S N Bose: Biographical Resumé

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1894 1 January. S N Bose is born in the family residence, 22, Iswar Mill Lane, Goabagan, Calcutta.

Bose is the only male child of his parents (to be followed by six sisters), Surendranath (1868-1964), an accountant in the Executive Engineering Department of the East India Railway, who later founded the Indian Chemical and Pharmaceutical Works, a small unit dealing in chemicals; and Amodini (d. 1939).

1899 Bose is admitted to the Normal School in north Calcutta.

1900 7 October. Max Planck discovers what later comes to be known as Planck's Radiation Law.

14 December. Planck gives his original derivation of the law, and lays the foundation of the quantum theory.

1905 The discovery of special relativity by Albert Einstein, that 'brought clarity to old physics and created new physics, in particular Einstein's derivation of the relation $\boldsymbol{E = mc^2}$.' In 1905, Einstein produces six papers, including one on the light-quantum and the photo-electric effect, completed 17 March, leading to his Nobel Prize in physics; his doctoral thesis on a new determination of molecular dimensions, completed 30 April; one on Brownian motion, received by the *Annalen der Physik* on 11 May; the first two papers on special relativity, received by the *Annalen* on 30 June and 27 September respectively; and a second paper on Brownian motion, received 19 December.

16 October. The Partition of Bengal. The day is declared a day of mourning throughout Bengal, with a day's fast, a closure of shops and institutions, people tying *rākhis* on each other's hands, demonstrations, and two huge rallies; giving a fillip to the Swadeshi movement.

1906 31 March. Sir Asutosh Mookerjee (1864-1924) becomes Vice-Chancellor, University of Calcutta, to continue till 30 March 1914 on his first term, running a second term, 4 April 1921-3 April 1923. Under the new Indian Universities Act which came into force on 1 September

1904, and under the leadership of Sir Asutosh, the University ceases to be a purely examining body, comes to exercise control over the schools and colleges, and 'provide for postgraduate teaching, study and research in the Faculties of Arts and Science'. The same year the National Council of Education, conceived as a parallel non-governmental University on the Swadeshi ideals, comes into being under the presidentship of Rashbehari Ghose (1845-1921).

1907 Bose changes school again - and joins the Hindu School, Calcutta, one of the city's oldest and best known schools.

1908 Down with an attack of chicken pox, Bose fails to appear for the school-leaving examination, then known as the Entrance Examination.

Bose appears for the Entrance Examination of the Calcutta University, and stands fifth in order of merit. The same year he joins the intermediate classes in science at the Presidency College, where his classmates include Jnanchandra Ghosh (1894-1959), Jnanendranath Mukherjee (1893-1983), and Nikhilranjan Sen (1894-1963).

1910 'Perhaps the neatest derivation of Planck's radiation formula' is given by P Debye, in the *Annalen der Physik*, 33, 1427.

1911 L Natanson draws attention to the 'indistinguishability' of Planck's energy quanta implied by Planck's permutation measure. Planck adapts statistical mechanics to suit the requirements of the quantum theory by introducing elementary phase cells of volume h^3. Solvay Congress at Brussels on The Theory of Radiation and Quanta.

Bose stands first in the intermediate science examination of the Calcutta University from Presidency College, and is awarded the Duff Scholarship for the best performance in Physics. He joins the B Sc classes at Presidency College the same year, and meets M N Saha (1893-1956) as classmate, beginning years of scientific collaboration and a lifelong friendship.

7 March. Rutherford presents his discovery of the atomic nucleus, at a meeting of the Manchester Literary and Philosophical Society. His definitive paper on the subject appears in *Phil. Mag.*, May 1911.

1912 Taraknath Palit (1831-1914), an eminent lawyer, executes two Trust Deeds in favour of the University of Calcutta, the effect of which is to vest in the University, lands and money of the aggregate value of 1 million 500 thousand rupees in aid of the foundation of a University College of Science and Technology and the maintenance of two Professorships, one in Chemistry and the other in Physics, and

scholarships for advanced students in science to enable them to carry on research or investigation abroad, with the stipulation that the 'chairs shall always be filled by Indians.'

