PUBLICLY FUNDED RESEARCH INSTITUTIONS AND THE LEGACY OF SIR SHANTI SWARUP BHATNAGAR

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SHANTI SWARUP BHATNAGAR: A BRIDGE BETWEEN CULTURE AND ERAS

- **Confluence of excellence in science, arts, languages, poetry and literature**
- **Bridge between colonialism and nationalism**
- **Bridge between scientists, scientific peers and political leadership**

LIFE AND TIMES OF SIR SS BHATNAGAR

- **1894 :Born in Lahore on 21 February to Parameshwari Sahai; father dies when the child is eight months old; raised by maternal grandfather, Munshi Pyarelal who had a big home library of Hindi, Urdu and some Persian books**
- **An ardent Brahmo Samajist who was adept in both Urdu and Hindi**
- **1911 : Publishes the first scientific work as a letters to the editor of 'The Leader" on how to make carbon electrodes for batteries using molasses and carbonaceous matter under heat and pressure.**
- **1913: Joins Forman Christian College**
- **1915: Fails in chemistry because he wrote that X Rays can be reflected, refracted and polarized just as ordinary light , something the text book of the day did not mention !**
- **1915 : Marries Lajwanti, his wife for 31 years**
- **1916: Graduates with B. Sc in Physics !**
- **1919: Obtains a M. Sc in Chemistry as a private student while working as a demonstrator in Dyal Singh College**

LIFE AND TIMES OF SIR SS BHATNAGAR

- **1921: D.Sc from the University of London working with Professor Donnan, FRS on a scholarship awarded by Dyal Singh Trust and DSIR, UK; the title of his thesis is " solubility of bi- and trivalent salts of higher fatty acids in oils and their effect on surface tension of oils"**
- **Thesis defense committee chaired by Sir William Bragg**
- **His contemporaries in the department : J. C. Ghosh, J. N. Mukherjee and Megnad Saha**
- **1921 : joins Benaras Hindu University as a Professor at the invitation of Pandit Madan Mohan Malaviya; His selection committee had Sir C.V. Raman, Sir J. C. Bose and Sir P. C. Ray as members; pens the University Song (http://bhu.ac.in/kulgeet.htm) for BHU**
- **1924: Moves to University Chemical Laboratory, Lahore as Director**
- **1940: Director, Scientific and Industrial Research, Calcutta**
- **1941: Knighted by the British Crown**

LIFE AND TIMES OF SIR SS BHATNAGAR

- **1942: Director, The Autonomous Council of Scientific and Industrial Research(CSIR), New Delhi**
- **1943 : Elected Fellow of the Royal Society**
- **1946: Sets up the Atomic Research Committee under the Chairmanship of Dr Homi Bhabha**
- **1946-47 : Lays the foundation for the first of the five National Laboratories, namely, Central Glass and Ceramic Research Institute, Calcutta, Central Fuel Research Station, Dhanbad, National Metallurgical Laboratory, Jamshedpur, National Physical Laboratory, Delhi and National Chemical Laboratory, Poona**
- **1948 : Secretary, Ministry of Education**
- **1951 : Secretary, Ministry of Natural Resources**
- **1952: Secretary, Atomic Energy Commission**

LIFE AND TIMES OF SIR SS BHATNAGAR

- **1952 : Chairman , University Grants Commission**
- **1954 : Establishes Tata Institute of Fundamental Research**
- **1953-55 : Establishes National Research and Development Corporation and Indian Rare Earths Limited as public sector companies; creation of co-operative research institutions ((Indian Jute Manufacturers Research Association, Calcutta, Indian Rubber Manufacturers Research Association, Bombay and Textile Research Association, Bombay); negotiated with global oil companies to set up petroleum refineries in India**
- **1954 : Conferred Padma Vibhushan**
- **1955 : January 1 passes away in harness**

"I have always been associated with many prominent figures eminent in other ways, but Dr. Bhatnagar was a special combination of many things, added to which was a tremendous energy with an enthusiasm to achieve things. The result was he left a record of achievement which was truly remarkable. I can truly say that but for Dr. Bhatnagar you could not have seen today the chain of national laboratories".

Pandit Jawaharlal Nehru, 3 January 1955

NORA RICHARDS : DR BHATNAGAR'S MUSE

- **English professor P. E. Richards and his wife Norah Richards at Dyal Singh College, Lahore were a source of great inspiration to Bhatnagar.**

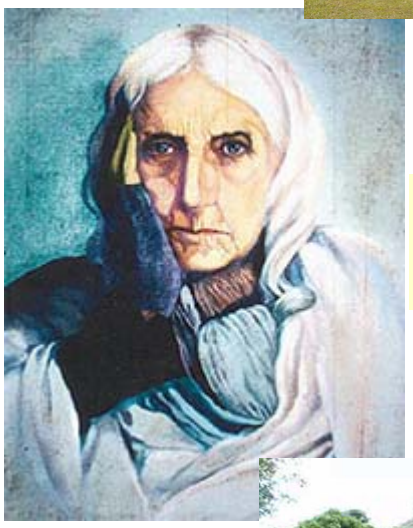
- **Nora started her life-long mission of training students, amateurs and social workers in writing plays. To demonstrate the realistic prevailing trend in the West, she staged Lady Gregory's play *Spreading the News* on April 12, 1912, in Dyal Singh College.**

- **Norah drew Bhatnagar towards theatre, and he played the roles of 'Puck' in *The Midsummer Night's Dream,* and 'Monsieur Jacques' in *As You Like It.***

- **She instituted one-act play competitions in Indian languages in 1912. S.S. Bhatnagar's play *Karamati* in Urdu got first prize in 1912**

- **Not many know that in memory of his dear wife, who died in 1946, Dr Bhatnagar wrote a book of poems called *Lajwanti***

- **After the demise of her husband, Nora retired to the Kangra Valley (close to Palampur) to a place she named Andretta where she devoted her life to theater and arts**



Nora Richards
1911-1971

PERSONAL EVOLUTION OF SHANTI SWARUP BHATNAGAR

- **University Professor and Teacher : 1921- 35**
- **Practitioner of Applied Industrial Chemistry: 1936-45**
- **Science Administrator and Institution Builder: 1945-55**

BHATNAGAR'S CONTRIBUTIONS TO FUNDAMENTAL SCIENCE

- **Physical chemistry of emulsions : The first to define the effect of electrolytes on the stability of colloidal solutions; enunciated simple rules govening colloid stability. His hypothesis that all emulsifying agent with an excess of negative ions and wetted by water will yield an oil in water emulsion while those having excess adsorbed positive ions and wetted by oil will result in water in oil emulsion, is true to this day!**

- **Magneto chemistry : Used magnetic suceptability measurements to explore properties of organic compounds, solutions, films and colloids. Established the structure of oxide film on the surface of copper produced by oxidation. He proved the existence of ionic miscelles by the study of magnetic rotations of solutions of salts of higher fatty acids in water and alcohols. Wrote a definitive text which was widely acclaimed titled"Physical Principles and Applications of Magneto Chemistry published by MacMillan and Co Ltd in 1935**

Access to Dr Bhatnagar's list of scientific papers : Repository of Publications of Fellows, The Indian Academy of Science, Bangalore and Biographical Memoirs of Fellows of the Royal Society, UK by T.R.Seshadri

BHATNAGAR AS A BUILDER OF INSTRUMENTS

- He and his student Mr. K.N. Mathur (who later became the first Director, Central Scientific Instruments Organization, Chandigarh) designed an equipment, called Bhatnagar – Mathur light interference balance

