REFLECTION ON THE HISTORY, HOPE AND HYPE OF BOSE INSTITUTE

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To start with the reflection on the history of Bose Insititute, I must begin with Acharya Jagadish Chandra Bose. Returning to Calcutta from Cambridge, Bose joined Presidency College as a Professor of Physics in 1885. While science in the modern post-Newtonian sense was then being taught at a number of institutions and colleges in Calcutta and elsewhere, research in the experimental natural sciences was nonexistent in India at the time Bose took up his appointment. Indeed by starting his researches on the nature of radiowaves in 1894, Bose became literally pioneer and founding father of modern physical and biophysical research in this country.

Every generation produces scientists, who inspire enlighten and instruct next generation. Among these are some who make history because they are subtle, sombre and richly affirmative about their evocations. Acharya J. C. Bose was one of them. He established the Bose Institute in 1917 after his retirement from Presidency College and making a breakthrough on microwave. What Acharya J. C. Bose said in his inaugural address at the opening of Bose Institute, let me quote : "The personal and yet general, truth and faith whose establishment this Institute commemorate is this that when one has gained the vision of a purpose to which he can and must dedicate himself fully, then the closed door will be opened and seemingly impossible become fully attainable."

That was his life's philosophy and in fact, the door was opened to him which helped in the transformation of a Physicist to a Plant Physiologist. This transition within himself was not at all sudden and discontinuous, though from outside it was apparently so. The first phase of microwave generation and propagation was passed to the second phase concerning with the similarity and response of inanimate and animate matter to physicochemical stimuli likely to be linked with his observation of rather unexpected behaviour of the coherer, developing fatigue. The third phase, in turn, stemmed from the second and was focussed entirely on the physiological response of plants to physicochemical stimuli i.e., culminating to the unifying perception of stimuli by living matter. This is in the line with the thinking that the world is a construct of perceptions, sensations, memories and consciousness.

The primary question is what kind of material process is directly associated with the consciousness ? The answer to this is difficult to give even today, not to speak of time when J. C. Bose started experiments by fabricating new instrument. If one opens the book on initiation of modern science in India the first name what will be noticed is that of J. C. Bose and this should be remembered by the posterity. His objective was that of natural philosopher who desired to study the quasioptical properties of electricwaves and his contribution on this score was unique. The subsequent neglect by wastern historians or even their lack of awareness demands some explanation – especially when this neglect contrasts starkely with the Bose's lasting reputation in his own country. Inspite of Bose's work attained the level of what can be termed historical originality he was never accorded the status that others, such as Lodge, Marconi, Righi and others were given by historians of technology and by Nobel Committee. The denial of nobel prize to Bose is again a history now which was debated at the centenary celebration of Microwave discovery in U. K. What are possible causes that might have contributed to this anomalous situation. I think following might be the salient factors responsible for this situation : a) abandonment of the research programme on Microwaves, b) absence of school of thought on Radio

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research, c) disinterest in enterpreneurship, d) philosophical bend of mind to divert attention to the unifying responses by animate and inanimate objects and lastly e) the Indian factor.

Perhaps I have detracted from my point to project before you that Bose Institute has the distinctive mark because it started with very high ideals and highest standard of work. It was that, world did not want Bose Institute but Bose Institute wanted the world and at that juncture India wanted Bose Institute because seed of modern science was sown here. In fact, this is a real gift to the whole nation. How glorious is the origin of this Institute! That should be put in the mindset of the posterity.

From that glorious starting of the Institute under the leadership of Acharya J. C. Bose, the responsibility was entrusted to Prof. D. M. Bose after the demise of Jagadish Chandra. During his stewardship for thirty years (1938-67), Debendra Mohon tried and worked hard to preserve its high ideals and purpose as defined by Acharya J. C. Bose. Prof. D. M. Bose's work even before joining Bose Institute was of high order. He fabricated the cloud chamber indigeneously and photographed the tracks of radioactive nuclei during the process of α-particle emission. He recognized simultaneous emission of two ionizing electron tracks from helium atom due to collision with an α-particle. This work when published in Nature (1923) was warmly appreciated by Rutherford.

