Saha and Bose – Champions of a Common Cause

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The twenties and the thirties of the present century have been called the golden age of Indian Science. The standard reached by the stalwarts of that time has not been surpassed by the later generations although transfer of power in 1947 has brought about a sea-change in the science scene. People like Saha, Bose, Raman and their contemporaries worked in conditions which would seem pre-historic by present standards. Not only was there no government support, often there was active hostility. But they went on undaunted and succeeded. What was their motivation, we may very well wonder. Was it purely a passion for science, or was it something else?

Let us take a look back, to the atmosphere, the spirit of the time in which these brilliant people grew up. Though I am here to talk about Meghnad Saha and Satyendra Nath Bose, I should make it clear at the outset that no man is an island. He is affected by his contemporaries. So even when we consider Saha and Bose we cannot look at them in isolation. Others were there too, each complimenting the other – all of them contributing to the general atmosphere of intellectual excitement. The young men who were all destined to leave a mark in history – Saha, Bose, Mahalanobis, Jnan Ghosh – and in other fields Rajendra Prasad, Netaji Subhas Chandra Bose (who went to college in Calcutta) were influenced by a major event in their adolescence – it was the 1905 partition of Bengal.

The year 1905 was in many senses a turning point. Its immediate impact was political. Bengal at that time was the centre of anti-British political activity. Though for some time a partition of the huge province was being considered for administrative convenience, Curzon decided to kill two birds with one stone. By dividing the Bengali-speaking population on communal grounds (East Bengal had a Muslim majority, West Bengal had a Hindu majority) he hoped to break the nationalist movement. But what happened was quite contrary to his expectations. The smouldering discontent flared up. A new wave of patriotism swept through the province. The protest was so strong that finally in 1911 the partition was annulled. But the protesters had to pay a price. The capital was shifted to Delhi.

The year 1905

Events of Political, Historic and Scientific Importance

Political – Partition of Bengal

Historic – Graduation of C. V. Raman

Scientific – Einstein's special Theory of Relativity

Saha, Bose and their contemporaries grew up in this atmosphere of inspired idealism. Children along with their elders roamed the streets singing patriotic songs. British goods were burnt – 'Boycott British goods, buy Swadeshi' became a popular slogan. Satyen Bose had written in his memoir about those heady days: 'We must do something for our country just to show the British that we are in no way inferior.' The reason why many good students of the generation opted for science was again this vague sense of patriotism. Through science it was possible to do things, to improve things. So in 1909 a remarkable batch of students took admission in the intermediate class of Presidency College. Saha joined two years later, he passed his ISc from Dacca.

Many historic factors combined as though to make way for these two promising young men. After passing their MSc in Mixed Mathematics in 1915 both Saha and Bose were looking for suitable employment. An unexpected offer came from Sir Asutosh who was trying to introduce post-graduate teaching and research. He had already given appointment to C. V. Raman as the Palit Professor and D. M. Bose as the Ghose Professor (Palit and Ghose were the two generous donors who helped Sir Asutosh) but Raman was not yet released from the Finance department and D. M. Bose was stranded in Germany because of the war. Sir Asutosh asked the young men Saha and Bose in particular (because the others were students of physics, but Bose and Saha had specialized in mathematics) to prepare themselves to teach the subject.

