INDIAN KNOWLEDGE SYSTEM 1

What is traditional knowledge?

Traditional knowledge refers to the wisdom, practices, and insights accumulated over generations within specific cultures and communities. It embodies the collective experiences, beliefs, and understanding passed down orally or through cultural practices, rather than being formally documented.

Ancient methods of preserving Traditional knowledge

1 oral tradition and storytelling

2 Apprenticeship and mentorship with gurus

3 Rituals and ceremonies

4 proverbs and sayings

5 Cultural festivals and gatherings

Challenges Traditional knowledge faces in modern times

1 Western Dominance

2 Language Barriers

3 Globalization and Consumerism

4 Urbanization and Disconnection from nature

5 lack of documentation and preservation

6 changing social norms

7 Skepticism and lack of scientific validation

8 Generational Gap

Definitions and importance of Indian Knowledge System

Traditional Definition of Knowledge system: Any method or procedure of imparting knowledge from one person to another, or any and every procedure used to store, impart, or share information in a meaningful way so as to make that information useful for human purposes, comprises a knowledge system.

Technological definition of Knowledge system: A knowledge system is a structured framework that collects, processes, and disseminates information, enabling efficient learning, problem-solving, and decision-making.

Societal definition of Knowledge system: A knowledge system, from a social perspective, is an interconnected framework that facilitates the sharing and application of information among individuals and communities, fostering collective learning and societal development.

Characteristics of a Knowledge system

From the above three different definitions of Knowledge systems, it is clear that a knowledge system has the following characteristics:

1. It is a sum of many different methods / processes or activities.
2. The aim of this system is to keep knowledge flowing from generation to generation.

3. The basic function of a knowledge system is to transfer knowledge from a more knowledgeable source to a novice source.

Significance of knowledge system in modern times

1 Ancient knowledge system forms the backbone of modern education by providing wealth of information

2 It enhances research and development by providing base for researchers.

3 Knowledge System enables the efficient management, sharing and application of information

Indian Knowledge System: An Overview

Key aspects of Indian Knowledge System:

. Purpose of Education: Shape individuals into virtuous citizens rather than preparing them for specific careers

. Moral character development emphasized along with wisdom, courage and self discipline, critical thinking

. Pedagogical Methods: Heavily depended on oral tradition, memorization and master-apprentice model

. Not diverse kind of teaching methodologies like modern education system

. Content and curriculum: Curriculum typically classical literature, philosophy and physical education.

- Not wider range of subjects like modern education system
- Accessibility: Education primary available to elite and privileged class
- Perpetuate social hierarchies and inequality
- Role of state: Ancient education often intertwined with state idealogy.
- In some cases, education was tool for social control
- Politically influenced

For Domains of education in India:

Gurukul system

Paathshala

Vidyalaya

Vishwa vidhyalaya

INDIAN KNOWLEDGE SYSTEM 1

UNIT NO. 1 IKS – INDIAN KNOWLEDGE SYSTEM

Scientists of India by Dilip Salwi

Unit I: Trail-Blazer: Susruta, Charaka, Kanada, Patanjali, Nagarjuna

Charaka

Ayurveda is a holistic:

- Looks at body as whole
- Gives prevention -care in addition to treatment
- Looks at food as most important for medication
- Looks at body and mind
- Considers genetic and environmental factors
- Focuses on physiological as well as psychological factors

Charaka, also known as Charaka Maharishi or Agnivesh, was an ancient Indian physician and scholar who is considered one of the founding fathers of Ayurveda, the traditional system of medicine in India. He lived during the 3rd or 4th century BCE and his work, the "Charaka Samhita," is one of the most authoritative and comprehensive texts in Ayurvedic medicine.

Life and Times of Charaka:

The historical details about Charaka's life are not well- documented, and there are different accounts of his background and origins. He is believed to have lived in the ancient city of Taxila, which is in present-day Pakistan, and studied Ayurveda under the guidance of his teacher, Atreya Punarvasu.

Contributions of Charaka:

1. **Charaka Samhita**: Charaka's most significant contribution is the "Charaka Samhita," a compendium of Ayurvedic knowledge. The "Samhita" is written in Sanskrit and is one of the earliest and most important texts in Ayurveda. It is composed of eight books, or "sthanas," and covers various aspects of medicine, including anatomy, physiology, diagnosis, treatment, and pharmacology.

Charaka-samhita is a classical textbook of Internal medicine. It was probably first compiled around the first century BCE. It is considered a prime work on the basic concepts of Ayurveda. Charaka represents The Atreya School of physicians. The Charaka-samhita is written in prose as well as in beautiful poetry, comparable to any Sanskrit classic.

