

# **SHANTI SWARUP BHATNAGAR A GIFTED GENIUS**



**K. Venkataraman, Nandini Phanse  
Deepa Vanjani, Shilpa Parikh**

**SHANTI SWARUP  
BHATNAGAR  
A GIFTED GENIUS**



## **National Pledge**

*India is my country.*

*All Indians are my brothers and sisters.*

*I love my country,*

*and I am proud of its rich and varied heritage.*

*I shall always strive to be worthy of it.*

*I shall give respect to my parents, teachers and  
elders and treat everyone with courtesy.*

*To my country and my people, I pledge my devotion.*

*In their well being and prosperity alone,  
lies my happiness.*

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## *Authors*

K. Venkataraman, Ph.D.

Nandini Phanse, Ph.D.

Deepa Vanjani, Ph.D.

Shilpa Parikh, Ph.D.



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E-mail: [vijnanabharati@gmail.com](mailto:vijnanabharati@gmail.com)

Contact: +91-011- 49032436

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*Dedicated to our nation builders.*

# PREFACE

आ नो भद्राः क्रतवो यन्तु विश्वतः।

Rig Veda, 1.89.1

“Let noble thoughts come to us from all and every direction in the universe.”

India has had glorious traditions in knowledge generation and dissemination from ancient times. Bharat contributed in all spheres of human knowledge, be it Mathematics, Physics, Metallurgy, Chemistry, Medicine, Surgery, Astronomy, Language, Grammar, Architecture and so on. Moreover, Bharat’s spiritual advancements have been widely admired all over the world.

Our great scientists in modern times have carried forward this legacy by their path breaking and exemplary inventions, discoveries and research. Remembering their immense contribution in laying the foundation of a strong nation, is a humble reminder to all the countrymen to have the vision for shaping a Viksit Bharat@ 2047.

Among such luminaries as Homi Jehangir Bhabha, Vikram Sarabhai, Hargovind Khurana, C.V. Raman, Ramanujan, Jagdish Chandra Bose, only to name a few, is another pioneering scientist Dr. Shanti Swarup Bhatnagar. This Indian chemist, revered as the Father of Research Laboratories in India, played a major role in shaping the future of science and technology in the country. It is



no doubt that the Government of India instituted the Shanti Swarup Bhatnagar Prize for Science and Technology in memory of the Founder Director of CSIR. The prize has and should continue to inspire young Indians to enrich the horizon of our scientific research.

Vidyarthi Vigyan Manthan(VVM) is one such endeavour that aims to instil a scientific temper in young minds to create “ignited minds”, to use the words of Dr. APJ Abdul Kalam. I am hopeful that this book on the life and works of Dr. Bhatnagar will be a source of knowledge and inspiration to our scientists in the making. I extend my good wishes to the writers of the book.

Let our quest for knowledge take us to new realms. May we shine in our deeds and actions and strive to make India a Vishwa Guru in every sense of the word.

**Shekhar C. Mande**, FNA, FASc, FNASc  
Former Director General, CSIR.  
Distinguished Professor,  
Honorary Distinguished Scientist  
National Centre for Cell Science, Pune

## Authors' Note

**W**e are profoundly grateful to Vidyarthi Vigyan Manthan for entrusting us with the responsibility of writing this book. The book is a humble contribution for giving an impetus to young scientists in the making who can change the future of India.

The facts from the life of Dr. Shanti Swarup Bhatnagar remain the same and we do not claim that we are adding anything new. What we have attempted is to gather the major facts of Dr. Bhatnagar's life in a way that can be read and understood by young children and be a source of their inspiration.

In this digital age, when technology has besieged our lives, a book in printed form is a welcome opportunity to reach out to those curious, young minds out there, who might be inspired by the life and work of this great scientist and administrator, Dr. Shanti Swarup Bhatnagar.

In his poem "Ulysses", Lord Alfred Tennyson wrote: "Strong in will- To strive, to seek, to find and not to yield."

Let the seeking in the journey of learning go on and let us endeavour to seek and find new things, so that the country finds young fresh minds with new ideas.

The research papers of Prof. Bhatnagar that have been added to the book are a treasure-trove of knowledge which can be of use to students who wish to embark on their scientific careers. Information regarding the Shanti Swarup Bhatnagar Prize and CSIR Laboratories has also been included in appendices to motivate young minds. Furthermore, important milestones in the life of Dr. Shanti Swarup Bhatnagar have been tabulated in the appendix as a ready reckoner for readers.

We hope our account of Dr. Bhatnagar's life will be read by young people of India, who will shape the future of our country. Following Dr. Bhatnagar's ideals will persuade them to work for the country, to take up challenges and new initiatives and to be useful members of the society. If we are to fulfil the dream of Viksit Bharat@ 2047, the youth of the country will have to be filled with national pride and an appreciation of the wealth of our knowledge, the legends and scholars the country have produced, and the achievements of this great civilization. This humble book, hopefully, is a step in that direction.

We acknowledge the inputs given by Mr. Arun Bhatnagar, grandson of Dr. Shanti Swarup Bhatnagar. His efforts and valuable suggestions have guided us in making of the book.

*Authors:*  
K. Venkataraman  
Nandini Phanse  
Deepa Vanjani  
Shilpa Parikh

# THE MAKING OF THE GENIUS EARLY LIFE OF DR. SHANTI SWARUP BHATNAGAR

यथा हयकेन चक्रेण न रथस्य गतिर्भवेत्।  
एवं परुषकारेण विना दैवं न सिद्ध्यति॥

Just as a chariot cannot be driven without a wheel,  
a man's destiny cannot be fulfilled without perseverance.

**T**he persona of Dr. Shanti Swarup Bhatnagar is reflected as a man who stood tall, who set standards, and laid the foundation stone for building a strong nation. He is an amalgamation of an accomplished scientist, an able administrator, a poet, a wonderful communicator and above all an exemplary human being characterized by his generosity, values, integrity, humility and commitment to serve others.

## Family Background and Early Childhood

Born on 21st February 1894 at Bhera in the Shahpur District in the then undivided state of Punjab (now in Pakistan), Shanti Swarup Bhatnagar belonged to an elite, educated family both from the paternal and maternal sides.

His mother, Parbati Bhatnagar was the daughter of a distinguished engineer, Munshi Pyarelal of Sikandrabad in U.P, while his father Parmeshwari Sahai Bhatnagar was the eldest son of Rai Bahadur Munshi Manoharlal of Panipat. Munshi Manoharlal held a high executive post and was particularly noted for his piety and honesty.

Shanti Swarup inherited from his mother's family the scientific temper and poetic attributes, and from his paternal family, especially from his father, he imbibed an independent spirit.

Shanti Swarup's father Parmeshwari Sahai Bhatnagar, was a distinguished graduate of the Punjab University. He refused to take up judicial or executive service which was the tradition of the family and became a teacher of a high school in Bhera. Parmeshwari Sahai Bhatnagar became a member of the Brahmo Samaj, a moment which stood against Hindu orthodoxy and the caste system and was committed to social equity. For his religious beliefs, Parmeswari Sahai Bhatnagar was totally estranged from his family members.

When his father Parmeshwari Sahai Bhatnagar died on 26th October 1894, at the young age of 22, Shanti Swarup was just eight months old, whereas his elder sister was two years old. Parmeswari Sahai's sudden death left his young wife and children in dire poverty. Since Parmeshwari Sahai's father and mother had both died and his uncles were in Lahore, there was no other option for Shanti Swarup's mother than to go to Sikanderabad to her father, Munshi Pyarelal. She took over many household responsibilities in her father's house, where she and her children were well taken care of.

It was at Sikanderabad, under the guardianship of his maternal grandfather, Munshi Pyarelal, that the childhood of Shanti Swarup was passed. Young Shanti Swarup received guidance from Munshi Pyarelal, who was an engineer, one of the first to have qualified from the Roorkee College (presently IIT, Roorkee), the first engineering college in India.

Munshi Pyarelal was a strict disciplinarian but was never harsh. He did not allow the children any pocket money because he thought it would make them self-indulgent. However, he always gave them money whenever they really needed it. He told them never to get involved in disputes. As he grew older, Munshi Pyarelal became more religious and reclusive. A new house was built at some distance from the older one, into which the family shifted. Shanti Swarup stayed with his grandfather who continued to live in the old house and thereby developed a liking for solitude.

Fruit trees were planted around the house and young Shanti Swarup would often climb trees and feast on the guavas and mangoes. At the height of the mango season, hundreds of the luscious fruits were plucked and thrown overnight into a water tank in the garden. Such was Shanti Swarup's liking for mangoes that during summers, when the family sat in the shady bower of trees to enjoy mangoes being cooled in a water tank, he would be thrown in it to eat as many of them as he liked.

Under the influence of his grandfather, Munshi Pyarelal, young Shanti Swarup, developed a taste for engineering, and also in Physics and Chemistry. He became interested in his grandfather's geometrical instruments, Euclid and algebra, and in making mechanical toys. Clay-modelling greatly attracted him and he spent much time at it. At the age of eight, while his classmates were playing up a storm on the playground, this young boy was using the instruments and tools of his grandfather to build mechanical toys. He had constructed a steam engine and one day, to his great joy, the clay vessel that served as a boiler, burst. Dr. Bhatnagar always recollected the inner happiness and joy he had experienced in his childhood due to the explosion and little movement of the engine on the crude rails.