1913 Bose stands first in the B Sc Examination of the Calcutta University, with Honours in Mixed Mathematics, from Presidency College, and is awarded the Harischandra Prize and the Herschel Gold Medal for being the Best in Mathematics and the Manmathanath Bhattacharya Gold Medal for standing first in the B Sc Examination. M N Saha stands second, and Nikhilranjan Sen third.

8 August. Rashbehari Ghose comes forward with an offer of one million rupees 'in furtherance of the University College of Science' and for the maintenance of four Professorships, one each in Applied Mathematics, Physics, Chemistry, and Botany with special reference to Agriculture; with the stipulation that the chairs 'must be always filled by Indians.'

Niels Bohr's paper on the quantum theory of the hydrogen atom, completed 5 April, and appearing in *Phil. Mag.*, 26, 1, in July, is the next major step in quantum theory after Planck's introduction of energy quanta and Einstein's hypothesis of light quanta. On 20 December, in a lecture before the Danish Physical Society, Bohr presents the germs of the correspondence principle,-a powerful method of calculating the energies of the states of an atom.

1914 Bose marries Ushabati Ghosh, aged eleven. They would have nine children, of whom seven survive.

27 March. The foundation stone is laid for the building designed to house the University College of Science.

Ehrenfest and Kamerlingh Onnes distinguish between Planck's energy quanta ('indistinguishable') and Einstein's hypothetical light quanta ('distinguishable').

1 August. World War I breaks out.

1915 Bose stands first in the M Sc Examination, Calcutta University, in Mixed Mathematics, from Presidency College, and is awarded the Hemchandra Gossain Prize and Gold Medal. M N Saha stands second.

25 November. Einstein presents to the physics-mathematics section of the Prussian Academy of Science his paper, 'The Field Equation of Gravitation', in which 'finally the general theory of relativity is closed as a logical structure.'

1916 Prafullachandra Ray joins the University College of Science as the first Palit Professor of Chemistry, a post which he holds till 1937. Teaching in the postgraduate departments in the sciences begins in July. Bose joins the University College of Science as a research scholar.

20 March. The *Annalen der Physik* receives 'Grundlage der Allgemein Relativitatstheorie', the first systematic exposé of general relativity, to be published later in the year as Einstein's first book.

July. Einstein returns to the quantum theory, and in the next eight months publishes three overlapping papers on the subject, containing the coefficients of spontaneous and induced emission and absorption, a new derivation of Planck's law, and the first statement in print by Einstein that a light-quantum with energy *hv* carries a momentum *hv / c*.

December. Einstein completes *Über die Spezielle und die Allgemeine Relativitätstheorie, Gemeinverständlich*, to be published early next year, to remain his most widely known book.

1917 Bose becomes a Lecturer in Physics and Applied Mathematics at the University College of Science, Calcutta University. C V Raman joins the same institution as the first Palit Professor of Physics, to continue in the post till 1934.

1918 Bohr formulates the correspondence principle in the lengthy memoir 'On the quantum theory of line spectra', part I appearing in April, part II in December, and part III in 1922.

Bose's first important contribution to theoretical physics, a paper (jointly with M N Saha) 'On the Influence of the Finite Volume of Molecules on the Equation of State', published in *Phil. Mag.*, Ser. 6,36, 199-203. The equation of state proposed in the paper is generally known as the 'Saha-Bose equation of state'.

1919 6 April. Bose reads 'The Stress-Equations of Equilibrium' at the Calcutta Mathematical Society. The paper is published in the Society's *Bulletin*, 10, 117-21.

31 August. Bose reads 'On the Herpolhode'at the Calcutta Mathematical Society. The paper is published in the Society's *Bulletin*, 11, 21-22.

'On the Equation of State', another joint paper by Bose and Saha, is published in *Phil. Mag.*, Ser. 6, 39, 456.

Calcutta University publishes The Principle of Relativity, containing the original papers by Einstein and H Minkowski, translated from German by Saha and Bose, with an historical introduction by P C Mahalanobis.

6 November. At a joint meeting of the Royal Society and the Royal Astronomical Society in London, it is announced that the 29 May observations of the total solar eclipse, conducted under the supervision of Eddington on the island of Principe and under Crommelin in northern Brazil, confirm Einstein's predictions about the bending of light made in 1915, and wildly enthusiastic press announcements mark the beginning of the perception by the general public of Einstein as a world figure. Pais, Einstein's biographer, describes it as 'the day on which Einstein was canonized.'