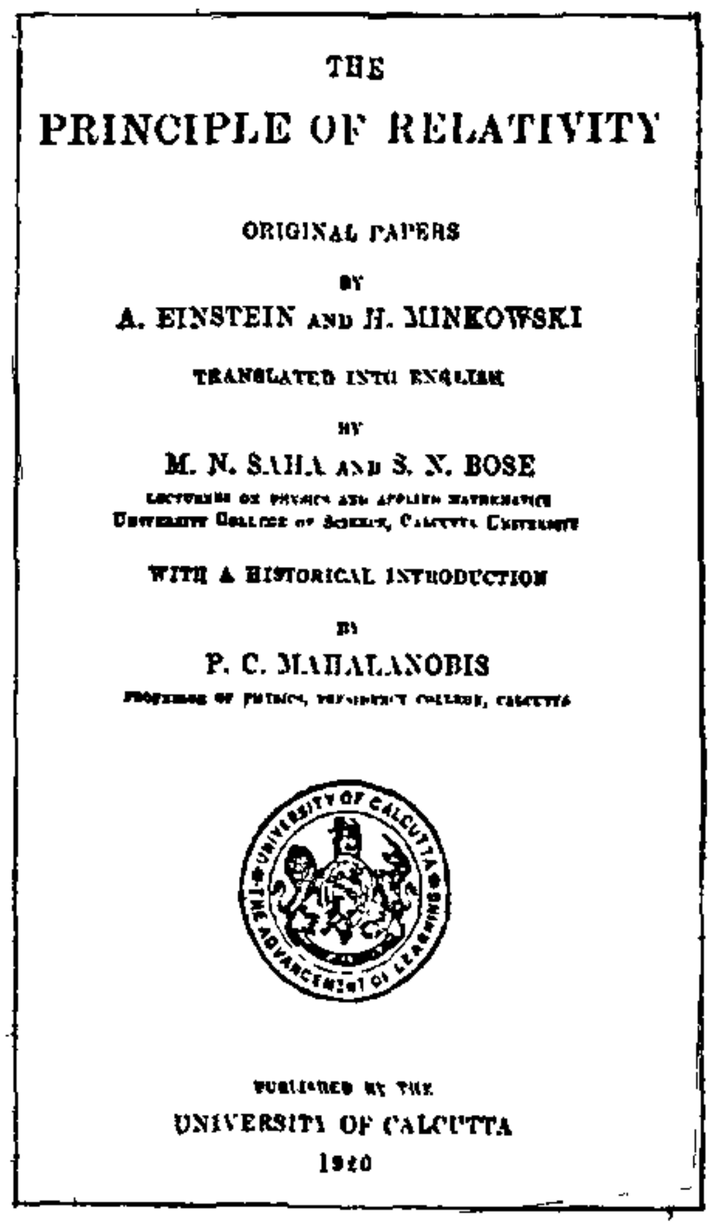
Then began a period of intensive study. New things were happening in physics. Germany was then in the forefront of physics research. The war created the extra problem of unavailability of books and periodicals. Saha already knew German. Bose started taking lessons – but he already knew some French. Equipped with great confidence they procured books from a German professor who was then teaching in Shibpur Engineering College. They were also allowed to use Sir Asutosh's huge collection After D M. Bose's return they also learnt from him about the new physics that was making waves in Europe. It is a measure of their involvement in the subject that they, for the benefit of the students of the post-graduate classes, undertook a translation of Einstein and Minkowski papers on the theory of relativity from the original German. It was published in 1920 by the Calcutta University with an introduction by P. C. Mahalanobis. Surprisingly, it was then the only available translation of those papers of Einstein.

The British press was not pleased A reviewer in *Nature* commented in the August 1922 issue:

Based on a lecture given on 6 November 1993 during the 59th Annual Meeting of the Indian Academy of Sciences in Dehra Dun.

prompted purely by a desire to make it accessible to Indian students. For the charge of errors in translation we have a recent comment from Prof. Max Jammer from Israel:

I wish to inform you that the M. N. Saha and S. N. Bose translation of Einstein's papers on relativity, published in 1920 in Calcutta, do not contain the error which C. B. Jeffry and W. Perrett committed in their well-known 1922 translation. It concerns Einstein's definitions of simultaneity at the very beginning of the kinematical part of Einstein's famous 1905 paper 'On the electrodynamics of moving bodies'. The British translators misread Einstein's 'nun' as 'nur' and rendered thereby erroneously a sufficient condition as a necessary condition, thus excluding the possibility of alternative definitions of simultaneity, a possibility contended by the proponents of the so-called conventionality thesis of distant simultaneity (Reichenback, Grünbaum and others).