Those were the happy early childhood days. Munshi Pyarelal accompanied his grandson Shanti Swarup on the first day of his school. On that day, Shanti Swarup learnt that his father had died when he was just a eight month old baby. Till then, he considered his maternal grandfather Munshi Pyarelal to be his father. The little child, aged six, was disheartened and wept to accept the bitter truth. Thus began his school days where seeds to his wholesome personality were sown which found a conducive atmosphere to boom and blossom later in life.

### Poetic Inclination

From his childhood, thanks to the literacy atmosphere in his grandfather's house, Shanti Swarup enjoyed listening to poetry and took up to writing. Munshi Pyarelal's ancestral house had a big library of Hindi and Urdu books. Mostly while travelling or on holiday he would write verses on scraps of paper and pocket them.

Shanti Swarup's interest in poetry and literature came from his mother's family who produced a number of poets, the most famous of them was Munshi Hargopal. Munshi Hargopal was a well-known poet and wrote under a pseudo name 'Tafta'. He had a collection of rare books and manuscripts which, upon his death, were bequeathed to Shanti Swarup by his grandfather. He then donated them to the Lahore University Library.

Shanti Swarup Bhatnagar's collection of Urdu poems, titled Lajwanti after his wife, was published in 1948.

### Take Aways

- People who are ready to take risks and face the consequences, stand out in a crowd and carve a niche for themselves.
- Learning, the foundations of which should be laid early, is the stepping stone to a solid future.

## THE FORMATIVE YEARS EDUCATION AND INFLUENCES

नास्ति विद्यासमो बन्धुर्नास्ति विद्यासमः सुहृत् ।  
नास्ति विद्यासमं वित्तं नास्ति विद्यासमं सुखम् ॥

There is no brother like knowledge, no friend like knowledge,  
and no wealth or happiness like it.

**A**n extraordinarily gifted person, Dr. Bhatnagar was not just a scientist of eminence, but also an accomplished poet and an able administrator. Education was his legacy, his father, Parmeshwari Sahai Bhatnagar, being a distinguished scholar of English and History from Punjab University and his mother, Parbati Bhatnagar, being the daughter of Munshi Pyarelal, one of the first to qualify from Roorkee Engineering College. His grandfather on the paternal side, Rai Bahadur Munshi Manoharlal Bhatnagar too, held high positions. It is interesting to know how the formative years shaped the persona of Dr. Bhatnagar and gave him the ground from which to take off with the help of good education.



## The School Days

Shanti Swarup's earliest schooling was in a private Maktab (a primary school, the medium of teaching being Urdu) which he joined in 1901. Later, up to the year 1907 he studied at Dayanand Anglo-Vedic (DAV) High School, Sikandrabad in U.P.

Shanti Swarup's father, Parmeshwari Sahai had a childhood friend Rai Sahib Lala Raghunath Sahai, who later was to play an important role in the life of Shanti Swarup. Raghunath Sahai was the Headmaster of Dyal Singh High School in Lahore.

In 1908, Raghunath Sahai, visited the family and found young Shanti Swarup specially good in literature and science. He persuaded Parbati to send her son, Shanti Swarup, for schooling at Lahore in his school. At the Dyal Singh High School, Shanti Swarup earned a scholarship in open competition (in fact he got scholarships throughout his studies) and also made his living by teaching young students privately.

Shanti Swarup was good at all subjects. He was not only an inquisitive student of science but was interested and proficient in Sanskrit and Urdu, too.

In school he was considered to be distinctly high up in literary attainment in Urdu too. He was so proficient in both, Urdu grammar and Urdu poetry that his teachers thought that his attendance in these classes was not necessary.

Shanti Swarup distinguished himself in every branch of the work of his classes- literary, scientific, dramatic, social and gave the most complete satisfaction to his teachers by the excellence of his behaviour.

During these years his headmaster, Rai Sahib Lala Raghunath Sahai, was a great influence on him and it was here that he came in contact with the Brahmo Samaj. These formative years were crucial because his personality was greatly formed by the scholarly pursuits of his headmaster and future father-in-law, Rai Sahib Lala Raghunath Sahai, and his teacher Rai Bahadur Lala Ram Kishore.

The scientific bent of mind that he gained from scholars like Lala Bishen Narain Mathur and Mohd. Ashraf developed in him an interest in experiments related to electrical fields, string telephones, and electrical batteries. He published his first ‘paper’ (letter) on how to make carbon electrodes for batteries in 1911, in the Allahabad newspaper, The Leader.

In his childhood, Shanti Swarup, took delight in conducting scientific experiments. While in school he even created a “laboratory” of his own in one of the galleries of the school hall for conducting experiments, where he gathered all kinds of things which he thought would be useful in conducting experiments—old tubes, broken flasks, batteries and so on. As early as 1911, young Shanti Swarup published a letter in the Allahabad newspaper, ‘The Leader’, on a method of making substitute carbon electrodes for a battery by heating molasses and carbonaceous matter under pressure. This publication has significance because in 1942 he developed a process for carbon electrodes using indigenous materials!

## Higher Education

In 1911, Shanti Swarup passed the matriculation examination with a first division from the Dyal Singh High School and joined the Dyal Singh College, Lahore, with a university scholarship. Here he developed an interest in theatre under the tutelage of distinguished professors. His own writing talent was recognized when his sectional play “Karamat” won the first prize in a one-act play competition. Even when studying later at Forman Christian College, Lahore, he contributed his literacy talents to the Dyal Singh College. On one instance he translated a song in Twelfth Night into Urdu.

Social Service was inculcated among students of Dyal Singh College, and Shanti Swarup was happily a part of this, displaying great enthusiasm.

At the Dyal Singh College, Shanti Swarup had won a college scholarship. His subjects were English, Sanskrit, Physics, Chemistry and Mathematics. Professor N. N. Godbole mentored Shanti Swarup and was friendly with him. He stimulated Bhatnagar's enthusiasm for indigenous industrial products. In those days, Shanti Swarup wrote a paper on "Fermentation Phenomena of Pomegranate Juice." which was published as an article in the magazine "Raushni", a periodical of the Society for Promoting Scientific Knowledge.

Shanti Swarup passed the Intermediate Examination of the Punjab University in 1913, with a first division and joined Forman Christian College, Lahore for the B.Sc. degree for which he studied Physics and Chemistry. He took up an Honours in Physics in 1916.

At Forman Christian College he began his scientific pursuits in earnest. Chemistry was taught by Professor P. Carter Speers who used to be regarded as the father of technical education in the University. The grasp on theoretical chemistry acquired from Professor Carter Speers, laid the foundation for his work in Industrial Chemistry. He was taught Physics by Professor J. M. Benade, M.A. (Princeton), who was excellent in experimental physics and had done research with Arthur Holly Compton, the Nobel Laureate in Physics. It was Prof. J.M. Benade who taught him this subject, and with him Shanti Swarup did his first research on surface tension for his M.Sc. degree.

An interesting incident of Shanti Swarup's graduation days cannot be left out. In the examination of chemistry subject, he wrote that X-rays could also be reflected, refracted and polarized, as ordinary light. But Mellor's Textbook of Inorganic Chemistry being followed in the college did not mention this fact. This textbook was the "Bible" for the examiner and there was no wonder that the examiner failed Shanti Swarup for writing something which was not in the textbook.

During his college days, Shanti Swarup had been under strained circumstances. As an undergraduate he had earned his examination fees by making an inventory of the contents of the Forman Chemical Laboratories.

On 31st May 1915, Shanti Swarup married Lajwanti, the elder daughter of Rai Sahib Lala Raghunath Sahai, in accordance with the Civil Marriage Act of 1872 with Brahma rites. To shoulder the added responsibilities, Shanti Swarup Bhatnagar worked as a demonstrator in Physics and Chemistry in Forman Christian College, and then as a senior demonstrator in Chemistry in Dyal College.

The employment, however, did not hinder Shanti Swarup's efforts in pursuing higher studies. He joined the M.Sc. course in Chemistry in the Forman Christian College and completed his post-graduation in 1919. In M.Sc., his thesis was on "The Effect of Absorbed Gases on the Surface Tension of Water." His ability as a university student was such that the principal of Dyal Singh College, Mr. Welinkar, wrote "Mr. Shanti Swarup was one of the ablest students in that large class. He distinguished himself in every branch of the work of his class."

One of his professors, Prof. Ruchi Ram Sahni helped him get a scholarship from Dyal Singh College to study abroad. This made it possible for him to set off for America, in 1919. He reached London en route to America but

Shanti Swarup Bhatnagar was greatly influenced by his mentor Prof. Ruchi Ram Sahni who took keen interest in shaping his scientific career. While recalling, the influences of his teachers in him, Bhatnagar writes: "Prof. Ruchi Ram Sahni took special interest in me and was largely responsible for the award of a scholarship from the Dyal Singh College Trust for my studies abroad".

was held up there because all the ships sailing from England to the US were carrying American soldiers who were returning home after the World War I. After trying for several days to find a ticket for a US ship, he requested the Dyal Singh Trust to let him stay on in London. The trust permitted him to join the University College London under chemistry professor Frederick G. Donnan. He obtained the Doctor of Science (D.Sc.) degree in Chemistry, in 1921, from Ramsay Laboratories of University College, London, under the guidance of Prof. Donnan.

Shanti Swarup Bhatnagar immersed himself into his research work on the subject, “Colloidal Chemistry and Emulsions and Emulsifications”. Two years later in 1921, he presented his thesis titled, “Solubilities of bi-and trivalent salts of higher fatty acids in oils and their effect on surface tension of oils”.