1920 Bose's paper 'On the Deduction of Rydberg's Law from the Quantum Theory of Spectral Emission', published in *Phil. Mag.*, 40, 619-27.

1921 15 July. The University of Dhaka (then spelt Dacca) starts functioning. Bose joins the new University as a Reader in the Department of Physics, with J C Ghosh as his colleague in the Department of Chemisty. He starts teaching quantum theory and acutely feels the lack of a logically satisfactory derivation of Planck's law. He attempts to provide one in his own way.

1922 January. Einstein completes his first paper on unified field theory.

9 November. The Nobel Prize for physics for 1921 is awarded to Einstein while he is en route to Japan.

1923 The general acceptance of Einstein's light-quantum hypothesis comes through the Theoretical work of Peter Debye and the experimental studies of A H Compton. Pauli shows that free electrons and radiation can be in thermal equilibrium (described by Planck's law), provided the probability of collisions between electrons and light-quanta satisfies a certain condition. Einstein and Ehrenfest generalize Pauli's work to elementary processes involving more than two light-quanta.

1924 M N Saha, then Professor of Physics, Allahabad University, meets Bose in Dhaka, and draws his attention to the papers of Pauli (1923) and Einstein and Ehrenfest (1923), published in *Zeitschrift für Physik***.** Bose studies them and produces his celebrated paper, 'Planck's Law and the Light-Quantum Hypothesis'. He sends the paper to *Phil. Mag.*, but receives no response.

4 June. Bose sends his paper to Einstein, with an accompanying letter, asking him for his opinion and to 'arrange for its publication in *Zeitschrift für Physik.*'

15 June. Bose sends another paper, 'Thermal Equilibrium in the Radiation Field in the Presence of Matter', to Einstein.

2 July. In a postcard Einstein informs Bose that he has 'translated your work [the first paper] and communicated it to *Zeitschrift für Physik* for publication', and tells him that his work 'signifies an important step forward and I liked it very much . . . You are the first to derive the factor quantum theoretically, even though because of the polarization factor 2 not wholly rigorously. It is a beautiful step forward.' The journal receives the paper on the same day and publishes it in its August issue under the title, 'Plancks Gestez und Lichtquantenhypothese', with a note by Einstein at the end: 'Bose's derivation of Planck's law signifies, in my opinion, an important step forward. The method used here gives also the quantum theory of an ideal gas, as I shall show elsewhere.'

7 July. *Zeitschrift für Physik* receives Bose's second paper translated and communicated by Einstein, and publishes it in its September issue.

10 July. Einstein presents his first paper on Bose's counting method to the Prussian Academy, in which he extends Bose's methoa'to ordinary material atoms.

September. Bose sails from Bombay on board a steamer of the Lloyd Triestine Line, for Paris.

18 October. Bose reaches Paris, where he stays at 17 Rue du Sommerard, Paris 5, with his Indian friends, Prabodh Bagchi (1898-1956) and others.

Bagchi introduces him to Sylvain Levi, the well-known French Indologist, who in his turn introduces Bose to Paul Langevin, Professor titulaire at the College de France. On Langevin's recommendation, Bose has the opportunity of working on X-ray spectroscopy at the laboratory of Maurice de Broglie, and in a letter tells P J Hartog, Vice-Chancellor, Dhaka University, that 'Madame Curie also has given me hopes of allowing me facilities for work in the Radium Institute from the beginning of the new year.'

25 November. Louis de Broglie defends his thesis, which is a development of ‘the idea, during the year 1923, that the discovery made by Einstein in 1905 should be generalized by extending it to all material particles and notably to electrons.' Einstein receives a copy of

the thesis from Langevin, who was one of de Broglie's examiners, and considers it, in a letter to Lorentz (in December), 'a first feeble ray of light on this worst of our physics enigmas.'

1925 8 January. Einstein presents his second paper on Bose's counting method to the Prussian Academy, in which he discusses the differences between the counting methods of Boltzmann and Bose, and draws the inference that material particles obeying Bose's statistics should have a wave-like character. He draws attention to Louis de Broglie's doctoral thesis in which the latter had attached wave properties to ponderable matter.