- The instrument measures the diamagnetic susceptibilities of materials

- The instrument was patented and exhibited ay the Royal Society Exhibition in London in 1928

- This attracted the attention of M/s Adam Hilger and Company, London who licensed the patent and commercially produced the instrument

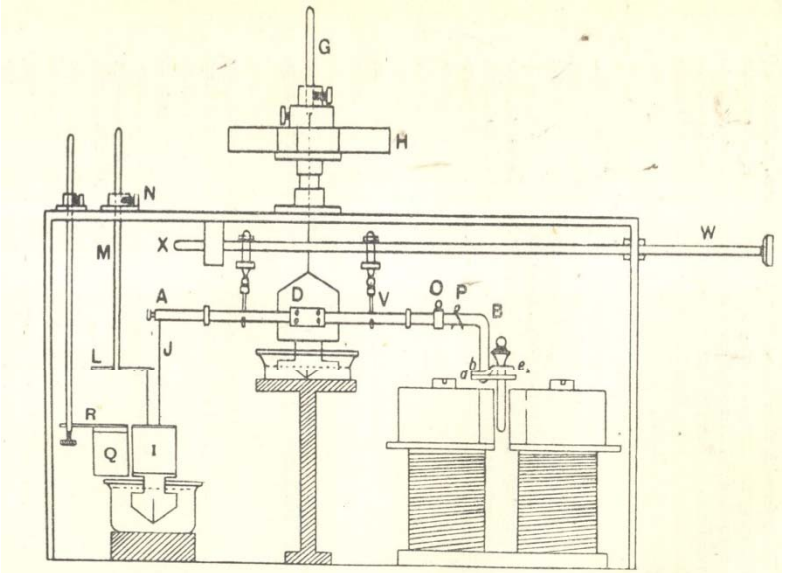


Figure. Magnetic Interference Balance (Bhatnagar and R.N. Mathur). See Appendix for the description of working of the balance.

Reference : Investigations on the effect of crystalline structure on magnetic susceptibilities by a new magnetic balance based on the principle of interference of light, Philosophical Magazine Series, 8 (54), 1041-1055 (1929)

“On turning over the pages of Nature my eyes chanced upon 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. As far as I know Meghnad’s is the only text book in physical sciences which has been adopted by foreign universities; and it gladdens my heart that another work in physical science is likely to occupy a similar place. My days are practically numbered; and my great consolation is that you, in chemistry, are raising the reputation, abroad, of Indian workers".

Acharya P. C.Ray, on Bhatnagar’s book “ Physical Principles and Applications of Magneto Chemistry”, 1935

FROM SIR C.V RAMAN TO DR S.S. BHATNAGAR

- "…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"

FORAYS INTO INDUSTRIAL RESEARCH

“ It was in 1933 that Dr Bhatnagar demonstrated that the very first requirement of an industrial chemist is a very thorough grasp of the fundamentals. The Attock Oil Company of Lahore was faced with a problem, of the coagulation of muds (clays) in their drilling operations when they encountered salt deposits. Upon discussion with the company’s chemists, Dr Bhatnagar insisted that it was a simple problem in colloid chemistry. He suggested that a method for protecting the colloid that made up the drilling mud so that salt could not coagulate the clay. He used certain Indian plant gums as a protective coating to prevent the mud(clay) from coagulating”.

P. Carter Speers, J. Scientific and Industrial Research, April 1943

As a compensation for his services, the company (Steel Brothers, UK) offered Dr Bhatnagar a sum of Rs 1,50,000 for research work on any subject related to petroleum. Dr Bhatnagar, In turn, turned the money over to the University for the establishment of six research scholarships. This sum was later enhanced to Rs Four Lakhs

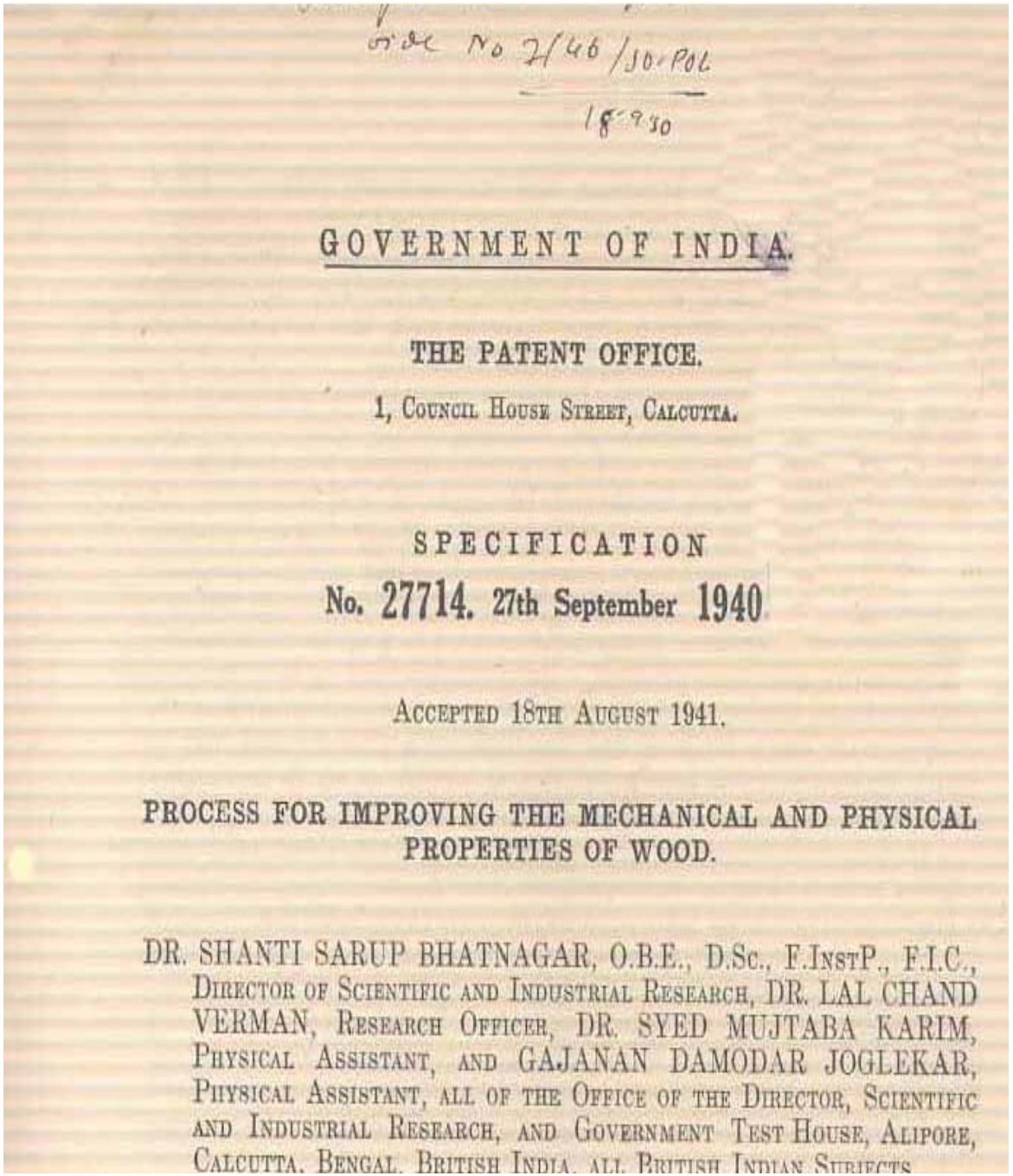
“You have hereby raised the status of the university teachers in the estimation of public, not to speak of the benefit conferred on your Alma Mater. India does not lack in men earning in millions; but if a few of these millionaires were guided by the fine example of a comparatively poor teacher like yourself her scientific and social progress would have been more rapid”.