1. **Theory of Tridosha**: Charaka is credited with formulating the theory of Tridosha, which is a fundamental concept in Ayurveda. According to this theory, the human body is governed by three vital energies or doshas: Vata (air and ether), Pitta (fire and water), and

Kapha (water and earth). The balance of these doshas is essential for maintaining health, and their imbalance can lead to disease.

2. **Diagnosis and Treatment**: In the "Charaka Samhita," Charaka elaborates on various methods of diagnosis, including examination of the pulse, urine, tongue, and other bodily signs. He also emphasizes preventive medicine and offers guidelines for maintaining health and preventing diseases. Charaka's approach to treatment includes the use of herbal medicines, diet, lifestyle modifications, and therapeutic procedures.

3. **Pharmacology**: Charaka's work contains a wealth of information on medicinal plants and their properties. He classified herbs based on their tastes, potencies, and effects on the doshas. His contributions to pharmacology have been significant in the development of herbal medicine in Ayurveda.

Apart from this he explained the types of diseases:

- Hereditary disease
- Vitiation of humours – Vat, Pitt, kaff
- Contagious
- Seasonal
- Caused by divine forces(of unknown origin)
- Natural to body- normal disease

All these are of three types — treatable, to be endured and to be rejected.

He gave number of vulnerable spots of the body which is helpful in performing surgery as some are fatal, painful when the instrument touches.

Legacy:

Charaka's "Charaka Samhita" remains one of the most respected and authoritative texts in Ayurvedic medicine. It has been studied, translated, and commented upon by countless scholars and practitioners over the centuries. His contributions to Ayurveda have had a profound and enduring impact on traditional medicine in India and continue to be relevant in contemporary holistic healthcare practices.

Charaka's emphasis on the holistic approach to health, the concept of the Tridosha theory, and his insights into diagnosis and treatment have made Ayurveda a comprehensive system of medicine.

The three epochal works (Charaka-samhita, Sushruta-samhita and Ashtanga-hridaya), of

These illustrious authors, are referred to as the Brihat Trayi – the Big Three of Ayurvedic literature.

Sushruta

Sushruta, also known as Sushruta Maharishi or Sushruta Acharya, was an ancient Indian physician and surgeon who is widely regarded as one of the founding fathers of surgery. He lived during the 6th century BCE and his work, the "Sushruta Samhita," is one of the most comprehensive and authoritative texts on surgery and medicine in ancient India.

Life and Times of Sushruta:

The historical details about Sushruta's life are not well- documented, and there are various accounts and legends about his background and origins. He is believed to have lived in the ancient city of Varanasi (Benares) in present-day Uttar Pradesh India. Sushruta is often considered a contemporary of the famous sage Atreya, and he is believed to have studied Ayurveda under Atreya's guidance.

Contributions of Sushruta:

1. **Sushruta Samhita**: Sushruta's most significant contribution is the "Sushruta Samhita," an encyclopedic text on surgery and medicine. The "Samhita" is written in Sanskrit and is considered one of the earliest and most comprehensive works in the field of surgery. It consists of six books, or "sthanas," covering various aspects of medicine, including surgery, anatomy, paediatrics, pharmacology, and more.

2. **Surgical Techniques**: Sushruta's work in the "Sushruta Samhita" contains detailed descriptions of various surgical techniques, instruments, and procedures. He wrote extensively about different types of surgeries, including plastic and reconstructive surgeries, eye surgeries, removal of urinary stones, and many others.

Different surgical instruments –

Probes- to arrange, move and extract something from body. Cotton headed probes, ladle and mortar headed probes for applying medicine.

Cutting instruments – razor,nail like plucker

1. **Anaesthesia** : Sushruta was one of the earliest recorded surgeons to use anaesthesia during surgical procedures. He described the use of herbal concoctions and intoxicating beverages to dull the pain and sedate patients before surgery.

2. **Classification of Diseases**: Sushruta classified diseases into different categories based on their causes and symptoms. His understanding of diseases and their classifications has been valuable in the field of diagnosis and treatment.

3. **Prosthetics and Ophthalmology:** Sushruta's expertise extended to the fields of prosthetics and ophthalmology. He devised methods for creating artificial limbs and restoring eyesight through surgical procedures.

- Intestinal surgery –

Surgery of stomach- smearing of honey and clarified butter on stitches.

- Intestinal perforated tract surgery –

He make blank ants bite on it and later remove their bodies but not head then stitch the stomach as before-

After the surgery black earth paste is applied with bandage

Patient is made to sit in airless room in oil or bathed with clarified butter with completely on diet of milk.

