S.S. Bhatnagar, C.V. Raman, Homi Bhabha and Research in Physics at Lahore and Chandigarh

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(*on leave of absence from TIFR, Mumbai)

ABSTRACT

- I shall present a personal perspective of initiation of research in Physical Sciences at the University of Punjab at Lahore, and then at the Panjab University, Chandigarh in the context of life and times of Nobel Laureate Sir C.V. Raman, FRS; Sir S.S. Bhatnagar, FRS and Dr. Homi Bhabha, FRS.
- Dr. Shanti Swarup Bhatnagar was not only the first Professor of Physical Chemistry and the Founder Director of University Chemical Laboratories, the Dean University Instruction (DUI) at Punjab University and the Founder Director of CSIR, but also a part of an expedition team on Cosmic Ray Research at high altitudes led by Nobel Laureate A.H. Compton in 1926 on behalf of the University at Lahore.

ABSTRACT

- Dr. Homi Bhabha was motivated to commence Cosmic Ray Research while he was at sojourn at C.V. Raman's Department of Physics at the Indian Institute of Science, Bangalore during a visit of Nobel Laureate Robert A. Millikan to perform Cosmic Ray explorations in India.
- The CSIR had funded the initiation of research based on Nuclear Accelerators at the Tata Institute of Fundamental Research (TIFR),founded by Homi Bhabha in 1945. Close bonds have existed between the TIFR and the Department of Physics of Panjab University ever since the movement of Physics Honours School from Govt. College, Hoshiarpur to Chandigarh campus in 1960.

Glimpses into timelines of selected Icons

- Robert A. Millikan, Nobel Prize for Measuring Charge on Electron (1923)
- A.H. Compton, Nobel Prize for Compton Effect (1927) .
- Shanti Swarup Bhatnagar, F.R.S., Founder Director of University Chemical Laboratories, Lahore.
- Homi Jehangir Bhabha, F.R.S., Founder Director, Tata Institute of Fundamental Research, Bombay.
- Piara Singh Gill, Ph.D. Student of A.H. Compton at University of Chicago and Faculty member at Forman Christian College, Lahore

Glimpses into timelines of selected icons

- Pratap Krishan Kitchlew, Ph.D. student of Meghanand Saha, F.R.S. and Faculty member at Govt. College Lahore.
- Prof. Harnam Singh Hans: Ph.D. student of P.S. Gill at Aligarh Muslim University and appointed Professor and Head, Department of Physics, Panjab University, Chandigarh in 1967.

Professor Robert Andrews Millikan
(March 22, 1868 – December 19, 1953)

Nobel Prize in Physics in 1923 for his measurement of the elementary electronic charge and for his work on the photoelectric effect.

Professor Robert Andrews Millikan (March 22, 1868 – December 19, 1953)

- 1891: B.A.
- In second year of B.A., asked by Greek Professor to teach elementary course in physics to first year students. His Professor remarked "Anyone who can do well in my Greek can teach physics."
- Millikan has said, “I doubt if I have ever taught better in my life than in my first course in physics in 1889. I was so intensely interested in keeping my knowledge ahead of that of the class that they may have caught some of my own interest and enthusiasm.”
- 1895: First Ph.D. holder in Physics from Columbia University
- 1896: Joins University of Chicago as an Assistant Professor.

Professor Robert Andrews Millikan (March 22, 1868 – December 19, 1953)

- **1910: Designated as Professor of Physics, University of Chicago.**
- **1909-1913: Performs series of experiments to determine charge of electron via "Millikan Oil Drop Experiment".**
- **His experiments also elucidated that charge is quantized. His experiment measured the force on tiny charged droplets of oil suspended against gravity between two metal electrodes. Knowing the electric field, the charge on the droplet could be determined. Repeating the experiment for many droplets, Millikan showed that the results could be explained as integer multiple of a common value, the charge on a single electron.**

Professor Robert Andrews Millikan
(March 22, 1868 – December 19, 1953)

- 1916: Obtains accurate value of Planck's constant.
- 1914-19: Vice Chairperson of National Research Council; Develops anti-submarine and meteorological devices to aid First World War.
- 1921: Moves to nucleate Physics Research at Throop College of Technology which becomes **California Institute of Technology (Caltech)** at Pasadena, California.
- 1921-1945: Chairman of the Executive Council of Caltech.
- **Studies Cosmic Rays at Caltech**.

Professor Robert Andrews Millikan (March 22, 1868 – December 19, 1953)

- 1921 onwards: Initiates research in Cosmic rays.
- The nomenclature 'Cosmic Ray' given by R.A. Millikan himself as he demonstrated that these Rays were extraterrestrial in origin.
- Believed that the Cosmic Rays were primarily photons, but Compton thought they were largely charged particles and Compton proved it experimentally.
- **1924: Invites C. V. Raman to Caltech** as a Visiting Professor under a programmes where earlier visitors were Sommefeld, Lorentz and Einstein.
- During 1924 US visit, **Raman had also met A.H. Compton, who had discovered Compton Effect in 1923**.

Extracted from biography of C.V. Raman titled 'Journey into Light' by G. Venkataraman, 1988.

A Souvenir from the American Tour of 1924.

