Dr. Vikram Sarabhai

Priyanka V

Space Books Series for Children
U. R. Rao Satellite Centre-
Bengaluru-560017

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Chairman's Message

Scientific literature for children is an essential and distinctive literary work. It is to observe all the happenings around us from a scientific point of view and explain it in simple words. This endeavour can make a high school student understand complex subjects like astronomy, satellite and rocket technology, which is highly appreciable.

In this regard, U R Rao Satellite Centre, a prestigious research Institute in Bengaluru, has launched a new program called "Space Books Series for Children" through which it plans to bring out pocket-books on "Space Technology Space

Science and Space Scientists". This book, which is now in your hands, is one such work. This work a significant step toward enriching science literature for children.

Explaining various scientific and technical topics in simple language is necessary to inculcate interest in science among children. Similarly, it is essential to explain the scientific achievements of our organization to the masses and create awareness about it. The "Space Books Series for Children" programme will fulfil these requirements.

I congratulate the Director of U R Rao Satellite Centre for conceiving and implementing this programme. I hope more topics will be covered and reach more children and commoners in the coming days.

S. Somanath

Chairman, ISRO

Director's Message

Satellite, space science, technology and related topics should be explained in simple language so everyone can easily understand them. Such a literary effort will provide essential and authentic information, especially to the young talents of rural areas. Thus, it is a significant step in providing them with better opportunities and building a great future.

This work should be done by the skilled and experienced scientists of U R Rao Satellite Centre who have been working in this field of technology for five decades. To educate children about space science and technology, U R Rao Satellite

Centre is bringing out the "Space Books Series for Children".

Our enthusiastic colleagues have written books on these topics in response to this idea. It is a pleasure to put seven pocket-books of this series in your hands today. I congratulate the authors for their efforts and wish the program success. I want the students to develop interest and curiosity in these subjects. I also hope they understand the principles, get inspiration and create a better future, thereby contributing to the country's and society's overall development. I am confident that our objective will be realized and the desired result will be achieved.

M Sankaran

Director

U R Rao Satellite Centre

Editorial Board

Space Books Series for Children

Dear Children,

U R Rao Satellite Centre (URSC) celebrated its Golden Jubilee in 2022. On this occasion, the Karnataka Rajyothsava Committee of URSC had taken up the task of publishing a series of Kannada books on Space and Space Scientists which have been translated into English for the benefit of students across the country.

Our committee plans to publish pocket-books in simple language to make school children easily understand many topics like space science, rocket and satellite technology, etc. These books are written by the scientists of our organization. As the first set of books in this series, seven books are published. Our aim is to provide electronic version of the books to children through our website.

Our committee is grateful to Shri M Sankaran, Director, URSC who is the key person behind the successful realization of these books. Our heartfelt thanks to Shri HN Suresh Kumar, Shri KV Govinda, Dr. M Ravindra, Smt. Lalitha Abraham, Smt. Anuradha S Prakasha and Smt. Sreedevi S for having reviewed all seven books in detail and suggested suitable modifications.

We are grateful to all the authors who took time off from their work and authored the books. We are thankful to all colleagues of our Centre who helped us to bring out these books.

If you read them and give your suggestions and comments, we will be able to incorporate the same in the next set of books in this series.

Ramanagouda V Nadagouda

President

Author's Note

The purpose of this book is to introduce school children to ISRO and space technologies. Towards this motive, U.R. Rao Satellite Center of ISRO is publishing booklets to introduce the children to the fundamentals of space science.

This book gives a short introduction about Dr. Vikram Sarabhai, the founding father of ISRO. It describes his childhood, education, work ethics, upbringing and involvement in various organizations.

The goal of this book will be achieved if, after reading this, his life has an impact, even on a small percentage of children. I hope that the children of today will continue to carry out research in the field of space and improve the lives of common man.

My heartfelt thanks to Shri M. Sankaran, Director, U. R. Rao Satellite Centre, for giving me an opportunity to write this book. Salutations to Shri Ramanagouda V Nadagouda, Chairman of the Editorial Board of this book series and to all the senior colleagues of the organization.