27 January. Bose writes to Einstein, forwarding his 'third paper' to the latter 'under separate cover,' with the information that 'Langevin . . . seems to think it interesting and worth publishing.' This paper remains unpublished and untraceable even in the Einstein archives.

29 January. Einstein presents his third paper to the Prussian Academy.

July. Heisenberg sends a paper to *Zeitschriff für Physik*, giving a preliminary account of matrix mechanics. Pauli discovers the exclusion principle.

8 October. Bose, in Berlin, writes to Einstein seeking an appointment.

November. First Bose-Einstein meeting in Berlin, followed by several meetings and encounters with the leading German scientists: 'I was very friendly with Franck, Einstein, Born, Ewald, Szilard and Mark,' Bose would later recall.

1926 Bose, in Berlin, studies X-ray crystallography at Polanyi's laboratory, conducts a physical experimental investigation about the refractive index of Roentgen rays in the Kaiser Wilhelm Institute, and engages in theoretical studies with Gordon (of Klein-Gordon equation fame) and visits the radioactivity laboratories of Hahn and Meitner. He visits Gottingen where he meets Max Born and Erich Hückel.

Schrödinger writes four papers in which he develops wave mechanics and proves its equivalence with matrix mechanics. Fermi publishes his paper on the statistics of particles, obeying Pauli's principle. Dirac links the Bose and Fermi statistics of particles to the symmetry properties of their wave functions and names them 'bosons' and fermions'.

Bose applies for a Professor's post at Dhaka University, with recommendations from Einstein, Langevin, and Mark. Later in the year, he returns to Dhaka, and is appointed Professor and Head of the

Department of Physics, when D M Bose, the original appointee, declines the offer. In his Dhaka years, he reorganizes the Physics Department, developing special facilities for research work in X-ray spectroscopy, X-ray diffraction, magnetic properties of matter, optical spectroscopy including Raman spectra, wireless etc.

1927 February. Dirac invents 'second quantization' of the electromagnetic field, and establishes a logical quantum theory of the interaction of light and matter in which the light field is represented by quantized harmonic oscillators.

Bose is appointed Dean, Faculty of Science, Dhaka University.

Bose and Sushilchandra Biswas publish a joint paper 'Measurements of the Decomposition Voltage in Non-Aqueous Solvents', in ***Z. Phys. Chem***, 125, 442-51.

1928 February. Dirac announces his discovery of the relativistic wave equation for the electron, incorporating the spin; followed by several applications.

October. Arnold Sommerfeld, visiting Calcutta to receive a doctoral degree, honoris causa, writes to the Vice-chancellor, Dhaka University, expressing a desire to meet Bose : 'It would be a great pleasure for me indeed if Professor S N Bose could decide to see [me] at Calcutta.' Bose comes down to Calcutta to see Sommerfeld, and attends Raman's talk on the discovery of the new radiation.

1929 Bose presides over the Physics and Mathematics section of the Indian Science Congress held at Madras, and devotes his Presidential address to "Tendencies in the Modern Theoretical Physics'.

March. General quantum field theory outlined by Heisenberg and Pauli.

Bose contributes (jointly with S K Mukherjee, Assistant Lecturer in Physics, Dhaka University) 'Beryllium Spectrum in the Region **λ** 3367-1964', to ***Phil. Mag***., **Ser.7**, 7, 197-200.

K S Krishnan joins Dhaka University as Reader in Physics.

1931 Bose contributes his first article in Bengali, *Vijnaner Sankat* (Crisis in Science) to the first issue of ***Parichay***, a major Bengali periodical, beginning his lifelong campaign for the dissemination and teaching of scientific ideas through 'the mother tongue'.

May. Dirac declares the 'holes' to be new unknown particles, 'anti-electrons', which had the same mass as electrons, but with charge + e, and postulates the positron.

1932 February. Discovery of the neutron by Chadwick.

June. First nuclear process produced by an accelerator: Cockcroft and Walton become first men to accelerate protons &d split lithium nuclei.