From cosmic ray ionization with the help of cloud chamber and photographic emulsion, Prof. D. M. Bose developed a method of determining the mass of track producing particles which are different from those of proton and α-particles and infact discovered the existence of particles having a mass equal to 216 times the mass of electron (1942)[1]. The work was hampered due to unavailability of photographic emulsion from Ilford duirng the second world war period. In 1945, C. F. Powel followed exactly the same method of determining the mass of mesons as devised by Bose and Choudhury. Powel announced the existence of two kinds of mesons μ & π of masses 214 and 290 m.e. respectively and received Nobel Prize. It is my feeling that D.M.Bose missed the Nobel Prize in physics because of his intensive involvement in the development of biological sciences in the Institute when his apt attention would have been required for the work just mentioned as well as untoward situation arisen due to second world war.

From this what I want to point out is that the standard of work even after J. C. Bose reached the similar height and prestige of the Institute was well maintained. Associated with this what was also apparent that both in the case of microwave and μ meson the work was discontinued and sustained effort was not made to develop a school of thought.

Under the guidance and direction of Prof. D. M. Bose researches in various branches in biological sciences were introduced for the first time in this Institute and in certain cases in India. Acharya J. C. Bose's plant physiological investigations particularly plant responses were further extended and continued with finer details biochemically and biophysically. It has now been established that plant responds to different stimuli and evokes the physicochemical events very simlar to those in animals entailing the different signal transduction pathways. Jagadish Chandra was able to record the response 10^6 times amplified within a millisecond to unravel the similarity to the mechanism. His proposed unifying concept of eliciting responses to stimuli is gaining ground. About 100 years ago J. C. Bose began biophysical experiments on plants and arrives at some far reaching conclusions. He was the first to recognize the ubiquitous importance of electrical signalling between plant cells in coordinating responses to the environment. He put forward that regular wave like pulsations in cell electric-potential and turgor pressure were an endogenous form of cell signalling and also a radical theory for the mechanism of the ascent of sap, based on electromechanical activities of living cells. Bose's place in history has now been revaluated not only in discovery of microwave but also in plant biophysics.

What appears again is that the gravity of his findings during the last phase of his research and to make linkage of the three phases as mentioned earlier was difficult to conceive of at that time by his audience of different kinds in each phase., i e, first phase consisted of physicists and engineers, second phase, a mixture of physicists and physiologists and third phase was entirely of plant physiologists and botanists.

So, what is apparent that Bose Institute has another crown of having initiated a discipline called Biophysics. But that branch of science was also neglected. D. M. Bose introduced the subject like Microbiology in this Institute as early as 1942. It is a sense of pride that atleast 3-4 antibiotics like Rubidin, Boseomycin etc were discovered here and at the same time it was unfortunate that no follow up work was done by chemically modifying the antibiotics to remove the toxicity. That shows the lack of collaboration

1. One may look at the article published in the Nov-Dec. 2016 issue, pp. 364-377.

between the departments / institutions at the time. D. M. Bose first introduced in this Institute a project from Atomic Energy Commission on the application of radioactive chemicals for the study of Intermediary metabolism and for inducing useful mutation in crop plants. New mutants of jute, rice and other plants were raised but no effort was made to maintain the variety. A noble metabolic cycle entailing myoinositol phosphate in plant was also established. A laboratory of plant cell culture was set up in 1950s which has now grown up to undertake the work on Plant Genomics and Genetic Engineering in collaboration with departments of Biochemistry and Botany. The protein chemistry laboratory was associated with the characterization of cholera toxin in collaboration with Prof. S. N. De (Calcutta Medical College) which attracted he attention of Nobel Committee. Seventy five years after the discovery of *Vivrio cholerae*, Dr. S. N. De discovered the exotoxin responsible for the disease. He devised the rabbit ileal loop technique for making the discovery of the cholera exotoxin. This is still the best method for detecting diarrhoeal sympotoms of cholera. Plant chemistry laboratory contributed much in isolating new types of compounds such as carbazole and triterpenes etc having antifungal and antitumor activities as well as plant lectins which are now (Protein Chemistry Lab) used for diagnostic purposes. Here also follow up work is lacking.

