Dr. Shanti Swarup Bhatnagar and the research in CSIR, TIFR and the Universities

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58th DAE-SSPS , December 17, 2013
Thapar University, Patiala

ABSTRACT

- Professor S.S. Bhatnagar, the first Research Professor in Chemistry at Banaras Hindu University (1921-24), and the founder Director of University Chemical Laboratories at University of Punjab at Lahore (1925-40), was invited to assume the Directorship of Board of Scientific and Industrial Research (BSIR) in colonial India. His vision eventually nucleated the CSIR in 1942 to shore up the Second World War efforts. A Committee for Atomic Research with Dr. Homi Bhabha as Chairman was set up within CSIR soon after the dropping of two nuclear bombs by U.S. in Japan.

- Dr. S.S. Bhatnagar, FRS went on to be appointed as the first Indian Secretary of Department of Higher Education of Government of India after Indian independence. Dr. Bhatnagar had recognized the potential of Dr. Homi Bhabha, FRS to build modern India via the development of Atomic Energy Programme. The two titans of science worked in close synergy under the patronage of Prime Minister Pt. Jawaharlal Nehru and his stalwart Education Minister Maulana Abul Kalam Azad. Dr. Bhatnagar headed the CSIR as well as the newly created UGC (in November 1953) at the time of his sudden passing away on January 1, 1955.
- A personal assessment on the contributions of Dr. Bhatnagar and Dr. Bhabha to build large scale scientific research and human resource development in India shall be presented.

Regulation of Education in colonial India

- 1849: British annex Punjab & establish control entire Indian sub-continent
- 1854: Enunciation of Education Policy, education in schools to be monitored
- 1856: D.P.I., Punjab to regulate School Education from Delhi to Peshawar
- 1857: Commencement of Universities at Calcutta, Bombay and Madras as affiliating and Examination bodies

Univ. Entrance Examinations initiated

Situation in Punjab ~ 1860

- 1861: Only 4 students from Punjab qualify Entrance Exam of Calcutta University ,
- There was no College in Punjab till 1964

College Education in Punjab: 1864-1902

- Jan., 1864: Govt. Colleges at Lahore (GCL) and Delhi, the latter fold up in 1877 merged with GCL
- Dec., 1869: Punjab Univ. Constituent College (PUCL) Lahore, appended to GCL
- Oct 14, 1882: University of Punjab at Lahore, centered around GCL & PUCL, and affiliating other colleges, like, Oriental College, Law School, St Stephen's (Delhi), etc.
- 1886: DAV College, Lahore,

  Forman Christian College, Lahore

  1887: Mahindra College, Patiala

  1901-02: 15 Colleges affiliated to P.U. at Lahore

Higher Education 1904 onwards

- 1904: Indian Universities Act
- Universities empowered to appoint Professors & Lecturers & to undertake Research
- 1904 onwards: College Teachers given sabbatical leave to go abroad for research
- Eminent teachers invited from Britain for extended stays at Indian Universities

Scene at University of Punjab at Lahore

- 1912: Astronomical Observatory set up at Lahore
- 1916: M.Sc. Degree instituted
- 1919: Hons Schools (inegrated BSc/BA. & MSc/MA started in Oriental Languages, History, Mathematics, Chemistry, Botany & Zoology

  Mr. A W Woolner is first Dean, S R Kashyap is Prof. of Botany, Dewan Anand Kumar of Biology, Gopal Singh Chawla of Mathematics
- 1920s: Faculty of Commerce Instituted.
- Dr. S S Bhatnagar appointed founder Director of University Chemical Laboratories & Professor of Physical Chemistry in 1924

1925-39

Dr. S S Bhatnagar made pioneering contributions in fundamental research, applications to industry & consultancy

Indian Scientists Contemporaries of Dr. S S Bhatnagar at Lahore:

Botany: Prof S R Kashyap

(Dr Birbal Sahni, Dr A C Joshi, Dr P N Mehra, Dr M S Randhawa)

Zoology: Prof Vishwanath, Diwan Anand Kumar

Chemistry: Prof Kartar Singh Bawa, Dr. Sri Krishna, Dr. Mata Prasad

Physics: Dr. Nazir Ahmed, Dr. P K Kitchlew, Dr Piara Singh Gill

Nobel Laureate A H Compton had visited Lahore on invitation from PU and conducted Cosmic Ray explorations at Gulmarg along with Dr. S. S. Bhatnagar and Dr. Nazir Ahmed (a Ph.D student of Rutherford).

Contemporaries of Dr. S S Bhatnagar at Lahore …

Mathematics: Prof Sarvadaman Singh Chowla (students of Chowla: R P Bambah, F C Kohli, Abdus Salam)

Agriculture: Khan Bahadur Mian Mohammad Afzal Hussain,

First full time Vice Chancellor of University of Punjab at Lahore (1938-44) & Foundation Fellow of National Institute of Sciences (INSA) in 1934, along with Dr. S S Bhatnagar

Professor Ruchi Ram Sahni (April 5, 1863 – June 3, 1948)

Mentor of Shanti Swarup Bhatnagar

Stamp released to honour on RRS on October 24, 2013

Professor Ruchi Ram Sahni
(April 5, 1863 – June 3, 1948)

His life span covered an important part of Punjab's and India's history. He was prominent figure in the intellectual and public life of Punjab.

