sounded like poetry – and I said so. 'Yes, Bengali is a beautiful language; I think it is one of the most beautiful languages in the world'. I said 'French too has this reputation'. 'Yes I agree, it is also a language of love. We have been inhibited far too much in the last 100 years. That is probably why exquisite love poetry is not being written in our languages. Bengali has directly descended from Sanskrit. Can anyone say Kalidasa's language is not the language of love? But I am digressing too much'.

We went on and on and finally I asked him whether he felt elated or happy or transported when he discovered what is called the Bose Statistics. 'If I were truly honest I can say NO. My feelings were entirely different. Let me put it this way: Suppose you had a severe headache or stomachache – and the ache suddenly stopped. That was the feeling I had. For all the previous derivations gave me ceaseless pain. If you call cessation of pain as happiness – then I can say I was happy. I must also add that I never felt I had done something great. Everyone insists on saying that I have done something remarkable. Because of this insistence I have come to accept it. But still I feel that all I did was just to clear up a messy situation. So I was really satisfied. But because of my attitude people think I did not understand what I was saying. The few sentences which Einstein crossed out about the angular momentum of light quanta is evidence of this (Bose was referring to the later discovery of the spin of the photon which his reference to angular momentum implied).'

'Since you are interested in my interaction with Raman you may be interested to know that once Raman accosted me and asked me "You once told me that you were convinced that photon had angular momentum, i.e. spin." I told him about how I was unhappy that Einstein removed a couple of sentences I had written and substituted a sentence or two. I then explained to him my point of view. He said that he and Bhagavantam were doing

some experiments which indicate that the photon had a spin. May I put in your views in the paper? I said yes and I think Raman also wrote about my conversation with him in his paper with Bhagavantam.' I said that I had read it. I quote from *Indian Journal of Physics*, 1931, 6, 353.

'In his well-known derivation of the Planck radiation formula from quantum statistics, Prof. S. N. Bose obtained an expression for the number of cells in phase space occupied by the radiation, and found himself obliged to multiply it by a numerical factor 2 in order to derive from it the correct number of possible arrangements of the quantum in unit volume. The paper as published did not contain a detailed discussion of the necessity for the introduction of this factor, but we understand from a personal communication by Prof. Bose that he envisaged the possibility of the quantum possessing besides energy  $h\nu$  and linear-momentum  $h\nu/c$  also an intrinsic spin or angular momentum  $\pm h/2\pi$  round an axis parallel to the direction of its motion.'

I told Bose that it was the only statement in a scientific journal that he had proposed *for the first time* that photon had a spin. I asked him whether something should be done so that he be given the credit for proposing the existence of the spin of the photon, for the first time. Bose suddenly showed some annoyance. 'You are descending from the sacred to the profane – as the saying goes. What is important is whether the photon has a spin and it is not important as to who proposed it and when. The high aims of science get very debased by such talks of priority etc'. I told him that I stand rebuked but my admiration for the man went up greatly.

'Reverting to your question, you asked about elation. Yes, it would surely have come later; but many things happened almost immediately afterwards which made me very very sad'. I (SR) did not have the courage to pursue this further.

'You enquire about happiness. When a man does what he *has* to do, does it bring him happiness? When a man does what he *wants* to do, does it bring happiness? It is so difficult to say when a man can experience happiness. Happiness can sometimes be experienced when you are in an environment different from the ordinary. Happiness can possibly come only when you feel free and unfettered. You never know when it can hit you. I think I had a

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glimpse of it when I was once out of India.'

I started asking him some more questions. 'Enough' he said.