Priyanka V.

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1. Introduction

Different types of satellites are a part of our daily life today. These days, the life of common people cannot progress without the help of satellites. Every Indian citizen directly or indirectly gets benefittedby satellites. Very few countries in the world are involved in research and development in the field of space. Every Indian is proud that India is also a leading country in thatcluster.

Who is responsible for this state of space advancement today? Who is responsible for India being able to make unprecedented achievements in the field of space? Who is the father of India's space research? The great personbehind all this is Dr. Vikram Ambalal Sarabhai.

Although every person in the world is the leader of his own life, only a few achievers go on to become a leader for the

entire mankind. One such person was Dr. Vikram Ambalal Sarabhai. Dr. Sarabhai was not a person but a huge force which attracted people towards advancement in terms of developments. His achievements show that his ingenuity and ability were much higher than that of ordinary people.

2. Childhood and education

Dr. Vikram Ambalal Sarabhai was born on 20 August 1919. His father Mr. Ambalal Sarabhai, wasone of the richest businessmen inAhmedabad, and his mother was Mrs. Saraladevi. Vikram Sarabhai, who was one of the Ambalal couple's eight children, started showing his talent from an early age.

Although he grew up in a palatial house called "The Treat", which had more than fifty rooms, Vikram Sarabhai did not want to spend his childhood in the comfort of wealth. Mr. Ambalal took special care of

his children's education. He gave a different and unique system of education to his children namely the Montessori education which was introduced for the first time in India. With such a different education, Vikram Sarabai started to become a unique boy due to his extraordinary intelligence and learning abilities.

When Vikram Sarabai was six years old, he used to carefullyobserve and assemble the toys of railway engines, bogies, signals and stations bought by his father. Apart from that, he was extremely skilled in activities like cycling, boating etc. He used to regularly practise boating in the pond in his garden.

Vikram Sarabhai's parents and teachers, who saw his unparalleled memory, quick wit, ability to grasp many things simultaneously and concentration, dreamt that Vikram Sarabhai would

achieve great things in the future. Rabindranath Tagore, who visited his house in 1920, saw Vikram Sarabhai's behavior and talent and predicted to his mother Saraladevi that Vikram Sarabhai would do great things in the near future.

At the end of his Montessori education at home, Sarabhai tookup theMatriculation (Class 10) examination as an external candidate from RC High School, Ahmedabad. During childhood, although he practiced several languages, mathematics and arts, his favorite subject was basic science.

After Matriculation, Vikram Sarabhai took the Intermediate (Class XII) examination at Gujarat College under Bombay University.

In that exam, he scored the highest marks in Physics and Chemistry. Later, he enrolled in Cambridge University in

England for higher studies. Shortly after Sarabhai joined Cambridge University, the Nobel Prize winner who was the director of the Cavendish Laboratory and the father of nuclear physics, Ernest Rutherford, a native of New Zealand, passed away. Also, because of the dark shadow of World War II, Jewish scientists in Europe turned to America. In 1940, Sarabhai received a Tripos (degree in Natural Sciences from Cambridge University), but had to return to India as a result of the Second World War.

It can be considered that it isIndia's luck that Sarabhai did not continue his research in England. Sarabhai graduated from Cambridge and enrolled at the Indian Institute of Science (IISC), Bengaluru, India's premier scientific institution, under the guidance of Sir C.V. Raman, a Nobel laureate, awarded for discovering the “Raman effect”. Under the guidance of Sir C.V. Raman, Sarabhai started his research

studies on cosmic rays from space from 1940 to 1945, which can be said to be responsible for India's future great achievements in the field of space.

Homi Jehangir Bhabha, who graduated from Cambridge 10 years before Sarabhai and is known as the Father of India's nuclear power program, was then working as a Reader at IISc. After meeting Homi Bhabha, Sarabhai's life took a new turn and led Sarabhai to take the lead in the Indian nuclear energy program.