Professor Megnad Saha, 1934

AN EYE FOR THE DETAIL : THE IP CLAUSE

"The patents issued will be jointly in the name of Steel Brothers and Company Limited and Professor Bhatnagar and, or his chemists and any profits would be shared equally between the company on the one hand and the partied concerned on the other"

Agreement between Steel Brothers, Dr Bhatnagar and the University



Dec No 2/46/30-Pol

18-9-30

GOVERNMENT OF INDIA.

THE PATENT OFFICE.

1, Council House Street, Calcutta.

SPECIFICATION

No. 27714. 27th September 1940

Accepted 18th August 1941.

PROCESS FOR IMPROVING THE MECHANICAL AND PHYSICAL PROPERTIES OF WOOD.

DR. SHANTI SARUP BHATNAGAR, O.B.E., D.Sc., F.InstP., F.I.C., Director of Scientific and Industrial Research, DR. LAL CHAND VERMAN, Research Officer, DR. SYED MUJTABA KARIM, Physical Assistant, and GAJANAN DAMODAR JOGLEKAR, Physical Assistant, all of the Office of the Director, Scientific and Industrial Research, and Government Test House, Alipore, Calcutta, Bengal, British India, all British Indian Subjects

Twenty nine patents issued to Shanti Swarup Bhatnagar and assigned to CSIR between 1941 and 1959

EXAMPLES OF APPLIED SCIENCE UNDER THE DIRECTION OF DR BHATNAGAR

- **A varnish to make gas masks impervious to gases**
- **A special lubricating oil for bronze bearings**
- **A petroleum derived preservative for wood**
- **A method for purifying sulfur**
- **Making fuels and lubricating oil from vegetable oils**
- **Jute and Shellac derived containers for storng hydrocarbons**
- **Resins from bagasse and jute**
- **Enamels and lacquers from Bhilawan nut**
- **A stove, the size of a matchbox which gives off intense heat using a solid fuel**
- **Cotton cloth with a heat insulating property of wool**
- **Rendering textile fabrics non flammable and water resistant**

Our troops have greatly been aided by the invention of unbreakable containers in which even liquids can be dropped from airplanes on hard ground without being shattered. These inventions are the work of Professor S. S. Bhatnagar of BSIR.

New Republic of USA, 18 September 1943

BHATNAGAR ON FUNDAMENTAL AND APPLIED RESEARCH

"…..research can scarcely be divided into water tight compartments; such division is a purely scholastic distinction which ignores how scientific research develops. What is fundamental today may become very much of applied research in a very short time. In actual practice both theoretical and practical aspects of research have progressed by an intimate interplay. Any artificial separation will render theory arid and practice petrified routine.

He went on to add that the mission of CSIR will "……. Form a continuous spectrum, at one end of which research work of the purest academic type and the highest quality is carried out and at the other, the technical developments of processes and equipment proceeds by stages."

PURE AND APPLIED SCIENCE

“Rigorous research in pure science is the only possible basis for applied science in the cause of industry. Any attempt to avoid pure chemistry and begin with applied chemistry is like erecting a fortress on a foundation of sand”.

Lecture, Pure and Applied Chemistry, Indian Chemical Society, Calcutta, 1941

PURE AND APPLIED CHEMISTRY

" Since my association with industry and some of the rapidly advancing departments of Industrial Chemistry in India, I have come in contact with large number of non descript men of our profession for whom I have acquired a great admiration and respect. I remember the days when we used to consider greasy, fatty, oily, cement, leather, textile, coal tar, paint and varnish chemists as something far removed from the realm of real chemistry, to be looked down upon by Pundits of Chemistry, who arrogated to themselves the self styled title of pure chemists, almost implying that all others not of this kind are impure. In this age even the pure chemist must soil his hands, although the spoils of academic reputation may be the privilege of the pure scientist"

Lecture at Indian Chemical Society, Calcutta,1941

One of the first persons to voice concern about the divide between those practicing academic chemistry and those pursuing applications of chemistry; Regrettably, this divide has only grown larger in India in the last seventy years

THE PURPOSE OF RESEARCH

“Scientific and industrial research thrives best when it is applied to material benefits of human kind and to existing industries and agricultural enterprises”

A VISION FOR THE FUTURE

There are hardly any new lands which Indian can hope to exploit. The only new lands on which we may have our eyes must lie in the domain of mind and have to be created in the research laboratory. It is on these sources which will emerge from the national laboratories that we may have to depend now and in the future for the means to maintain and raise our standard of living and to keep abreast amongst the best nations of the world.