Professor Robert Andrews Millikan (March 22, 1868 – December 19, 1953)

- In 1941 the Franklin Institute, Philadelphia, awarded Raman the Medal of Merit, its highest honour, and elected him an honorary member. A similar distinction had earlier been conferred upon Einstein, Millikan and Compton.
- 1941: R.A. Millikan visits Indian Institute of Science, Bangalore, meets Prof. C.V. Raman and Dr. Homi Bhabha.
- Flies cosmic ray payloads in Balloons to high altitudes near the magnetic equator in South India.

C.V. Raman's observations after R.A. Millikan's visit to Bangalore

- The total energy received by the earth as cosmic radiation is about the same as that which comes to us every night as starlight and may not therefore seem at first sight particularly significant. But actually, it is most significant because of the form which it takes, namely in discrete units expressible in many millions or even billions of electron volts, a quantity which is immensely larger than anything that can be produced in our laboratories even with the most modern equipment. **It is this enormous energy of the individual particles or units that invests the study of the cosmic radiations with extreme interest, opening out as it does the possibility of observing phenomena which we could never hope to reproduce in our laboratories.**

Annual Report (1943-44) of IISc. Cosmic Ray Unit headed by Dr. Homi Bhabha

- 1942: Cosmic Ray Research Unit Set up in Dept. of Physics, IISc., Bangalore.
- 1943: Experiments Commence
- **Premises:** The study of the variation of the intensity of the hard component with altitude is of fundamental importance. This is done by sending Cosmic Ray apparatus controlling a radio signaller up in Balloons.
- Cosmic Rays are believed to have some effect on mutations. Their phenomenon will be studied by sending up certain biological specimen with the balloons used for stratosphere flights.

Annual Report (1945-46) of IISc. Cosmic Ray Unit headed by Dr. Homi Bhabha

- By the courtesy of Colonal Lynn the Commanding Officer of the 84th Depot of the U.S. Air Force at Bangalore, a specially prepared 087 transport Liberator under the command of Col. Reynolds carried apparatus weighing nearly a ton to an altitude 40,000 feet for measuring the penetrating component of Cosmic Rays

  Dr. Homi Bhabha and Mr. Vikram Sarabhai were coincidentally together at IISc. from 1939-45.

Professor Arthur Holly Compton
(September 10, 1892 – March 15, 1962)

Nobel Prize in Physics 1927 for Discovery & Explanation of Compton Effect.

Professor Arthur Holly Compton
(September 10, 1892 – March 15, 1962)

- 1913: As an undergraduate at Princeton University devised a method for demonstrating the rotation of the Earth.
- 1914: Master Degree
- 1916: Ph.D. titled "The intensity of X-ray reflection, and the distribution of the electrons in atoms" under supervision of Herewald L. Crooke, of ‘Crooke’s tube fame’.
- 1916-18: Worked on development of Sodium vapour lamp at Westinghouse Lamp Company in Pittsburgh.

Professor Arthur Holly Compton
(September 10, 1892 – March 15, 1962)

- 1919: NRC Travelling Fellowship to Cavendish Laboratory at Cambridge in England.
- Inspired to meet Ernest Rutherford, Charles Galton Darwin and Arthur Eddington
- Works with George Paget Thomson (son of J. J. Thomson, who discovered electron and determined e/m ratio).
- Names his second son as J. J. Compton.

Professor Arthur Holly Compton
(September 10, 1892 – March 15, 1962)

- 1920: Professor and Head of Physics Department at Washington University, St. Louis in USA.
- 1922: Discovers Compton Effect and explains it in terms of Energy-Momentum conservation phenomenon.
- Shift (**= h/mc**) in wave length (of scattered radiation) is independent of wavelength of incident radiation.
- 1923: Moves to University of Chicago as Professor.
- 1926: Writes to S.S. Bhatnagar for Explorations of Cosmic Rays in a Mountain Lake in Kashmir.

Professor Arthur Holly Compton (September 10, 1892 – March 15, 1962)

- 1927: Nobel prize in Physics for 'Compton Effect'.
- 1935: Motivates development of Fluorescent Lamps at General Electric Company.
- 1940: Piara Singh Gill obtains Ph.D. under him at Chicago.
- 1941: Appointed Head, National Defense Research Committee of U.S.A.
- 1941-45: Proposes Uranium Programme; Works with Enrico Fermi and Eugene Wigner; Plans separation of Plutonium from Uranium to initiate Plutonium Reactor and Plutonium Bomb Programme.
- 1942: Assigns responsibility of Bomb Design to Robert Oppenheimer.
- 1946-54: Chancellor of Washington University, St. Louis.

Professor Arthur Holly Compton visits India

- Visits Lahore to carry out Cosmic Ray explorations at High Altitudes on a **Research Project funded by University of Punjab at Lahore.** Dr. S.S. Bhatnagar was a part of his experimental team.
- A.H. Compton's sister was spouse of Missionary C. Herbert Rice, who served as Principal of Forman Christian College (F. C. College), Lahore.
- S.S. Bhatnagar had also studied at **F. C. College**.
- Cosmic Rays are 15 percent more intense at the poles than at the equator.
- Compton proved that Cosmic Rays are made up principally of charged particles, rather than photons as Robert Millikan had suggested, with the **Latitude effect in Cosmic Rays** being due to **Earth's Magnetic Field**.