Retting of jutes by microbes is an important contribution which is at present on great demand. This was never been patented. Introduction of Molecular biology helped two of the Insitute scientists in deciphering for the first time the information flow from DNA to RNA while they were in study leave in USA. Other aspect which was revealing that there was an attempt to develop the techniques and instruments. Say, for example, the fabrication of counter, dosimeter, gas chromatograph, counter- current-distribution apparatus, electrophoretic apparatus, neutron generator and ultrasonic apparatus during 1950s and 1960s are to be mentioned.

I am mentioning all these just to show that how Bose Institute tried to fulfill the ideals of the founder in opening up the nascent sciences. Due to the same trend many of the promising observations were either dropped out or not followed up. This is perhaps mainly due to poor job potentiality and other facilities in the Institute when other institutes are mushrooming. Promising workers used the Institute as a spring-board to develop their career and were bound to leave for better opportunities. Expansion of the Institute was not made as needed at that time. As a result Bose Institute did not get the prominence apparently either in research grant or in national policy making as compared to the Institutions later established. Depending on digging out funds on the basis of research projects sustainance of a particular research activity was difficult, thereby missing the impact of recognition as deserved. Due to lack of infrastructural & other facilities it is becoming increasingly difficult to attract the best available.

Scientific vision of Bose Institute as visualized by Acharya J. C. Bose was strengthened subsequently after the retirement of Prof. D. M. Bose in 1967. From 1967 till the end of twentieth century the activities were diversified under the directorship of Prof. S. M. Sarcar, Prof. S. C. Bhattacharya and others creating the department of Biochemistry, Biophysics, Plant Molecular and Cellular Genetic, Bioinformatics Centre and Environmental Science section. The Institute has been successful in building up its reputation in the areas of Radiation Physics, Quantum Mechanics ; Condensed Matter Physics, Natural Products, Synthetic Chemistry, Structural Biology, Protein Engineering, Molecular Biology, Genetic Engineering, Bioinformatics, Microbial Fermentation Technology, Immunology and Environmental Biology etc. The Institute at present caters to this need through six departments (Physics Chemistry, Biochemistry, Biophysics, Botany, Microbiology) and four sections (Animal Physiology, Plant Molecular and Cellular Genetics, Immunology and Environmental Biology). At present about fifty Scientists with hundred students are engaged in research on the above mentioned areas with financial assistance not only from DST but also from other agencies. From the above picture it is apparent that did not grow as it should be and, Bose Institute remained small. Small might be beautiful but not effective in tackling the diversified problems as deliberately as desired. Inspite of these constrains, scientific contributions in certain areas from this Institute still excel and can be projected nationally and internationally.

For Bose Institute the past is so glorious that the present is seemingly turnished ; that does not mean that the contribution from Bose Institute at present is not significant or not of topical interest. Recent research in this Institute on the possibility of light exhibiting wave-like particle-like behaviour in a significant role in changing our understanding of light. The noises of having transgenic crop plants, if established might help in second green revolution and that of microbe might help in recovery of metals from low grade ores as well as proteomics to design drugs definitely satisfying Science and Society at large ; provided judicious and correct steps are taken by the management and particularly the workers enlarging the

vision on the continuity of such work with devotion. Otherwise the history will repeat itself denying the honour to the scientists of this Institute deserve.

I think Collectivity, Unity and Execution (CUE) is the key feature for the success and posterity of the Institute and it is expected to take a long way in its journey to scientific discoveries. The much talked concern now is the gap between standard of modern research in this country and other developed parts of the world which is increasing continuously. The only way to shorten the gap is to plan to sustain the diversified research undertaken in this Institute carefully in a coordinated way so that this temple of research demand to declare as a National Centre of Excellence and an Institute of heritage. This, I feel, the best way to honour the founder of this Institute and also the initiator of modern science in this country. This historical depiction of the author who spent about four decades in this Institute, though emerged from personal nostalgia is expected to throw up plethora of erudite opinion from the people at large and particularly the management and government both central and state, as how to explore to fulfill the hope and hype of this Institute of such a glorious heritage. ❒