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GREAT INDIAN PHYSICISTS WHO MISSED THE NOBEL PRIZE

COLA WAR WITH TENDER COCONUT

WE NEED TO REVISE OUR TRADITIONAL KNOWLEDGE SYSTEM

The prizes for outstanding accomplishments in physics, chemistry, physiology or medicine, literature, and peace instituted by Alfred Nobel and the subsequently instituted prize for economics have acquired an aura and respect unmatched by any other prize and are viewed by public in general as a recognition of the highest order achievement in

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secular human endeavors. In particular, Nobel prize winners in physics have a special status because the list of physics Nobel Laureates includes all time greats like Albert Einstein, Max Planck, Niels Bohr, Dirac ,W Heisenberg, E Schrodinger, C V Raman and Richard Feynmann whose fundamental discoveries have made them famous beyond the confines of physics. Therefore, if an outstanding physicist who has clearly contributed very significantly for the advancement of the subject is not honored with this prize, it causes anguish and dismay among many of his peers and countrymen and leads to controversies regarding the procedure and methodology adopted in selecting the prize winners. This is so in the case of other disciplines too even though general public is aware that Nobel Prize for peace is more' political' in character and considering the vast literature written in large number of different languages selecting the generally acceptable best literary prize may not be possible. Thus, Mahatma Gandhi not getting this honor does not decrease his status but remains an inedible black spot on the Nobel Foundation itself. There are a large number of great physicists who did not get the Nobel Prize which they richly deserved. In such a group one can easily include five Indian physicists-namely, Jagdish Chandra Bose, Satyendra Nath Bose, Meghnad Saha, G N Ramachandran and E. C. G. Sudarshan- who belong clearly to this ' Nobel class'. It is the purpose of this article to briefly outline the world class achievements of these Indian physicists and not to dwell into the controversies associated with the award of Nobel prizes in general.

Jagdish Chandra Bose (1858 - 1937)

Jagdish Chandra Bose was born on 30-11-1858 at Mymensinghin (now in Bangladesh) located in the Bengal Province of British India and was fortunate enough to have education at Cambridge (B.A.) and London(B. Sc) and received the exposure to science which was fast altering the face of western civilization even though British colonial power had no interest in nurturing science in India. Bose having the heritage of ancient Indian civilization with its multi faceted accomplishments could easily absorb the spirit of science and pursued it at Presidency college, Calcutta after returning to India.Initially he faced some discrimination but his exceptional talent as a teacher and scientist was too overwhelming and was eventually given due recognition. Bose's research works are mainly in two areas-(i) electromagnetic waves, their transmission and reception and (ii) nature of life process present in plants. His pioneering breakthroughs in both these are outstanding. However, in this article will confine ourselves to the former.

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electromagnetic waves and their generation in different frequencies and application was a hot priority area of work. As far as Bose's work is concerened, the following facts are known:

•In 1895 at Presidency college Bose ignited gun powder and rang a bell kept at a reasonably large distance using the electromagnetic wave signaling and thus demonstrated for the first time that communication could be sent through electro-magnetic waves.

He was vehemently against making money out of his researches and had no hesitation in generously sharing the path breaking works that he did. He introduced the best research attitude to his generation of Indians. For them, he represented the spirit of old selfless rishis of India whose teachings and insights are open to all willing to accept it. Unlike Marconi who sought commercialize his work on radio waves, Bose was interested in all his researches purely as a scientific endeavor in quest of nature.

•In 1899 he announced his invention of iron-mercury-iron coherer (transmitter) in a paper submitted to Royal Society. Bose's demonstration of wireless signaling has priority over that of Marconi.

The period 1894-1900 was very productive years for Bose. He performed pioneering research in radio transmission and mm range microwaves. He designed equipment for radio wave transmission and reception and also studied the wave properties of reflection,refraction and polarization. Based on his experiments with galena he developed a type of semi conductor diode useful for detection of cm range electromagnetic waves.