A colloquium was held in April 1921 at which Shanti Swarup Bhatnagar was to give a discourse as a thesis for his doctorate. On the strength of his publication on Surface Tension, he was exempted from taking the Ph.D. a pre-qualification necessary for a D.Sc. For the doctorate his research had been on Colloidal Chemistry, and Emulsions and Emulsification. The audience at the colloquium was composed of professors, research students and experts on the subject of exposition. William Bragg presided and Prof. Donnan sat in a conspicuous place.

Shanti Swarup Bhatnagar, well aware that this was the climax of his student career, was very much on his mettle. He delivered the thesis to his own satisfaction. He was amazed when Professor Donnan rose and riddled it with shattering criticism. Shanti Swarup Bhatnagar rose to defend his thesis and at the end Professor Donnan embraced him. Sir William Bragg patted him on the back and said his defence was wonderful and he deserved to be a Doctor of Science.

While working in London he received a Fellowship of £250 a year which enabled him to travel to Germany and France. He worked as a research student in the Kaiser-Wilhelm Institute Berlin and also in Sorbonne, Paris. In Sorbonne he met Madame Curie and visited her laboratories.

### Facts

- Dr. Bhatnagar's D.Sc. degree was on the surface tension of oils.
- When visiting France and Germany he met Prof. Walther Hermann Nernst (winner of 1920 Nobel Prize for Chemistry).

### Take Aways

- Hard work and perseverance are the keys to building a successful career.
- There is no replacement of good qualification.
- Short cuts don't exist. Every destination is reached through dedication and will-power.

CHAPTER

# 3

## AN EXEMPLARY EDUCATIONIST AND SCIENTIST

यथा ह्येकेन चक्रे ण न रथस्य गतिर्भवेत्।  
एवं परुषकारेण विना दैवं न सिद्ध्यति॥

Just like a chariot cannot move with one wheel, we cannot attain our destiny without hard work or effort.

*“The heights by great men reached and kept  
Were not attained by sudden flight,  
But they, while their companions slept,  
Were toiling upward in the night”.*

*Henry Longfellow*

**S**hanti Swarup Bhatnagar was one of the ablest and most illustrious sons of India. He was a man who succeeded against overwhelming odds, a man who worshipped science, who never lost faith in his own abilities and a man who worked for the betterment of the society, not just for his own interests.

Dr. Bhatnagar's contribution to the field of education is quite significant. He was an excellent teacher and an accomplished researcher. He had the reputation of being a very inspiring teacher and it was as a teacher that he himself was the happiest. He taught for nearly 19 years in various universities and inspired a large number of students. Many of his students, in later life, occupied important positions and spread the ideals of their teacher. Not only was he a great experimenter, but was also a well-read and gifted writer.

### **An Exemplary University Teacher**

Shanti Swarup Bhatnagar was a university professor for 19 years (1921-1940), first at the Banaras Hindu University (BHU), Varanasi and then at the Punjab University, Lahore.

He joined the Banaras Hindu University as a Professor of Chemistry in August 1921 where he spent three years at the Chemistry Department.

Pandit Madan Mohan Malviya, the founder Vice Chancellor of the Banaras Hindu University needed to appoint a University Professor in Chemistry. At that time Dr. Bhatnagar was in England, Pandit Malviya wrote to three stalwarts of Indian science- Chandrasekhara Venkata Raman, Acharya Jagadish Chandra Bose and Acharya Prafulla Chandra Ray, requesting them to recommend a suitable candidate for the post. All three of them were also in England at that point of time. After consulting each other, all three unanimously agreed upon the candidature of Dr. Shanti Swarup Bhatnagar and the same was conveyed to Pandit Malviya. Based on their recommendations Dr. Bhatnagar was sent an offer to join BHU. He accepted the offer from Pandit Malviya. and joined the Banaras Hindu University in August 1921.

Within a short span of time at the Chemistry Department of BHU, Professor Bhatnagar was able to create an active school of physico-chemical research. Pandit Malviya was very impressed by Professor Bhatnagar's abilities



and his dedication and would often recommend the visitors to the University to see Dr. Bhatnagar's laboratory.

At the Banaras Hindu University, Dr. Bhatnagar did research mainly in colloids, geo-chemistry and photochemistry.

Professor Bhatnagar was very generous and extended his large heartedness to students who could not pay their fees and he paid stipends out of his own pocket to students showing promise.

Being a Hindi poet of repute, Professor Bhatnagar, during his stay in Banaras, composed the 'Kulgeet' (Song for the University).

### **A Magnanimous Gesture**

At the time of his joining the Chemistry Department of BHU, Dr. Bhatnagar's magnanimous gesture to allow the former head to continue as Head of the Department, had no precedent and is highly appreciable.

There is an interesting episode that took place at the time of his joining the Chemistry Department of the Banaras Hindu University. Dr. Nitya Anand, Former Director of the Central Drug Research Institute, Lucknow, has described this episode in this way: "He started his innings at BHU with a magnanimous gesture which had no precedent. When the former Head of the Department of Chemistry from whom he was to take charge expressed his distress at handling over the keys which he had held for fifteen years, Bhatnagar's spontaneous response was: "then hold them still", and he really meant it. He persuaded the Executive Council of the University to allow the former head to continue as Head of the Department. This unique gesture was greatly appreciated by his new colleagues and by Pt. M.M. Malviya, the Vice Chancellor.

In 1924, Dr. Bhatnagar moved to the Punjab University, Lahore, as a Professor of Physical Chemistry and the Director of the University Chemical Laboratories. The appointment was an important milestone in Bhatnagar's career and the selection for this post testified to his high accomplishment as a researcher. The post had been advertised in Nature, a highly acclaimed international scientific journal published in London.

While working at the Punjab University, Lahore, Dr. Bhatnagar earned a considerable sum of money from his applied research work. However, he donated all his earnings from such activities to the University. He refused to accept any financial award personally, as he believed that scientific work loses its selfless character if the worker becomes money-minded and begins to get financial benefits for himself. Also, the public begins to doubt the sincerity of a worker who works hard in order to make riches for himself. He felt that students derive inspiration from only a selfless worker. The span of 16 years (1924-40) as Professor in the Punjab University was the most active period of his life for original scientific work. He was fondly called as “ Doctor Saheb” in University Chemical Laboratories.

## **Scientific Contributions**

Dr. S. S. Bhatnagar made pioneering contributions in fundamental research, applications to industry & consultancy. He made a large number of publications, most of them being in the field of physical chemistry and the major subjects were magneto-chemistry and physical chemistry of emulsions. He made use of magnetic susceptibility measurements for studying the properties of organic compounds, solutions, films and colloids. He designed an instrument, jointly with his student K.N. Mathur, for measuring small variations in magnetic susceptibilities. The instrument, called the Bhatnagar-Mathur Magnetic Interference Balance, was one of the most sensitive instruments devised for measuring magnetic properties.

The invention was patented and it was licensed to Messrs Adam Hilger and Co., Camden Town, London, for production and marketing. It was exhibited at the Royal Society Soiree in 1931.

Shanti Swarup Bhatnagar and his group examined the scope of Pascal's Law of Additivity. They demonstrated that the law could be applied not only to organic compounds, but also to inorganic compounds.

In addition to his significant contributions to the areas of magneto-chemistry and physical chemistry of emulsions, Shanti Swarup did outstanding work in the area of applied research, in industrial and practical chemistry.

Dr. Bhatnagar remained at the University Chemical Laboratories, Lahore, till 1940. The laboratories addressed problems in industrial and applied chemistry brought in by agriculturists and industrialists, such as Sir Ganga Ram, an engineer-turned neo-agriculturist; Lala Shri Ram of Delhi; J K Mills Kanpur; and Tata Oil Mills.

### **Examples of Applied Science under the Guidance 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 sulphur
- Making fuels and lubricating oil from vegetable oils
- Jute and Shellac derived containers for storing 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

## Dr. Bhatnagar's Contributions to Fundamental Science

### Physical chemistry of emulsions:

- Dr. Bhatnagar was the first to define the effect of electrolytes on the stability of colloidal solutions.
- He enunciated simple rules governing colloid stability.
- His hypothesis that all emulsifying agents 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:

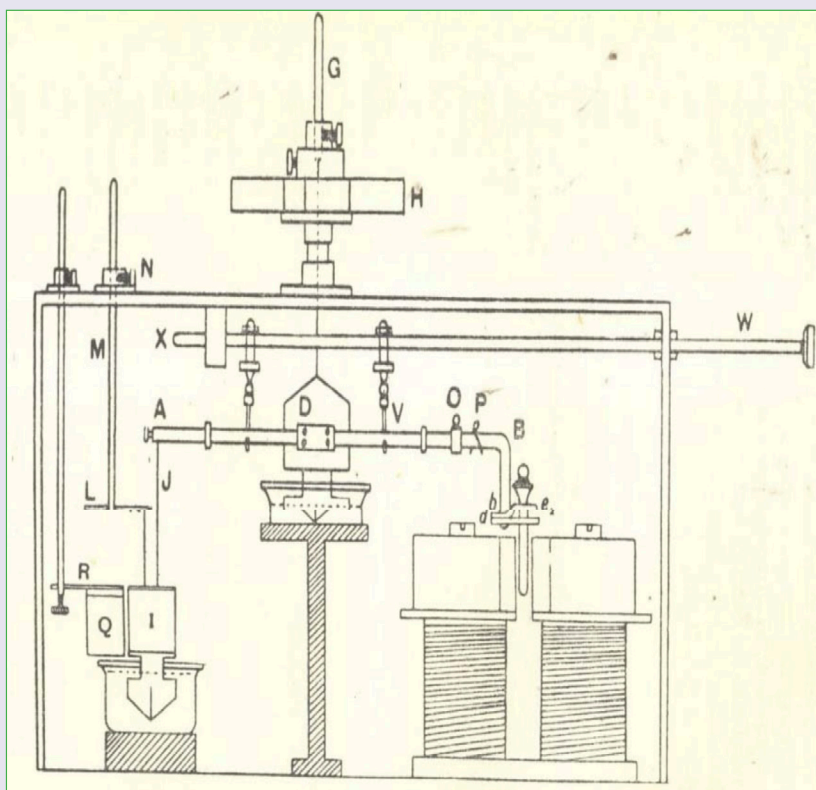
- Dr. Bhatnagar used magnetic susceptibility measurements to explore the properties of organic compounds, solutions, films and colloids.
- He established the structure of oxide film on the surface of copper produced by oxidation.
- He proved the existence of ionic micelles by the study of magnetic rotations

## A Thorough Industrial Chemist

Dr. Bhatnagar's first industrial problem was developing the process for converting bagasse (peelings of sugarcane) into food-cake for cattle. This was done for Sir Ganga Ram, the Grand Old Man of Punjab. He also solved industrial problems for Delhi Cloth & General Mills, J.K. Mills Ltd. of Kanpur, Ganesh Flour Mills Ltd. of Layallapur, Tata Oil Mills Ltd. of Bombay, and Steel Brothers & Co. Ltd. of India. His major innovation was an improvement of the procedure for drilling crude oil.

## Bhatnagar – Mathur Magnetic Interference Balance

- Dr. Shanti Swarup Bhatnagar and his student Mr. K.N. Mathur (who later became the first Director, Central Scientific Instruments Organization, Chandigarh) designed an equipment, called Bhatnagar – Mathur Magnetic Interference Balance.
- The instrument measures the diamagnetic susceptibilities of materials.



### Magnetic Interference Balance (Bhatnagar-Mathur)

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).

In 1933, Dr. Bhatnagar demonstrated that the very first requirement of an industrial chemist is a very thorough grasp of the fundamentals. The Attock Oil Company at Rawalpindi (representative of Messers Steel Brothers & Co London) had confronted a peculiar problem, wherein the mud (clay) used for the drilling operation was hardened upon contact with saline water, thereby clogging the drill holes. Dr. Bhatnagar realised that this problem could be solved by colloidal chemistry. He added Indian plant gum, as a protective coating to prevent the mud (clay) from coagulating. The gum had a remarkable property of lowering the viscosity of the mud suspension and increasing its stability against the flocculating action of electrolytes.

M/s Steel Brothers was so pleased that they offered Dr. Bhatnagar a sum of Rs. 1,50,000/- for research work on any subject related to petroleum. The company placed the fund through the university and it was used to establish the Department of Petroleum Research under the guidance of Dr. Bhatnagar. Investigations carried out under this collaborative scheme included deodorisation of waxes, increasing flame height of kerosene and utilisation of waste products in the vegetable oil and mineral oil industries.

While pursuing his B.Sc., Shanti Swarup Bhatnagar solved an industrial problem. During the Second World War things could not be imported from Germany and other countries and many business enterprises were facing shortage of goods. A leading stationer at Lahore who was unable to import hectographic pads required for duplication. (Hectograph is a device for making copies of written work). He approached Prof. Carter Speers of Forman College with a request to solve his problem. Prof. Speers assigned the task to Shanti Swarup Bhatnagar and he solved the problem. The stationer gave him Rs. 150 for his services.

Dr. Bhatnagar persistently refused any personal monetary benefit from his research fundings, and instead advocated for strengthening research facilities at the university.

## A Dedicated Scientist and a Generous Human

आत्मार्थं जीवल्लोकेऽस्मिन् को न जीवति मानवः।  
परं परोपकारार्थं यो जीवति स जीवति।

(In this world everyone lives to satisfy his/her own interests But those who live for the sake of helping others, live a real and prosperous life)

Being In recognition of the great work done by Dr. Bhatnagar, Messers Steel Brothers & Co., London, had made a very generous gift of money and awarded him Rs 1.5 lakh, and offered him a job to conduct further research in petroleum. However, as a man dedicated to spreading the gospel of science, Dr. Bhatnagar refused the job offer and instead donated his winnings to the Chemistry Department of the Punjab University, Lahore, so that it could set up its own Department of Petroleum Research. He transmitted a considerable part of that gift to create an Industrial Research Department in which research scholars could develop new processes for the industrial utilization of Indian raw materials. Dr. Bhatnagar's act was an exemplary one without any parallel in the history of Indian universities and is highly inspirational.

### Take Aways

- Large-heartedness can win hearts more than anything else. Giving is an act of humility.
- People who make it big, work with perseverance and selflessness.

CHAPTER

# 4

## THE FATHER OF RESEARCH LABORATORIES: DEVELOPING INDUSTRIAL RESEARCH IN INDIA

अप्राप्यं नाम नेहास्ति धीरस्य व्यवसायिनः।

There is nothing unattainable to the one who has courage  
and who works hard.

“I can truly say that but for Dr. Bhatnagar you could not have  
seen today the chain of national laboratories.”

– Jawaharlal Nehru

### Constitution of the Council of Scientific and Industrial Research (CSIR)

**D**r. Shanti Swarup Bhatnagar played a significant role in the building of post-independent Science and Technology (S & T) infrastructure and in the formulation of India's S & T policies. He was the Founder Director (and later the first Director General) of the Council of Scientific &



Industrial Research (CSIR). He is credited with establishing a chain of national laboratories in the country.

In the 1930s there were no research labs for the development of India's natural resources and industry. Just before the outbreak of the Second World War, the Government of India established the Board of Scientific and Industrial Research (BSIR) with the efforts of Sir Ramaswamy Mudaliar, Commerce Member in Viceroy's Committee. Dr. Bhatnagar, who by then had made remarkable contributions to Chemistry was called on to take charge. In December 1939, Dr. Bhatnagar was appointed as an Advisor on Scientific and Industrial Research to the Government of India. Thus began his fifteen-year long association with the Council of Scientific & Industrial Research (CSIR) which was established on 26 September 1942.

In 1940, Sir Mudaliar became BSIR's first Chairman and Dr. Bhatnagar was appointed as the Director of Scientific and Industrial Research. Though earlier he had declined tempting offers of posts in industrial research, he took this up as national service. He took this opportunity to help in building up India's scientific research, and to train and inspire young scientists to take up research as a career. He dreamt of a chain of national laboratories of large teams of scientists working for the development of India and the creation of a scientific outlook on life among the masses.

By the end of 1940, about eighty researchers were engaged under BSIR. Within two years of its establishment, the BSIR was able to work out a number

The efforts of Sir Mudaliar and Dr. Bhatnagar led to the constitution of the Council of Scientific and Industrial Research (CSIR) as an autonomous body, to administer the Research Fund created by the government.

of processes at the laboratory level for industrial utilisation. Those included techniques for the purification of Baluchistan sulphur anti-gas cloth manufacture, the development of vegetable oil blends as fuel and lubricants, the invention of a pyrethrum emulsifier and cream, the development of plastic packing cases for army boots and ammunition, dyes for uniforms and the preparation of vitamins.

In early 1941, Dr. Bhatnagar persuaded the Government to set up an Industrial Research Utilisation Committee (IRUC) for translating results into application. The Government agreed to make a separate fund out of the royalties received from industry for further investment into industrial research. An Industrial Research Fund was constituted for the purpose of fostering industrial development in the country. The CSIR came into operation on 26th September 1942. The BSIR and IRUC were designated as advisory bodies to the Governing body of the CSIR.

In 1943, the Governing Body of the CSIR approved the proposal of Dr. Bhatnagar to establish five national laboratories. These included National Chemical Laboratory (NCL), National Physical Laboratory (NPL), National Metallurgical Laboratory (NML), Central Fuel Research Institute (CFRI) and Central Glass & Silicate Research Institute (CGSRI).

In 1944, in addition to its annual budget of Rs. 1 million, the CSIR received a grant of Rs.10 million for the establishment of these laboratories. The Tata Industrial House donated Rs. 2 million for the chemical, metallurgical and fuel research laboratories.

## **The Father of Research Laboratories: Developing Industrial Research in India**

India's flagship science institution, the Council of Scientific and Industrial Research (CSIR), was thus established with Dr. S. S. Bhatnagar at the helm of its affairs. Dr. Bhatnagar wanted to extend the scope of the CSIR by establishing a chain of national laboratories in the country under its command.

## Torchbearer Institutes of Scientific and Industrial Research in the Pre-Independence Era

During 1945 to 1947, India witnessed two important sides. One was the fanatic religious violent riots, bloodshed, dead corpses on streets and quest for partition. This was the darkest side of Indian History, the brighter side was, seeds for science and technology research sown by Dr. Shanti Swarup Bhatnagar had started taking shape. This period has seen the commencement of a chain of National Research Laboratories and Institutions that became at par with other labs in the world. The five torchbearer institutions of Scientific and Industrial research started their journey during this period, just before Independence.