2 August. Experimental observation of the positron for the first time, by Carl D Anderson, in a cloud chamber exposed to cosmic radiation.

1933 October. 'The canonization of the new developments,' at the seventh Solvay Conference, Brussels, in which the evidence for both the positron and the neutron is discussed by Bohr, Curie, Dirac, Heisenberg, Pauli, and others.

Dirac is awarded the Nobel Prize.

30 January. The Nazis come to power in Germany.

20 March. While Einstein is on a visit to the USA, the Nazis raid his summer house in Caputh to look for weapons allegedly hidden there by the Communist Party.

28 March. Einstein returns to Europe, and settles temporarily in Belgium, never to set foot in Germany again; and sends his resignation to the Prussian Academy.

7 April. The *Beamtengesetz* (the civil service law) authorizes German Universities to fire staff on grounds of politics and/or race.

10 May. Burning of books in Germany.

1934 January. Iréne and Frédéric Joliot-Curie first produce artificial radioactivity.

March. Fermi uses slow neutrons to bombard nuclei. 'In rapid succession, 40 of the 60 elements the [Fermi] group irradiated revealed the existence of at least one new isotope. A new one was found every few days'(G Holton, in ***Minerva***, 12, 159, 1974, quoted by Pais, *Niels Bohr's Times*, Oxford 1991).

1935 7 January. Bose is nominated a Foundation Fellow of the National Institute of Sciences that has its inaugural meeting at the Senate Hall of the Calcutta University; and is also one of the five members

representing the Indian Science Congress on the first general committee of the Institute.

Bose delivers the Adharchandra Memorial Lecture at Calcutta University, on
'Recent Progress in Nuclear Physics'.

Chadwick receives the year's Nobel Prize in physics, and the Curies in chemistry.

1936 January. Bohr describes for the first time his theory of the compound atomic nucleus. 'The compound nucleus dominated the theory of nuclear reactions at least from 1936 to 1954. . . At Los Alamos . . . the compound model could explain many phenomena.'

February. Bose lectures on 'Science in Education' at a conference held in connection with the Bengal Education Week.

June. Bose makes his first contribution to statistics - a paper 'On the Complete Moment-Coefficients of the D^2-statistic', in Sankhyā, 2, 385-96.

1937 Rabindranath Tagore dedicates his first book on science - *Visva-Parichay* (Introduction to the Universe) - to Bose.

Bose contributes his second paper in statistics to Sankhyā, 3, 105-24 'On the Moment-Coefficients of the D^2-Statistic and Certain Integral and Differential Equations Connected with the Multivariate Normal Population'. 'Recent Progress in Nuclear Physics', the text of his Adharchandra Memorial lecture, appears in *Science and Culture*, 2, 473-79. *Science and Culture*, 3, 335-7, carries 'Anomalous Dielectric Constant of Artificial Ionosphere'.

1938 28 January. Bose writes to Syamaprasad Mookerjee, Vice-Chancellor, Calcutta University, in response to a feeler sent by the latter, stating that 'it will not be wise for me to go in for change at this age.'

5 April. Indian Journal of Physics receives Bose's 'On the Total Reflection of Electromagnetic Waves in the Ionosphere', and carries it in issue no. 12, 121-44.

10 December. Fermi receives the Nobel Prize in physics 'for his demonstration of the existence of new radioactive elements produced by neutron irradiation, and for his related discovery of nuclear reactions brought out by slow neutrons.'

1939 January. Hahn and Strassmann in Germany, Meitner and Frisch in Denmark in cooperation with Bohr and Fermi establish the practicability of fission and chain reaction. Joliot, Halban and Kowarski in Paris prove that uranium and thorium could perhaps be burned to yield energy.

March. Fermi meets US Navy officials and points out the possibility of obtaining atomic power with fission by fast neutrons; but the Navy officials are unimpressed.

July. Szilard and Wigner take up the subject of the bomb with Einstein, and the three subsequently talk with Alexander Sachs, who had served as an advisor to President Roosevelt on several occasions.

2 August. Einstein sends a letter to Roosevelt drawing the latter's attention to the military implications of atomic energy.

