HOMI JEHANGIR BHABA, A TRIBUTE

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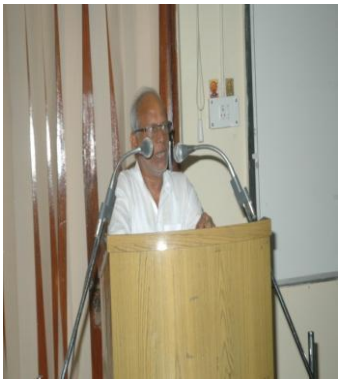

We have all assembled here to pay tribute to a great man, Homi Jehangir Bhabha who was born on this day, 30th October in the year 1909. Let us listen to two prominent voices as measures of Bhabha's greatness. Thus speaks Lord Red Cliffe-Maud, "Homi Jehangir Bhabha stood out as a world citizen qualified in all three subjects, education, science and culture." Switching on to Sir C.V. Raman, we hear, "Bhabha is a great lover of music, a gifted artist, a brilliant engineer and an outstanding scientist. He is the modern equivalent of Leonardo da Vinci."

Let us then start with his education and research. After completing his school studies in Bombay, he was sent to Cambridge, England, at the age of eighteen. He completed his TRIPOS examinations – one in Mechanical Engineering in 1930 and the other in Mathematics in 1932 – with first classes. His brilliant academic record earned him the Rouse-Ball travelling fellowship which enabled him to visit great physicists like Pauli in Zurich, Fermi in Rome and Bohr in Copenhagen. Returning back to Cambridge he decided to pursue his doctoral research in physics. Cambridge, those days had great Rutherford and Dirac helping to create an academic atmosphere of highest quality and churning out great discoveries almost in a regular basis. Awarded with Isaac Newton Fellowship, Bhabha settled down in Cambridge for his doctoral

research. His guide was Professor R.H. Fowler who also happened to be the guide of S. Chandrasekhar. Bhabha started working on cosmic rays and particle physics.

Cosmic rays, as the name suggests, have its origin in the cosmos and particles present in the rays possess very high energies running up to 10^5 – 10^6GeV. Cosmic rays seemed to consist of two clear components – a soft component with particles of low energies and a hard component with high energies. Bhabha's doctoral thesis proposed a solution to the generation of these two components using the newly discovered particle by Anderson in 1932 i.e. positron. Bhabha proposed that the high-energy component is generated by capture of positron by the K-Bhell electrons of the atom and the soft-component from annihilation of positron with free electron.

Bhabha, as his next project of research, considered e^+ e^- scattering using quantum field theory. In this he not only considered annihilation process, he also considered exchange effect. He published his theoretical result in 1936. The importance of his foresight to work on the scattering of newly discovered positron particle can only be gauged from the fact that the first experimental result on this scattering could only be available in 1954; clear eighteen years after Bhabha's calculation! The agreement between the two was, however, very good. The scattering today bears the name "Bhabha scattering" and is used to calibrate beams of positrons or other particles at large accelerators.

Bhabha, then, in collaboration with Professor Heitler developed the cascade theory of the soft-component of the cosmic rays using the processes involving Brehmstrahlung radiation emission, pair creation and pair

annihilation in a cascade manner. Interestingly, even as their paper was submitted to Proceedings of Royal Society on 11th December 1936, an almost similar work by Carlson and Oppenheimer was submitted to Physical Review on 8th December 1936. The main import of the cascade theory proposed by both the groups was that the cosmic ray showers are built by a long chain of elementary processes and are not created by simultaneous production of large number of particles in one single event as was earlier proposed by Heisenberg.