THE

PRINCIPLE OF RELATIVITY

ORIGINAL PAPERS

BY

A. EINSTEIN AND H. MINKOWSKI

TRANSLATED INTO ENGLISH

BY

M. N. SAHA AND S. N. BOSE

LECTURERS ON PHYSICS AND APPLIED MATHEMATICS
UNIVERSITY COLLEGE OF SCIENCE, CALCUTTA UNIVERSITY

WITH A HISTORICAL INTRODUCTION

BY

P. C. MAHALANOBIS

PROFESSOR OF PHYSICS, PRESIDENCY COLLEGE, CALCUTTA

PUBLISHED BY THE
UNIVERSITY OF CALCUTTA
1920

The translation cannot be called a good one. In a work of this kind we expect a fairly literal translation, but in the present book there are numerous errors in translation, and the choice of English equivalents for German words is frequently unfortunate. In many instances the mathematics is faultily reproduced. The numbering of the pages is not continuous but recommences at the beginning of Section 4, and the omission of the footnotes from the original is regret table Provided it is studied with care, the translation nevertheless will be of service to those who are unfamiliar with German, and wish to grapple with the pioneer works on this subject, some of which are rather inaccessible.

Technically it was not of a high quality which is understandable It was

Between 1918 and 1920 Saha and Bose produced two joint papers on Equation-of-State. Very soon came a parting of ways – in a physical sense. Both of them left their Alma Mater – Saha joined the University of Allahabad in 1923 and Bose moved to Dacca in 1921.

Both of them were forced to leave because Calcutta University was then locked in a battle with the Government and funds had frozen. For Saha who had already done his theory of thermal ionization, it was imperative to have a furnace for experimental verification. But £300.00 was an impossible sum for the Calcutta University. So Saha had to look for greener pastures. Finally in Allahabad he was successful in obtaining the necessary finance.

For Bose it was a chance to go to Europe where all the exciting things were happening. All his classmates were in Europe either on a fellowship, a travel grant or like Saha, borrowing money. Bose was not eligible for the Palit grant because he was married. When all doors seemed to be closed an offer came from the newly founded University of Dacca.

Both Saha and Bose spent the greater and the most creative parts of their career in Allahabad and Dacca. They were in touch. At least once a year Saha used to come down to Dacca either as an external examiner or on some family business. It was during one of those visits that Saha drew his attention to some strange relation in the Pauli paper published in the *Zeitschrift fur Physik* and asked Bose to think about it.

Actually Bose's interest in the matter goes back to 1919 when he first saw a copy of Max Planck's work, brought by D. M. Bose from Germany. Bose was not satisfied with the ad hoc assumption contained in the Planck derivation. Saha's request provided him the spark. He wrote his now famous paper on 'Planck's law and light quantum hypothesis' – the history of the publication of this and the second paper is well known. But there was a third paper in this series which seems to have been lost.

Einstein had certain disagreement with Bose's second paper. Bose pondered over them for two months and wrote a third paper. In his letter to Einstein on 27 January 1925, he mentions having shown the paper to Langevin who thought it was interesting and worth publishing. The paper was sent under separate cover, but nobody has heard of it since. Bose claimed that he has anticipated the idea of photon spin in his first paper to derive the factor 2 but Einstein had struck it off. In fact, C. V. Raman on his paper on photon spin (communicated to the *Indian Journal of Physics* on 24 October 1931) writes: '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 of momentum $\pm h/2\pi$ round an axis parallel to the direction of its motion. The weight factor 2 thus arises from the possibility of the spin of the quantum being either right-handed or left-handed, corresponding to the two alternative signs of the angular momentum.'