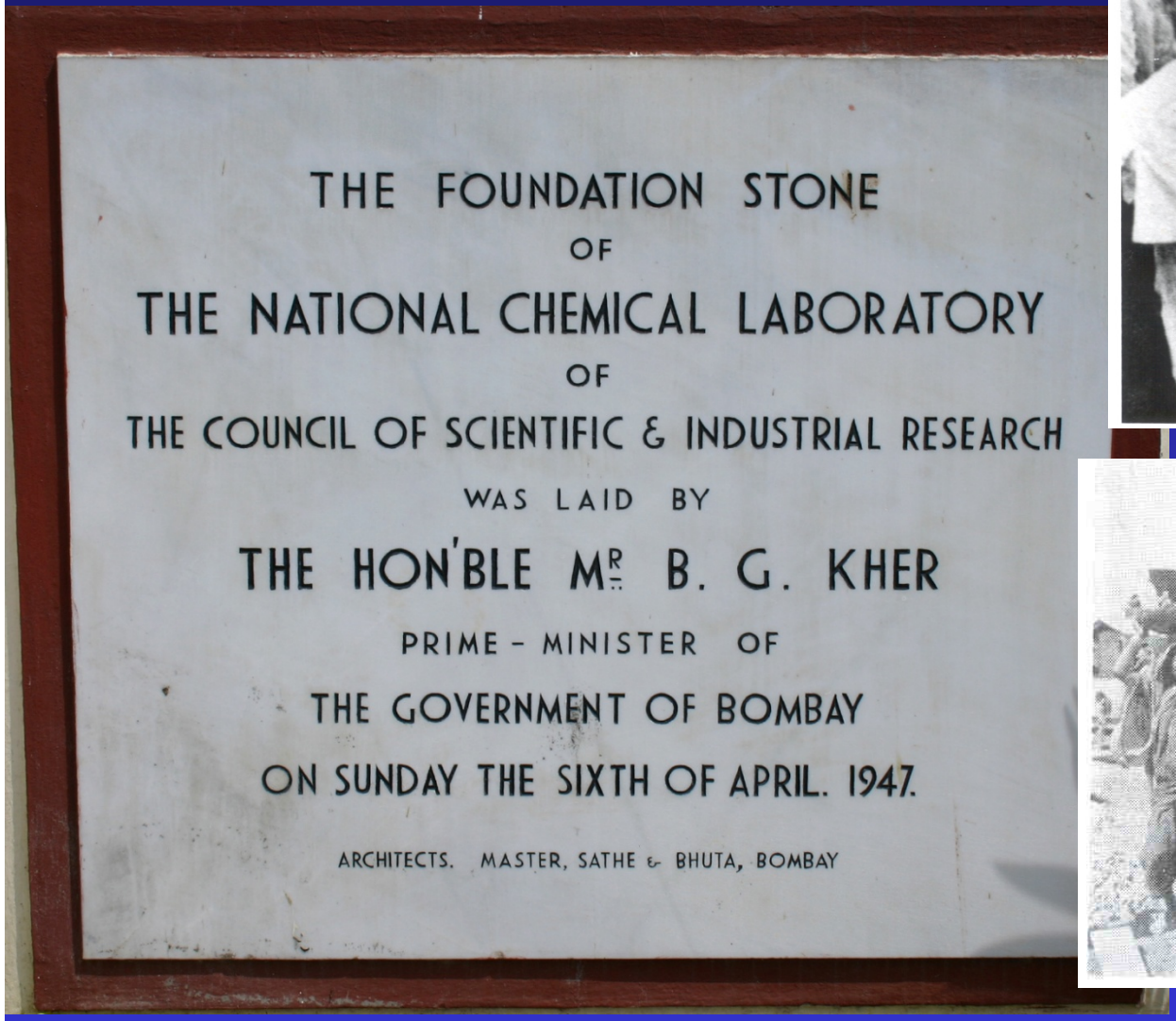
S.S. Bhatnagar
6th April 1947

THE BIRTH OF AN IDEA

It was as early as September 1941 that I submitted my proposals to the Government of India regarding the desirability of *establishing in India a National Chemical Laboratory.* The proposal was finally accepted by the Government of India and the Board of Scientific and Industrial Research under the Chairmanship of Sir A. Ramaswamy Mudaliar in their tenth meeting held in July 1943 and proceeded to appoint a planning committee for the National Chemical Laboratory

Shanti Swarup Bhatnagar

SIXTH OF APRIL, 1947 : THE BIRTH OF AN INSTITUTION



“It is science alone…. that can solve the problem of hunger and poverty.. of vast resources running to waste, of a rich country inhabited by starving people”

Jawaharlal Nehru

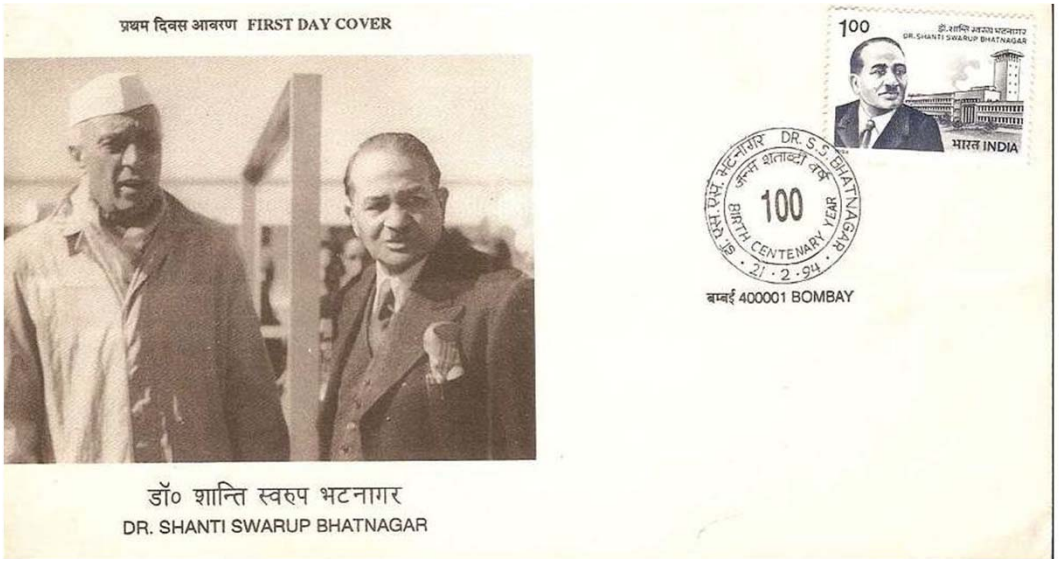
“There is talent in our country. But the question is how to tap that talent and give opportunities to the young men and women of India, who had the requisite ability. I hope that so far as these laboratories are concerned they would help to some extent at least in opening the doors to a large numbers of young men and women and give them opportunity to do good work for the country in the cause of science and in application of science for the public good”

Jawaharlal Nehru, January 3, 1950

A DREAM FOR INDIA

When in 1941 I was asked by the Viceroy to take up the Directorship of the Board, I was convinced that I must leave the university for a larger field to help in building India's scientific research, training her young scientists and inspiring her young men to take up research as a career. In that hour when I decided to take up the office, *I dreamt of a chain of National Laboratories, of large teams of scientists working on the development of India and the creation of scientific outlook on life amongst India's masses.*

S.S. Bhatnagar, 1950



BHATNAGAR AND THE BIRTH OF TIFR

- "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 Bhabha on January 1, 1954)
- 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 and Rs 10,000 from the Council of Scientific and Industrial Research. (First Meeting of TIFR Council , May 1945)
- The Council of Scientific and Industrial Research sanctioned an annual block grant of Rs 75,000 to the Institute during the year1946-47 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 , 1946-47)

Laying of the Foundation Stone of TIFR
January 1, 1954

BHATNAGAR AND THE BIRTH OF TIFR

- 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" (Bhabha's communication to Pandit Nehru)

- 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 (TIFR Annual Report , 1948-49)

Bhabha and Bhatnagar

ORGANIZED SCIENCE AND NATIONAL DEVELOPMENT

- **Summer of 1920 and 1921 : Visited leading laboratories in France and Germany; Influenced by the visit to Kaiser Wilhelm Institute (laboratories of Fritz Haber) and Walter Nernst at Berlin**
- **1944-45 : Visited UK, US and Canada to study post war development of science and technology; Observed first hand events associated with the discovery of Penicillin, DDT, developments in metallurgy, aviation and communication technologies; visited great industrial laboratories of ICI, Shell, Vickers (in UK) and Bell Labs, General Electric, DuPont, American Cyanamid, Eastman Kodak, and several Petroleum Companies (In US) in addition to visiting MIT, Caltech, Carnegie Mellon University**

"The tale of Tennessee Valley is the romance of a wandering and inconstant river tamed by human ingenuity, creating electrical energy which has been America's Alladins Lamp. I dream of the Tennessee Valley that may happen to any river valley in India, from Damodar, to Ganges, to Sutlej and Narmada, if the people and the Government just give science a chance "

CSIR : TIME LINES IN HISTORY

1938 - At the behest of Dr Meghnad Saha, Subash Chandra Bose, the then President of the Indian National Congress creates a National Planning Committee for Scientific Research under the Chairmanship of Pandit Jawaharlal Nehru

1939 - Bureau of Scientific Research set up

1940 - Creation of the Board of Scientific and Industrial Research (BSIR) with a budgetary allocation of Rs 5.00 lakhs

1941- Lord Linlithgow, the Viceroy of India invites Sir Shanti Swarup Bhatnagar to become the first Director of the Board

14 November 1941- A Resolution for the creation of CSIR prepared by the Commerce department and moved by Sir Arcot Ramaswamy Mudaliar passed in the Legislative Assembly

21 March 1942- BSIR reconstituted as the Council of Scientific and Industrial research (CSIR); Registered as a Society under the Societies Registration Act XXI, 1860

26 September 1942- CSIR is born as an Autonomous Body

CHARTER OF CSIR
RESOLUTION DATED 14 NOVEMBER 1941

- **The promotion, guidance and coordination of scientific and industrial research in India including the institution and financing of specific researches;**
- **The establishment and award of research studentships and fellowships;**
- **The utilization of the results of the researches conducted under the auspices of the Council towards the development of industries and the payment of a share of royalties arising out of the development of the results of researchers to those who are considered as having contributed towards the pursuit of such researches;**
- **The establishment, maintenance and management of Laboratories to further scientific and industrial research and to utilize and exploit for purposes of experiment or otherwise any discovery or invention likely to be of use;**
- **The collection and dissemination of information in regard not only to research but to industrial matters generally;**
- **Publication of scientific papers and a journal of industrial research and development**

FUNCTIONS AND OBJECTIVES
(From the address of Sir S.S. Bhatnagar)

- **One of the most important functions of this Laboratory will be to bridge the serious gulf between scientific research and its industrial applications**
- **It will work out ways and means for the application of scientific knowledge to practical problems of human welfare**
- **NCL will stand or fall according to the quality of its scientific staff. It must achieve national and ultimately international recognition**
- **The Laboratory will try to improve old processes in the light of new scientific knowledge and discover new processes**
- **In short, the National Chemical Laboratory will be a living and vital link with the universities, scientific institutes and industry**

Contd…..