Prof. Sahni was a multi-faceted personality. He was a scientist, an innovator, an educationist, a devoted patriot, social worker and a pioneer of science popularisation. Prof. Sahni became the first Indian officer in India Met Dept. (1885-87) and, also, the the first Indian science professor at Government college, Lahore (1887-1918). Late in life, he worked for his Ph.D at Rutherford's Manchester Lab. in the company of Neils Bohr and published two single author research papers on radioactivity communicated by Lord Rutherford himself to Phil. Mag.

(from Compendium on RRS, P.U., Chandigarh, 2013)

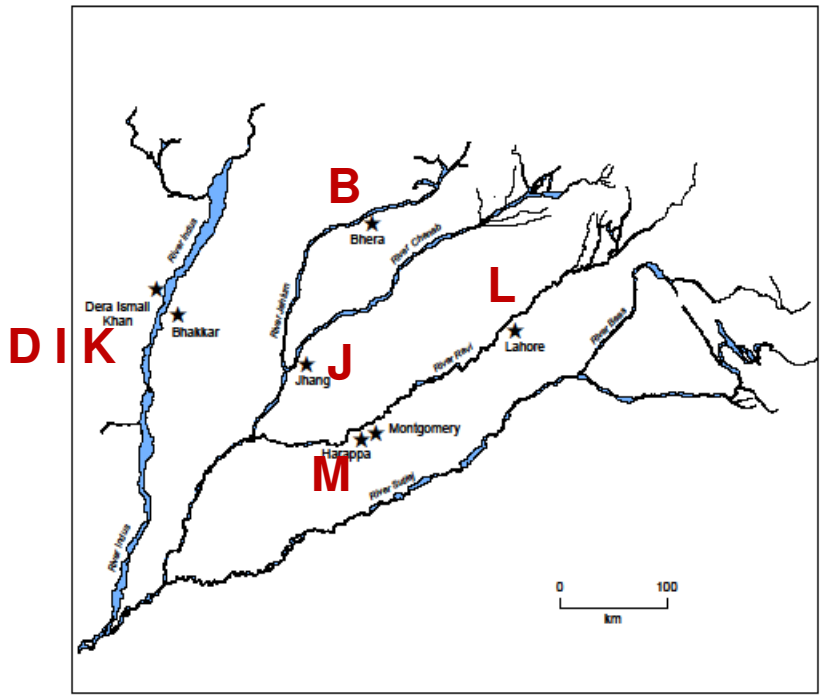
150th Birth Year of Ruchi Ram Sahni

(An Extract from an editorial in 'Dream 2047' , November 2012, Vol.15, No.2, p. 33, by Dr. Subodh Mahanti)

R. Ramachandran while reviewing the "Memoirs of Ruchi Ram Sahni" correctly argued why Sahni should be accorded as prominent as a place given to pioneers of modern India science as J.C. Bose, P.C. Ray, M.N. Saha, C.V. Raman and S.N. Bose. Though the sub-title of the book refers to him as the pioneer of science popularisation in Punjab, his were the pioneering efforts in the entire country. And it may not be an exaggeration to say that they remain unique to this day.

The 150th birth anniversary of Ruchi Ram Sahni should be celebrated throughout the country. Sahni should be accorded his due place for his multi-faceted contribution in shaping modern India.

The year 2013 should be declared as the Year of Scientific Temper to honour Sahni, who did so much for creating scientific awareness in the country.



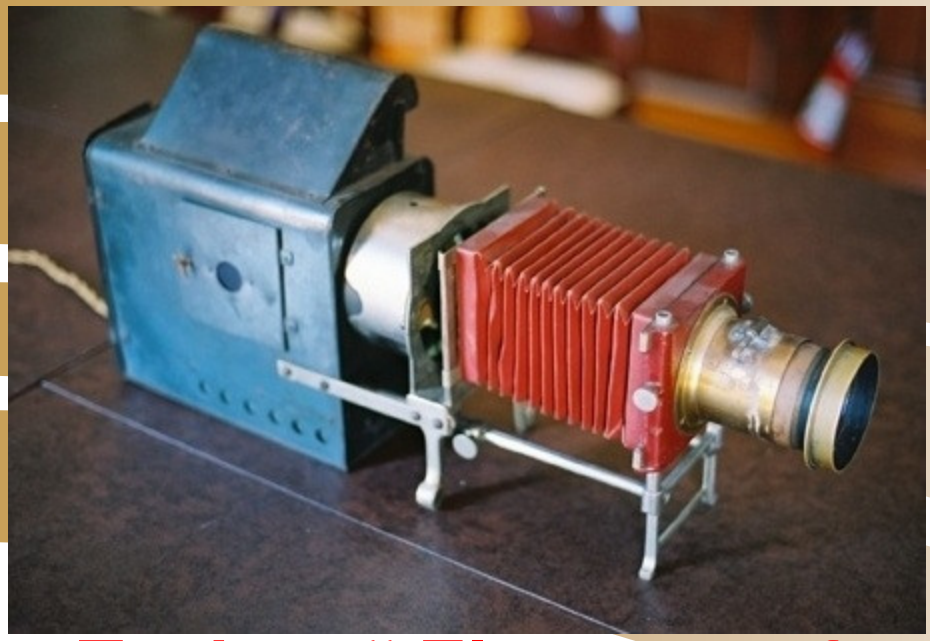
Rivers and Cities of Punjab

Prof. Ruchi Ram Sahni graduated (1984) and served (1887-1918) at Govt. College, Lahore

Government College - Lahore. circa 1928.