- December 1945: Central Glass and Ceramic Research Institute, Calcutta (Kolkatta). The foundation stone was laid by Sir Ardeshir Dalai, then Member for Planning and Development in the Government of India.
- 17th November, 1946: Central Fuel Research Institute, Dhanbad. The stone-laying ceremony was performed by the Hon. C. H. Bhaba, Minister for Works, Mines and Power.
- 21st November, 1946: National Metallurgical Laboratory, Jamshedpur, for which the Hon. C. Rajagopalachari, Minister Education and Arts, laid the foundation stone.
- 4th January, 1947: National Physical Laboratory, New Delhi. The foundation stone was well laid by Pt. Jawahar Lal Nehru.
- 6th April, 1947: National Chemical Laboratory, Pune. The foundation stone was laid by the Hon. B. G. Kher, Prime Minister of Bombay.

After India's independence the CSIR was placed under Prime Minister Jawaharlal Nehru himself, who was equally enthusiastic about the development of science in the country. By the end of 1954 twelve national laboratories were established and a dozen more were at the planning stage.

During Dr. Bhatnagar lifetime, 14 national laboratories were operational, acquired or had their foundation stone laid. They were:

1. National Chemical Laboratory (NCL), Pune
2. National Physical Laboratory (NPL), New Delhi
3. Central Fuel Research Institute (CFRI), Dhanbad
4. Central Glass and Ceramic Research Institute (CGCRI), Kolkata
5. Central Food Technological Research Institute (CFTRI), Mysore
6. National Metallurgical Laboratory (NML), Jamshedpur
7. Central Drug Research Institute (CDRI), Lucknow
8. Central Road Research Institute (CRRI), Roorkee
9. Central Electrochemical Research Institute (CERI), Karaikudi
10. Central Leather Research Institute (CLRI), Chennai
11. Central Building Research Institute (CBRI), New Delhi
12. Central Salt Research Institute (CSRI), Bhabnagar
13. Central Electronics Engineering Research Institute (CEERI), Pilani
14. National Botanical Research Institute (NBRI), Lucknow

The first eleven laboratories listed above are often called the “Bhatnagar Eleven”. These laboratories were operational by 1951.

The first Director-General of the Council of Scientific and Industrial Research (CSIR), Dr. Bhatnagar is revered as the “Father of Research Laboratories” in India.

### **At the Helm:-Important Positions Held**

Dr. Bhatnagar’s interest in science and its practical utilization was very wide and he did a great deal of pioneering work especially on the organizational side. He concurrently held a number of important positions in the Government.

He was the first Chairman of the University Grants Commission (UGC).

## Contributions to Industrial Research in India

Very few scientists have contributed to both science and nation-building like Dr. Shanti Swarup Bhatnagar. He was truly in a class of his own.

In 1940, the Board of Scientific and Industrial Research (BSIR) was formed by the Government of India and Dr. Bhatnagar was appointed as the Director. In 1942, the Council of Scientific and Industrial Research (CSIR) was constituted as an autonomous body. In 1943, Dr. Bhatnagar's proposal to establish five national laboratories was approved. These included National Chemical Laboratory (NCL), National Physical Laboratory (NPL), National Metallurgical Laboratory (NML), Central Fuel Research Institute (CFRI) and Central Glass & Silicate Research Institute (CGSRI), which were set up to mark the beginning of scientific laboratories in India.

At CSIR, he also mentored a number of promising young scientists of the time. Shanti Swarup Bhatnagar along with Homi Jehangir Bhabha, Prasanta Chandra Mahalanobis, Vikram Sarabhai and others, helped in building India's post-independence science and technology infrastructure.

He also served as the Secretary of the Ministry of Education and Educational Adviser to the government. He played an instrumental role in the establishment of the National Research Development Corporation (NRDC) of India.

He was Secretary, the Ministry of Education and Educational Adviser of the Government.

Dr. Bhatnagar was associated with the development of the Atomic Energy Programme of India. In 1945, an Atomic Energy Committee was set up under the aegis of the Council of Scientific and Industrial Research. The Committee was chaired by Homi Jehangir Bhabha, and it included Shanti Swarup Bhatnagar, Meghnad Saha and D.N.Wadia, then Mineral Adviser to the Central Government.

The Atomic Energy Commission was established under the Chairmanship of Homi Bhabha. Its other members were Shanti Swarup Bhatnagar and K.S. Krishnan.

Dr. Bhatnagar was the first Secretary to the Ministry of Natural Resource & Scientific Research and also the Secretary of the Atomic Energy Commission.

He played an instrumental role in the establishment of the National Research Development Corporation (NRDC) of India, which was visualized to bridge the gap between research and development.

Dr. Bhatnagar was responsible for the initiation of the Industrial Research Movement in the country. The Government of India, being persuaded by the efforts made by Shanti Swarup Bhatnagar, set up an Industrial Research Utilisation Committee for translating science and technology into industrial applications.

In 1935, Dr. Bhatnagar and Dr. K. N. Mathur published a comprehensive paper entitled "Physical Principles and Applications of Magneto Chemistry". This publication is recognised as a standard work on the subject, the first to be written in English. When it appeared, letters of congratulations were received from Prof. Donnan, Prof. Stoner, Lord Rutherford, Mr P. C. Ray, Sir C. V. Raman, Prof. G. N. Lewis and many others.

His research contributions in the areas of magneto-chemistry and physical chemistry of emulsion were widely recognized.

### **Fighting Against Odds**

Like many other great achievers, Shanti Swarup Bhatnagar had to struggle to realise his goal in life. Having lost his father when he was just eight months old, Shanti Swarup lived in his maternal grandfather's house till he was 13. After that he supported himself. His mother had no inheritance or income of her own for the upbringing of her children. He managed to study either by getting a scholarship or by working outside school and college hours. By his sheer willpower and hard work, Dr. Bhatnagar was elected a Fellow of the Royal Society of London—the highest honour that an Indian scientist could aspire to get other than the Nobel Prize. Whoever came in contact with him was touched by his intellect, diligence, honesty and above all, his simplicity.

### **Take Aways**

- Nation building calls for zealous passion. Men who devote themselves to this noble task, are the real heroes.
- Integrity of character and principles forge destinies.

## CHAPTER

# 5

## AWARDS AND RECOGNITIONS

- Dr. Shanti Swaroop Bhatnagar was elected as Fellow of the Indian Academy of Sciences (FASc) in 1934.
- He was appointed a Foundation Fellow of the National Institute of Sciences of India (FNI; now the Indian National Science Academy) in 1935.
- In 1936, Dr. Bhatnagar was conferred with the Order of British Empire (OBE), based on his excellent work in pure and applied Chemistry.
- He was knighted with the title “Sir”, in 1941 for his contributions to the advancement of science.
- In 1942, Dr. Bhatnagar was appointed a Fellow of the Institute of Physics (FInstP), and a Fellow of the Royal Institute of Chemistry (FRIC)
- In 1943, he was elected Fellow of Royal Society (FRS), London.
- In 1943, the Society of Chemical Industry, London, elected him an Honorary Member and later Vice-President.



- In 1954, Dr. Shanti Swarup Bhatnagar was honoured with the Padma Bhushan, the third highest civilian award in the Republic of India.
- Dr. Bhatnagar was the President of the Indian Chemical Society, the National Institute of Sciences of India and the Indian Science Congress. Besides them he was a member of a large number of Indian and British Societies and Academies.
- Dr. Bhatnagar was awarded Honorary Doctorate degree by a number of Universities: Patna University (1944), Oxford University (1946), Allahabad University (1947), Delhi University (1948), Lucknow University (1949), Agra University (1949), BHU (1949), Punjab University (1949), Sagar University (1949).
- Dr. Bhatnagar was awarded the H.K. Sen Memorial Gold Medal for distinguished research work in Industrial Chemistry (1945), the J.K. Mukherjee Gold Medal awarded by the Indian Association for the Cultivation of Sciences for eminence in science (1945) and the Madathu Reddy National Prize for best work in Chemistry from India (1946).
- He was the first Chairman of the University Grants Commission.
- In 1994, the Government of India brought out a Postal Stamp at the birth centenary of Dr. Shanti Swarup Bhatnagar.

In 1958, to honour his name and legacy, the Indian Council of Scientific and Industrial Research (CSIR) instituted the Shanti Swarup Bhatnagar Prize for Science and Technology for scientists who have made significant contributions in various branches of science.

Dr. Shanti Swarup Bhatnagar was honoured with the Padma Vibhushan Doosra Varg in August 1954, in the first ever list of the Awards.

A while later, vide Presidential notification issued on January 8, 1955, the Padma Vibhushan Doosra Varg was designated as the Padma Bhushan. The Padma Vibhushan Pratham Varg remained the Padma Vibhushan.

So, Dr. Shanti Swarup Bhatnagar was awarded the Padma Bhushan that was formally given to his elder son in January, 1955, as he had already passed away (on 1st January, 1955).

## REMINISCING SHANTI SWARUP BHATNAGAR

**I**n his lifetime, Dr. Bhatnagar, did remarkable and pioneering work, as a scientist, teacher and administrator. He also worked with eminent personalities and won accolades from them.

Dr. Bhatnagar's vision is revealed in his thoughts; his noteworthy contributions are encapsulated in the words of his teachers, peers, leaders, and the scientific community, both from within and outside the country.