FUNCTIONS AND OBJECTIVES

- **Another principal objectives of this Laboratory will be to undertake fundamental research to extend the frontiers of knowledge. Fundamental research has always had a stimulating influence upon research workers and has attracted to the laboratory men who worked for ideals and whose motto is “it is better to have wisdom than gold”**

Sir S.S. Bhatnagar

January 3, 1950

PURPOSE OF NCL (1945)

- **Embrace all applications of chemistry with due attention to the advancement of the fundamental science**
- **To serve as a link between university, the state, the scientific institutions and industry**
- **To undertake fundamental research directed towards the acquisition of knowledge which is likely to help overall industrial development**
- **Applied and development work will be concerned with improvement of existing processes, efficient utilization of raw material resources and the discovery of new processes and products**

UNIVERSITIES AND NATIONAL LABORATORIES

“ I would like to take this opportunity of dispelling any misconceptions and of reemphasizing that universities and national laboratories have complementary functions to perform. National Laboratories are not intended to supplant, but, to supplement the work of individual or collective industrial concerns and universities in respect of research; generally speaking universities are concerned mainly with fundamental research while the activities of national laboratories lie essentially in the domain of applied research, though these laboratories are not precluded from taking up investigations of a fundamental character”

Convocation Address, M.S University of Baroda, 10 October 1953

A PRESCIENT CALL FOR PRESERVING THE AUTONOMY OF UNIVERSITIES

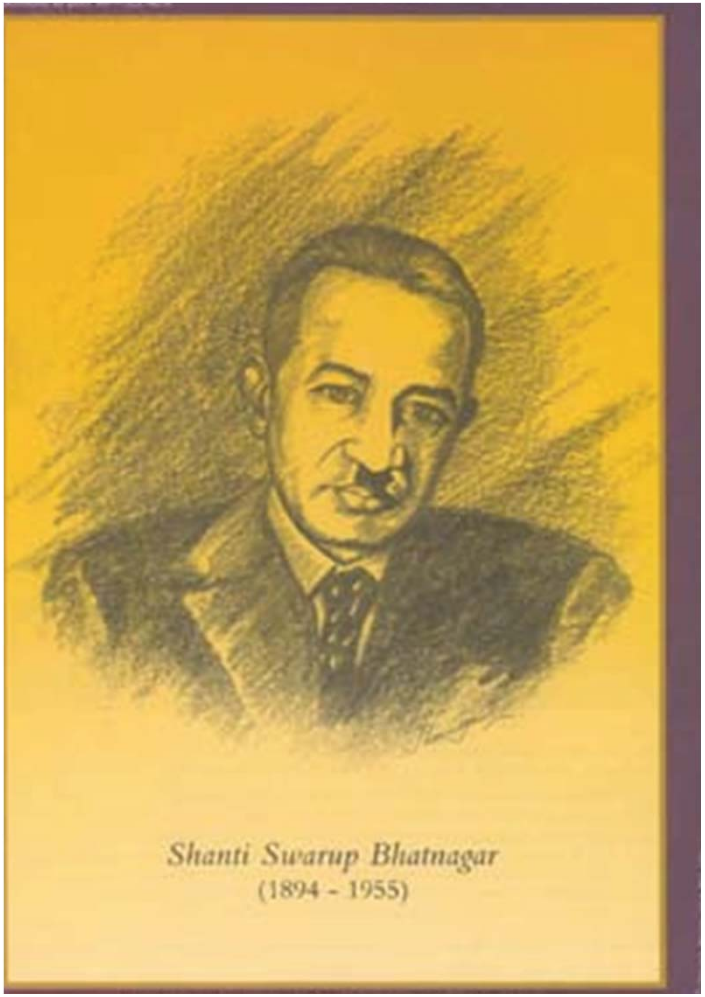
"I take this opportunity of drawing attention of those who love their country to see that our universities are kept as free as possible from narrow communalism and politics. Since politics has begun to play a part in the selection of Vice Chancellors, the university standards have tended to deteriorate. If these evils are not looked into, these institutions will cease to be real seats of learning and will turn into areas of political ambitions"

Presidential Address, Indian Science Congress, 1945

THE ANGUISH OF A HUMANIST

"These are the days of decision for India and if she is to take, as she must, her rightful and honoured place amongst nations of the world she will have to grow strong and great industrially….vast are the fields to conquer, plenty the harvest to reap. It is only the divisions among our people that are holding us back from a leaping march. Here science can intercede with its message of concordance in truth and unity in endeavour. The realm of science is bound finally to establish itself. Convinced of the inevitable, we must sink our differences and march ahead in unity"

Speech at the Foundation Stone Laying Ceremony of NPL, New Delhi, 4 January 1947



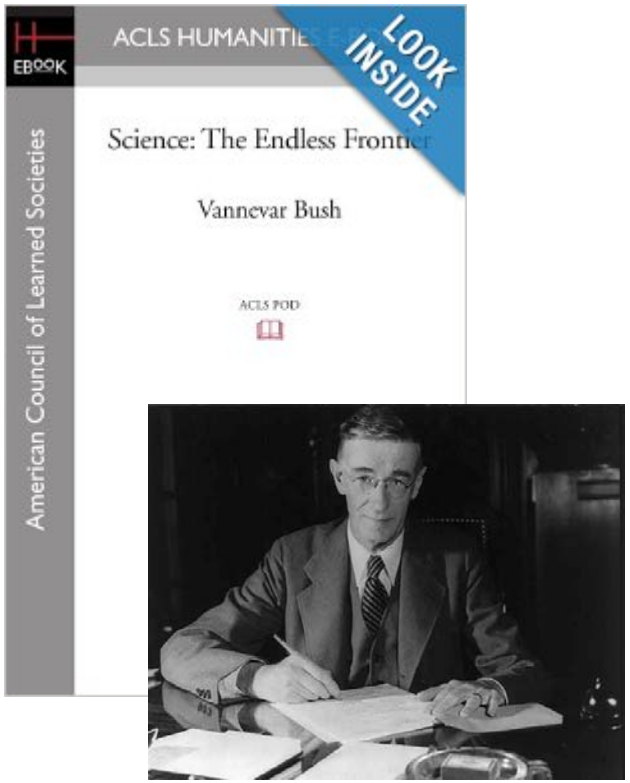
MISSION OF CSIR, 26 SEPTEMBER 1942

" The establishment, maintenance and management of laboratories, workshops, institutes and organizations to further scientific and industrial research and to exploit any discovery or invention likely to be of use to *Indian Industries* "

A clear vision to bring to bear the tools of science to the economic development of post war, independent India ; an echo of Vannevar Bush's Science : The Endless Frontier

IMPACT OF SCIENCE ON SOCIETY : THE LINEAR MODEL

- The tenet : investment in “basic research” by a nation ”performed without thought of practical ends” will lead to prosperity for its people.
- More money, more Institutions, more research, more papers and PhD’s will result in greater prosperity and wealth creation in society
- Basic leading to applied leading to development leading to production and markets : A linear model
- This tenet was implicitly accepted by Governments around the world as an established public policy
- Only a few years ago, the world began to question this assumption
- Rising above the gathering storm: Energizing America for a better future : National Academy of Sciences , 2007; Is the frontier really endless ? Bruce Alberts, Science 330, 1587 (2010); Gathering Storm revisited : Rapidly approaching Category 5 : National Academy Press, 2010



1945

WE ARE STILL GRAPPLING WITH SEMANTICS !