(Established January, 1864)

SCIENCE POPULARIZATION BY RR SAHNI



Early model of a *Magic* Lantern Slide Projector and methods used by RRS to make slides

Topics: " Elements of weather, Soap-making, The water *Lahoris* drank before 1880, Pure and impure air, Electricity in the service of man, Electroplating, Glass-making, How does the telegraph speak, The Punjab and its rivers"

Dr. Birbal Sahni, FRS (in 1936)

- (First) Son of RR Sahni to take to science
- Birbal was greatly influenced by his father, and nature trekked extensively in the Himalaya.
- He himself undertook arduous and numerous excursions to the Himalayas during which Hooker' *Flora Indica* was always by his side
- *"1907 and 1911, his brother Mulk Raj accompanied him on most of these Himalayan excursions.*

Dr. Birbal Sahni, FRS & Dr. SS Bhatnagar, FRS

Dr. S S Bhatnagar, FRS & Dr. Homi J Bhabha, FRS

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.

Dr. 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, his father's childhood friend.
- 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

Dr. 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 Translucsence of Paper dipped in them (Zeit. Phys. Chem., 122, 88, 1926).

Magnetometer Designed, Built and Patented (1928) at Lahore and Manufactured & Marketed by Adam Hilger Co. in England

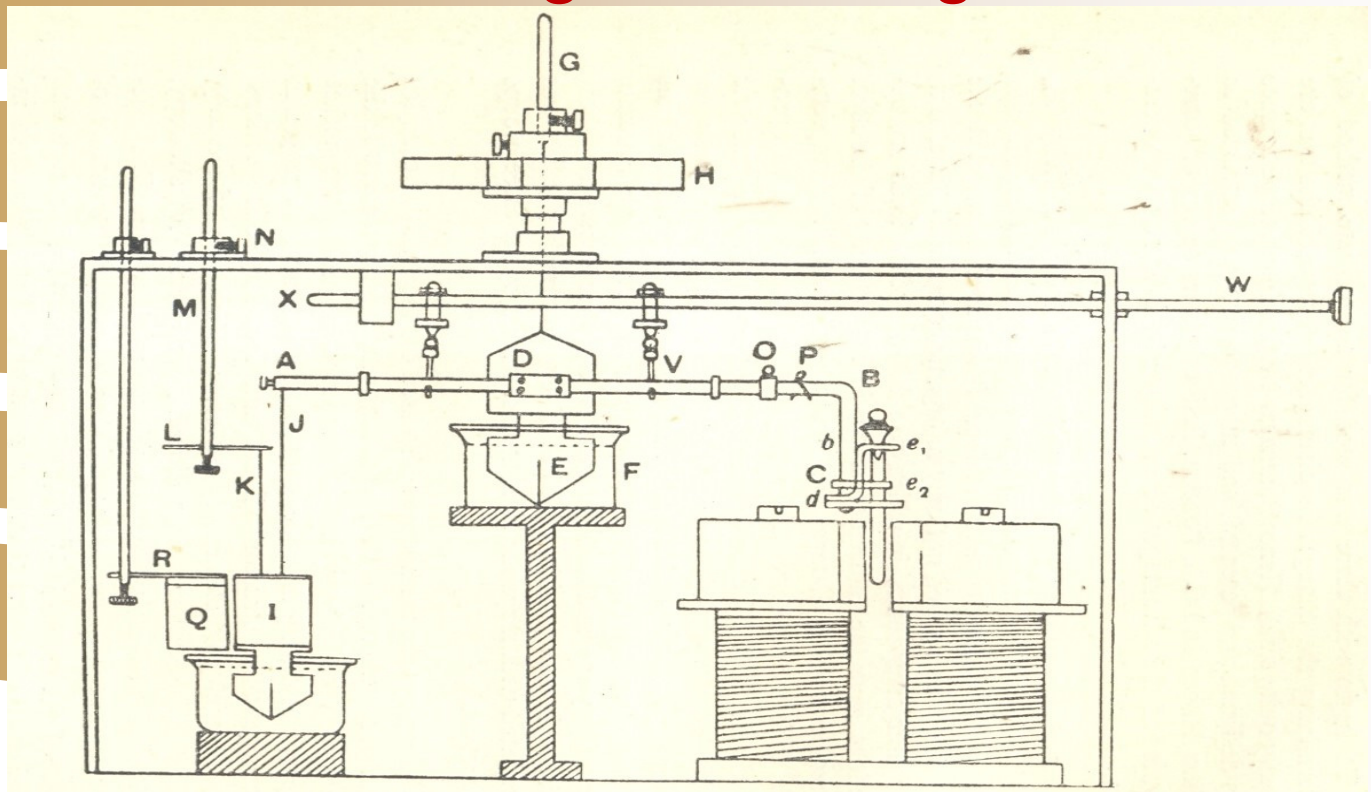


Figure. Magnetic Interference Balance (Bhatnagar and R.N. Mathur). See Appendix for the description of working of the balance.