1 September. Germany invades Poland, and sparks off World War II.

11 October. Sachs carries Einstein's letter to the White House in person.

21 October. The Advisory Committee on Uranium, headed by Lyman J Briggs, holds its first meeting – the three-man committee was appointed on the same day Roosevelt replied to Einstein's letter. Einstein would later regret having written the letter to Roosevelt, 'Had I known that the Germans would not succeed in producing an atomic bomb, I would not have lifted a finger.'

Bose publishes his paper in mathematical physics - 'Studies in Lorentz Group' – in the *Bulletin of the Calcutta Mathematical Society,* 31, 137-47.

16 November. Bose is appointed Provost of the Dhaka Hall at the University.

1940 June. With the Uranium Advisory Committee recommending funding for the procurement of uranium and graphite and the construction of a lattice, and the creation of the National Defence Research Committee, the US government enters the project that would lead to the making of the first atom bomb.

17 November. The complete solution of the Equation

$\nabla^2\varphi - \frac{\partial^2\varphi}{c^2\partial t^2} - k^2\varphi = -4\pi\rho(xyzt)'$, joint paper by Bose and S C Kar, received

by the *Proceedings* of *the National Institute of Sciences,* India, to be published in issue 7, 93-102.

1941 Compton, Chadwick, and Cockcroft, among others, prove the feasibility of the atomic bomb.

1942 July. Bose is nominated member of the Agricultural Research Sub-committee of the Indian Central Jute Committee.

2 December. Under Fermi's supervision, the first nuclear reactor comes into operation in Chicago, producing the first self-sustaining chain reaction, and thereby initiating the controlled release of nuclear energy.

1943 March. J R Oppenheimer arrives at the site of the Los Alamos Scientific Laboratory and takes charge as director, to be soon joined by Bethe, Fermi, Chadwick, Bohr, Wilson, Kennedy, Smith, Parsons, Kistiakowsky, Bacher, and others, on a project of making the atomic bomb.

Bose is nominated Chairman, Weights and Measures Committee, Government of Bengal.

Bose contributes paper on 'Reaction of Sulphonazides with Pyridine : Salts and Derivatives of Pyridine-Imine', to *Science and Culture,* 9, 48-9; and 'A Note on Dirac Equations and the Zeeman Effect'(joint1y with K Basu) to the *Indian Journal* of *Physics,* 17, 301-08.

1944 3 January. In his presidential address at the Thirty-first Indian Science Congress, Bose speaks on 'The Classical Determinism and the Quantum Theory'.

30 April. Hitler takes his own life under the ruins of his Chancellery in Berlin.

7-8 May. Germans surrender in Reims and Berlin.

19 July. Bose addresses the annual convocation of the College of Engineering and Technology, Jadavpur University.

11 December. As member of the Bengal Industrial Research Committee, Bose attends the first meeting of the Committee.

1945 15 May. *Bulletin of the Calcutta Mathematical Society* receives Bose's paper 'On an Integral Equation associated with the Equation for Hydrogen Atom', to be published in the *Bulletin***,** 37, 51-61.

16 July. The first atomic explosion at the Alamogordo Air Base in the New Mexico desert takes place at 5.30 a.m.

6 August. The first atomic bomb is dropped on Hiroshima at 8.15 a.m. (Japanese time) from a B-29 aircraft, Enola Gay.

9 August. The second atomic bomb is dropped on Nagasaki at 11.02 a.m. (Japanese time) from a B-29 aircraft, the Great Artiste.

Bose returns to Calcutta as Khaira Professor of Physics at Calcutta University, and becomes President of the Indian Physical Society (in the latter position he would continue till 1948).

2 September. The Japanese surrender, bringing World War II to an end.

10 December. Einstein delivers an address in New York, 'The War is Won but Peace is Not'.

1946 Einstein agrees to serve as Chairmarn, of the Emergency Committee for Atomic Scientists.

October. Einstein writes an open letter to the general assembly of the United Nations, urging the formation of a world government.

1947 15 August. India gains independence.

1948 25 January. Bose launches the Bangiya Vijnan Parishad (Science Association of Bengal), and its monthly organ, *Jnan 0 Vijnan* (Knowledge and Science), to popularize science in and through Bengali.

Bose becomes President of the National Institute of Sciences of India (to continue in this position till 1950).