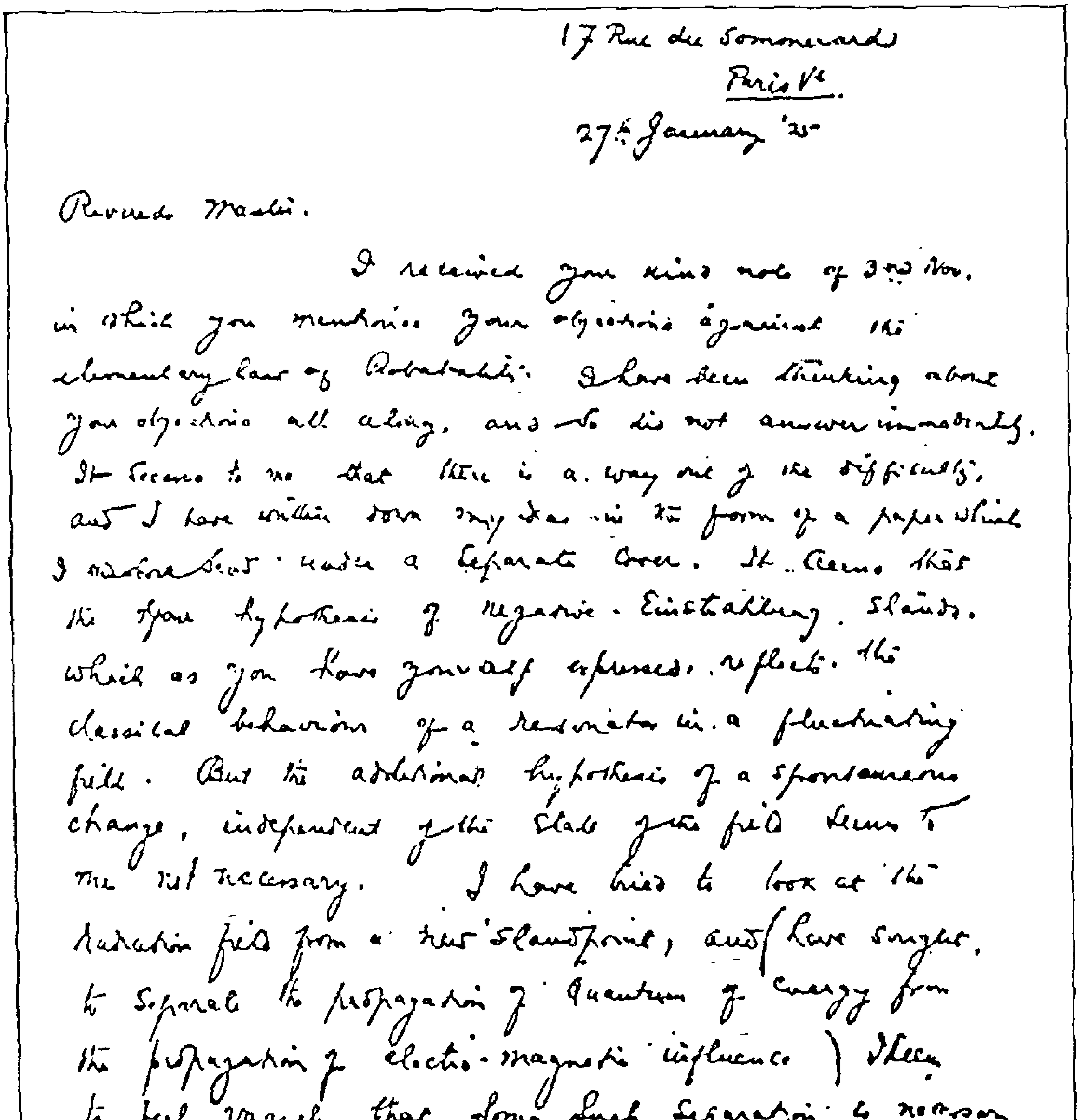
Prof. Partha Ghose of S. N. Bose Centre for Basic Sciences has shown that Bose was also denied credit of (a) the idea that spontaneous emission is not an inherent property of an isolated atom, totally independent of the radiation field and (b) the idea of the propagation of empty electromagnetic waves carrying no quanta of energy.