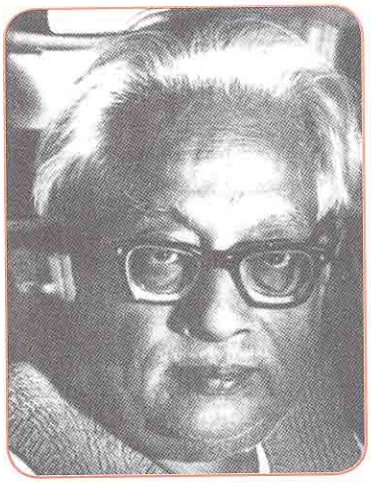
In spite of these, it was Guglielmo Marconi and Carl Ferdinand Braun who were awarded1909 Nobel prize in physice for 'their contributions for the developoment of wireless telegraphy'. It may be noted that in 1896 both Bose and Marconi were in London and had interactions.

Over the years, fortunately, the scientific community seems to have got the historical records right. In 1998 IEEE (Institution of Electrical and Electronics Engineers) accepted that it was J C Bose who invented the mercury drop coherer which was used by Marconi. Bose also holds the first patent for the solid state detector based on galena crystal and was the first to use a semiconducting junction to detect mm length microwaves. His pioneering work on microwaves was acknowledged by great physicists like Lord Kelvin and Lord Rayleigh.A book by Dunlop [Ch VIII p.95] gives a 11/2 page tribute to J C Bose for providing crucial support to Marconi when he needed it most. Many of the instruments designed by Bose are still on display at Bose Institute, Kolkata and largely in usable condition.They include antennas, polarizers and wave guides. Neville Francis Mott, who received Nobel Prize in 1977 for his work on solid state electronics remarked that "J C Bose was at least 60 years ahead of his time....". " In fact he had anticipated the existence of P-type and N-type semiconductors".

J C Bose was an example of the best in India's spiritual tradition. He was vehemently against making money out of his researches and had no hesitation in generously sharing the path breaking works that he did. Reflecting on his works on life in plants he felt that he experimentally substantiated the Hindu belief that whole universe was an aspect of the Eternal One.He introduced the best research attitude to his generation of Indians. For them, he represented the spirit of old selfless rishis of India whose teachings and insights are open to all willing to accept it. Unlike Marconi who sought commercialize his work on radio waves, Bose was interested in all his researches purely as a scientific endeavor in quest of nature.

Satyendra Nath Bose(1894-1974)

Satyendranath Bose was a Kolkata born(1-1-1894) physicist and he and the other great Bengali physicist M N Saha studied together at Calcutta university and respectively ranked first and second in their M.Sc exami-



nation. Both were students of Jagdish Chandra Bose and it is like one lighted a candle triggering the lighting of other candles.Both Bose and Saha were highly motivated young men who were excited by the revolution taking place in physics triggered by relativity and quantum hypothesis. In fact the first English translation of Einstein's relativity papers were by Bose and Saha.After serving some years at Calcutta university, in 1921 Bose joined Dacca university (now in Bangladesh) as a lecturer.

In sharp contrast to the attitude of Drona, Einstein immediately realized that Bose's paper was an important step forward in understanding the general quantal behavior of particles . He himself translated it into German and got it published in the famous German research journal Zeitschrift fur Physik(Vol26,178-181,1924) and elaborated the ideas further to formulate what is now known as Bose Einstein statistics

At that time Planck's quantum hypothesis was well accepted but quantum mechanics was yet to emerge. It was the era of old quantum theory. While studying the black body radiation as photon gas, Bose used a counting procedure (statistics) for the gas constituents (photons) different from the then well known Maxwell-Boltzmann statistics which to his surprise and excitement gave the correct radiation intensity distribution discovered by Planck.He had difficulty in getting this new derivation published and hence decided to request the great Einstein for help in its publication.Like Ekalavya of Mahabharata who considered Drona as his guru, Bose was considering himself as a humble disciple of the 'revered master' that Einstein was. In sharp contrast to the attitude of Drona, Einstein immediately realized that Bose's paper was an important step forward in understanding the general quantal behavior of particles . He himself translated it into German and got it published in the famous German research journal Zeitschrift fur Physik(Vol26,178-181,1924) and elaborated the ideas further to formulate what is now known as Bose Einstein statistics. In fact this work is the origin of quantum statistics dealing with Bose Einstein statistics for bosons(integer spin ,i.e.,0,1,..spin particles) and Fermi-Dirac statistics for fermions (half integer spin ,i.e.,1/2.3/2,.. spin particles)

Einstein,and Bohr. But the irony of it all is that in spite of this revolutionary work, Bose is not a Nobel Laureate even though he was nominated for it!