1949 27 October. Bose sends a communication on 'Germanium in Sphalerite from Nepal' to the *Journal of Scientific and Industrial Research*, to be published in its issue no. 9B, 52-53, 1950.

1950 The *Journal of Scientific and Industrial Research*, New Delhi, carries 'Extraction of Germanium from Sphalerite Collected from Nepal' by Bose and R K Dutta of the University College of Science, in two parts in 9B, 251-52, and in the following issue.

1951 As a Special Representative from India, Bose attends a meeting, sponsored by the UNESCO, at Paris, to consider the establishment of an international statistical centre. He visits Germany and meets

Walther Bothe, Otto Haxel, J H D Jenson and H Meier Leibnitz in Heidelberg, and Otto Hahn, Werner Heisenberg and Houtermans in Göttingen.

1952 Bose addresses the All India Bengali Literature Conference at Cuttack, as President of the Science Section.

20 September. Bose writes to Einstein - what amounts to his first contribution to Einstein's 'new' unified field theory.

29 September. Bose's paper 'The Affine Connection in Einstein's New Unitary Field Theory', is received by the *Annals of Mathematics, USA*, which publishes it in issue 59, 171-76, 1954.

4 October. Einstein acknowledges Bose's communication, appreciating his 'interest' in the theory, and his 'so much work and penetration to the solution of the equations' of the unitary field, but does not find 'the solution of those equations . . . of great help'.

1953 Bose attends the World Congress for General Disarmament and Peace at Budapest; and visits the USSR, Denmark, Czechoslovakia and Switzerland; meeting Wolfgang Pauli in Zurich and Niels Bohr in Copenhagen.

Bose publishes a Note on 'The Identities of Divergence in the New Unitary Theory' in the *Comptes rendus de L'Academie des Sciences*, Paris, 236, 1333-5, 'presented by Louis de Broglie'.

18 July. *Le Journal de Physiqueet le Radium*, Paris, receives Bose's papers 'A Unitary Field Theory with $\Gamma\mu\neq O'$, and 'Certain Consequences of the Existence of the Tensor *g* in the Affine Relativistic Field' which it publishes in its issue no. 14, 641-47.

22 October. Einstein writes a long letter to Bose, commenting on the paper 'A Unified Field Theory. . .'

1954 26 January. The Republic Day Honours List shows Bose as Padmavibhushan, one of the highest national honours conferred by the President of India.

3 May. Bose is sworn in as a member of the Rajya Sabha, the upper house of the Indian parliament, on a special nomination made by the President of India.

Bose attends the International Crystallography Conference at Paris, where he presents the constructional details of his Spectrophotometer, subsequently adopted in several well-known laboratories in Europe.

13 April. The trial of Oppenheimer begins.

Einstein sides with the overwhelming majority of atomic scientists who publicly condemn the United States government's actions in the security case against Oppenheimer.

30 November. Bose delivers the sixteenth Acharya Jagadischandra Bose Memorial Lecture at the Bose Institute, on 'Search for New Sources of Power'.

1955 9 February. 'A Report on the Study of Thermoluminescence', a joint paper by Bose, J Sharma, and B C Dutta, is received for publication by the *Transactions* of *the Bose Research Institute*, which carries it in its issue 20, 177-80.

Bose's last scientific paper, 'Solution of a Tensor Equation Occurring in the Unitary Field Theory', appears in the *Bulletin de Société Mathématique de France*, 83, 81-85.

11 April. Einstein's last signed letter (to Bertrand Russell), in which he agrees to sign a manifesto urging all nations to renounce nuclear weapons. That same week, Einstein writes his final phrase in life, in an unfinished manuscript: 'Political passions, aroused everywhere, demand their victims'.

18 April. 1.15 a.m. Death of Einstein.

Bose visits Paris, on an invitation from the Council of National Scientific Research of France.

July. Bose attends the international conference commemorating Fifty Years of Relativity, at Berne.

1956 Bose retires from the post of Khaira Professor at Calcutta University.

July. Bose takes over as Vice-chancellor of the Visva-Bharati University.

Bose attends as a special invitee the annual meeting of the British Association for the Cultivation of Science.