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

(Eminent Chemist, 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

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

Convocation Address of Sir Herbert Emerson, Governor of the Punjab to the Punjab University,

1935

- "…..**first class work being done by that very distinguished scientist Dr. Bhatnagar in the University Laboratories on the technology of oils**. In am told by men who know the practical side of the industry that the results already attained promise to be of very great commercial value. While the possibilities are immense, we know that **a well-known firm has shown its faith in Dr. Bhatnagar** and his assistants by a handsome financial contribution towards the cost of the work that is being done".

Convocation Address of Sir Tej Bahadur Sapru at the PU, Lahore 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.

Convocation Address of Sir Sikander Hayat Khan Prime Minister , Punjab at PU,Lahore, 1937

- "It is gratifying that the Chemistry laboratory under the able and enthusiastic guidance of Dr. Bhatnagar continues to do valuable research work, which apart from its educational valueis proving of great benefit to the industrial concerns in Punjab and elsewhere. Some of the results of Dr. Bhatnagar's researches have deservedly earned for him and his associates an international place in the field of Applied Chemistry.

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, …

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

- "There is every reason to suppose that the war will give an immense filip to Indian industry. There will be double stimulus. The great demand for industrial products created by the War will be the direct incentive to the existing industries while the difficulty of obtaining many of the articles, we are importing before will stimulate, the search for substitutes or ways and means of producing them here.

Sir Henry Craik ….contd.

- .. and in order to promote and coordinate and to facilitate the exploration of more fields of development the **Central Government has 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.

Sir Henry Craik ….contd.

- 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

Dr Bhabha's letter to Sir Sorab Saklatvala (1944)

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.

Bulletin Board of TIFR ARCHIVES

Early days of TIFR

1945-1950

In **May 1945**, the Trustees of **the Sir Dorabji Tata Trust** decided to sponsor an Institute for Fundamental Research, in co-operation with the Government of Bombay. It was decided to incorporate the Cosmic Ray Unit of the Indian Institute of Science, Bangalore in this Institute. It was also decided to name the new Institute

"The Tata Institute of Fundamental Research"

The Provisional Council consisting of

Sir S.D. Saklatvala (Chairman)	**Representative of Sir Dorab Tata Trust**
Mr S.N. Moos	**Representative of Government of Bombay**
Dr John Mathai	**Representative of Sir Dorab Tata Trust**
Dr H.J. Bhabha	**Director of the Institute**

held its first meeting on May 18, 1945.

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 : 1947-48

Dr. P.S. Gill joined the Institute on June 26, 1947 as a Professor of Experimental Physics. Mr S. Gupta joined the Institute as a Reader in Theoretical Physics on August 13, 1947. Dr F.W. Levi joined the Institute as Professor of Mathematics from February 6, 1948.

Sir S.S. Bhatnagar, Sir K.S. Krishnan, Dr D.M. Bose and Mr D.N. Wadia, members of the Board of Research on Atomic Energy also visited TIFR on April 9, 1948.

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.**

The following eight appointments were made.

Mr R.P. Thatte, Mr A.B. Sahiar, Mr P.C. Vaidya, Mr G.H. Vaze, Mr G.S. Gokhale, **Mr R.R. Daniel**, Dr Pritam Sen and Mr R.V.S. Sitaram.

Dr Bhabha personally was in charge of the team.

TIFR ANNUAL REPORT : 1948-49

In September 1949, the Institute moved from its old premises of Kennilworth Bungalow at Pedder Road to the converted Old Yacht Club (OYC) buildings near Gateway of India.

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 Bhabha's communication to Pandit Nehru (1953)

The **Atomic Energy Commission**, on the initiative of D **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.

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.

Dr. S.S. Bhatnagar (Jan. 1,1954) contd…

A distinguished young politician walked into my room and asked me about the nature of discussion which we *(he and Homi Bhabha*) were having.

Dr. Bhabha had to go away for, he had another appointment and this young man found time to ask me in all curiousness as to why as a practical scientist I wanted to associate myself with the transfer of such important practical activities to the care of Dr. Bhabha whose fame rested mainly on subjects which were highly mathematical and of little significance to the material development of our country. He said a senior scientist asked him to dissuade me from being a party to an ambitious project which could not be brought into being in my life time.

Dr. S.S. Bhatnagar contd…

With all the patience and gentleness I am capable of having, I told my friend that he did not know Dr. Bhabha intimately enough and that although his fame in mathematical physics brought a great deal of credit to India, his talents in other fields such as arts and paintings were no less creditable and that above all he had had his basic training in engineering subjects and he holds a degree in engineering and that nobody in India was in my opinion better fitted to take up this task which was assuming world importance and could not be neglected by us.