Astrophysicist J V Narlikar considers this as an achievement in the Nobel Prize class.Abraham Pais who has written an authoritative biography of Einstein considers Bose's paper as the fourth and last revolutionary papers of old quantum theory. The other three are by Planck,Einstein and Bohr. Thus Bose belongs to the exalted group of Bose,Einstein,Fermi, and Dirac on one hand and equally formidable company of Planck,Einstein,and Bohr. But the irony of it all is that in spite of this revolutionary work, Bose is not a Nobel Laureate even though he was nominated for it!

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Bose Einstein statistics has a crucial role in the governing principle of lasers,superfluid quantum systems, superonductivity and Bose-Einstein condensates.In fact more than one Nobel prizes were awarded for research related to the concept of Boson and the latest one was in 2001for the discovery of Bose-Einstein condensates.Bose's work stands out as one of the corner stones of the way we understand the micro world and quantal phenomena. Every student of physics learns about bosons which is the most lasting honor for his memory and achievements.

Meghnad Saha(1893-1956)

Meghnad Saha was born on the 6th October 1893 in a village named Shaoratoli near Dhaka. He belonged to very poor backward community and had to struggle before he could come to eminence.Fortunate circumstances helped him to get good education and he was a class fellow of S N Bose at Presidency college.Before shifting to Allahabad university in 1923 he was working in Calcutta. There in 1920 he formulated the famous theory of ionization and equation bearing his name which is a major achivement crucial in understanding stellar structure and evolution.That both S N Bose and M N Saha could incorporate correct quatum mechanical concepts in their theories even before the formal advent of quantum mechanics speaks highly of their physical insight.

Saha's theory deals with high temperature ionization of elements and its application to stellar atmosphere. His theory and subsequent developments led to detailed study of stellar spectra and knowledge of pressure and temperature distribution in stellar atmosphere.In his book Theoretical Astrophysics(Oxford University Press 1939) Professor S Rosseland writes:'The impetus given to astrophysics by Saha's work can scarcely be overestimated,as nearly all later progress in this field has been influenced by it and much of the subsequent work has the character of refinement of Saha's idea.'Again, Narlikar considers that Saha's work belongs to Nobel class.

Saha is equally well known for his sustained efforts in nurturing research in physics.During his leadership the physics department at Allahabad became well known for its acdemic excellence.He was the leading light in organizing scientific socities like National Academy of Sciences,Allahabad,Indian Physical Socity, and Indian Association for Cultivation of Science.He continued to diversfy his areas of interest and has trained or inspired a large number of physicists. His greatest contribution to the cause of Indian Science is the establishment of Institute of Nuclear Physics at Kolkota in 1943 presently known as Saha Institute of Nuclear Physics run by the Department of Atomic Energy and has evolved as a prominent center of physics research in India.He was an architect of river planning and played a critical role in reforming the traditional Indian calender. He was a social activist and was a member of Indian Parliament .He died when he was 63 but fully active in his mutifarious academic and social persuits till the end

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G.N.Ramachandran

(1922-2001)

Gopalasamudram Narayana Iyer Ramachandran was born on 8-10-1922 at Ernakulam ,Kerala and studied for his B Sc at St Joseph's college,t Tiruchi.In 1942 he moved to Indian Institute of Science, Bangalore to study electrical engineering. Sir C V Raman spotted the research potential of Ramachandran and got him transferred to physics. It is said that he told the chairmman of the department of electrical engineering that "I am admitting Ramachandran into my department as he is a bit too bright to be in yours." Ramachandran is perhaps the most distinguished of Raman's students. He obtained his D Sc from IISc also later a Ph.D from from Cambridge. Soon the then famous Vice-Chancellor of Madras university spotted Ramachandran's potential and appointed him as professor and head of physics department when he was just 30.World renowned works of Ramachandran were accomplished at Madras.