1957 15 January. Bose delivers the Vice-Chancellor's formal address at the Convocation of Visva-Bharati, also addressed by Jawaharlal Nehru,

then Prime Minister of the country and Chancellor of the University. Calcutta University, on the occasion of its centenary, confers a D Sc, honoris causa, on Bose; followed by honorary doctoral degrees from the Allahabad and Jadavpur Universities.

1958 Bose is elected Fellow of the Royal Society, and visits London via Paris for the occasion.

Bose is nominated Professor Emeritus at Calcutta University.

Bose presides over the year's session of the All India Bengali Literature Conference, at Jabbalpur.

1959 Bose is appointed National Professor.

10 August. Bose's resignation from the Rajya Sabha is reported in the House.

1960 January. Bohr visits India to attend the Indian Science Congress session at Bombay, where he gives two lectures; and comes to Calcutta to deliver the M N Saha Memorial lecture at the M N Saha Institute of Nuclear Physics, Calcutta University College of Science; the session is chaired by Bose.

1961 Bose receives the title of Deshikottama – equivalent to a doctorate, honoris causa – from the Visva-Bharati University.

March. Bose speaks at the Indian Association for the Cultivation of Science at a meeting held to commemorate the death anniversary of Mahendralal Sircar.

1962 May. Bose participates in the deliberations of the Organizing Committee of the World Peace Council, held in Stockholm.

August. Bose attends and addresses a seminar on 'Science and Philosophy' held in Tokyo.

September. Bose attends the World Peace Conference in Moscow.

October. Bose inaugurates and addresses the Angrezi Hatao (Banish English) Conference, held at Hyderabad.

Bose receives an honorary D Sc degree from the Indian Statistical Institute.

Bose delivers the convocation address at the Calcutta University Convocation.

1963 11 May. Bose delivers the convocation address at Ranchi University.

July. Bose visits Cairo as a member of a delegation of Indian scientists.

1964 1 January. Bose is felicitated on his seventieth birthday, at the Mahajati Sadan auditorium, with Prafullachandra Sen, then Chief Minister of the State, as President of the Celebration Committee.

Bose receives an honorary D Sc from the Delhi University, and the title 'Vijnan-Bhaskaram' from Sanskrit College, Calcutta.

1965 1 January. Bose inaugurates the 51-52nd session of the Indian Science Congress.

Bose receives the Jagattarini Medal from Calcutta University in recognition of his contribution to the Bengali language.

7 April. Bose delivers the convocation address at the Indian Institute of Technology, Kharagpur.

1968 Bose elected President of the Asiatic Society.

1969 Bose inaugurates the building of the Vangiya Vijnan Parishad, at P 23, Raja Rajkrishna Street, Calcutta.

1 March. Bose delivers the convocation address at the Indian Agricultural Research Institute, New Delhi.

1970 Bose is awarded a D Litt, honoris causa, by Rabindra Bharati University.

1971 12 March. Bose delivers the Krishnan Memorial Lecture at the Nationil Physical Laboratory.

10 May. Bose delivers the convocation address at Rabindra Bharati University.

1973 16 June. Bose delivers the convocation address at Calcutta University.

29 December. Bose speaks at the inaugural session of a Seminar on the Scientific Contributions of Professor S N Bose, held at the Calcutta Mathematical Society.

1974 1 January. Bose's eightieth birth anniversary is celebrated throughout the country.

The fiftieth year of Bose Statistics is commemorated at the Bose Institute, Calcutta.

4 February. Death of S N Bose.

Books by S N Bose (in Bengali): **in chronological sequence**

Vijnaner Sankat O Anyanya Prabandha (Crisis in Science and Other Essays), Lekhak Samabaya Samiti, Calcutta, 1371 [Bengali era, corresponding to 1964], 176 pages, and prelims, including a dedicatory note by Bose, dated 24 May 1964.

Satyendranath Bose Rachana Sankalan (A Selection or Satyendranath Bose's Writings), Vangiya Vijnan Parishad, Calcutta, 1387 [Bengali era, corresponding to 1980), 422 pages, and prelims, including a prefatory note, a life sketch of Bose, and a memoiral piece by Gaganbehari Banerjee. Enlarged second edition, published as centenary edition, 1993, 450 pages, with additional articles, letters and photographs.