Dr. S.S. Bhatnagar … Jan. 1, 1954

…I hope my desire to see the grandeur and beauty of this new Institute with my own eyes will be fulfilled. **I have decided to live to see it fully constructed and equipped.**


1954

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

Architectural Model of TIFR

Pandit Jawahar Lal Nehru

"I have always associated with many prominent figures closely connected with the Science Congress and among them the chief was Dr. S.S. Bhatnagar. We have eminent scientists in this country and people eminent in other ways. **Dr. Bhatnagar was a special combination of many things added to which was a tremendous energy, with an enthusiasm to achieve things.**"

"Bhatnagar-Nehru Effect"

Pandit Jawahar Lal Nehru *contd.* …

" There are many things which he discussed with me and which he hoped to put through soon. **We want many more scientists like him if we are to go ahead and solve our problems".**

"Bhabha-Nehru Effect"

Pandit Nehru, Maulana Azad & Dr. S S Bhatnagar

Shri Maulana Abul Kalam Azad

I met Dr. Bhatnagar for the first time in 1942. I was returning to Calcutta **after release from the central jail at Naini**. As was the convention in those days, there was a crowd of some thousands at Howrah to receive me. When I came out of the crowd and got into the car, one man detached himself from the crowd and came up to me. **He touched my feet and said, " I am Shanti Swarup Bhatnagar".**

Shri Maulana Abul Kalam Azad
contd…

The Govt. of India had, at that time, appointed Dr, Bhatnagar as Director, Council of Scientific and Industrial Research. As such, **he was a Government servant while I was Congress President and a rebel against the Government.**

Shri Maulana Abul Kalam Azad

contd…

- During the last 7 years, I have come into the contact with many officers of the Government of India but I can say, without reservation, that **I have not met a man who was more active and energetic.**
- **In 1948, he was also Secretary to the Ministry of Education.**
- **In 1953, he was asked to Chair, UGC**

Shri Maulana Abul Kalam Azad

contd…

I had still greater opportunity of seeing for myself his work since 1952 when I assumed the charge of the Ministry of Natural Resources and Scientific Research and Dr. Bhatnagar was, for over a year, Secretary of both the ministries.

Shri Maulana Abul Kalam Azad (January, 1955)

Dr. Bhatnagar was carrying the burden of four men. He was secretary to two ministries, Director of the Council of Scientific Research and Industrial research and also Secretary of the Atomic Energy Commission. He however carried out single handed, the duties of four officers with great devotion and ease.

Dr. H.J. Bhabha, F.R.S. (1955)

I had worked with him as a colleague for nearly 10 years and I can, therefore say personally, his premature death was due to over work. Science is today an integral part of the modern civilization and it is Dr. Bhatnagar's outstanding achievement that in the short period of a few years he conceived and built in India a chain of magnificent National Laboratories.

Dr. Homi Bhabha on 'Science and Problems of Development', Jan. 7, 1966, Mumbai

I would like at this point to pay a tribute to the memory of my friend and colleague, the late Dr S.S. Bhatnagar, thanks to whose enthusiasm, energy and dynamic personality a large number of national laboratories were established within a period of some seven years.