While doing research at IISc, Sarabhai lived separately in a house called Premalaya in nearby Malleswaram instead of living in the student hostel. Due to the influence of the name of the house, he became interested in art, music and dance and eventually fell in love with the famous Bharatanatyam dancer Mrinalini Swaminathan; they both got married in the month of August 1942.

In 1943, Sarabhai went to Kashmir to measure cosmic rays at high altitude. As instructed by Homi Bhabha, he discovered a method of directly measuring slow mesons using a Geiger counter. Mesons are particles formed when cosmic rays from outside collide with atoms in the Earth's upper atmosphere. When these measurements were studied, the intensity of the cosmic rays continued to vary with time during the day. Finding this fact, Sarabhai changed his research topic from "Cosmic Ray Investigation in Tropical Latitudes" to "Time Variations of Cosmic Rays".

After the end of the Second World War in 1945, Sarabhai left for Cambridge with his wife to complete his PhD studies. His final oral examination in Manchester was conducted by Blackett, a Nobel laureate in Nuclear Physics and cosmic radiation, after which Vikram Sarabhai was

awarded his Ph.D. in 1947.

Vikram Sarabhai, who returned to India after completing his PhD, established Physical Research Laboratory. Vikram Sarabhai continued his post-doctoral research at this institution. Initially he started research on his favorite subject, cosmic rays, atmospheric layersand gradually expanded into Physics, Earth's atmosphere and space science. It can be said that Sarabhai's foresight resulted in undertaking research in Astronomy, studying the sun and other planets. The institute functioned in Vikram Sarabhai's home "The Retreat" in its early days, reflecting the significant contribution of the Sarabhai family to the scientific field in India.

Kartikeya Sarabhai, born in 1947 to the Sarabhai couple, achieved great laurelsin the field of science like his father and Mallika Sarabhai, born in 1954, excelled

and proved her skills in the art of dance like her mother. Mahatma Gandhi was very close to Sarabhai's family. Gandhi often visited Vikram Sarabhai's house when he was a boy. At that time, Gandhiji's ideals, philosophy and theories had a great influence on Vikram Sarabhai. Throughout his life he followed Gandhiji's Satyasiddhanta and wanted others to be truthful as well. Vikram Sarabhai's personality of direct speech, truthfulness, humility and soft heart was accepted and embraced by many people in India.

Fig-1 Dr. Vikram Sarabhai

Fig-2 Dr. Vikram Sarabhai and Mrinalini Sarabhai

Fig-3 Sarabhai with his parents in childhood

Fig-4 Sarabhai with his children

Fig-5 Sarabhai with ISRO Scientists

Fig-6 Sarabhai in foreign land

3. Areas of Signioficant contribution by Sarabhai

Vikram Sarabhai did not limit himself to the field of science and technology. He involved himself in every fieldfrom the field of art to the field of space. In every field, new procedures, new systems, new projects, new processes, new methods of increasing the capacity of human resources, etc. were established by him. Apart from that, he participated in joint projects of organizations in various fields. For example, the joint project of agriculture and nuclear organizations, the joint project of radio and space organizations and so on. This provided new contributions to the common people of the country by acting in a complementary manner.

Let us take a look at the various fields of work that Vikram Sarabhai undertook before he fully involved himself in the field

of nuclear energy and space. Vikram Sarabhai, who had a great interest in art, music and dance, established an art institution called "Darpana Academy of Performing Arts" in Ahmedabad in 1949, jointly with his wife Mrinalini Sarabhai, a renowned Bharatanatyam and multi-style dance expert. In this Institute, youth and interested people were trained in various arts like music, dance, drama etc. Many celebrities have been trained in this institute.

In 1950, Sarabhai took over the leadership of his family-owned chemicals firm in Baroda. In 1955, he established his own company, Suhrud Geegi Limited. In 1956, Sarabhai started the manufacturing of medicines like vitamins, penicillin, streptomycin etc. which are essential for the masses in collaboration with European and American countries.

