

SIR JC BOSE AND HIS EXPERIMENTS

From the viewpoint of pertinence

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INDIA was impregnated with a bunch of true cabochons in the nineteenth century, amongst which Sir JC Bose is one of them who has kept an immovable imprint in front of the global scientific fraternity with his loads of research-based achievements and experimental manoeuvres. He had to face constant scrimmages to execute a few fundamental scientific feats. Acharya Bose had made a structured bequest regarding contemporary research in physics and various biological phenomena.

During his variegated research career, Prof. Bose fabricated a few novel instruments from scratch to meet the need for several experiments.

For future 5G broadband mobile communication networks, the use of millimetre-wave has become the primal linchpin now as bandwidth shortage is being experienced by wireless communication. The recipient of the DSc degree from London University in 1896, JC Bose, worked on the measurement of the wavelength of electric radiation by diffraction grating and millimetre-wave nearly a century back. JC Bose is being contemplated as the father of plant neurobiology worldwide.

Unlike Bose's epoch-making works in plant science, his experiments in Physics were fully compatible with the extant thoughts and were amalgamated seamlessly into the previous corpus of scientific wisdom.

Interminable Cutting-edge and Ground-breaking Research
After returning to Kolkata, Prof. Bose found immense interest



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in studying and working more on electric waves. At the end of 1894, he presented a microwave demonstration in Town Hall, Kolkata. By 1896, he published his research work in one of the journals of the Royal Society London titled "On the Determination of the Indices of Refraction of Sulphur for the Electric Ray".

Significantly, this article was probably the first ever research publication by an Indian in a Western scientific journal. At the very onset of the twentieth century, Prof. Bose altered his domain of research interest almost entirely to plant physiology and plant neurobiology. A substantial portion of his

botanical research consisted of the leaf movements of two legume species, the sensitive plant and the telegraph plant. The sensitive one rapidly folds its leaflets when those get touched, and the folding response disseminates down the leaf, each pair of leaflets closing in turn.

According to Prof. Bose, these propagating movements were reminiscent of the action potentials which promulgate along the nerves of animals. On the other hand, the telegraph plant shows an uninhibited oscillatory leaf movement within which the two diminutive lateral leaflets of the trifoliate leaf alternately rise and fall with a periodicity of a few minutes. Prof. Bose got the idea of heart beating by observing these movements minutely. As far as the measuring apparatus and instruments with exquisite sensitivity are concerned, Bose was phenomenal with his own inventiveness and devising aptitude,

which he obtained from Lord Rayleigh himself.

To mitigate the pharmacological complexities, JC Bose proved some of the specific conditions whereby he could study the pulsations of isolated pulvini. His astounding detection was the immersion of isolated pulvini, which in water abolished the oscillatory locomotion, but their occurrence would be revived by the addition of dilute Hydrogen Peroxide (H_2O_2). Some of Bose's other noteworthy works mentioned were the physiology of the ascent of sap, the physiology of photosynthesis, plant autographs and their revelations and comparative electrophysiology.

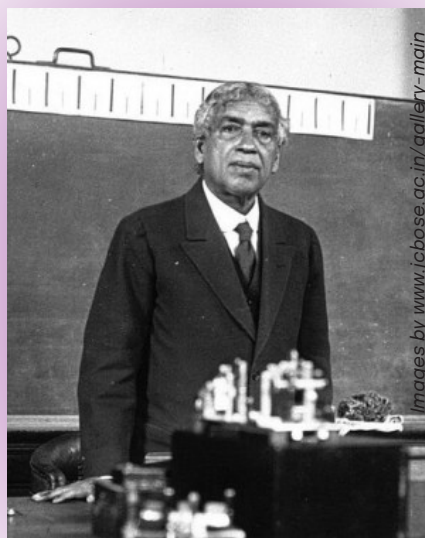
At almost the denouement of the nineteenth century, Bose had performed spectacular research on radio waves and proved the generation of waves even in the range of 5 millimetres. Factually, the work of Prof. Bose predates that of Marconi. During the fabrication of the semiconductor diode, Bose used galena (a form of lead sulphide) as a radio wave detector. Unless and until the tube radios started supplanting, these galena detectors engulfed the crux of the popularisation of radio waves. Prof. Bose ideated a continuous recording instrument to chronicle the re-erection upon rehydration of wilted excised shoots. Bose clearly noted that the application of camphor, a heart stimulant whose cardio-pharmacological mode of action is less understood, to withered cut shoots greatly stimulated their re-erection.