Remembering the Legends at PU Campus

Feb. 21, 2013

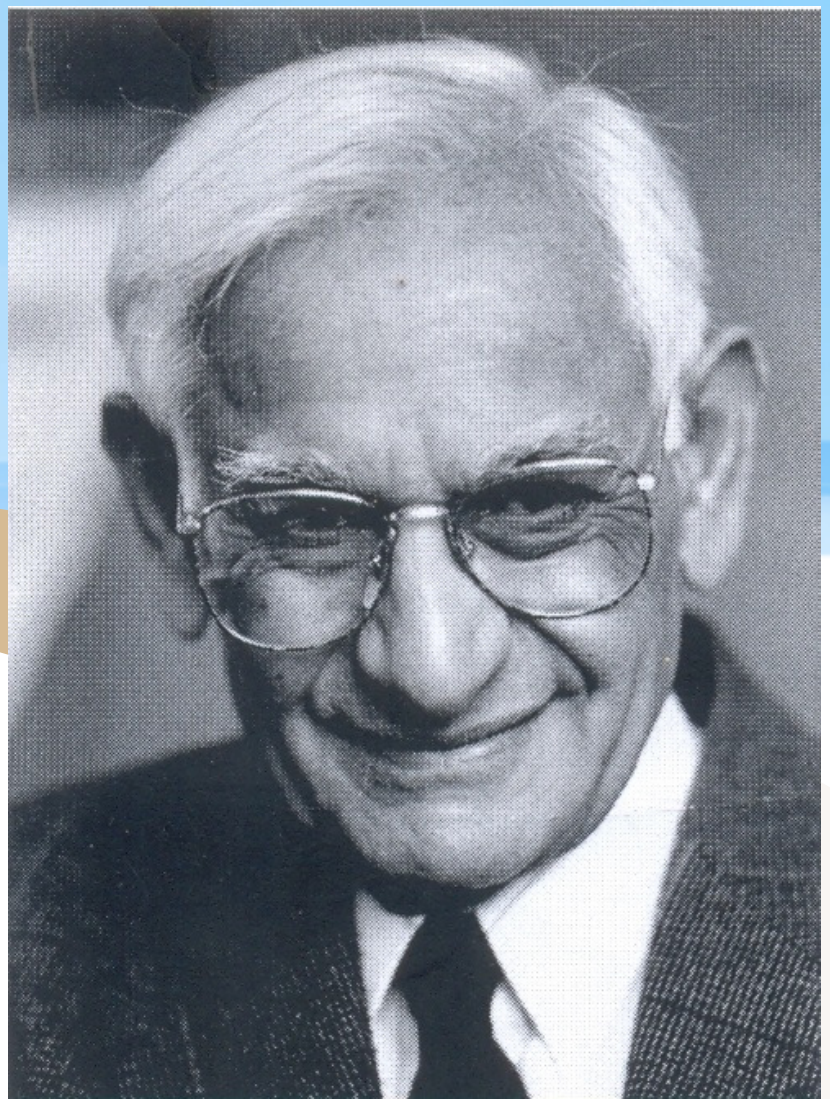

Feb. 21, 2013

- S R Kashyap Hall
- S S Bhatnagar Hall
- Mehr Chand Mahajan Hall
- G C Chatterji Hall
- P N Mehra Botanical Garden
- Dewan Anand Kumar Admn. Block
- G P Sharma Herbal Park
- R C Paul Rose Garden
- M R Sahni Geology Block
- H R Gupta Mathematics Block
- Balwant Gargi Theatre
- SS Bhatnagar Univ. Inst. of Chemical Engg & Technology

Apr. 5, 2013
150th Birthday of R R Sahni (1863-1948)

Professor Har Gobind Khorana
(January 9, 1922 – November 9, 2011)

Graduated from PU Institute of Chemistry at Lahore (1942-46)



First publication of Hargobind Khorana as student at Lahore

SYNTHESIS IN XANTHONE SERIES PART I.

BY

Hargobind, Gurbakhsh Singh & Mahan Singh,
(CHEMISTRY DEPARTMENT, GOVERNMENT COLLEGE, LAHORE.)

Gurbaksh Singh
27·9·95

Part III
R. Bharucha to
follow 7/14/99

Publication of PU Institute of Chemistry at Lahore, 1945

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THE LAHORE PHILOSOPHICAL SOCIETY,
Punjab University Institute of Chemistry, Lahore.

SYNTHESES IN THE XANTHONE SERIES. PART III (SUBSTITUTED DIPHENYL ETHERS DERIVED FROM 2-CHLORO-4-NITRO BENZOIC ACID AND VARIOUS SUBSTITUTED PHENOLS AND THE CORRESPONDING XANTHONES)

By (Miss) R. Bharucha, H. G. Khorana, Gurbakhsh Singh and Mahan Singh

The object of these investigations has been sufficiently brought out in earlier publications. [This Journal, Vol. 7. page 32 (1945)]. In this paper we have dealt with the preparation of various 3-nitro substituted xanthones, derived by the cyclisation of the intermediate 5-nitro substituted diphenyl ether 2-carboxylic acids obtained by the condensation of 2-chloro 4-nitro benzoic acid and substituted phenols. Ring closure of m-substituted o-aryl salicylic acids may follow two alternative routes, according as the ring closure takes place at position 2' or 6'. Accordingly in all such cases a mixture of two xanthones has been obtained but no attempt has been made to separate the two isomers. 3-amino xanthone and 3-amino-7-chloro xanthone have been prepared by the reduction of the corresponding nitro xanthones. The latter has been condensed with p-acetyl amino benzene sulphonyl chloride.

Experimental

Preparation of materials. 2-chloro 4-nitro benzoic acid was obtained by the oxidation of 2-chloro 4-nitro toluene (Ber. 1933, 66, 869 and J. S. C. I. 1936, 54T), which in turn was obtained by the chlorination of p-nitro toluene (J. C. S., 1921, 119) or from 4-nitro 2-amino toluene (Ann. 355, 360). m-bromophenol was prepared from m-bromoaniline according to (C. F. Koelsh) (J. A. C. S. 1939, p. 969). m-chlorophenol was also prepared similarly from m-chloro aniline (Yield 75%).

The condensation of 2-chloro 4-nitrobenzoic acid with various phenols was carried according to the general procedure already described [This Journal Vol. 7, p. 32 (1945)] The ring

H G Khorana writing in SCIENCE , February, 2000

A Life in Science

H. Gobind Khorana

I have met people who believed they knew at a very young age what they wanted to do in their lives. I envied them, but my own life was not like that. At age 18, when I sought admission to the Punjab University in Lahore, I applied to two departments, English Literature and the honors course in Chemistry. Admission into the latter was restricted and required an interview. My shyness kept me from the interview, but they saved a place for me anyway, and thus I became a chemist. At the end of World War II, I was awarded a studentship by the Government of India to study insecticides and fungicides in England. However, the Indian High Commissioner's office in London could only get me admitted into the Chemistry Department at Liverpool University, and I began to study Organic Chemistry. After I received my Ph.D. in 1948, I was eager to spend some time in a German-speaking part of Europe, and I managed to do this at the Eidgenössische Technische Hochschule in Zurich, Switzerland. I worked with Vladimir Prelog. He was inspiring and so was the institute, with its long tradition of excellence in organic chemistry. I spent a great deal of time studying the German chemical literature. It was then that I came across Fritz Zetzsche's work on carbodiimides. Serendipitously, carbodiimides became important in my synthetic work later.

After a year in Switzerland, I returned to India. However, in the aftermath of partition of my province, Punjab, I could not find a job. In fact, many of my old friends and teachers were now refugees in Delhi without jobs. Fortunately, a postdoctoral fellowship in Alexander Todd's laboratory in Cambridge (England) turned up, for work on peptides related to the newly discovered adrenocorticotropic hormone. Cambridge was a uniquely exciting place at that time. Todd's own work was at the climactic point of defining the chemical structures of the nucleic acids. Frederick Sanger was sequencing insulin, the first protein to be so tackled. At the Cavendish laboratory, Max Perutz and John Kendrew were embarked on the first x-ray structures of myoglobin and hemoglobin, and soon the Watson-Crick structure for DNA was to emerge from the same laboratory. Molecular biology was in the making.