In 1957, he took over the management

of Swastik Oil Mills Ltd. Vikram Sarabai started bringing changes in thefactory with a scientific perspective. Ahmedabad Textile Industries Research Association was started in 1957 to usher in the textile revolution in the country by adopting modern technologies. In 1958, Sarabhai found Merck Limited. Between 1960-62, he took over Standard Pharmaceuticals, Kolkata and established Sarabhai Research Center and Operations Research Group. Sarabhai, who also founded three new companies, worked 20 hours a day and slept only 4 hours. He involved himself in new fields and was successful in all projects by applying his own new scientific methods.

Between 1955-62, he was a visiting professor at MIT, Boston, USA, taking classes for students. Vikram Sarabhai thought that there was a need for special education for the Indian industrial

category. In this regard, with his unrelenting efforts, with the cooperation of the heads of Industries of the Government of India, the Government of Gujarat, andthe famous businessman Kastur-bai Lal-bai of Ahmedabad, he established the Indian Institute of Management in Ahmedabad in 1961, which has become the best management educational institution inIndia today; he was its director for the first three years.

4. His Achievements in the field of space

Vikram Sarabhai was involved in various fields and modernized the Indian industrial scene with his vision, scientific method and application of technologies. He then ventured into his favorite research subject, space. This one step is said to have led to a great step taken by India in the field of space. On October 4, 1957, the then Soviet Russia launched a satellite into

space for the first time in the world.

After the launch of Sputnik, the International Science Organization established a new body for space research, namely the Committee on Space Research (COSPAR)in 1958. In 1962, the organization decided that it would be best to launch satellites at the Earth's magnetic equator. This fact was recorded by Vikram Sarabhai in his Ph.D. thesis in 1947. This is an example of Sarabhai's unique knowledge of space science, satellite launchingand rocket technology.

Realizing the importance of the space sector, the Government of India directed the Department of Atomic Energy under Homi Jehangir Bhabha to undertake space research in August 1961. Thus the space research work in India started under the Department of Atomic Energy. Homi Bhabha established the Indian National Committee on Space Research(INCOSPAR)

on February 16, 1962. Thiswas a separate department under the Department of Atomic Energy, to carry out space research and works like that of the international organization COSPAR.He madeVikram Sarabhai take its lead. In order to prepare space scientists in India, many selected young engineers were sent to the American space agency NASA for training. They were the ones who supported the development of ISRO's rockets and satellites in the next decade. One of those young scientists was former President of India Dr. A.P.J. Abdul Kalam. This shows Sarabhai's ability to spot talent in the youth.

What happened next can be termed as the golden history of India's space sector. The first sounding rocket of India was launched on November 21, 1963 from "Thumba Equatorial Rocket Launching Station (TERLS)" at Thumba near

Thiruvananthapuram, Kerala. This kickstarted the series of projects undertaken by Sarabhai there. As Vikram Sarabhai had done extensive research on the magnetic equator, as well as the ionosphere layers during his PhD studies, he was convinced and chose to build a launching station for sounding rockets at Thumba, as it was very close to the magnetic equator. His in-depth knowledge of these subjects made the launch of sounding rockets a success. A sounding rocket is an experimental rocket that carries instruments for conducting various scientific experiments during its suborbital flight. Sub-orbital flight is the trajectory of a rocket that is launched from the Earth and returns to the Earth without going around the Earth even once. Work on sounding rockets and space research under the leadership of Vikram Sarabhai at “Thumba” evolved rapidly.

On 1 January 1965, Sarabhai set up the Space Science and Technology Center (SSTC) (later renamed as Vikram Sarabhai Space Center - VSSC) nearVeli, taking another step towards further research in space. The objective of this Institute was to carry out research in aerospace engineering, design and development of sounding rockets and satellite launch rockets.

Meanwhile, the tragic death of Homi Jehangir Bhabha in a plane crash on January 24, 1966 caused a major setback to the country's nuclear research and development activities. Sarabhai was given overall responsibility of Indian nuclear energy research as the Chairman of the Atomic Energy Commission and Secretary of the Department of Atomic Energy. In the same year, 1966, Sarabhai became a member of the International Council of Scientific Union on behalf of India, serving

as the Chairman of the Government of India's Electronic Committee. In between, Nehru established the Foundation for Development and Community Service Centre. Recognizing all these contributions of Sarabhai to the country, the Government of India honored him with the Padma Bhushan Award in 1966.