- Basic research
- Fundamental research
- Directed basic research
- Use inspired basic research
- Translational research
- Socially relevant research
- Applied research

POLITICAL AND ECONOMIC THOUGHT AND THE BIRTH OF CSIR

- State wielding “commanding heights” of the economy
- State ownership of industries; Government’s ability to promote technologies in public enterprises
- Control on import of processes, products and knowhow; regime of industrial licenses
- Central planning as an instrument of public policy (The Soviet Model)

For a country gaining independence after almost four hundred years of external dominance, issues such as “self-reliance”, “conserving foreign exchange” and “indigenous development” of technology were the underlying basis of Indian pride, echoes of which we hear even today

PUBLIC POLICIES ON SCIENCE AND TECHNOLOGY

- Science Policy Resolution of 1958
- Technology Policy Statement of 1983
- Science and Technology Policy of 2003
- Science, Technology and Innovation Policy 2013

R&D INSTITUTIONS AND NATIONAL INVESTMENT ON R&D ACTIVITIES (DSIR, 2007)

R&D Institutes	Number of institutions	Percentage of national investment on R&D (2003-04)
Central government R&D institutions	707	62.6
Public sector institutions	115	4.5
State government institutions	834	8.5
Universities and institutions of National importance	284	4.1
Private sector institutions	2020	20.3
Total	3960	100

UNIVERSITIES AND NATIONAL LABORATORIES: CONTINUING CONFLICT

- "National laboratories will drain the Universities and compete for scarce resources": Meghnad Saha *(1)*
- "Shah Jahan built the Taj Mahal to bury one of his favorite women. The National laboratories were built to bury scientific instruments": Sir C.V. Raman*(2)*
- "All these laboratories were brought to existence in the same way. The planning was based on similar institutions abroad, divided into divisions and sections, and an estimate of staff made based on this basis. An attempt to fill the post was then made based on advertisements" : Dr Homi Bhabha *(2)*

References: 1.S.S Bhatnagar on Science, Technology and Development, ed V. V. Krishna, Wiley Eastern, 1993, p.17 ; 2. Journey into Light, G. Venkataraman, Indian Academy of sciences, 1988, p.517, p.463)

CSIR REVIEW COMMITTEES

Committee	Year	Chairman / Members
First Review	1948	Sir Ardeshir Dalal Sir J.C. Ghosh and four FRS's
Second Review	1954	Sir A. Egerton / Head of CNRS France / S.N. Bose
Third Review	1964	Sir A. Ramaswami Mudaliar and others
Sarkar Committee	1971	Shri A.K.Sarkar
Fourth Review	1986	Shri Abid Hussain and others
Assessment of Outcomes of CSIR	2004	Dr Vijay Kelkar and others

A fresh review of CSIR is imminent !

ILLUSTRATIVE RECOMMENDATIONS !
(some implemented and many ignored)

- Bring CSIR laboratories under the administrative control of relevant ministries
- Transfer a few Laboratories to Department of Governments such as Environment, Biotechnology, Ocean Development or Petroleum
- No basic research should be performed in CSIR labs. All research must be applied
- The share of basic research should not exceed 20 % of the financial resources invested
- The number of PhD students should not exceed 10 % of the total scientific strength of the Laboratories
- CSIR should focus on corporate opportunities for R&D
- 33 % of the revenues of CSIR must come outside of the budgetary grant (External Cash Flow)

"We strongly feel that in CSIR science has perished while a few scientists have flourished. This is an alternative to ossification that stares CSIR at its face " : Abid Hussain Committee, December 1986, p.iv

CSIR AS A NATIONAL ASSET

- Largest concentration of inter-disciplinary talent in S&T
- Finest infrastructure for S&T in India : Land , buildings, research facilities, demonstration facilities etc
- Long tradition of scholarship and leadership in science and technology and has nurtured some our most distinguished scientists and engineers
- A great generator of human resources in S&T ; A significant percentage of India's S&T manpower must have been beneficiary of a CSIR-JRF or SRF !
- Generous public funding for R&D; most scientists do not need to write proposals and compete for funding
- Systems and procedures in CSIR are not too overpowering although scope exists for further simplifications
- In spite of many weaknesses, CSIR is still a good place to work, providing great freedom to scientists to express themselves in S&T

PUBLICLY FUNDED RESEARCH INSTITUTIONS : ARE THEY STILL RELEVANT ?

- **Publicly funded R&D organizations have existed for over seventy years in India**

- **Many of them serve the strategic sectors of the economy, such as , defense, space, atomic energy, food and agriculture, public health etc where public funding of S&T is essential (Public Goods and Services)**

- **CSIR was originally created for the purpose of serving the non strategic sectors of the economy, namely, industry, consumers, making Indian products globally competitive (Private Goods and Services)**

PUBLICLY FUNDED RESEARCH INSTITUTIONS : ARE THEY STILL RELEVANT ?

- **industrial research in India is slowly, but steadily maturing. This is bound to alter the relationship of CSIR with industry. Drugs and Pharma as well as automotive industry are two examples where industry is well on its way to maturity in terms of customer centric new product development and R&D efficiency.**

- **So where does CSIR position itself in the coming years? What aspects of research and development will be still relevant for CSIR ?**

- **A deep introspection is called for if CSIR has to remain within the folds of public funding**

IS THERE A NEED TO REDEFINE THE MISSIONS AND GOALS OF CSIR ?

- Where does CSIR fit in in the nation's Innovation Systems ?
- Are we a mission oriented R&D organization akin to ISRO, DAE or DRDO?
- Are we a knowledge producing and teaching organization like a University ?
- Are we a contract research organization for industry ?
- Is our mission to find affordable solutions to those at the bottom of the economic and social pyramid ?
- Are we just a haven for scientists to perform research so that they can excel in their narrow confines of research with a view to gain peer recognitions and win coveted honours ?
- Or are we a little bit of everything that is mentioned above? Is there a crisis of identity?

All institutions must eventually pass the "deletion" test; removing an institution from the future scientific landscape should reveal its vital importance

Clear thinking about the history, nature, direction and development of an organization is imperative. The past lives on in most institutions, influencing attitudes and judgments in a manner which is deeply hidden. Successfully managing change depends on getting these issues in the open

WHAT BUSINESS ARE WE IN?

- Our business is to perform research and provide knowledge based services to fulfill stakeholder expectations

- These functions are , to differing degrees, performed by industry, public institutions of research and universities

SO HOW DO WE DIFFERENTIATE OURSELVES?