'I have talked too much today. You have asked me so many questions and these have provoked me into saying many things which I may not have said otherwise. Now I have to punish you. You have to listen to my playing the esraj'. It

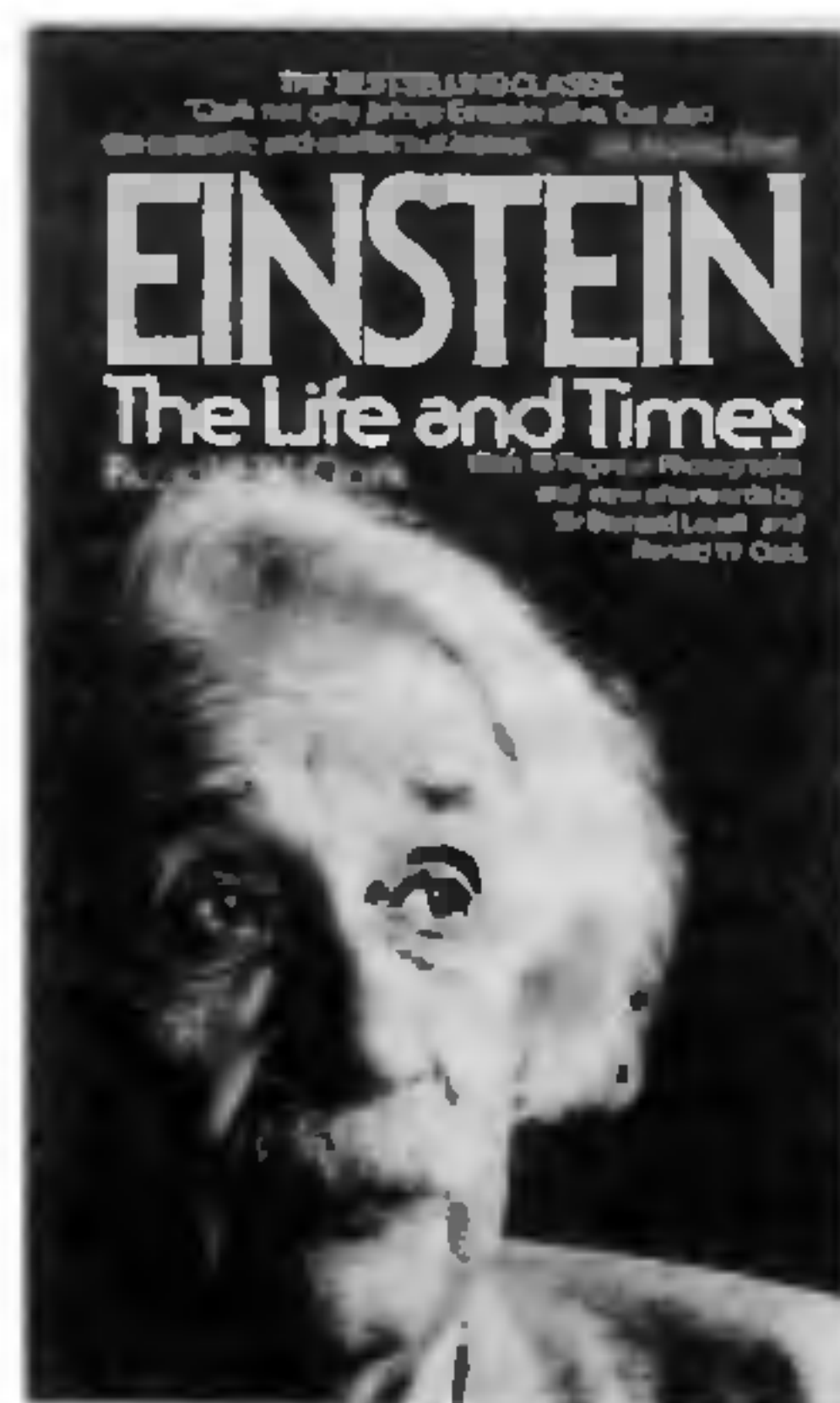
was a delightful ending to an unforgettable meeting. After half an hour of esraj I rose and said good bye.

For me it had been a great experience. As I wended my way back through the Calcutta lanes this man haunted me – his gentleness, his warmth, his incredible modesty, one whom fame had not spoiled and veneration had not touched.

Neither could I stop speculating as to

what happened to him after his famous discovery which made him so unhappy and what made him see a glimpse of happiness in a foreign land.

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