Bhabha's attention then shifted to the hard-component of cosmic rays. After going through the paper of Yukawa in October 1937, he wrote a long paper in February 1938 wherein he predicted the existence of a particle in the shower with mass greater than one hundred times the mass of the electron. This was the first example of cosmic ray phenomenology. This predicted particle eventually turned out to be the pi-meson that Yukawa predicted as the cause of the strong force responsible for stability of nuclei, the name "meson" was, indeed, christened by none other than Bhabha himself. Later, Robert Marshak demonstrated the existence of muons in the shower as decay products of pi-mesons. Thus the real nature of hard and soft components of cosmic rays were understood through pioneering investigations carried out by Bhabha.

Bhabha returned to India in 1939 on vacation. The outbreak of Second World War prevented him to return to Cambridge. However, such an innocuous turn of event turned out to be a watershed in the history of development of science in India. The visionary institution builder in Bhabha bloomed to its full potential as year rolled by. After a brief period of service as a Reader in Physics Deptt. Of Indian Institute of Science, Bangalore headed by Prof. C.V. Raman, Bhabha dreamt of establishing a world class institute committed to excellence. With joint grants from Tata Trust, Government of

Maharastra and the Government of India, the Tata Institute of Fundamental Research (TIFR) started functioning from 1st June, 1945. Bhabha, then, turned his attention to the development of atomic energy prgramme in India and created Atomic Energy Training Establishment (AETET) in 1954. The training school was started within AEET in 1958. The centre was later renamed as Bhabha Atomic Research Centre (BARC) by Indian Prime Minister Mrs. Indira Gandhi as a mark of respect to the memory of the creator of Atom Energy programme in the country. At the behest of Bhabha, the Departments of Atomic Energy, Dept. Of Space and Dept. of Electronics were created within the ambit of Govt. of India. Bhabha also envisioned the three stage programme for production of atomic energy using uranium, plutonium and thorium as the main nuclear fuels in different stages of the development of atomic energy programme in India. For his pioneering role in the peaceful use of atomic energy, Bhabha was elected the first President of "Atom for Peace" international conference held in Geneva.

Apart from his brilliance a scientist and as an institution builder, he too was a connoisseur of music of both eastern and western classical. He was simply moved by listening to the ninth-symphony of Beethoven and writes

"Ninth Symphony is sheer greatness, the sublimest and most colossal achievement of human mind. He was also a gifted artist. He commissioned M.F. Hussain to paint for the lobby of TIFR. He, too had great love for the gardens and passion for the trees. He took great pains in creating an ambience conducive for fostering creativity in all the institutions he established.

One could easily wonder at the massive achievements of his life time! In Bhabha's case everything, sort of, fell into his lap. He had the right

connections. The Parsi community to which he belonged had great achievers in Tata, Zubin Mehta, Palkhivala for inspiration. He belonged to a highly educated family with his father educated at Oxford. He could, therefore, find good collection of books on music and art in his home. The Tata connection, his fathers' sister was married to Dorab Tata, Jamshedji Tata's son, stood in good stead when he planned to create institutions. He, in later years of his life, could establish personal relationship with Prime Minister Jawaharlal Nehru whom he addressed as "Bhai". Lastly, of course, he was born with a brilliant mind that was passionately attracted towards science. It is said, he had read Special Theory of Relativity by the age of sixteen! Even as a child he had sleeplessness which was diagnosed as due to a superactive mind. His passion for science led him to beg of his father to study science by saying, "I am burning with a desire to do physics. Therefore, I implore you to let me do physics." All these parts combined to produce the beautiful whole that Bhabha's life was!

This, therefore, is a small sketch of a great life. It may be worthwhile to ask at this moment "What do we all carry home as a message of his life?" Let us listen to him. In his own words, "Art, music, poetry or physics that I do have this one purpose – increasing the intensity of my consciousness of life." Let us take this message to "increase the intensity of consciousness of our lives" with dreams soaring high and fully supported by hard striving for their realization.

Allow me to end with the words of Swami Vivekananda, "Arise, awake and stop not till the goal is reached." My grateful thanks to the authorities for kind invitation and providing me an opportunity of sharing my thoughts with you on this auspicious day, the birthday of one of the greatest visionaries of our land.