SCIENCE IN THE 21st CENTURY

- Blue skies vs Directed Science
- Small vs Big Science
- Individual vs Team Science
- Curiosity driven vs Grand Challenges or Utilitarian Science
- Open access vs Intellectual Property

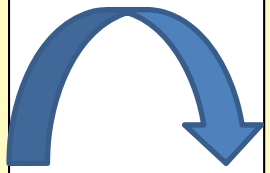
TRANSLATIONAL SCIENCE

- A new term increasingly used in biology and medical science
- Develop, design, engineer and produce/ commercialize: from bench to bedside
- This was once the exclusive prerogative of industry
- With industry stepping back, Government through public funding is increasingly stepping in to fill the vacuum, especially in high risk R&D
- Success of translational efforts using public funds still not proven
- Government picking technology winners is beset with great dangers and risks

BASIC RESEARCH IN TIMES OF CHANGE IN SOCIAL CONTRACT BETWEEN SCIENCE AND SOCIETY

Do fundamental research

(and someone will solve social problems)



Solve societal problems

(and, by the way, if you want to do some fundamental research, that's OK

REDEFINITION OF ACTIVITIES OF GLOBAL PUBLICLY FUNDED INSTITUTIONS

TNO innovation for life

CSIRO

cnrs dépasser les frontières

VTT

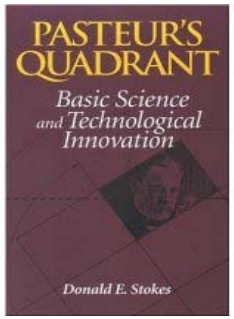
CSIR our future through science

Fraunhofer

Activities no longer defined in terms of scientific disciplines but by stakeholder focus

Health, nutrition and well being
Environment
Safety and Security
Information and communication
Transport and Mobility
Built Habitats
Energy and water