- Bladder stone removal
- Plastic surgery of Nose-

First they take nose size leaf and cut the skin from patient's forehead in the size of leaf. Then they joint that skin with bandage and patient is fed repeatedly with ghee of seasame seed. Sushruta (7th Century BCE) defined the function of the heart ahead of Harvey (17t1-century AD)

Legacy:

Sushruta's "Sushruta Samhita" remains one of the most significant and revered texts in the history of surgery and medicine. It has been studied and respected for its detailed and systematic approach to surgical knowledge. Sushruta's contributions to surgery, anaesthesia, and medical knowledge were well ahead of his time and have had a lasting impact on the development of surgical practices in ancient India and beyond.

Sushruta's work – the Sushruta-samhita was revised and updated (for current knowledge) by the great Mahayana Buddhist scholar Nagarjuna in the 5th century AD and by Chandradutta in the 10th Century AD. In the Buddhist period along with Buddhism, the science of Ayurveda also spread to countries like China and Tibet. The three epochal works (Charaka-samhita, Sushruta-samhita and Ashtanga-hridaya), of These illustrious authors, are referred to as the Brihat Trayi – the Big Three of Ayurvedic literature.

Maharshi Patanjali

Maharshi Patanjali, also known simply as Patanjali, also known as Gonardiya or Gonikaputra—was an ancient Indian sage and scholar who is revered as the compiler of the Yoga Sutras. He is considered one of the most important figures in the history of yoga and is often referred to as the – "Father of Yoga." Patanjali's work has had a profound and lasting influence on the practice and philosophy of yoga.

Life and Times of Maharshi Patanjali:

The historical details about Patanjali's life are not well- documented, and there are different accounts and legends about him. According to tradition, Patanjali is believed to have lived during the 2nd century BCE or earlier. He is associated with the ancient city of Mathura, which is in present-day Uttar Pradesh, India. Patanjali is also believed to be an incarnation of Adi Sesha, the celestial serpent on which Lord Vishnu rests.

Contributions of Maharshi Patanjali:

1. **Yoga Sutras:** Patanjali's most significant contribution is the "Yoga Sutras," a collection of 196 aphorisms that outline the philosophy and practice of yoga. The "Sutras" provide a systematic and comprehensive guide to the path of yoga, covering various aspects such as ethics, meditation, concentration, and spiritual liberation (samadhi).

2. **Eight "Anga" of Yoga:** Patanjali's "Yoga Sutras" describe the "Eight Limbs of Yoga," known as Ashtanga Yoga. These limbs provide a step-by-step approach to spiritual development and self-realization. The eight limbs are Yama (ethical restraints), Niyama (observances), Asana (physical postures), Pranayama (breath control), Pratyahara (withdrawal of the senses), Dharana (concentration), Dhyana (meditation), and Samadhi (absorption).

1. **Classical Yoga Philosophy:** Patanjali's "Yoga Sutras" expound on the philosophy of classical yoga, also known as Raja Yoga. He discusses the nature of the mind, the concept of the "chitta" (mind stuff), and the ways to overcome the fluctuations of the mind to achieve spiritual realization.

2. **Influence on Yoga Tradition:** Patanjali's "Yoga Sutras" became the foundation of the yoga tradition. They provided a concise and authoritative guide to understanding and

Yoga" is a Sanskrit word meaning to yoke or to unite. A yoke, or wooden beam used between a pair of animals to allow them to pull a cart together, generally serves two functions: to unite the animals to said cart, and to control the movements of the animals using ropes attached to the yoke.

Just as a yoke is a mechanism of control and unity, yogic practice is a mechanism of controlling the body, breath, senses and mind to enable more effective meditation for the purpose of liberation.

Legacy:

Maharshi Patanjali's legacy as the "Father of Yoga" is unparalleled. His "Yoga Sutras" remain one of the most important and revered texts in the philosophy and practice of yoga. They continue to be studied, translated, and commented upon by countless yoga practitioners, scholars, and philosophers worldwide.

Patanjali's fame rests on 3 main contribution to the world:

The creator of the Mahabhaṣya, a classic work on Sanskrit linguistics and grammar that was based on Panini's Aṣṭadhyayi.

The author of the Yoga Sutras, a book on the philosophy and practice of yoga, and a renowned expert in Hindu philosophy from the Samkhya school.

The creator of Patanjalatantra, a medicinal book.

Tamil Saivite Legend:

According to Tirumular's Tirumandiram, a Tamil Saiva Siddhanta tradition from around the 10th century AD claims that Patanjali studied yoga with seven other students under the famous Yogic Guru Nandhi Deva (Tantra 1). He is claimed to have passed away at the Rameswaram Shiva temple, where there is still a shrine dedicated to him.

Role and contribution of patanjali to yoga:

- Systematic understanding and practice of yoga

- Exploration of mind
- Emphasis on samadhi
- Ethical guidelines to practitioner of yoga of non-violence, truthfulness, non-stealing, purity, contentment, self-discipline, self-study, and surrender to a higher power.