Almost a century after Bose's innovation in pulsating plant cells in the inner cortex of plants, scientists made a huge invention which may elaborate the mechanism underlying the oscillations recorded by Bose. Waves of calcium release had been recorded propagating through the inner cortex of the roots of the model plant *Arabidopsis thaliana* by Acharya Bose only. In 1924, he documented his photosynthesis works in the form of a book called *The Physiology of Photosynthesis* by Longman, Green and Company.

Prof. Bose's intensive research on instruments and apparatus includes the magnetic crescograph, which recorded propagation beyond the highest powers of microscope, the magnification produced being 50 million times, transpirograph that measured the extent of water transpired by a single stoma of leaf, magnetic radiometer which made an accurate measurement of the energy of every ray in the solar spectrum, resonant recorder which inscribed time as short as a 1/1000 part of a second, and the most accurate determination of the latent period of the plant, the velocity of transmission of excitation, a conductivity balance which gave measurement of the effect of various drugs on enhancement or depression of the electrical impulse suddenly.

The Obstacles Faced by Acharya Bose

Acharya Bose was an Indian scientist from the very core of his heart, and his national roots were imbibed within him from the beginning. He had to face several severe



impediments throughout his entire scientific endeavours. When Acharya Bose joined Presidency College in Kolkata after coming back from abroad, he had to face compulsive discrimination being an Indian. Even Charles Tawney, the then Principal of Presidency College, opposed the appointment of Acharya Bose as a Professor of Physics.

In this context, with the immense succour of famous economist Prof. Fawcett and the then viceroy Lord Ripon, Prof. JC Bose joined Presidency College. But after all these, he was not even provided with proper facilities & basic minimum infrastructure for conducting laboratory research. This is why he had to extemporise his equipment by himself and started to live thriftily. The contemporary

British counterparts challenged him in many ways to stop his fast-paced journey. He had been offered an extremely low salary compared to the other faculty members of the same domain and his very same department.

He was a fighter in front of the diverse odds. Even Prof. Bose had to listen to the Indians not being able to teach science in their own languages. He had to tolerate a colossal amount of torture, teasing and scoffs even after getting a hugely low salary for over two years and without pay for three years in his early career life.

A Legendary Indian Scientist

Prof. JC Bose could have easily stayed abroad to lead a so-called better life in an upmarket place with a secluded zone. But he didn't do so. He returned to India and established a benchmark organisation called Bose Institute in Kolkata in 1917. This institute is now a public research institute in India.

But we need to give it a bit of outlandish focus just to understand his basic motto to set up a separate institution. When the dedication ceremony commenced, he clearly depicted that this institute wouldn't be a mere laboratory but a temple in the true sense. He has consciously chosen the teaching of science as his profession by vocation. JC Bose was indeed a patriot, loyalist to all types of Indian dribbles and unfeigned meditator of science as a whole.

Nearly all the detections of JC Bose are some of the incredible milestones of world science. Bose has kept a mammoth of contributions almost 150 years ago in the works, starting from capturing the signals of radio waves, millimetre-length electromagnetic waves, and plant physiology to photosynthesis, which are still being researched further by many world leaders of science. His place in history is now being re-evaluated everywhere. The top-notch yet esteemed journal *Nature* has re-published a few of Prof. Bose's publications. On the verge of getting 5G technology in everyone's hands, we can't pretermite Acharya Bose's benefactions to mankind.

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