Extract from 'Life & Work of Sir S.S. Bhatnagar' by Norah Richards*, 1948.

Cosmic Ray expedition to Gulmarg :

- The Cosmic Ray expedition was planned and **financed by the University of the Punjab**, members of which, in addition to Prof. Compton, were Prof. Benade, Dr. Bhatnagar and Dr. Nazir Ahmad#. Some science students also accompanied them. Mrs. Compton had come out to India with her husband and their son aged fourteen. They also were of the party.
- Arrived at **Gulmarg**, in Kashmir, they planned their trek up to a lake in the Tosh Maidans that would serve their purpose. Mrs. Compton elected to accompany the expedition with her son. They had taken with them provisions for one month and also **the instruments that Dr. Bhatnagar had had made for the experiment.** Prof. Compton had with him his own equipment that he had brought from America.

*** Wife of Mr. Philip Ernest Richards, Professor of English Literature, Dyal Singh College, Lahore**

 # Ph.D. student of Lord Rutherford at Manchester

Extract from 'Life & Work of Sir S.S. Bhatnagar' by Norah Richards*, 1948.

- It was a stiff climb to the **lake that lay at an altitude of about 17.000 feet** and bitterly cold. However, they were all fit and greatly enjoying the adventure, particularly the nightly halts. They had done themselves well and Prof. Compton had also brought some provisions from America. This went into the common stock and they ate with relish in the cold temperature after their arduous days. Mrs. Compton stood it well, and her boy did justice to the sweets they carried with them. Taking it by and large he had a really good time.

- Arrived at Tosh Maidans they pitched camp. **Soundings were made in the lake with an electrometre to a depth of 250 feet, taking measurements of the intensity of cosmic rays.** This went on continuously by day and by night for more than a week-the four of them getting up **two by two in rotation at night to take the readings.** The cold was hard to bear and' eventually a blizzard put a stop to their work. **Their cook had died of heart failure** and they returned to Gulmarg on their way back to Lahore, having shown that the intensity of cosmic rays decreased as the ionization chamber (measuring instrument) went deeper and deeper. Before they struck camp they had the thrilling adventure of being lost and losing one another. For three or four hours they shouted to attract each other and by slow and rather terrifying degrees they converged and found themselves, happily, above their camp. They celebrated the joyful re-union by sliding down on the snow of the very steep mountain side.

Professor Arthur Holly Compton
(September 10, 1892 – March 15, 1962)

A.H. Compton as a Human being

- Compton played the mandolin and was a scientific glass blower.
- "Science can have no quarrel," he said "with a religion which postulates God, and living beings as God's creation.

Professor Arthur Holly Compton
(September 10, 1892 – March 15, 1962)

His Legacy:

- Compton creator on Moon.
- NASA Compton Gamma Ray Observatory.
- A University of Chicago Hall of Residence is called A.H. Compton House.
- Speed Breaker designed by him and called ‘Holly Hump’ are on the roads of St. Louis Campus.

A H Compton's contact with Homi Bhabha

- A H Compton had visited England again in 1930s, while Homi Bhabha had developed Bhabha–Heitler Theory on electron-positron sacattering ,and explored its application to **Extensive Air Showers in Cosmic Rays.**
- Bhabha also gave the nomenclature '**Mesons**'

Bhabha's contact with P S Gill

Extract from Annual Report of TIFR (1947-48)

Dr. Homi Bhabha Reports:

- **Dr. P.S. Gill joined the Institution on 26th June 1947, as Professor of Experimental Physics.** Prof. Gill is well known as one of the leading workers on Cosmic Rays in India, and, with the cooperation of the University of Chicago and the United States' Navy, undertook a series of flights in California at an altitude of 40,000 ft. for the measurement of the intensity of Cosmic radiation at high altitude, last year.

Dr. Bhatnagar and Dr. Bhabha

Two Doyens

Sir Shanti Swarup Bhatnagar

- 21 February, 1894, **Bhera**, Shahpur in Distt. (Pakistan) - Jan 1 1955, Baroda
- Parents : Smt. Parbati and Shri Parmeshwari Sahai
- Childhood at Sikandarabad, Distt. Bulandshahar, UP, after losing his father when he was just 8 months old
- 1908 : Moves to Lahore, under the care of **Shri Raghunath Sahai,** the famous headmaster of the **Dyal Singh High School** at Lahore and a close friend of his father

Dr Homi J. Bhabha

(October 30, 1909, Mumbai – January 24, 1966, Mount Alps
* Parents : Smt. Meharbai and Mr J. H . Bhabha, Barristor, Legal Advisor to Tatas ,
Grandson of Dr Col. Hormusji J. Bhabha, M.A. , D.Litt., Inspector General of Education at Mysore

Childhood and Early Education: Mumbai.