Kanada

Kaṇāda (Sanskrit: कणाद), also known as Ulka, Kashyapa, Kaṇabhaksha, Kaṇabhuj was an ancient Indian natural scientist and philosopher who founded the Vaisheshika school of Indian philosophy that also represents the earliest Indian physics.

When the entire people credit the Western World for modern physics and its development, it is India's own scientist "Sage Kanad", otherwise known as "Acharya Kanad", who should be highly revered and credited. He discovered the atomic structure, atomic theory, and even sub-atomic particles some 2600 years before. Kanad in Sanskrit denotes the smallest particle. He is revered as the "Father of Atomic Theory". He has rendered Kanada Sutras, which are the Aphorisms of Kanada, which is considered as one of the greatest works in the field of physics.

The theory of "Anu", the atom was postulated even before Dalton's theory. But, may people do not consider it, as it is not highly empirical. He was able to bring a theory on the creation and existence of the universe.

Life of Acharya Kanad:

He was believed to have born in the year 600 BC or 800 BC in Gujarat, India. His father was a philosopher Ulka. His birth name was Kashyap. As a child, he always accompanied his father and observed many things. But despite of all those things around him, his interest was always on the smallest things. He was able to look beyond the general concepts which were underlying in the universe.

Legend of Acharya Kanad:

When Acharya Kanad was young, he always admired the grain of rice. It was the tradition of the early Hindu family, to scatter grains of rice along the streets, for the people to follow it as a ritual. The young boy was looking at the ant, which was eating the rice. He was fascinated by the idea that a small piece of rice could become food for a small creature like an ant, but it needs a lot of grains, collected together to make a complete meal for a person, which could satiate his hunger.

The idea of looking deep and beyond was highly fascinating, and he started to look deep into the rice particle, which suggested to him the concept of "Anu", the smallest particle.

Since then, people began calling him Kanad, as Kan in Sanskrit means "the smallest particle." Kanad went on to pursue his fascination with the unseen world and with conceptualizing the idea of the smallest particle. He began writing down his ideas and teaching them to others. Thus, people began calling him Acharya (meaning "the teacher") which explains the name Acharya Kanad, meaning "the teacher of small particles."

Kaṇāda suggested that everything can be subdivided, but this subdivision cannot go on forever, and there must be smallest entities (paramanu) that cannot be divided, that are eternal, that aggregate in different ways to yield complex substances and bodies with unique identity, a process that involves heat, and this is the basis for all material existence. He used these ideas with the concept of Atman (soul, Self) to develop a non-theistic. If viewed from the prism of physics, his ideas imply a clear role for the observer as independent of the system being studied.

Kanad suggested that it was the different combinations of Parmanu which produced different types of substances. He also put forward the idea that atoms could be combined in various ways to produce chemical changes in presence of other factors such as heat. He gave blackening of earthen pot and ripening of fruit as examples of this phenomenon.

Kaṇāda's system speaks of six properties (padārthas) that are nameable and knowable. He claims that these are sufficient to describe everything in the universe, including observers. These six categories are dravya (substance), guna (quality), karma (action/ motion), samanya (generality/ commonness), visesa (particular), and samavaya (inherence). There are nine classes of substances (dravya), some of which are atomic, some non-atomic, and others that are all-pervasive.

In the fifth chapter of Vaisheshika Sutra, Kaṇāda mentions various empirical observations and natural phenomena such as the falling of objects to the ground, rising of fire and heat upwards, the growth of grass upwards, the nature of rainfall and thunderstorms, the flow of liquids, the movement towards a magnet among many others, asks why these things happen, then attempts to integrate his observations with his theories on atoms, molecules, and their interaction. He classifies observed events into two: those caused by volition, and those caused by subject-object conjunctions.

Thus, great philosophers and Saints like Sage Kanad were parallelly able to travel on both philosophy and spirituality. He has made several people think about science and was a great inspiration for several other philosophers and thinkers.

Indian scientist “Sage Kanad,” also known as “Acharya Kanad,” deserves a great deal of respect and credit when the general public attributes the development of modern physics to the West. Some 2600 years earlier, he discovered the atomic structure, the atomic theory, and even subatomic particles. In Sanskrit, the word “kanad” means the smallest particle. As the “Father of Atomic Theory,” he is revered. He has written the Kanada Sutras, or Aphorisms of Kanada, which are regarded as one of the greatest physics works. In addition to being revered in Hinduism, his ideas are highly praised in Jainism and Buddhism

Nagarjuna

The flourishing of chemistry in India, especially alchemy, has an interesting phase during the period of tantra. Rasaratnakara ascribed to Nagarjuna belongs to this category.