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At IISc Ramachandran had become an expert in X-ray diffraction techniques and this was being applied at that time to a wide variety of bio-molecules.Ramachandran's works bring together the fields of molecular biophysics, X-ray crystallography,peptide synthesis,NMR and other optical studies.He(along with his students) is most widely known for discovering triple helix structure of collagen-most abundant protein of connective tissues- in 1955 and his analysis of allowed conformations of proteins through the use of what are known as 'Ramachandran plots' was published in the Journal of Molecular Biology in 1963.These rank among the most outstanding works on structural biology along with the other two famous works namely alpha helix structure folded polypeptides discovered by Linus Pauling and double helix structure of DNA discovered by Watson and Crick.It is remarkable that Ramachandran's works were carried out in India facing all the problems associated with Indian science. In this sense, he is a true successor to C V Raman's legacy. G N Ramachandran. was clearely a 'Nobel class' scientist who did not get entry into this class.His works are text book material in the area of structural biology and molecular biophysics. However, in 1999 the international scientific community made some amends to this omission. The Edwald Prize(1999) of the International Union of Crystallography was awarded to G N Ramachandran for his 'outstanding contribution in the field of crystallography, in the area

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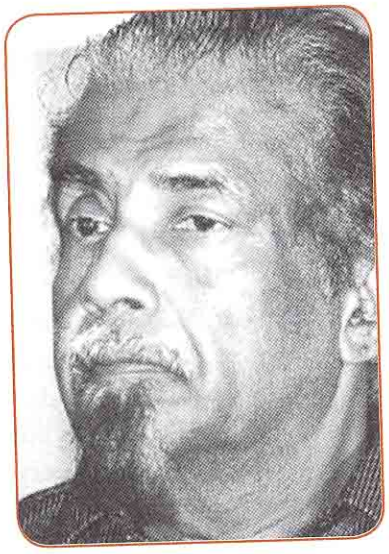
of anomalous scattering and its use in the solution of the phase problem, in the analysis of fibres,collagen in particular and foremost for his fundamental work on the macromolecular conformation and the validation of macromolecular structures by means of "Ramachandran Plot" which even today remains the most useful validation tool'.

Ramachandran returened from Madras(Chennai) to IISc in 1971 and led a new department which has evolved as a important center for research in structural biology.During his last years he suffered from Parkinsonisim and died on 7-4-2001 at the age of 78.



E C G SUDARSHAN(1931-)

Ennakkal Chandy George Sudarshan was born on 16-9-1931 at Pollam,Kottayam district of Kerala. He did his M Sc from Madras university(1952) and PhD from University of Rochester, New York in 1958.His academic career is mostly in USA and he is at the University of Texas at Austin since 1969.He

Sudarshan is undoubtedly the most accomplished and renowned living theoretical physicists of Indian origin and has prodigious creative output. His research interests span the fields of particle physics, quantum optics, quantum field theory, quantum information theory, gauge theories, and classical mechanics. He has deep interest in Vedanta philosophy and spirituality

worked as Director of Institute of Mathematical Sciences at Chennai for over five years during 1980s. Sudarshan is undoubtedly the most accomplished and renowned living theoretical physicists of Indian origin and has prodigious creative output. His research interests span the fields of particle physics, quantum optics, quantum field theory, quantum information theory, gauge theories, and classical mechanics. He has deep interest in Vedanta philosophy and spirituality. He was nominated to Nobel prize several times but the coveted honor has eluded him so far. His major contributions are:

- He together with Robert Marshaks the invented in 1957 of what is known as the V-A theory of weak interaction. Around the same time Gell-Mann and Feynmann also published similar work.In fact, Sudarshan and Marshak narrowly missed the full credit for this important work which clearly belongs to Nobel class because of some delay in the publication of their work in a regular research journal. This theory eventually evolved as electro weak theory of weak interactions developed by Sheldon Glashow,Abdus Salam and Steven Weinberg .They were honored with Nobel prize in 1979.