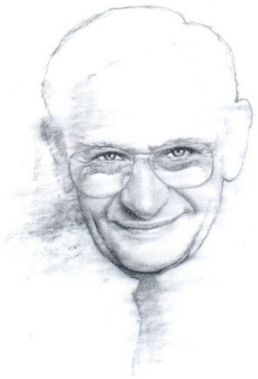
At the end of 1952, the offer of a non-academic research job took me to Vancouver, British Columbia. The scientific stimulation I had received in Cambridge sustained me in the first years in Vancouver. My first aim was to use carbodiimides in the synthesis of nucleotide coenzymes and related compounds. Biochemistry was experiencing its golden age in elucidating metabolic pathways and the biosynthesis of macromolecules. At almost every turn, new nucleotidic cofactors were being discovered. I also began to work on the synthesis of short oligonucleotides with precise chemical linkages as in DNA. I hoped that, in analogy with the synthesis of peptides started by Fischer in the early 20th century, this work could be significant.

In retrospect, my success in applying carbodiimides to the synthesis of nucleotides of interest to biochemists came astonishingly rapidly. The methods I developed attracted attention, and a number of established biochemists began to visit my small emerging group during the summers. In 1956, Arthur Kornberg and Paul Berg's visit provided my first intimate exposure to biochemistry and biochemical thinking. I decided to spend some time in Kornberg's laboratory to learn the practice of biochemistry from this great master. In the subsequent years, work in my laboratory became increasingly interdisciplinary.

The one gene–one enzyme hypothesis of Beadle and Tatum in 1941 had been important in christening the field of molecular genetics. By the early 1950s, genes were shown to be made up of nucleic acids. Therefore, nucleic acids directed the synthesis of proteins. During the same period, an in vitro system for protein synthesis was developed, culminating in 1961 in the electrifying experiment by Nirenberg that demonstrated the synthesis of polyphenylalanine under the direction of polyuridylate. Subsequently, biochemistry took the center stage in further definitive work on the genetic code. The most exciting experiments in my laboratory started with synthetic DNA polymers of defined nucleotide sequence and arrived at polypeptides of defined amino acid sequence. We prepared our high-molecular-weight DNA-like polymers by using short synthetic DNAs with specific sequences as templates for Kornberg's DNA polymerase. Fortuitously, reiterative copying resulted in size amplification and multiplication of the products.

The 1960s were the golden age of molecular biology. Scientists from a variety of disciplines came together and gave a unique momentum to the new field. However, many of my friends, with whom I had shared the most exciting period, felt that after the elucidation of the genetic code and the chemical basis of heredity, an era had ended. The new frontier had to be the brain. An exodus of scientists to neurobiology began. In my own work, I pursued the challenge I had posed in the late 1950s, namely, the total synthesis of genes. In the late 1960s, the necessity to amplify synthetic genes became clear and principles for their amplification, later rediscovered and named PCR, were worked out.

Making a radical switch in the mid-1970s, I became interested in biological membranes and in bacteriorhodopsin, the light-driven proton pump. This in turn led to interest in light transduction in the mammalian photoreceptor, rhodopsin, and in the photoreceptor cells in the retina. The transductions carried out by these cells—conversion of photons to chemical energy to drive biochemistry and conversion of chemical energy to electricity, the language of the brain—are extremely complex. This undertaking is very different from my earlier projects. In organochemical syntheses, the total synthesis of genes, and proton translocation by bacteriorhodopsin, I had been lucky to find answers at least in outline. In contrast, understanding of the sensory system, in particular, sensitization and desensitization, still lies far in the future.



CREDIT: ALLAN BURCH

H. Gobind Khorana

was born in 1922 in Raipur, Punjab, India (now Pakistan). He trained as an organic chemist, and was awarded the Nobel Prize for Physiology or Medicine in 1968, together with Robert W. Holley and Marshall W. Nirenberg, "for their interpretation of the genetic code and its function in protein synthesis."