Biography

The alchemist Nagarjuna is well known for his treatise on alchemy titled Rasaratnakara, which was perhaps originally compiled around 7th or 8th Century CE. Nagarjuna was certainly a great scientist, who, for the first time, not only described cementation processes but also zinc production by a distillation technique.

Arabian scholar Alberuni (10th century AD) mentioned about Nagarjuna, as native of the fort Daihak near Somnath, nearly a century before his own time and described as great adopt in Rasayana. If we shift Alberuni date about Nagarjuna a century or two backwords that is 8th century AD. Perhaps, Nagarjuna was born at Fort Daihak near the famous shrine of Somnath in Gujarat in 8th century A.D. He was a chemist, or an alchemist, as his efforts had been concentrated on transforming the base metals into gold. We are told that he had acquired such a reputation, due to his activities, that the people believed that Nagarjuna was in communion with gods and goddesses who had blessed him with the power of changing base metals into gold.

Works of Nagarjuna

Nagarjuna apparently reveled in the idea of his being looked upon as blessed by the gods. He himself added to this belief by writing his treatise, Rasaratnakara in the form of a dialogue between him and the Gods. The treatise dealt with the preparation of rasa (liquids, mainly mercury). Nagarjuna has discussed various combinations of liquids in this volume. His treatise, the Rasaratnakara also gave a survey of the status of metallurgy and alchemy as it existed in India in those days. Methods for the extraction of metals like gold, silver, tin and copper from their ores and their purification were also mentioned, in Rasaratnakara.

In his attempt to prepare the 'elixir of life' from mercury, Nagarjuna made use of animal and vegetable products, apart from minerals and alkalis. For the dissolution of diamonds, metals and pearls, he suggested the use of vegetable acids like sour gruel and juices of fruits and bark. Some historian opined that Nagarjuna was at a time a chemist, an alchemist, metallurgist and medicine man. His works are Rasaratnakara, Rashrudaya, Rasendramangal, Arogyamanjari, Kakshaputatantra, Yogasara, Yogasatak, Uttaratantra. Mohammed of Ghazni invaded India and is said to have destroyed some and taken some of the sciences manuscripts to the outside world. The Arabs learnt the transmutation of base metals to gold from Nagarjuna. They called it Al Kimia. Medieval Europeans learnt about it from the Arabs and called it Alchemy. In his treatise, he has also listed the apparatus that was used by earlier alchemists.

The process of distillation, liquefaction, sublimation and roasting were also mentioned. Nagarjuna also discussed, in detail, the possibility of transmutation of base metals into gold. But

although he could not produce gold, these techniques did yield metals with gold like yellowish brilliance. Till today these methods are being used to manufacture imitation jewelry.

Nagarjuna has also discussed methods for the preparation of mercury like calamine. Later Nagarjuna seems to have turned towards organic chemistry and medicine. He has written a text called Uttaratantra which is supposed to be a supplement to an earlier text the Shusrutasamahita which is said to have been written by Shusruta long before him. Nagarjuna's Uttaratantra deals mainly with the preparation of medicinal drugs. He also wrote four Ayurvedic treatises named Arogyamanjari Kakshaputatantra, Yogasara and Yogasatak.

Contribution

An alchemist he knew the art of transmuting base metals to look like gold. This method is today being used to make imitation jewellery, Preparation of mercury, Extraction of metals like gold, silver, tin and copper from the ore, Dissolution of diamonds, metals and pearls, Process of distillation, liquefication, sublimation and roasting, Combinations of liquids, Preparation of medicinal drugs. As Alchemy, as is well known, has a twofold objective: (i) the preparation of an elixir of life and (ii) the production of the philosophers' stone for the transmutation of base metals into gold. Tantric treatises, both Brahmanic and Buddhistic, abound in recipes for such transmutation of base metals, particularly of mercury into gold.

The Rasa-ratnakara, attributed to the Nagarjuna, contains descriptions of alchemical processes and preparations of many mercurial compounds. It gives an account of many chemical processes like the extraction of zinc, Mercury, and copper, and the preparation of crystalline red sulphide

of mercury (svarnasindura or Makaradhvaja). This medicament is still used as a panacea for many ailments by physicians in India

Following the indigenous system of medicine. The treatise also describes more than two dozen varieties of Apparatuses (yaniras) for carrying out various physico-chemical processes like distillation, sublimation, extraction, calcination, digestion, evaporation, filtration, fumigation, fusion, pulverization, heating by steam and by sand, and the preparation of many metallic compounds.