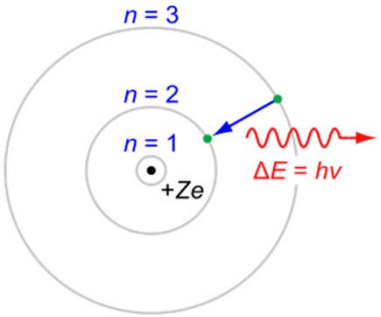
Pasteur's Quadrant



1997

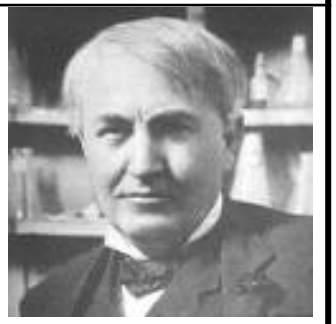
Fundamental Research

Bohr



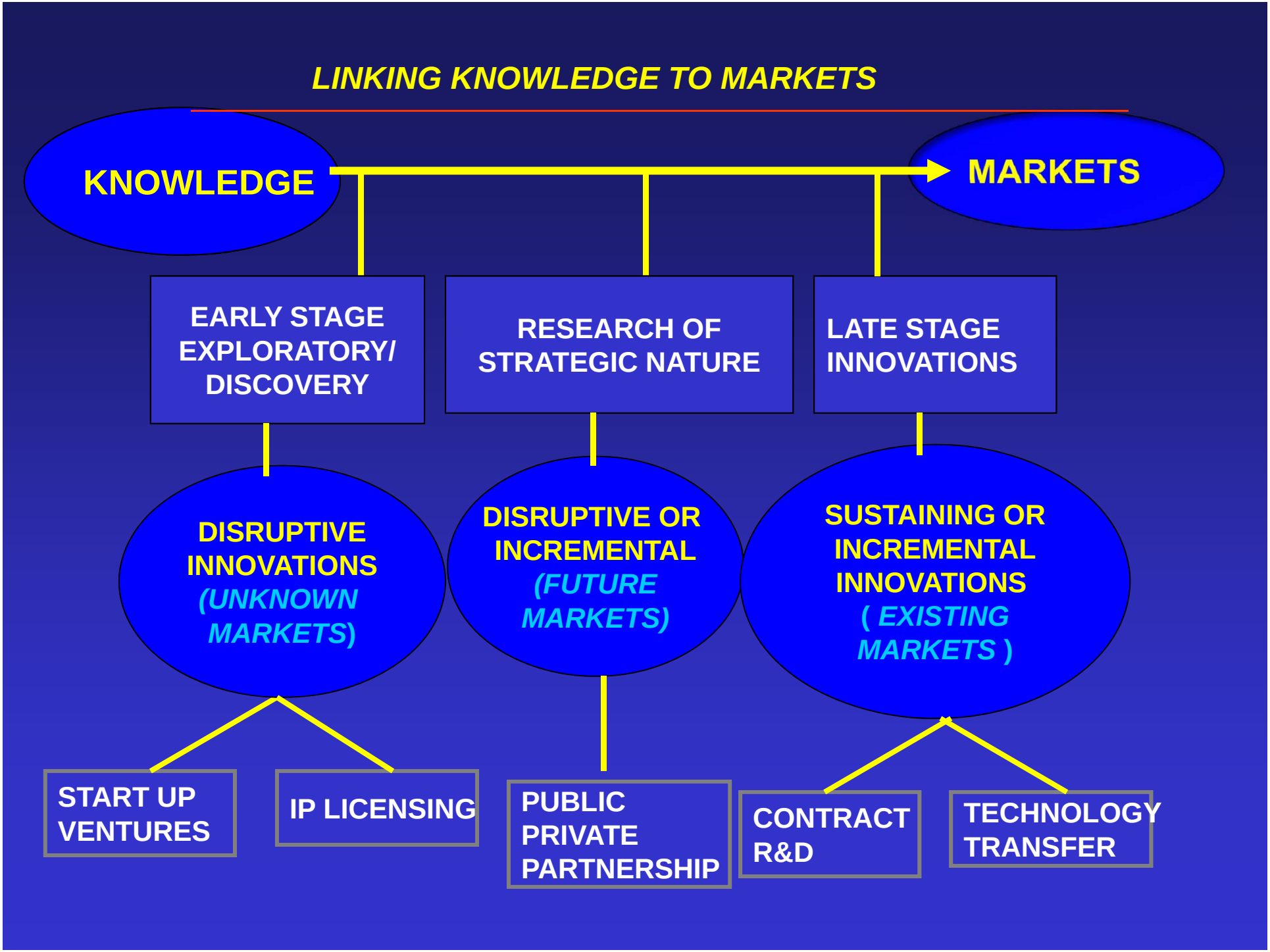
Pasteur

Average
Academic
&
Industrial
R & D

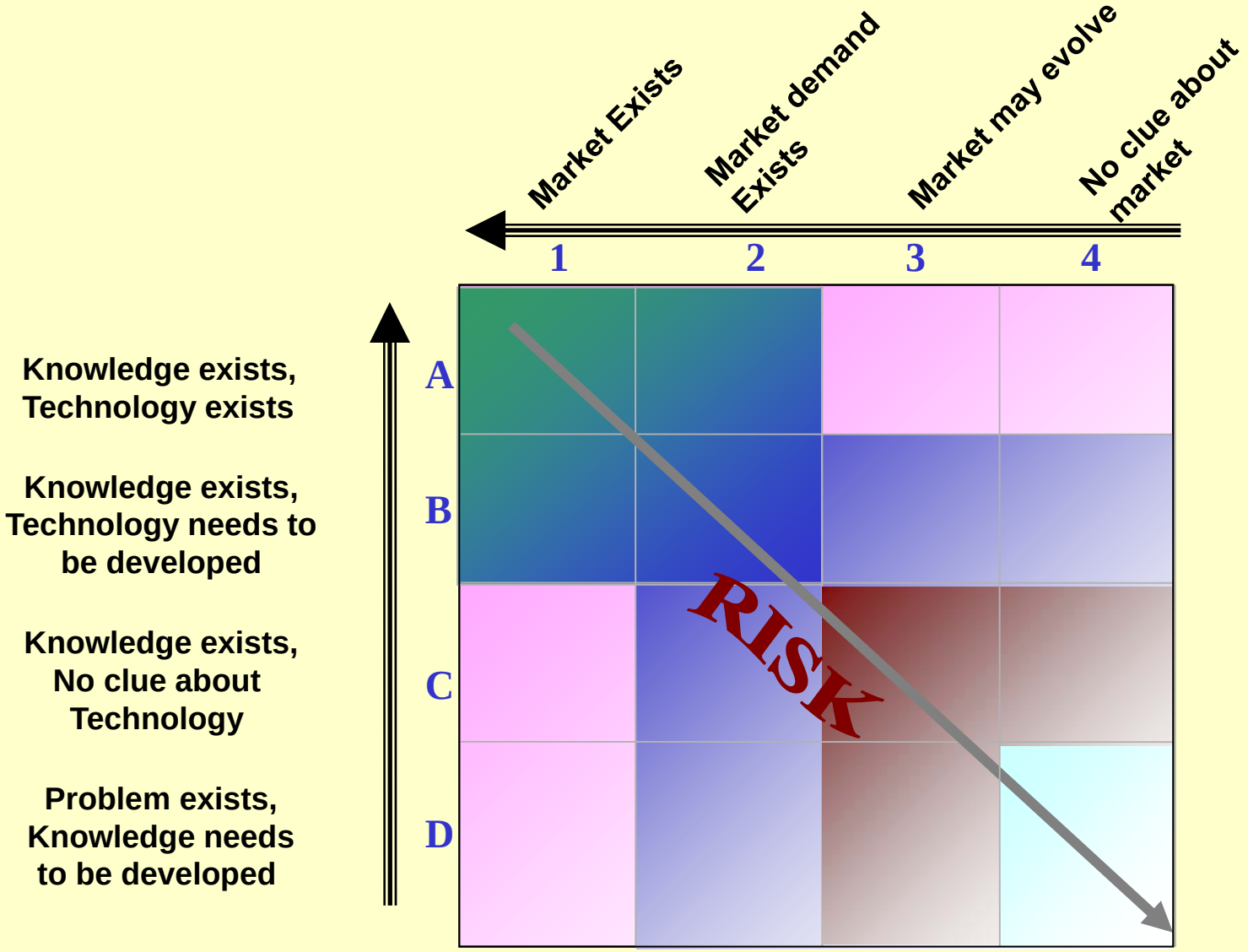


Edison

Use Inspired Research


LINKING KNOWLEDGE TO MARKETS
KNOWLEDGE
MARKETS
EARLY STAGE EXPLORATORY/ DISCOVERY
RESEARCH OF STRATEGIC NATURE
LATE STAGE INNOVATIONS
DISRUPTIVE INNOVATIONS (UNKNOWN MARKETS)
DISRUPTIVE OR INCREMENTAL (FUTURE MARKETS)
SUSTAINING OR INCREMENTAL INNOVATIONS (EXISTING MARKETS)
START UP VENTURES
IP LICENSING
PUBLIC PRIVATE PARTNERSHIP
CONTRACT R&D
TECHNOLOGY TRANSFER

KNOWLEDGE – MARKET MATRIX : ANOTHER PERSPECTIVE



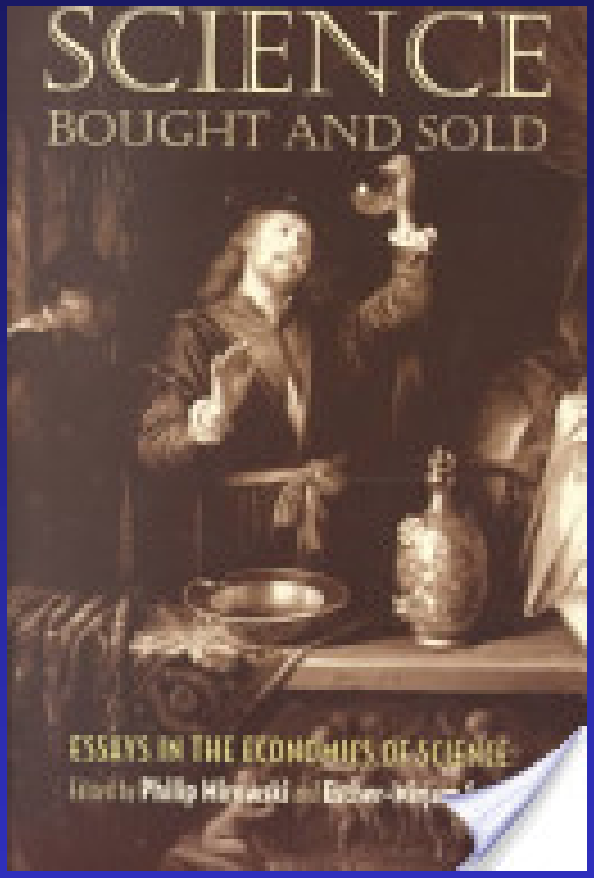
CSIR needs to operate increasingly in the lower half of this knowledge – market matrix

CSIR IN THE NEXT DECADE

- S&T operates within the framework of politics, economics and social fabric of a nation
- India is changing rapidly in all these spheres
- Resources will always be lesser than the demands of a growing economy.
- Private sector will become increasingly more important; Government function will be limited to acting as regulators and facilitators, not gatekeepers
- Government focus will remain limited to public health, water, sanitation, education, infrastructure, energy and national security.
- In the economic sphere emphasis will be on manufacturing indusries leading to creation of employment; However, much of “make in India - sell anywhere” policy will be initially based on capital and technologies sourced from outside India
- Funding for scientific research in public institutions will become more directed and even scarcer in the next few years.
- CSIR will be asked to focus more on science that contributes to “nation building” and improve the “quality of life” of its citizens.

In the short and medium term , CSIR will have to tighten its belt and refocus its efforts; more questions are likely to be asked on how and where CSIR is making an impact; merely saying that we are doing cutting edge, globally competitive science will not do!

Goethe once said about science: "To one man it is the highest thing, a goddess; to another it is a productive cow who supplies them with butter. We must honor the goddess and feed the cow.



Science Bought and Sold: Essays in the Economics of Science, University of Chicago Press, 2002

BIBLIOGRAPHY

- The Life and Times of S.S. Bhatnagar, Nora Richards, New Book Society of India, 1948; reprinted by CSIR-NISTADS, 2004
- S.S. Bhatnagar, The Man and his Mission, Sukanya Datta, CSIR-NISCAIR , 2013
- Nucleus and Nation: Scientists, International Networks and Power in India, R.S. Anderson, University of Chicago Press, 2010.
- Excellence in an Overlapping Culture: The Big History of India's National Chemical Laboratory, L. K. Doraiswamy, Rutledge, 2010
- Beyond Belief: India and the Politics of Postcolonial Nationalism, Srirupa Roy, Duke University Press, 2007
- Saga of Indian Science since the Independence, P.M. Bhargava and Chandana Chakraborti, Sangam Books, 2003
- S. Sivaram, Resonance,p.82, April 2002; Rajesh Kochhar, Resonance, p.90, April 2002
- S.S. Bhatnagar on Science, Technology and Development, 1938-45, ed. V. V. Krishna, Wiley Eastern, 1993.
- S.S. Bhatnagar: His Life and Work, Indus Publishers, 1989
- Collected Works of S.S. Bhatnagar, CSIR, 1987
- National Research Laboratories of India : Introduction, Shanti Swarup Bhatnagar, Nature, 159, 183-184 (8 February 1947) ; doi:10.1038/159183a0


THANK YOU