Sarabhai, who had the ability to involve himself in many fields simultaneously, took up several tasks to further accelerate India's nuclear energy and space research. In this regard, on January 1, 1967, an earth station called Experimental Satellite Telecommunication Earth Station (ESCES) was established in Ahmedabad to communicate with satellites from Earth. In the same year, Sarabhai established Uranium Corporation of India Limited in Jaduguda, Bihar and Electronics Corporation of India Limited in Hyderabad, Andhra Pradesh.

At SSTC, which was established for space research, experts in various subjects of space science started research under the guidance of Sarabhai. Sarabhai's contribution was invaluable in helping Indians develop expertise in various fields such as propulsion, structure, aerodynamics, materials, control and guidance, astronomy, electronics, and systems engineering. As a result of their tireless efforts, the first Rohini rocket (RH-75) was successfully launched in November 1967 under the guidance of Sarabhai.

On 2 February 1968, Indian Prime Minister dedicated the Thumba Sounding Rocket Launching Station found by Vikram Sarabhai to the International Space Agency, making India one of the world's leading space explorers.

ISRO (Indian Space Research Organisation), the proud organization of every Indian today, was established on 15

August 1969. Founded fifty years ago by the untiringefforts of Vikram Sarabhai, the achievements of this organization since then till today can be said to be unique and amazing. The challenges faced by Vikram Sarabhai, the first chairman of ISRO, were enormous. Vikram Sarabhai, who was the chairman of the 14th International Atomic Energy Agency (IAEA) Conference held in Vienna in 1970, presented a blueprint for India's nuclear energy and space cooperation in the 1970s and 1980s. In the same year, he became the president of the Indian Geophysical Union. He was the President of the 4th United Nations Conference.

Since 1947, Sarabhai had set up several organizations, factories and organizations and led them successfully, constantly traveling all over India, sleeping only four hours a day. He wasengaging in various activities for 20 hourswith a very

sharp mind and very enthutiastic heart but his body was not able to handle the stress. There is a record that Sarabhai, who had set up several factories to manufacture medicines, had expressed to his dear colleague Dr. Rajaramanna, his desire to learn yoga to control his stress.

He travelled very often to Delhi, Ahmedabad and Thiruvananthapuram. On December 30, 1971, the nation was shocked when Vikram Sarabai died of a massive heart attack at the age of 52 at the Kovalam Guest House in Thiruvananthapuram. The scientists of the Atomic Energy and Space Departments were very sad, but Vikram Sarabhai had prepared his colleagues well and had trained them to continue research and improve the institutions after him.

The scientists who were guided by Sarabhai became great people who were recognized throughout the world.

Professor Satish Dhawan, Prof U. R. Rao, Dr. A.P.J. Abdul Kalam, Dr. Raja Ramanna led the post-Sarabhai ISRO and the nuclear organization brilliantly, making Sarabhai's name to be written in golden letters in the field of Indian science.

Vikram Sarabhai was awarded the Padma Vibhushan posthumously by the Government of India in 1972 for his service to the country. In 1974, the International Astronomical Union, named a crater on the moon after Vikram Sarabhai and made his name immortal. Later, Prof. M.G.K. Menon, Prof. Satish Dhawan, Prof. U. R. Rao, Dr. Kasturi Rangan, Dr. Madhavan Nair, Dr. K. Radhakrishnan, Shri A.S. Kiran Kumar Dr. K. Sivan and today's S. Somnath have all shaped ISRO's space science and technology arenas in a unique and different way. Under their brilliant leadership, ISRO's achievements have seen continued growth.

5. Conclusion

We are lucky that such a unique scientist, engineer, businessman, a genius with a personality full of qualities was born in our country whomade an unparalleled contribution to our scientific world. It is our immense pleasure that he has developed and nurtured organizations in multiple domains to take our country to a high level in the field of science. Let us all follow his example and develop a scientific temper to enhance the scientific capabilities of ourcountry.

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2. Rocket - A Ticket to Space
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