His own words reflect his character and visionary outlook. His never give up attitude helped him pave his path. He had a clear vision about the role of students, science and the symbiotic ties between academia and industry. All these attributes are clearly reflected in his thoughts:

### **A Man of Will and Determination**

- “As a young boy, my classmates used to tease me for being a day-dreamer. I used to think of great things which science could do for India and the part I, myself should play in it with the rest of my friends. The improbabilities

of my dreams coming true used to be the principal subject of jokes when I was a student. If I had not possessed a sense of humour and had taken those jests seriously I should have been a physical wreck. But, God be thanked, I have survived to see some of my dreams fulfilled. Failures have been many and successes rather few, but with an inborn optimism and faith in my country's future I pursue on."

## The Visionary

- "Science has no future in India unless our agriculture and our industries are fully developed; more food and more health are dependent upon these factors. Scientific and industrial research thrives best when it is applied to material benefit to humankind and to existing industries and agricultural enterprises.

*In his Presidential Address to the Indian Science Congress at Nagpur (1945)*

- "One of the most important functions of the NCL will be to bridge the gulf between science and its application. It will be the link between the universities and other scientific institutes in the country and industry.

*In his address on the occasion of the opening of the NCL on January 03, 1950*

- "None of the freedoms to which the modern world aspires seems to be more important than the freedom to learn, to speak and to write. Well used, this freedom of the universities would foster original thinking and independent action.

*In his address at the 28th Convocation of the Andhra University on*

*December 11, 1954*

- "In a country which has been under foreign rule, it is of greatest importance that the spirit of daring and adventure should be cultivated rather than suppressed".

- “I am all for the development of research associations but the universities should not and cannot be divorced from industrial research activities. Science and industry go hand in hand and any attempt to divorce them will lead to an unsatisfactory and unhappy state of affairs.

*In his Presidential address to the annual meeting of the Lahore Branch of the Indian Chemical Society on February 24, 1939*

### **Patriotic Zeal with Scientific Fervour**

- When he was asked by the Viceroy Lord Linlithgow, to take up the post of Scientific Adviser and Director, Scientific and Industrial Research in 1940, Dr. Bhatnagar was hesitant to leave the Punjab University. Later he was convinced and the following lines show his nationalism:
- “He (Sir Ramaswamy Mudaliar) assured me that this temporary activity might ultimately result in big developments for scientific research in this country. His statement convinced me that I must leave the university for a larger field to help in building up India’s scientific research, training her young scientists and inspiring her young men to take up research as a career not for monetary gain but for the sake of research itself.”

*In his address to the Opening Ceremony of the National Chemical Laboratory on January 03, 1950*

### **Fellow of the Royal Society (FRS): The Honour**

- “All luck and happiness to the new F.R.S. So far as I knew, you are the first Indian chemist to be elected. Needless to say, I am very proud that this honour and a well-deserved one, comes to my old friend and former research student, S.S.B!

*Donnan, his research guide*

The Royal Society of London is the oldest and most exclusive scientific society in Great Britain and one of the oldest in Europe. The Society is of very great importance in the world of science and to be elected a Fellow of the Royal Society is an honour of the highest degree. Newton was elected Fellow of the Royal Society in 1671 and in 1708 he became the President of the Royal Society.

“If India is shining today, it is because of its S&T strength, the foundations for which were laid by bureaucrats like Ramaswami Mudaliar, scientists like Bhatnagar and political leaders like Pt. Nehru, who were committed to protecting national interest in their own spheres of activity, and saw in science and technology the instrument needed for social transformation.”

Nitya Anand, formerly Director, Central Drug Research Institute,  
a CSIR laboratory

## On Publishing a Book

Dr. Bhatnagar, wrote the book “Physical Principles and Applications of Magneto Chemistry” along with K.N. Mathur The book was published by Macmillan Publishers in 1935.

### *P.C. Ray wrote about the book :*

- “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 textbook 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 my great consolation is that you, in chemistry, are raising the reputation, abroad of Indian workers.”

***C. V. Raman wrote:***

- “I specially admire your energy and perseverance in having produced such a book in spite of your other important scientific and practical activities. Your name now stands as one of the very few Indians who have written scientific books claiming the respect and attention of serious workers in every country.”

Shanti Swarup Bhatnagar’s research in the area of emulsions have been described in two books written by William Clayton— *Emulsion and Emulsification*, and *Emulsions and their Technical Treatment*.

## **The Magnanimous Man**

While working at the Punjab University, Lahore, Dr. Bhatnagar earned a considerable sum of money from his applied research work. However, he donated all his earnings from such activities to the University, which at one instance amounted to 1,50,000/- due to the solution he provided to a problem being faced by M/S Steel Brothers.

***Meghnad Saha, known for his pioneering contributions in astrophysics, wrote to Shanti Swarup Bhatnagar:***

- “Please accept my heartiest congratulations on your noble gift to the Punjab University. You have thereby raised the status of the university teachers in the estimation of the public. India does not lack men earning in millions, but if a few of these millionaires were guided by the fine examples set by a comparatively poor teacher like yourself, I think her scientific and moral progress would have been rapid.”

*J.C. Ghosh, a student of Acharya Prafulla Chandra Ray and an internationally acclaimed chemist, wrote:*

“Your generosity has no parallel in India. To make over to your alma mater, a sum of Rs. 1,50,000 which was the reward for your distinguished service in the field of applied research, is a unique gift and no praise can be too high: To be able to claim you as a friend has been a matter of pride—it is seen even more so now.”

*In his Presidential address to the Indian Science Congress held at Lahore in 1939, J.C. Ghosh said:*

“Within the precincts of this university, it is not necessary that I should have to make a special pleading that scientific knowledge and industrial activities should be coordinated or that our academic laboratories should not be divorced from practical affairs. We have here a flourishing Honours School of Technical Chemistry; and the genius of Professor Bhatnagar has provided a bridge of communication between scientists and industrialists. Nowhere is the beneficial effect of contact between universities and industry better exemplified than in the programme of research on oil technology, now carried out under the supervision of Professor Bhatnagar, with the aid of funds provided by Messrs Steel Brothers.”

## **Pioneering Work**

Sir Robert Robinson, the President of the Royal Society of London, in a message sent to Dr. Bhatnagar (in January 1950) on the occasion of the opening of the National Physical Laboratory wrote:

“We cannot forbear from adding a personal message of congratulations to Sir Shanti Bhatnagar who is so well known to us and whose practical initiative and capacity for action has made possible the realization of his dreams.”

## **Immortal Memories: A Life Well-Lived**

On his death, the Government of India issued a Gazette Extraordinary on 04 January, 1956, which stated the following:



Dr. Shanti Swarup Bhatnagar died on January 01, 1955. Pandit Jawaharlal Nehru, the first Prime Minister of India himself was present at his funeral on 02 January 1955.

“The President has learnt with deep regret of the death on Saturday, 1st January, 1955 of Dr. Shanti Swarup Bhatnagar, Secretary of the Government of India, Ministry of Natural Resources and Scientific Research, and Chairman, University Grants Commission. On his passing away, India has lost an able and trusted public servant who had served his country with signal distinction in the scientific world.”

After his death Maulana Abul Kalam Azad, the well-known Congress leader and then a minister in the Union Cabinet, said:

“I often felt that the effect of such hard work might fall upon his health. In spite of my repeated requests, he would not, however, refrain from his hard work. His life is a remarkable story of a man who believed in karma and worked with integrity in whatever role he took up. He believed in the power of science to improve the quality of lives of the people and the role of scientists in connecting the common man with science. Sir Shanti Swarup Bhatnagar was a great optimist and he firmly believed that there is always hope for a better future. “There is no reason to believe that all that is best has already been achieved and that there is no future for winning fresh laurels for younger men.”

To support his point once he quoted an optimistic poet:

“The best verse has not been rhymed yet;  
The best house hasn't been planned;  
Many majestic rivers aren't spanned;  
Don't worry and fret, faint-hearted;  
For the best jobs haven't been started;  
The best work hasn't been done.”

## **A Message for Posterity**

*“I would like students of Indian universities to develop a greater sense of devotion to duty and hard work. The force, the mass of character, mind, heart, or soul, that a man can put into any work is the most important factor in that work...If our students take interest in the developments which are taking place and shoulder a part of the burden, they will be assisting in the progressive march of the nation.”*

SS Bhatnagar addressing the  
third Convocation of the  
Maharana Sayajirao University of Baroda

## APPENDIX

### PHOTO GALLERY



Postal stamp released by the Government of India in 1994 to commemorate the birth centenary of Dr. Bhatnagar