Sir Shanti Swarup Bhatnagar

- 1911 Matriculation, Dyal Singh High School at Lahore
- 1913 Intermediate, Dyal Singh Intermediate College
- May, 1915: Married to Lajwanti, daughter of Shri Raghunath Sahai
- 1916 : Completes B.Sc. with Honours in Physics from Forman Christian College
- Was **failed in Chemistry** due to **an upto date answer on wave attributes of X-rays,** not available in then text books of Physics and Chemistry
- Provides import substitution for German Gelatin duplicating pads used for printing. **Rewarded Rs.150 for this innovation**

Dr Homi J. Bhabha

Schooling : Cathedral School and Royal Institute of Science, Mumbai

1927-1939 : Cambridge University, UK

First –Degree in Mechanical Engineering, followed by that in Mathematics and Physics. Ph.D. in Theoretical Physics.

Travelled to Europe on a Fellowship like SSB, met W. Pauli at Switzerland and Neils Bohr in Copenhagen.

Sir Shanti Swarup Bhatnagar

- 1919 : Completes M.Sc., takes three years as he has to earn while learning. Works for FC College, while studying at Government College, Lahore.
- 1919-1921 : D.Sc. Degree at University of London. Fellowship arranged by **Prof. Ruchi Ram Sahni from Dayal Singh Trust.**
- Meets Prof. Walther Hermann Nernst, Nobel Prize Chemistry (1920)
- 1921-1924 : **Research Professor at Banaras Hindu University**, on invitation from Pt. **M M Malviya** - Establishes Chemistry Laboratory

Dr Homi J. Bhabha

1939-1945: Stay at Dept. of Physics, Indian Institute of Science, Bangalore

19 August 1943 : Proposes the initiation of Tata Institute of Fundamental Research

1 June 1945 : TIFR Starts at IISc., Bangalore

19 December 1945 : TIFR inaugurated at Mumbai

Sir Shanti Swarup Bhatnagar

- 1924-1939 : Professor of Physical Chemistry and Founder Director of University Chemical Laboratory, Lahore. **Initiator of Chemistry Honours Schoo**l at P.U. Lahore.
- December 1939: Sir Ramaswami Mudaliar, Commerce Member in Viceroy's Committee identifies him to conceive plans for Scientific and Industrial Research (SIR) to aid war effort of British in Eruope.
- **1940: Director, Scientific and Industrial Research, Calcutta.**

Sets up Research Laboratory at Alipore in Calcutta

Dr Homi J. Bhabha

April, 1946: First meeting of CSIR Committee for Atomic Research conducted at TIFR, Mumbai in which Shanti Swarup Bhatnagar participated.

26 August, 1947: Board for Atomic Research created in CSIR

April 1948: Atomic Energy Commission created with Dr Homi Bhabha, Dr Shanti Swarup Bhatnagar and Dr K.S. Krishnan as members.

Sir Shanti Swarup Bhatnagar

- Nov. 14, 1941: Industrial Research Fund Created with an annual grant of Rs.10 lakhs
- 12 March 1942: CSIR registered as a Society
- September 26, 1942 : Research Fund transferred to CSIR, Hence the Foundation Day of CSIR.

(SS Bhatnagar Prizes announced every year on this day)

- After August 1945: Creates Committee for Atomic Research
- Starts setting up chain of CSIR Laboratories
- CGCRI, Calcutta, 24 December 1945

.* CFRI , Dhanbad , 17 Nov., 1946

•NML , Jamshedpur , 21, Nov., 1946

• NPL New Delhi , 4 January, 1947

•NCL Pune, April 6, 1947

Research papers published in 1926 by Dr. S.S. Bhatnagar from Punjab University Chemical Laboratories, Lahore

23.Effect of Polarised Light on Bacterial growth (Nature, 117, 302, 1926)

24.Effect of Polarised Radiations on Animal Metabolism (Nature, 118, II, 1926)

25.Conductivity and Surface Tension of Univalent Salts of Higher Fatty Acids in the Molten State (Kolloid Zeit., 38, 218, 1926).

26.Concentric Coloured Rings or the Beet-root and the Liese-gang Phenomenon (Kolloid Zeit., 39, 264, 1926).

27. Rates of Evaporation of Water absorbed on Metals and their Oxides (Jour. Chem. Phys. 25, 545, 1926).

28. Relations between the chemical Constitution of Organic Liquids and the Translusence of Paper dipped in them (Zeit. Phys. Chem., 122, 88, 1926).

Magnetometer Designed, Built and Patented at Lahore and Manufactured & Marketed by Adam Hilger Co. in England