Thus Nagarjuna seems to have been a copious writer. As he lived in the 8th Century A.D his works incorporate the ideas of earlier chemists and physicians. Only a few decades after Nagarjuna, India was invaded by the Mohammedans: Mahmud of Ghazni had raided and plundered Nagarjuna's hometown of Somnath in 1020 A.D. It is possible that Nagarjuna's texts fell into the hands of the invaders. While the invaders ruthlessly destroyed the architectural achievements of this country and imposed their despotic rule, they also transmitted Indian sciences to the outside world. Alongwith Mahmud of Ghazni came scholars like Al Beruni who studied Indian texts and translated them into Arabic. Many Indian ideas of medicine were incorporated into the Unani system of medicine of the Arabs. Nagarjuna's works could not have escaped their attention. It is possible that the technique of alchemy was borrowed by the Arabs from India. In the ancient world there is no reference to alchemy. We first hear of it in the

medieaval Europe. The homeland of the Arabs is not rich in metals, thus alchemy and the smelting of metals could not have been indigenous to the Arabs.

UNIT NO. 2 IKS –

New Frontiers: C. V. Raman, S. N. Bose, H. J. Bhabha, V. A. Sarabhai, M. G. K. Menon, J. V. Narlikar

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Unit II:

New Frontiers: C. V. Raman, S. N. Bose, H. J. Bhabha, V. A. Sarabhai, M. G. K. Menon, J. V. Narlikar

C V Raman

Chandrashekhara Venkata Raman was born on 7 November 1888 at Tiruchirappalli, Tamil Nadu. His father, Chandrashekhara Iyer, was a lecturer in physics, in a local college. His mother Parvathi was a homemaker. He passed his matriculation when he was 12. He joined Presidency College in Madras. He passed his Bachelors and Masters examinations in science with high distinction. He had a deep interest in physics. While doing his Masters, Raman wrote an article on physics and sent it to various scientific journals of England. On reading this article, many eminent scientists in London noted the talent of this young Indian.

Raman wanted to compete for the ICS examination. But to write that examination, one had to go to London. As he was poor and could not afford it, he took the Indian Financial Service Examination conducted in India. He was selected and posted at Rangoon, Burma (now Myanmar), which was then a part of British India.

Later, while working in Kolkata, he associated himself with an Institute called Indian Association for the Cultivation of Science, which was the only research institution in those days. While working there, his research work came to the notice of the Vice Chancellor of Calcutta University. The Vice Chancellor appointed him as Professor of Physics in Calcutta University. Sir Raman was in a good position in the Financial service. He sacrificed his profession and joined the academic career. When he was working as a professor, he got an invitation from England to attend a science conference

As the ship was sailing through the Mediterranean Sea, Raman had a doubt as to why the sea water was blue in colour.This doubt initiated his research on light. He found out by experiment that the sea looks blue because of the 'Scattering effect of the Sunlight'. This discovery is called 'The Raman Effect'. A question that was puzzling many other scientists at the time was easily solved by him. His pioneering work helped him become a Member of Royal Society of London in 1924. He was awarded with Knighthood by the British Empire in 1929.

This discovery also got Sir Raman the Nobel Prize for Physics for the year 1930. He became the first Indian scientist to receive the Nobel Prize. Raman discovered 'The Raman Effect' on 28 February 1928 and this day is observed as the 'National Science Day' in India. In 1933, he joined the Indian Institute of Science, Bangalore, as Director. Later he quit the post of Director and continued to work only in the Department of Physics. The university of Cambridge offered him a professor's job, which he declined stating that he is an Indian and wants to serve in his own country. Dr Homi Bhabha and Dr Vikram Sarabhai were his students. Sir C.V. Raman died on 21 November 1970.

Dr. Raman was a great teacher and a great guide as well. He generated immense confidence among his students. One of his students was in very low morale because he had only one Kilowatt powered X -Ray equipment, whereas a scientist in England was working with 5 Kilowatt powered X-Ray equipment. Dr. Raman inspired him to use his 10 kilowatt powered brain instead.

Dr. Raman's life is a great example for us to follow. Even when India was under British rule and there was hardly any basic infrastructure for experimentation, he used his great mind as his laboratory. He proved through the example of his life, how our ancestors formulated great theories using the power of their mind.

Satyendra Nath Bose Or S.N.Bose

Satyendra Nath Bose came into the news in connection with the discovery of 'Higgs Boson' or popularly called the 'God Particle'. Satyendra Nath Bose was an outstanding Indian physicist. He is known for his work in Quantum Physics. He is famous for the 'Bose-Einstein Theory' and a kind of particle in atom has been named after him as Boson.