Saha did not have it very smooth-sailing either. While he was in England frantically looking for a suitable place to verify his theory, he was told by Prof Turner of Oxford to write to Dr Hale of the Mount Wilson Observatory who had a large number of spectroscopic data on sun-spots In his letter Saha gave him the details of his predictions He was

not told of the follow-up research programme but came to know only when Prof Russell informed him that Rubidium has been found in the Sun. This was one of Saha's predictions. In a recent article in the *Scientific American*, Mr DeVorkin of the Smithsonian Institute has pointed out that in all fairness Saha should have been 'invited to the party'. Recently during the Saha centenary celebrations DeVorkin came down to Calcutta. He has unearthed stranger facts. It seems Saha's election to the Royal Society was delayed because prominent British astronomers felt that the election of a rabid revolutionary like him would lower the prestige of the Royal Society.

Saha and Bose came from very different backgrounds and temperamentally they were very different. Bose belonged to the mainstream. He was a kayastha by caste – this caste took to English education first. Bose had three generations of English education behind him. He was middle-class urban – his ancestral home at Calcutta was built by his great grandfather. Saha on the other hand came from rural East Bengal. His vaishya background did not place him high in the caste hierarchy. His father was a small trader – there was absolutely no tradition of college education in their family. He had to fight his way up, at every stage of his career. He rose by sheer virtue of his own talent and determination. But there was one common point between these two very dissimilar class friends. It was their concern for others, for the common people, for their country.

But their reaction to the prevailing situation was again different. S. N. Bose in his adolescence was attached to the romantic notion of a mother India in chains, he had great sympathy with the revolutionaries, was openly critical of the Gandhian philosophy. But after partition he was a frustrated man. Though he belonged to West Bengal, his 25 years in Dacca made him a strong Dacca man. That people from Dacca would now need passports to come to India was a ridiculous idea – he could



17 Rue du Sommerard
Paris Ve.
27th January '25

Revered Master.

I received your kind note of 3rd Nov. in which you mentioned your objections against the elementary law of Probability. I have been thinking about your objections all along, and so did not answer immediately. It seems to me that there is a way out of the difficulty, and I have written down my ideas in the form of a paper which I am now sending under a separate cover. It seems that the your hypothesis of negative Einstrahlung stands, which as you have yourself expressed, reflects the classical behaviour of a resonator in a fluctuating field. But the additional hypothesis of a spontaneous change, independent of the state of the field seems to me not necessary. I have tried to look at the radiation field from a new standpoint, and (I have sought to separate the propagation of quantum of energy from the propagation of electro-magnetic influence) I seem to feel vaguely that some such separation is necessary

of Quantum theory – to be brought in line with the generalised Relativity theory.

The ideas about the radiation-fields, which I have ventured to put forward seem to be very much like of what Bohr has recently espoused in May 1924. But if it only a guess, as I cannot say honestly to have exactly understood what he means to say, about his Virtual fields and Virtual oscillators.

I am rather anxious to know your opinion about it. I have shown it to Prof Langevin here and he seems to think it interesting, and worth publishing.

I cannot exactly express how grateful I feel for your encouragement, and the interest you have taken in my papers. Your first P. card, came at a critical moment, and it has more than any other made this sojourn in Europe possible for me. I am thinking of going to Berlin at '16 end of this week, where I hope to have your invaluable help and guidance.

Yours sincerely
S. N. Bose.

never accept it. His nationalism in the later stage became a kind of Bengali nationalism and the idea of making Bengali the medium of instruction at all levels became a kind of mission with him. He spoke at the *Ungreze Hatao* conference in Hyderabad – it was his firm conviction that English was our greatest block to progress – that our students had to spend all their energy learning a foreign tongue, this was standing in the way of creativity. Though he was not a prolific writer himself, he encouraged others to take up science writing in Bengali and formed the Bangiya Bijnan Parishad for this purpose. Established in 1948 this organization has been doing commendable work in popularizing science through Bengali.