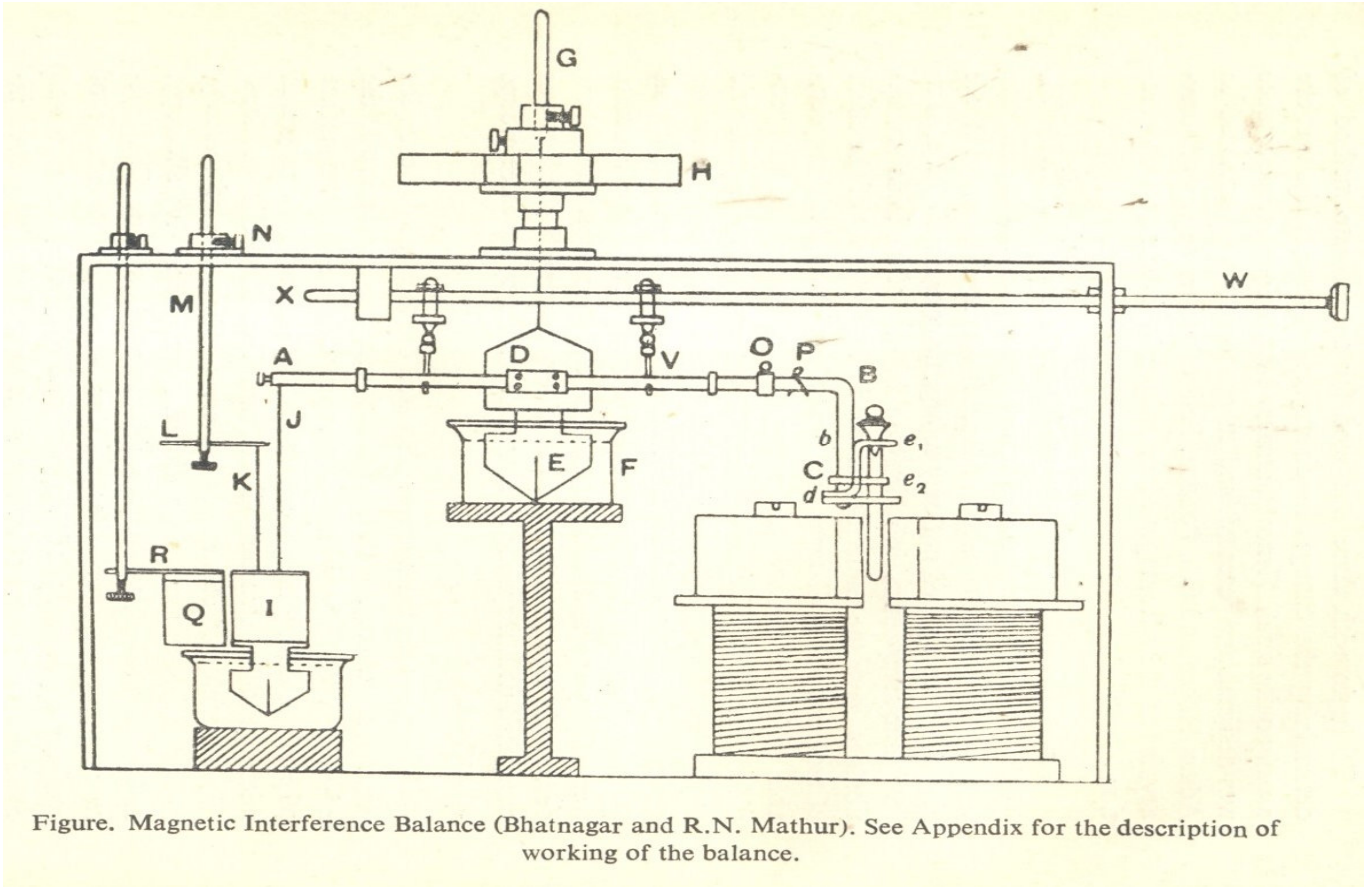

Figure. Magnetic Interference Balance (Bhatnagar and R.N. Mathur). See Appendix for the description of working of the balance.

A very small weight of the substance, of the order 0.01 gm., a change in diamagnetic susceptibility of the order of 0.2 per cent or even less can, therefore, be easily detected.

Acharya Praful Chandra Ray

(Chemistry teacher of Ruchi Ram Sahni at Calcutta)

- **"On turning over the pages of Nature my eyes changed across an advertisement of Macmillan's in which I find your book* at last advertised. That the book is of a high standard is indicated by the most excellent review in Current Science by Professor Stoner, who is competent to judge.**

Physical Principles and Applications of Magneto-Chemistry, by S S Bhatnagar and R N Mathur, Macmillan and Co. Ltd., 1935

Dr. P.C. Ray (contd…)

- **As far as I know, Meghnad's is the only text book in Physical Science that has been adopted in foreign universities and it gladdens my heart that another work in Physical Science is likely to occupy a similar place.**

- ***My days are numbered and my great consolation is that you in chemistry are trying to raise the reputation of Indian workers abroad".***

Prof. C.V. Raman

- **...it is always a pleasure to me to handle new scientific books by reputed authors. In the present instance, the pleasure has been greatly enhanced by the very attractive printing and get up of the book and by the fact that the authors are my own countrymen.**
- **I very much specially admire your energy and perseverance in having produced such a book in spite of your other important scientific activities. Your name now stands as one of the very few Indians who have written scientific books claiming the respect and attention of senior workers in every country".**

Prof. C V Raman & Dr. S S Bhatnagar

Prof. M.N. Saha, D.Sc., F.R.S.

- **"Congratulations on your noble gift to the Punjab University, you have hereby raised the status of the University teachers in the estimation of the public, not to speak of the benefit conferred on your Alma Mater.**

- **India does not lack in men earning millions but if a few of these millionaires were guided b the fine examples set up by a comparatively poor teacher like yourself, …**

Convocation Address of
Sir Tej Bahadur Sapru at the Panjab University, 1936

"When , therefore, I read the other day in the newspapers that Messers Steel Brothers had in recognition of the great work done by Dr. Bhatnagar, made very generous gift of money to him and he had with a singular sense of patriotism and self denial transmitted a considerable part of that gift to the Chemistry Department of your university so as to create an Industrial research Department in which some research scholars could develop new processes for the industrial utilization of Indian raw materials.