Satyendra Nath Bose was born on 1 January 1894 in Kolkata. His father Surendra Nath Bose was employed in the Engineering Department of the East India Railways. Satyendra Nath was the eldest of seven children. Satyendra did his schooling from Hindu High School in Kolkata. He was a brilliant student and did his college from the Presidency College, Kolkata with mathematics as his major. He topped the University in the bachelors and Masters. In 1916, the University of Calcutta started MSc classes in modern mathematics and modern physics. S.N.

Bose started his career in 1916 as a lecturer in physics in the University of Calcutta. He served there from 1916 to 1921.

He joined the newly established Dhaka University in 1921 as reader in the Department of Physics. In 1924, Satyendra Nath Bose published an article titled 'Max Planck's Law and Light Quantum Hypothesis'. This article was sent to Albert Einstein, who appreciated it so much that he himself translated it into German and sent it for publication to a famous periodical in Germany—Zeitschrift fur Physik. The hypothesis received great attention and was highly appreciated by scientists who named it as the 'Bose-Einstein Theory'.

In 1926, Satyendra Nath Bose became a professor of physics in Dhaka University. Though he had not completed his doctorate till then, he was appointed as professor on Einstein's recommendation. In 1929, Satyendra Nath Bose was elected as chairman of the Physics Session of the Indian Science Congress and, in 1944, as Chairman of the Congress. In 1945, he was appointed as Khaira Professor of Physics in the University of Calcutta. He retired from Calcutta University in 1956. The university honoured him on his retirement by appointing him as Emeritus Professor. Later, he became the Vice Chancellor of the Visva-Bharati University. In 1958, he was made a Fellow of The Royal Society, London.

Satyendra Nath Bose was honoured with Padma Bhushan by the Government of India in recognition of his outstanding achievements. He died in Kolkata on 4 February 1974.

H.J.Bhabha or Homi Jehangir Bhabha

Homi Jehangir Bhabha, the main architect of Indian Atomic Energy programme, was born in a rich Parsi family on 30 October 1909 in Mumbai. He received his early education at Mumbai's Cathedral Grammar School and did his college in Elphinstone College. He went to Cambridge University, forced by his father and his uncle Dorabji Tata, who wanted him to get a degree in mechanical engineering so that on his return to India he can join the Tata Mills in Jamshedpur as a metallurgist.

Bhabha's illustrious family background had a long tradition of learning and service to the country. The family, both on his father's and his mother's side was close to the house of Tatas, who had pioneered projects in the fields of metallurgy, power generation and science and engineering, in the early half of the twentieth century. The family imbibed a strong nationalistic spirit, under the influence of Mahatma Gandhi and the Nehru family. The family also had interests in fine arts, particularly Western classical music and painting, that aroused Bhabha's aesthetic sensibilities, and it remained a dominant influence in all the creative work he undertook during his life time.

Bhabha, after completion of his engineering, switched over to physics. During the period 1930–39, Bhabha carried out outstanding original research relating to cosmic radiation. This earned him a Fellowship of the Royal Society in 1940, at the young age of 31. Bhabha returned to India in 1939, and had to stay back on account of the outbreak of the Second World War. He was

selected to work at the Indian Institute of Science, Bangalore, where Sir C.V. Raman, India's first Nobel laureate in Science, was at the time Head of the Department of Physics.

Initially appointed as a Reader, Bhabha was soon designated as Professor of Cosmic Ray Research. Bhabha's leadership of the atomic energy programme spanned 22 years, from 1944 till 1966. The Tata Institute of Fundamental Research was formally inaugurated in December 1945 in 'Kenilworth' building, which was Bhabha's ancestral home. In January 1966, Bhabha died in a plane crash near Mont Blanc while heading to Vienna, Austria, to attend a meeting of the International Atomic Energy Agency.

Vikram Ambalal Sarabhai

Fondly referred to as the 'Father of the Indian space Programme', Vikram Sarabhai was born in Ahmedabad on 12 August 1919 to an affluent family. It was his early years at a private school that shaped his scientific bend of mind. After studying at the Gujarat College in his hometown in 1937, he left for England to study physics at St. John's College, Cambridge.

There, Sarabhai earned an undergraduate tripods degree. That was the year 1940 and the world was facing the Second World War. So, Sarabhai returned to India and became a research scholar at the Indian Institute of Science, Bangalore, where he studied the effects of cosmic rays.

It was at Bangalore, under the direct guidance of Nobel laureate, Dr C.V. Raman that he started setting up observatories in Bangalore, Pune and the Himalayas. Soon after the war was over, he

returned to UK for a while. Sarabhai received PhD from Cambridge University for his pathbreaking work.

His real work began in 1947 along with meteorologist, K.R. Ramanathan, who helped him establish the Physical Research Laboratory, Ahmedabad. Initially, it consisted of rooms at the Science Institute of the Ahmedabad Education Society. Analyzing and studying cosmic rays and atmospheric physics, the scientists set up two dedicated teams at the site. Sarabhai's team realized that evaluating the weather was not enough to comprehend variations in the cosmic rays; they had to relate it to variations in solar activity. He was the pioneer researcher in the field of solar physics.