Saha decided to come out of the 'ivory tower' in 1930. From 1923 to 1930 he was busy building his school of research at Allahabad. Then the time was ripe to give his thoughts to national planning. The two formative influences in his life were his two teachers – P. C. Sengupta of Dacca College and the great P. C. Ray. Sengupta was responsible for initiating him in the study of ancient and modern astronomy. They were Saha's life-long preoccupations. His love for modern astronomy led to his famous work in astrophysics. Interest in ancient astronomy led to his paper on 'The origin of the Saka era' and the reform of the Indian Calendar.

In P. C. Ray, Saha found a mentor. Like Saha, Ray too was from a village and kept in touch with his village all his life. P. C. Ray's pragmatic philosophy of improvement through the application of science made a strong appeal to Saha who had himself known poverty and seen extreme conditions in which the rustic poor live.

As early as in 1922 Saha spoke at the first Bengal Youth Conference, invited by Subhas Chandra Bose. In an inspiring speech Saha spoke in detail about how science has the key to all progress

In order to have a decent life we must extract whatever we can from nature and science is the best tool in this effort, he said. This speech contains his basic ideas and convictions which were later to develop into elaborate plans for national reconstruction. All his speeches and writings are now available in the four volumes of Collected Works of Meghnad Saha. Since it is impossible to cover the entire span I will just choose one subject – river planning.

Saha's interest and involvement in river planning evolved from his early acquaintance with floods. He came from a part of Bengal where children learn to swim before they can walk. The next phase was his training in flood relief work – first in 1913 during the devastating Damodar floods. Saha was then a student of fifth year class. The relief operations were conducted by Krishna Kumar Mitra of the Bramho Samaj. His next involvement was ten years later. He had just returned from England. This time floods devastated north Bengal. Acharya P. C. Ray conducted the relief operations. Saha was now in a position to take it up as a scientific challenge. The tremendous energy trapped in the flooding water can be converted to good use, as had been done in the West, as was being done in the princely state of Mysore.

He proposed setting up of hydraulic research laboratories and wrote a series of articles in *Science and Culture*. The plan for the D. V. C. was born in the pages of this journal. But when after independence multi-purpose river projects were taken up, Saha had to move back from the centre stage because of differences with Pandit Nehru. To make his voice heard he chose the parliament but his untimely death did not let him complete one full term.

The common bond which linked Bose and Saha, so dissimilar in background and temperament was a concern for their country. This concern brought both of them eventually out of their ivory tower. Along with this was a sense of national pride, evident less in words but more in deeds. Their sincerity of purpose won them the love and respect of their countrymen who were unaware of such terms as Bose statistics or thermal ionization.

Conclusion

No study of Saha and Bose can be complete without taking into account other scientists sharing their common concern. As mentioned in the beginning of this article, there were others, all adding their bit, but in the light of later developments two personalities stand out: H. J. Bhabha and S. Chandrasekhar. One could almost say they are studies in reverse, Bhabha could have stayed in Europe but he decided to come back (one should not forget the fact that C. V. Raman gave him a berth at the Indian Institute of Science, Bangalore), thus making a great deal of personal sacrifice. There is no doubt that he would have accomplished more had he chosen his own scientific career as his only goal in life. But he did not. As a result we have TIFR and BARC and what is more, a new scientific work culture in the country.

S. Chandrasekhar in spite of repeated offers from Raman and others preferred to stay back. But in an interview given to his biographer K. Wali he openly admits that his choice was wrong. 'How does one evaluate relative contributions? But I think I would have been satisfied with half my scientific work if I could have served the Indian Scientific Community at least to half the extent that I have served the American Scientific Community. Because in total terms for the future, it would have meant far more for Indian Science than in fact it has to American Science'.

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