His Excellency Sir Henry Craik, Governor of the Punjab while inaugurating 26th session of the All Indian Science Congress, Lahore (2nd Jan. 1939)

- **"There has been also been much of greater output of written work notably in Chemistry Department under the distinguished direction of Professor Bhatnagar which had attracted students from all parts of India, and its achievements have won recognition in Europe also.**

His Excellency Sir Henry Craik, Governor of the Punjab at the Annual Lunch of the Northern India Chamber of Commerce, Lahore, 13th April, 1940

- **And in order to promote and coordinate and to facilitate the exploration of more fields of development. The Central Government have just set up a Board of Scientific and Industrial Research on which a number of Scientists and Industrialists of this country have agreed to serve. I believe that the establishment of this new organization will prove to be an important landmark in the history of India's industrial development.**
- **And I am sure everybody here , would agree with me in congratulating the Central Government on having secured the services of Dr. Bhatnagar as member of the Board and as Director of Scientific and Industrial Research. As Chancellor of our provincial University of which he is so distinguished an ornament, I deeply regret his transfer to another sphere.**

Homi Bhabha's synergy with S S Bhatnagar

An Extract from Dr Bhabha's 1944 letter to Sir Sorab Saklatvala, Chairperson, Dorab Tata Trust, Bombay

I also hope that in time we shall receive liberal support from the Board of Scientific and Industrial Research whose avowed policy includes support of pure research.

It would be in the interest of efficiency if the Board of Scientific and Industrial Research decided to subsidise us to carry on pure research which is its intention to foster by paying us, say, ten percent of the annual expenditure it contemplates on the projected National Physical Laboratory.

Dr Bhabha's communication to Pandit Nehru (1953)

The **Atomic Energy Commission**, on the initiative of Dr **S.S. Bhatnagar**, at its 27th meeting on the 22nd and 23rd **April 1953** recorded the following:

"The Commission noted that it had recognized the **Tata Institute of Fundamental Research** as the only laboratory of the Commission for fundamental research in atomic science. **In view of this decision the Commission would not set up another laboratory of its own for fundamental research in atomic physics**."

Dr Bhabha's address on Foundation Stone Laying Ceremony at TIFR

(January 1, 1954)

I would also like to record here my appreciation of the tireless efforts made by my colleague, Dr Bhatnagar, in securing this site and it is, thanks to this, and all the help he has given, that we are today in a position to lay the foundation stone.

We have associated with them as executing architects, the well-known firm of Master, Sathe & Bhuta who built the National Chemical and the National Physical Laboratories and with them we have also associated Mr. Kanvinde of the Council of Scientific and Industrial Research for working out the details.

First Meeting of TIFR Council (May 1945)

In this meeting, a tentative proposal for the budget of Rs 80,000 was passed for the year 1945-46.

The income available was

- Rs 45,000 from the Sir Dorab Tata Trust
- Rs 25,000 from the Government of Bombay
- Rs 10,000 from the Council of Scientific and Industrial Research

TIFR ANNUAL REPORT 1946-47

The Council of Scientific and Industrial Research sanctioned an annual block grant of Rs 75,000 to the Institute during the year 1946-47 and requested for representation on the Council of the Institute.

This grant was to enable the Institute to create a chair of Astrophysics and to invite a Visiting Professor.

Sir S.S. Bhatnagar, Director CSIR, was appointed as a representative of the Central Government on the Council of the Institute.

TIFR ANNUAL REPORT 1948-49

Atomic Research Committee, appointed by the CSIR recommended in 1948 that TIFR should be the centre of all large-scale research in nuclear physics in India.

The Committee recommended that a high energy accelerator capable of producing particles of energy above 200 MeV and sufficient to create mesons should be set up in TIFR.

A committee was set up to appoint a team of ten scientists and train them in techniques of Nuclear Physics. CSIR also sanctioned a sum of Rs. 32,400 for the training of this team of scientists.

Dr Bhabha personally was in charge of the team.

TIFR ANNUAL REPORT : 1948-49

In September 1949, the Institute moved from its old premises at Pedder Road to the converted Yacht Club buildings.

The Department of Scientific Research sanctioned an additional grant of Rs 30,000 for the purpose of constructing suitable accommodation in the new premises.

Dr. S.S. Bhatnagar (1 January, 1954)
(Foundation stone laying of TIFR)

About a year ago, Dr. Bhabha and I were working on the plan for the development of the fundamental research laboratory for nuclear physics. The problem which perplexed us was whether we could afford to have a separate institute for nuclear studies or expand the Tata Fundamental Research Institute to include all this and develop it into a really very good laboratory for such investigations.

The lack of sufficient funds made me propose that the Tata Fundamental Research Institute should be expanded to include all scientific research of a fundamental character in these fields and that it should be ranked and perhaps named as a national institute.