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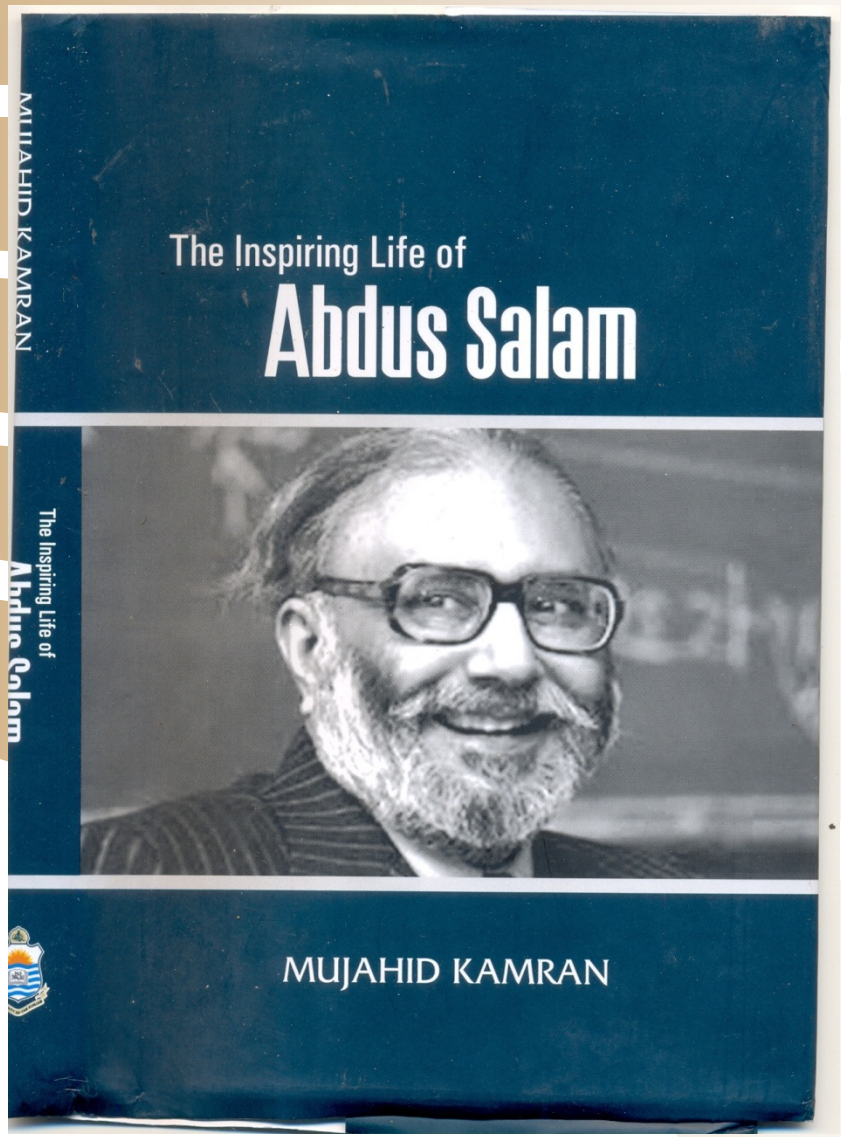
Professor H G Khorana (*Science 280, 810,2000*)

An extract from 'A Life in Science'

I have met people who believed they knew at a very young age what they wanted to do in their lives. I envied them, but my own life was not like that. At age 18, when I sought admission to the Punjab University in Lahore, I applied to two departments, English Literature and the honors course in Chemistry. Admission into the latter was restricted and required an interview. My shyness kept me from the interview, but, they saved a place for me anyway, and thus I became a chemist.

Student at Govt. College and Dept of Mathematics at Lahore (1940-46)



VC of Univ. of Punjab at Lahore

An inspiring life of Salam

His mathematics teacher Dr. Sarvadaman Chowla was particularly fond of Salam. He used to pose an unsolved problem at the end of a class. He and Salam would try to solve such a problem independently after college hours, and compare their answer the following day.

An inspiring life of Salam

- One of the problems posed by Dr. Chowla concerned four simultaneous equations in four variables – this was a problem due to Ramanujan.
- Salam's solution was sent by Dr. Chowla to a magazine. Thus, in the year 1943, Salam's first mathematical research paper titled "On a Problem of Ramanujan" was published in the March – July 1943 *issue of Maths. Student* (volumes XI, Nos 1-2).

An inspiring life of Salam

Salam asked him (*R P Bambah*) to convey the following message to Dyson if he happened to come across him in Princeton: "I have renormalized longitudinal photons". When Bambah conveyed Salam's message to Dyson he responded **"I don't believe it, but if he has done so he will be very famous".**

When Bambah commented that Salam had picked up the problem on account of suggestion in one of Dyson's papers, Dyson responded by saying **"I had said that it should be done and not that it could be done".**

An inspiring life of Salam

- **Today I (** *Salam's thesis adviser Dr. Kemmer* **) feel that I am very much more Salam's pupil than his teacher…I was not in the least surprised that Salam was gladly given membership at the Institute for Advanced Studies. Princeton less than one year after he began his theoretical research.**
- … When I (***Freeman J Dyson***) **first met Salam in 1950 I recognized him as an intellectual equal, a young man who could solve mathematical puzzles as quickly as I could. Ten year later I could see that he had grown over my head.**

An inspiring life of Salam

- The nearest physicist in the region with whom Salam could engage in useful discourse was **Bhabha** – Bombay, and that was another country.
- On his return to Lahore from Bombay he was **charge-sheeted** for absenting himself from the station of **duty without prior permission.**
- He had been directly appointed Professor at two institutions and his pay had been fixed at a much higher level than others who were his contemporaries. He was appointed Professor even though he had not yet formally acquired a Ph.D. degree. This was unprecedented … , as remarked by **Professor Bambah.**

An inspiring life of Salam

He (Dr. Salam) was not given an official residence in Lahore, as was his right. Minister of Education refused any help and declared: "***Pugdi e te kam karo warna jao***" (If it suits you, you may continue with your job; if not you may go).

The 26 years old Salam and Sir G. P. Thomson at the University of the Punjab, 1952

Thank You

for your patience