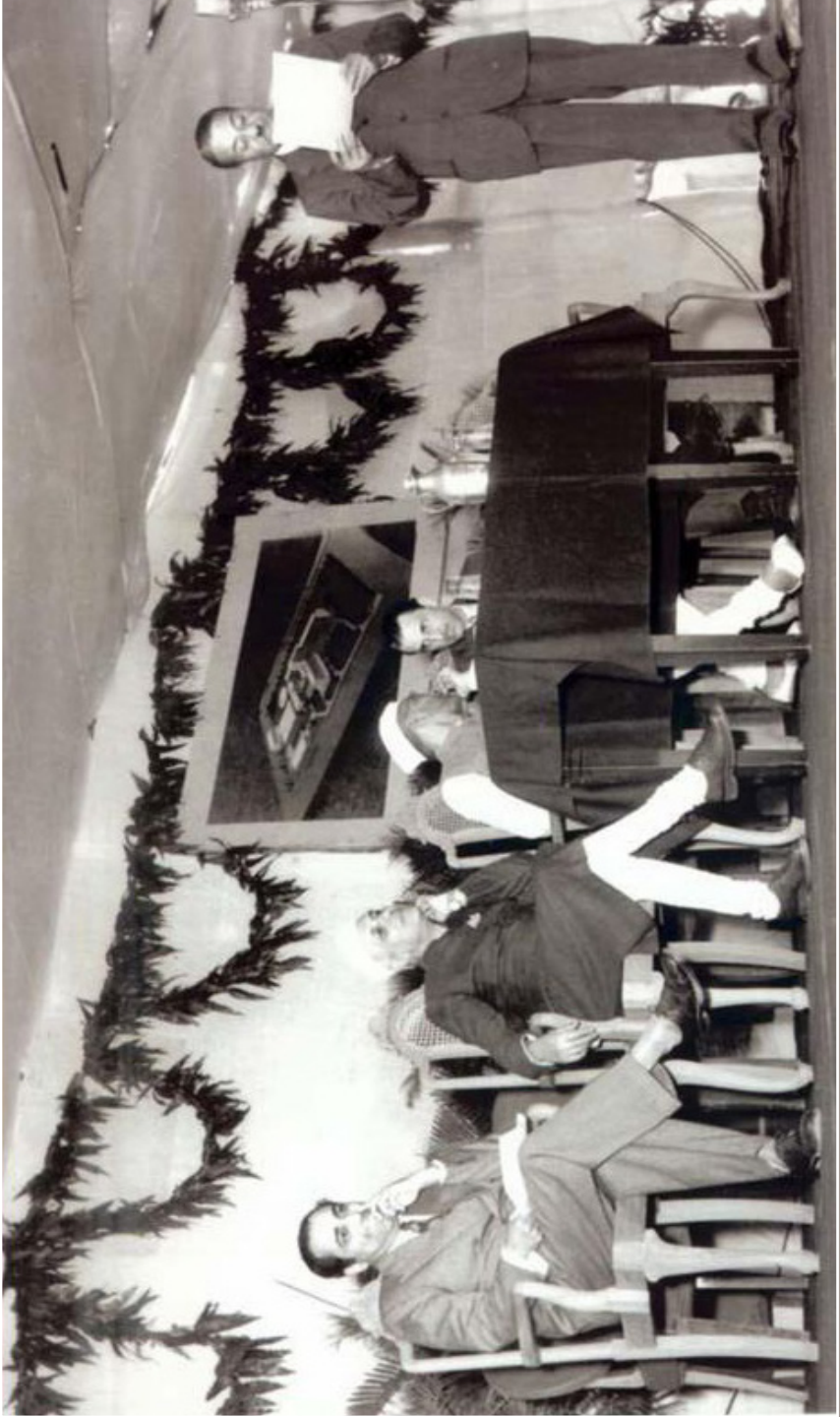


Council of Scientific & Industrial Research (CSIR)- Logo

सीएसआईआर  
**CSIR**  
भारत का नवाचार इंजन  
*The Innovation Engine of India*



Ruchi Ram Sahni : Mentor of Shanti Swarup Bhatnagar



Dr. S. S. Bhatnagar at Laying of Foundation Stone of TIFR, January 01, 1954



Sir Shanti Swaroop Bhatnagar with Pandit Jawaharlal Nehru,  
the first Prime Minister of India  
(Photo courtesy: Rinchen Norbu Wangchuk)



Stalwarts of science in one frame Shanti Swaroop Bhatnagar, Homi Jehangir Bhabha, CV Raman, Vikram Sarabhai



Dr. Birbal Sahni, FRS and Dr. Shanti Swarup Bhatnagar, FRS  
The first Botanist and first Chemist, respectively, from India to be elected Fellows of the Royal Society, London.

## APPENDIX

## 2

## IMPORTANT MILESTONES IN THE LIFE OF DR. SHANTI SWARUP BHATNAGAR

S. No.	Year	Event
1	21.02.1894	Birth at Bhera in Shahpur District (presently in Pakistan)
2	1911	Published a letter in the Allahabad newspaper, <i>The Leader</i>
3	1911	Matriculation from the Dyal Singh High School, Lahore
4	1913	Passed the intermediate examination of the Punjab University
5	1916	Graduation, B.Sc. Honours in Physics, from Forman Christian College, Lahore
6	1919	Post Graduation in Chemistry from Forman Christian College, Lahore
7	1921	Awarded D.Sc. degree from the University College, London, under the guidance of Prof. Donnan
8	Aug.1921	Joined the BHU, Varanasi as Professor of Chemistry



9	1924	Joined the Punjab University, Lahore, as Professor of Chemistry and as the Director of the University Chemical Laboratories
10	1933	Solved the industrial problem encountered during drilling operation by Attock Oil Company
11	1935	Published a book “Physical Principles and Applications of Magneto Chemistry” along with K. N. Mathur (Macmillan Publishers)
12	Dec. 1939	Appointed as an Advisor on Scientific and Industrial Research to the Government of India
13	1940	Appointed as the Director of Scientific and Industrial Research
14	26.09.1942	Establishment of Council of Scientific & Industrial Research (CSIR) due to the efforts of Sir Mudaliar and Dr. Bhatnagar with Dr. Bhatnagar as its Founding Director
15	1943	CSIR approval of the proposal of Dr. Bhatnagar to establish five national laboratories Elected as Fellow of the Royal Society (FRS), London
16	1954	Honoured with the Padma Bhushan
17	01.01.1955	Demise due to a severe heart attack
1958: The CSIR instituted the Shanti Swarup Bhatnagar Prize for Science and Technology, to honour the name and legacy of Dr. Bhatnagar		

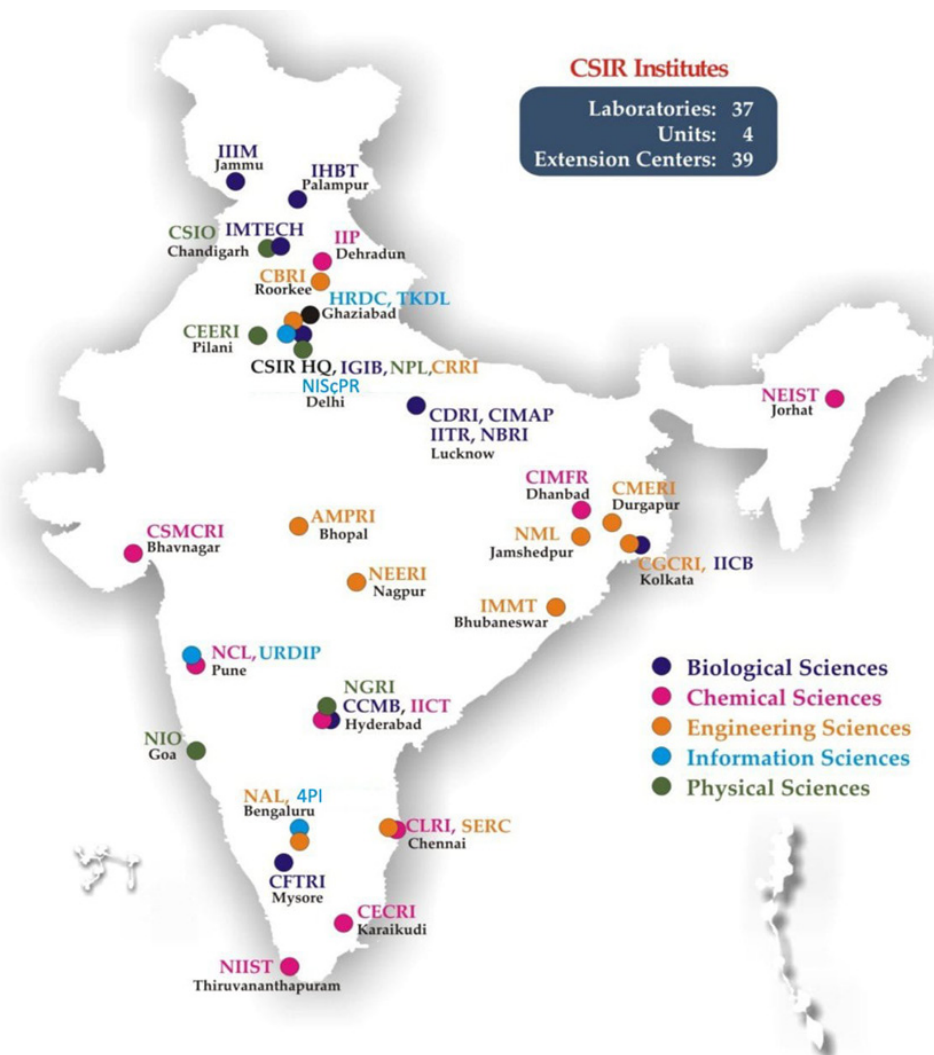
## LIST OF CSIR LABORATORIES

1. CSIR-Advanced Materials and Processes Research Institute (CSIR-AMPRI), Bhopal
2. CSIR-Central Building Research Institute (CSIR-CBRI), Roorkee
3. CSIR-Centre for Cellular Molecular Biology (CSIR-CCMB), Hyderabad
4. CSIR-Central Drug Research Institute (CSIR-CDRI), Lucknow
5. CSIR-Central Electrochemical Research Institute (CSIR-CECRI), Karaikudi
6. CSIR-Central Electronics Engineering Research Institute (CSIR-CEERI), Pilani
7. CSIR-Central Food Technological Research Institute (CSIR-CFTRI), Mysore
8. CSIR-Central Glass Ceramic Research Institute (CSIR-CGCRI), Kolkata
9. CSIR-Central Institute of Medicinal Aromatic Plants (CSIR-CIMAP), Lucknow
10. CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR) Dhanbad
11. CSIR-Central Leather Research Institute (CSIR-CLRI), Chennai
12. CSIR-Central Mechanical Engineering Research Institute (CSIR-CMERI), Durgapur
13. CSIR-Central Road Research Institute (CSIR-CRRI), New Delhi
14. CSIR-Central Scientific Instruments Organisation (CSIR-CSIO), Chandigarh