- In 1960s Sudarshan put forward the theory of tachyons-conjectured particles which have speeds larger than the speed of light in vacuum. Most of the journals were initially reluctant to publish novel idea but eventually it got the attention of a number of physicists and much work was done. However tachyons have remained elusive experimentally. If and when they get discovered it will completely change our conception and understanding of the universe and can also have several potential applications. The idea of tachyon was a revolutionary concept within the framework of special theory of relativity.

- He developed the quantum representation of coherent light which is being referred to in literature as Sudarshan-Glauber representation. It is said that original idea of coherent representation of light beams is due to Glauber However, the 'diagonal representation' discovered by Sudarshan is a far reaching result which showed the general equivalence of classical and quantal descriptions of all states of light field and is of wider validity.The mathematical equivalence is now referred as the 'Optical

Equivalence Theorem' and is a very fundamental result in modern optics. In fact Sudarshan's diagonal representation forms the starting point of later developments in quantum optics.

- He developed formalism called dynamical maps which is a fundamental work in the theory of open quantum systems.

- In collaboration with B Mishra he has proposed in 1977 what is known as quantum zeno effect It predicts an interesting result that an unstable particle, if subjected to continuous observation, will never decay. Quantum zeno effect corresponds to the limiting behavior of an unstable quantum system when subjected to infinitely strong coupling to environment. In 1989 there was a report of the experimental confirmation of quantum zeno effect by W Itano and collaborators.

The 2005 Nobel Prize given to Glauber for 'the contribution to the quantum theory of optical coherence' ignoring the seminal contributions of Sudarshan has caused much anguish among physicists who are admirers of Sudarshan's contributions to physics in general and quantum optics in particular. A number of physicists from India and abroad have expressed their concern and dismay to the Nobel committee regarding this. Sudarshan himself has put forward his forthright opinion to the Nobel committee in a letter.A section of the letter(taken from Frontline Vol22,Issue 24 Nov 19-Dec 02, 2005) reads:

"It is my belief that the Royal Swedish Academy was impartial and that to assure the proper priorities it has a Committee in Physics, with members competent to examine and understand the published work. It was also my belief that the members of the Committee did their work diligently and with care. I am therefore genuinely surprised and disappointed by this year's choice. It would distress many others and me if extra scientific considerations were responsible for this decision. It is my hope that these glaring injustices would be noted by the Academy and modify the citations.

Give unto Glauber only what is his. Sinserelyyours E.C.G. Sudarshan "

Reflections

Undoubtedly the five cases discussed above concern Indian scientists who carried out outstanding work deserving Nobel Prize. The researches of all of them except Sudarshan were carried out in India .The works of J C Bose, S N bose and Meghnad Saha were done during colonial period. One may suspect that Nobel prizes which epitomize the achievement of excellence as per the vision and norms of western civilization are hard to win by scientists from other nations, particularly from third world countries, in spite of the fact according to Nobel's will"in awarding the prizes no consideration be given to the nationality of the candidate". It is generally believed that to be worthy of the prize scientists from India have to stand out distinctly much above his western counterpart.

But such a view is perhaps too simplistic. Even in the western world there have been a number of cases where Nobel prizes were not awarded to very deserving cases. Confining only to physics, some of the glaring omissions (not in any particular order) are:

- Thomas Alva Edison(Inventor of many gadgets including telegraph,movies,electric bulb etc)
- Thomas Tesla(Electromagnetism)
- Lise Meitner (nuclear fission)
- Chien-Shiung Wu(Parity non-conservation)
- Yuval Ne'eman(Particle physics)
- George Zweig(quark composition of particles)
- Fred Hoyle(Astrophysics)
- Jocelyn Bell Burnell(Radio pulsars)
- George Gamow(Theory of Cosmic Microwave Background radiation)
- Freeman Dyson(quantum field theory)
- Robert Oppenheimer(Theoretical physics)
- Arnold Sommerfeld(Quantum mechanis)
- Sidney R Coleman(Particle physics)

The last case is quite agonizing one. The prize was given for the work on quantum chromo dynamics to the

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