Nehru, Bhatnagar and J.R.D. Tata
(1 January, 1954, Foundation stone laying of TIFR)

Dr. S S Bhatnagar at laying of Foundation Stone of TIFR, Jan. 1, 1954

Pt Nehru with Architectural Model of TIFR

Professor Piara Singh Gill
(October 28, 1911 – March 23, 2002)

Professor Piara Singh Gill
(October 28, 1911 – March 23, 2002)

- 1928: Matriculation, Khalsa High School, Mahilpur, Hoshiarpur
- 1929: Escapes to U.S.A. as an immigrant
- 1930-36: Bachelor and Master in Physics from University of Southern California, Los Angles.

Professor Piara Singh Gill
(October 28, 1911 – March 23, 2002)

- 1937-40: Ph.D. at University of Chicago, under A.H. Compton.
- His doctoral dissertation on "Further Studies of Cosmic Rays on the Pacific Ocean" established the latitude effect of Cosmic Rays at sea level. The **New York Times** reported his work and that of his associate Marcel Schein in its issue dated **June 30,1939**.
- After his return to India on a **Travelling Fellowship** (1940-41), Piara Singh Gill carried out experiments on the Azimuthal Variation of Cosmic Rays, which could be conducted at the latitudes and altitudes available in India.

Professor Piara Singh Gill
(October 28, 1911 – March 23, 2002)

- 1940-47: **Lecturer in F. C. College, Lahore**.
- 26th June 1947: Joins as Professor of Experimental Physics on invitation from Homi Bhabha at Tata Institute of Fundamental Research, Bombay.
- 1948: Atomic Energy Commission constituted with H.J. Bhabha, F.R.S.; S.S. Bhatnagar, F.R.S.; and K.S. Krishnan, F.R.S. with only three members.
- 1948-49: Joins to New Delhi as Officer-on-Special Duty (OSD) on behalf of Atomic Energy Commission.
- 1949-63: Professor and Head, Department of Physics, Aligarh Muslim University, Aligarh.
- **Guides H.S. Hans and S.P. Puri for their Ph.D. dissertations at AMU.**

Professor Piara Singh Gill
(October 28, 1911 – March 23, 2002)

- **1951-71: Founder Director, Gulmarg Research Observatory for Cosmic Ray research.**

- **1963-71: Director, Central Scientific Instruments Organization (CSIO), Chandigarh**

- **Honorary Professor of Physics, Panjab University**

- **1949-64: Advisor to Pt. Nehru on India's Nuclear weapons strategy.**

- **Robert Oppenheimer was a close colleague and friend who he worked with on the Manhattan project. Oppenheimer asked Gill to present a paper at the California Institute of Technology at a conference arranged to celebrate the 80th birthday of Professor Robert Millikan.**

Annual Report of TIFR (1948-49)

- Dr. Homi Bhabha Reports:
- 1948: The Institute has deputed Prof. P.S. Gill to the Carnegie Institution, Washington, for a period of six months from April, 1948, for special work on Cosmic Radiation. The ministry of Education, Government of India, have agreed to meet his travelling expenses in connection with his visit to the U.S.A.

  (*Coincidentally, Dr. S.S. Bhatnagar was the Education Secretary in New Delhi.*)

Annual Report of TIFR (1948-49)

Dr. Homi Bhabha Reports:

- Owing to the fact that azimuthal studies of Cosmic Radiation at intermediate latitudes are of fundamental importance in determining the sign and the energy spectrum of the Primary Cosmic Rays, it was decided to determine the azimuthal effect at Bombay and to compare it with the azimuthal measurements of Vallarta Perusquia and de Oyarazabal at Mexico City and **of Gill at Lahore**. The measurements at Bombay will also extend the energy spectrum to slightly higher energies than those covered by the experiments at Mexico and **Lahore**.

Professor Pratap Krishan Kitchlew (1899 – 1982)

Extracted from Chapter 25 titled "The Development of Modern Sciences in the Panjab University under Colonial Rule, 1882-1947" by Kamlesh Mohan, Professor (Retd.) of History at P.U.

- A renowned experimental physicist, Pratap Krishan Kitchlew passed his matriculation in 1917, then his B.Sc. in Physics in 1921, and M.Sc. in Physics from Panjab University, Under the supervision of Meghnand Saha, he received his D.Sc. degree from Allahabad University in 1927.

Professor Pratap Krishan Kitchlew (1899 – 1982)

- As a teacher and researcher at the Panjab University, Kitchlew devoted all his energy to developing scientific techniques for finding multiple axes of 'Diamond Crystals' for industrial purposes. **These experiments were conducted in his personal laboratory**, which contained a network of glass apparatus for studying phenomena connected with electrical discharge through nitrogen.
- **The Department of Physics of Panjab University, Lahore was smoothly run, dedicated and well-respected for teaching, training and applied research in physics.**

(As recalled by Dr. Harsh Vardhan, Former Director, CSIO and a student of Prof. P.K. Kitchlew).

Professor Pratap Krishan Kitchlew (1899 – 1982)

- Working with his assistants, Kitchlew developed the techniques of making quartz micro-balance, X-ray tubes, photoflash bulbs, diamond tools and diamond working machines, synthetic sapphires, vacuum furnaces, calcium fluoride crystals, vacuum units, etc., and many other items through various research schemes. **The techniques-oriented training imparted to so many students is 'an example of foresight and his unique contribution to the growth of technology at a time when few were even conscious of this need.**
- Just before the partition riots, Kitchlew joined as Professor in Physics at Delhi University.