15. CSIR-Central Salt Marine Chemicals Research Institute (CSIR-CSMCRI), Bhavnagar
16. CSIR Fourth Paradigm Institute (CSIR-4PI), Bengaluru (Formerly CSIR Centre for Mathematical Modelling and Computer Simulation).
17. CSIR-Institute of Genomics and Integrative Biology (CSIR-IGIB), Delhi
18. CSIR-Institute of Himalayan Bioresource Technology (CSIR-IHBT), Palampur
19. CSIR-Indian Institute of Chemical Biology (CSIR-IICB), Kolkata
20. CSIR-Indian Institute of Chemical Technology (CSIR-IICT), Hyderabad
21. CSIR-Indian Institute of Integrative Medicine (CSIR-IIIM), UT of J&K
22. CSIR-Indian Institute of Petroleum (CSIR-IIP), Dehradun
23. CSIR-Indian Institute of Toxicology Research (CSIR-IITR), Lucknow
24. CSIR-Institute of Minerals and Materials Technology (CSIR-IMMT), Bhubaneswar
25. CSIR-Institute of Microbial Technology (CSIR-IMTECH), Chandigarh
26. CSIR-National Aerospace Laboratories (CSIR-NAL), Bengaluru
27. CSIR-National Botanical Research Institute (CSIR-NBRI), Lucknow
28. CSIR-National Chemical Laboratory (CSIR-NCL), Pune
29. CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), Nagpur
30. CSIR-North - East Institute of Science and Technology (CSIR-NEIST), Jorhat
31. CSIR-National Geophysical Research Institute (CSIR-NGRI), Hyderabad
32. CSIR-National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Thiruvananthapuram.
33. CSIR-National Institute of Oceanography (CSIR-NIO), Goa
34. CSIR-National Metallurgical Laboratory (CSIR-NML), Jamshedpur
35. CSIR-National Physical Laboratory (CSIR-NPL), New Delhi
36. CSIR-National Institute of Science Communication & Policy Research (CSIR-NIScPR), New Delhi,
37. CSIR Madras Complex (CSIR-CMC), Chennai
38. CSIR-Structural Engineering Research Centre (CSIR-SERC), Chennai

Source: <https://www.csir.res.in/csir-labs>

# CSIR Network Map



Source: CSIR Website

## Shanti Swarup Bhatnagar (SSB) Award for Science and Technology

The Shanti Swarup Bhatnagar (SSB) Award was established in 1958, to recognize outstanding contributions of Indian researchers in science and technology.

Named after the founder Director of the Council of Scientific and Industrial Research, Shanti Swarup Bhatnagar, it is the most sought-after honour in multidisciplinary science in India that recognizes outstanding work by researchers under the age of 45, in the field of science and technology. Overseas Citizens of India (OCI) and Persons of Indian Origin (PIO) working in India are also eligible. It is the highest award for science in India.

SSB Prizes, are awarded annually for notable and outstanding research, applied or fundamental, in the following disciplines:

- i) Biological Sciences
- ii) Chemical Sciences
- iii) Earth, Atmosphere, Ocean and Planetary Sciences
- iv) Engineering Sciences
- v) Mathematical Sciences
- vi) Medical Sciences and
- vii) Physical Sciences

## Shanti Swarup Bhatnagar Prize Components

The SSB prize includes a citation, a plaque, and a cash award of ₹5 lakh.

### Presentation of Awards

The names of the recipients are made public on 26<sup>th</sup> September, the CSIR Foundation Day by the Director General, CSIR. The Prizes are awarded at a formal presentation ceremony arranged by CSIR.

At the ceremony, a suitable citation on work of the recipient of the Prize is read out.



## Recipients of Shanti Swarup Bhatnagar (SSB) Prize for Science and Technology - 2022

### Biological Sciences

**Dr. Ashwani Kumar**

CSIR-Institute of Microbial Technology, Chandigarh

**Dr. Maddika Subba Reddy**

Centre for DNA Fingerprinting Diagnostics, Hyderabad

### Chemical Sciences

**Dr. Akkattu T Biju**

Indian Institute of Science, Bengaluru

**Dr. Debabrata Maiti**

Indian Institute of Technology Bombay, Mumbai

### Earth, Atmosphere, Ocean and Planetary Sciences

**Dr. Vimal Mishra**

Indian Institute of Technology Gandhinagar, Gandhinagar

### Engineering Sciences

**Dr. Dipti Ranjan Sahoo**

Indian Institute of Technology Delhi, New Delhi

**Dr. Rajnish Kumar**

Indian Institute of Technology Madras, Chennai

### Mathematical Sciences

**Dr. Apoorva Khare**

Indian Institute of Science, Bengaluru

**Dr. Neeraj Kayal**

Microsoft Research Lab India,  
Bengaluru

### Medical Sciences

**Dr. Dipyaman Ganguli**

CSIR- Indian Institute of Chemical Biology, Kolkata

### Physical Sciences

**Dr. Anindya Das**

Indian Institute of Science Bengaluru

**Dr. Basudeb Dasgupta**

Tata Institute of Fundamental  
Research Mumbai

Source: [https://ssbprize.gov.in/Content/NewsandPublish.aspx?m\\_id=1](https://ssbprize.gov.in/Content/NewsandPublish.aspx?m_id=1)

<https://ssbprize.gov.in/WriteReadData/latestUpdates/202309110115561846131SSBPrize2022Website.pdf>

## APPENDIX

## 5

**Dr Bhatnagar's Scientific Papers\***

1920.	Studies in emulsions. Part I. A new method of determining the inversion of phases. J. Chem. Soc.117, 542.
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1921.	Pure aniline and water emulsions. J. Phys. Chem., Ithaca, 25,735.
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1924.	Surface tension of sodium and potassium amalgams at the amalgam benzene interface. <i>J. Indian Chem. Soc.</i> , 1, 81.
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1924.	Electrical conductivity of certain univalent salts of higher fatty acids in non-aqueous solutions and in fused state. <i>Kolloid.</i> , 34,193.
1924.	Effect of light on the interaction of water and sodium and potassium amalgams. <i>J. Indian Chem. Soc.</i> , 1, 263.
1925.	Protective action of soaps and further evidence in favour of the chemical theory of adsorption. <i>J. Indian Chem.</i> , 2, 11.
1925.	Electrical resistance of thin films of organic liquids on paper. <i>J. Phys. Chem.</i> , 117,88.
1925.	Effect of water on dried and pressed silica gel. <i>Kolloid</i> , 37, 97.
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1926.	Effect of polarised light on bacterial growth. <i>Nature, Lond.</i> , 117,302.
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1926.	Rates of evaporation of water absorbed on metals and their oxides. <i>J. chem. Phys.</i> , 23,545. 1926. Relation between the chemical constitution of organic liquids and the translucence of paper dipped in them. <i>J. Phy. Chem.</i> , 122,88.
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***\*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

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## ABOUT THE BOOK

Padma Bhushan, Dr. Shanti Swarup Bhatnagar, the man who dared to dream the unthinkable and traversed his life path with fortitude, laid the foundation of India's scientific future. Amidst the galaxy of luminaries who have lighted up the sky of our achievements in the various spheres of science and technology, Dr. Bhatnagar has carved for himself a place of great eminence. To introduce the young minds to this great visionary, giving them a little peek into the many challenges and the many achievements that have shaped his life, is a matter of pride. Our humble endeavour is to create a feeling of national pride and respect for the great men who have been stepping stones in the glorious journey of India's progress and development. Young minds can be ignited by setting before them exemplary role models and Dr. Bhatnagar is one such figure. We hope the book not just informs but also inspires.

## ABOUT THE AUTHORS

**K. Venkataraman**, Ph.D., former Curator of National Council of Science Museums, (Govt. of India), Kolkata, and presently a faculty of Physics at PMB Gujarati Science College, Indore. He is an academician, writer and the Editor-in-Chief of Vidarthi Vigyan Manthan (VVM).

**Nandini Phanse**, Ph.D., is presently the Head of the Post Graduate Department of Microbiology of PMB Gujarati Science College, Indore. An academician and researcher for 34 years, she is a writer and the Co-Editor of VVM.

**Deepa Vanjani**, Ph.D., is presently heading the English Department of PMB Gujarati Science College, Indore. An academic, poet, writer, animal rights activist, and freelance journalist and Editor of VVM.

**Shilpa Parikh**, Ph.D., is presently Head of the Computer Science department in MKHS Gujarati Girls College, Indore. An academician for the last four decades, she is a writer, philanthropist and spiritualist.



## VIJNANA BHARATI

A4, First Floor, Gulmohar Park,  
August Kranti Marg (Main Road), New Delhi- 110049  
E-mail: [vijnanabharati@gmail.com](mailto:vijnanabharati@gmail.com)  
Contact: +91-011- 49032436