Physics Department P.U. at Delhi and Hoshiarpur

- Early 1947: Dr. P.K. Kitchlew joined Physics Department of Delhi University where **Prof. D.S. Kothari was the Head**.
- October 1947 – April 30, 1949: Physics Department of P.U. Lahore given to the care of Kitchlew and Kothari.
- **Prof. Yash Pal** does his **M.Sc.** from Physics Department of **Panjab University at Delhi**, and joins **TIFR** for Ph.D. in 1949.
- August 1949: Dr. B.M. Anand initiates Physics Department of Panjab University at Govt. College, Hoshiarpur.
- 1950: Dr. H.R. Sarna is the Director of Physics Laboratory for the Panjab University (P.U. Constituent College, Hoshiarpur).
- Govt. College, Hoshiarpur and University Staff merged together.

Physics Department P.U. at Hoshiarpur

- 1953: Dr. B.M. Anand initiates Nuclear Emulsion Section for Cosmic Ray Research on his return on study leave for 3 years from England.
- 1954: UGC gives (with Dr. S.S. Bhatnagar as Chairman) Rs. 50,000 for developing PG-Laboratories in Physics.
- 1958: Physics Department shifts from Hoshiarpur to Chandigarh.

Physics Department P.U. at Chandigarh

- September 15, 1958: Dr. B.M. Anand is Head of Physics Department as well as that of Chemical Technology in the present UICET Building.
- 1960: Physics Department shifts to its present premises.
- **Dr. I.S. Mittra** is part of Nuclear Emulsion based Research Programme along with Dr. B.M. Anand.

Physics Department P.U. at Chandigarh

- 1957-62: Physics Department receives Rs. 6 lakhs for its expansion.
- 1961-62. Dr. David Carter visits Physics Honours School as Fulbright Visiting Professor and sets up Micro-waves and Solid State Laboratories.
- 1963: Department of Atomic Energy gives grant to initiate Experimental Nuclear Physics Programme, with Dr. P.N. Trehan as Principal Investigator.
- 1967: Prof. B.M. Anand retires and Prof. H.S. Hans is appointed Professor and Head, Department of Physics, Panjab University, Chandigarh.

Prof. Harnam Singh Hans
(born: November 21, 1922)

- 1950-56: Ph.D. student of Prof. P.S. Gill at AMU.
- Had exposure to Nuclear Detectors. Nuclear electronics and Nuclear Accelerator Techniques at AMU. G.M. Counters, Newton Counters, Nuclear Emulsions were developed/researched at AMU.
- 1950-60: Developed 150 kV Cockcroft and Walton Accelerator, first in any Indian University.
- Studied $He^3 + H^2 \rightarrow He^4 + n$ (14.8 MeV).

Prof. Harnam Singh Hans

Selected Publications (1954-58):

- An instrument for decay of mesons, H.S. Hans – *Indian J. of Physics*, p.93, 1954.
- Coincidence studies of the disintegrations of Pm141 and Nd147 – H.S. Hans, B.L. Saraf and C.E. Mandeville, *Physical Review,* Vol. 97 p. 1267, 1955.
- 150 KeV Cockroft Walton Type Particle Accelerator – H.S. Hans and C.S. Khurana – *Indian Journal of Physics,* Vol. 32 p. 68, 1958.
- The study of noise pulses and a liquid sciontillator – B.P. Singh, H.S. Hans and P.S. Gill – *Indian J. of Physics*, Vol. 32, No. 4, 183, 1958.

Prof. Harnam Singh Hans

- 1958-62: Reader, AMU.
- 1962-64: Faculty at Texas A&M University, USA.
- 1964: Meets Prof. S.P. Pandya (TIFR & PRL) at Argonne National Laboratory who motivates him to accept a working Variable Energy Cyclotron from University of Rochester for location in India.
- 1965: P.S. Gill arranged Professorship for H.S. Hans at Kurukshetra University, where Lala Suraj Bhan was the Vice Chancellor (1962-65).

Prof. Harnam Singh Hans

- At UGC, Prof. D.S. Kothari was the Chairman (1961-1973). Prof. Hans seeks help from Kothari and Homi Bhabha.
- 1965: Lala Suraj Bhan moves to to Panjab University, Chandigarh in 1965.
- 1967: Prof. B.M. Anand retires and Prof. H.S. Hans joins as Professor and Head of Physics Department at Chandigarh.

Department of Physics, P.U.

- Prof. H.S. Hans had visited Rochester University in 1965, where R.K. Bansal and M.P. Khanna were Ph.D. students. R.K. Bansal was deputed by TIFR to Rochester.
- Prof. R.K. Pathria joins as Professor of Theoretical Physics in 1967, however, leaves in 1969.
- Prof. H.S. Hans inducts Dr. R.K. Bansal and Dr. M.P. Khanna as Readers in Theoretical Nuclear Physics and Theoretical Particle Physics, respectively.
- Two years later, Dr. K.N. Pathak joined as Reader in Theoretical Solid State Physics.

Thank You