With such a big breakthrough in hand, Sarabhai soon received financial support from the Indian Council of Scientific and Industrial Research and the Department of Atomic Energy. And the support did not just end there. He was asked to organize the Indian programme for the International Geophysical Year of 1957. Around this time, the erstwhile Soviet Union launched Sputnik-1. India, not too far behind, decided to set up the Indian National Committee for Space research chaired by Sarabhai.

The visionary scientist set up India's first rocket launching station, TERLS in Thumba on the coast of the Arabian Sea on 21 November 1963 with the support of Homi Bhabha from the Atomic Energy Commission. In 1966, Sarabhai was appointed as chairman of the Indian Atomic Energy Commission following Bhabha's untimely demise. Sarabhai's greatest achievement was the establishment of the Indian Space Research Organization (ISRO). He died in his sleep at 52 on 31 December 1971.

The pioneering work on space science and research done by Dr Vikram Sarabhai earned him Shanti Swarup Bhatnagar Medal in 1962 and Padma Bhushan in 1966.

M.G.K. Menon

Mambillikalathil Govind Kumar Menon (28 August 1928 – 22 November 2016) also known as M. G. K. Menon, or Goku was a physicist and policy maker from India. He had a prominent role in the development of science and technology in India over four decades. One of his most important contributions was nurturing the Tata Institute of Fundamental Research, Mumbai, which his mentor Homi J. Bhabha founded in 1945.

Early life and education

Menon was educated at Jaswant College, Jodhpur, and the Royal Institute of Science, Bombay (now called The Institute of Science, Mumbai), before he moved to the University of Bristol for his PhD in elementary particle physics under the guidance of Nobel Laureate Cecil F. Powell in 1953.

Career

Menon joined Tata Institute of Fundamental Research in 1955 “essentially because of Bhabha”, and the association lasted nearly five decades. He became the director of the institute in 1966, at the age of 38, following Bhabha’s untimely death.

Menon was the chairman of the ISRO in 1972. He was a member of the Planning Commission (1982–1989), Scientific Adviser to the Prime Minister (1986–1989) and vice-president, Council of Scientific & Industrial Research (CSIR) (1989–1990).

Menon was elected as a Member of Parliament, Rajya Sabha during 1990–96. In 1989, then Prime Minister of India, Vishwanath Pratap Singh appointed him as the Minister of State for Science, Technology and Education.

Contribution

Though trained as a high energy physicist, Prof. Menon made rich contributions to both scientific and technological domains of independent India as a prominent science administrator.

Prof. Menon was associated with Indian Space Programme right from its inception. He was a member of Indian National Committee on Space Research (INCOSPAR), a national body of eminent scientists chaired by Dr Vikram Sarabhai set up by the Government of India in February 1962 to oversee the space programme of India. Prof. Menon was a close associate of Dr. Vikram Sarabhai, the architect of Indian Space Programme and was involved in many critical decisions taken during the Genesis and early evolutionary years of Indian Space Programme.

Following the sudden death of Dr. Sarabhai on December 30, 1971, the Indian government asked Prof. Menon to head the Indian Space Programme. In spite of his other significant responsibilities like the head of Electronics commission, Director, Tata Institute of Fundamental Research and Director, PRL, Prof. Menon accepted this formidable challenge and steered the Indian Space Programme during January-September 1972.

His decisions as chairman, ISRO facilitated the later rapid and orderly progress of Indian Space Programme and its entry into the domain of satellites and Launch Vehicles during 1970s.

It was during the chairmanship of Prof. Menon the agreement between India and Soviet Union on the launch of India's first satellite Aryabhata by a Soviet Rocket was signed in May 1972. Prof. Menon also took the important decision to amalgamate various entities involved in Space Research work at Thumba and Veli Hills into a single large entity which later achieved fame as the Vikram Sarabhai Space Centre (VSSC). Later, Prof Menon served as a member of space commission.

Though the period during which Prof. Menon steered the Indian Space Programme was brief, it was a momentous time and the decisions which he took during that period had a profound influence on the expansion and sustenance of Indian Space Programme resulting in India achieving the status of a key player in the domain of space.

Awards and recognition

He won the Abdus Salam Medal in 1996

Special Awards: He won the Padma Shri in 1961, Padma Bhushan in 1968 and Padma Vibhushan in 1985.

The asteroid 7564 Gokumenon was named in his honour in late 2008.

Legacy

Amidst his incessant activities, he retained his gentle character, his love for children, and his affection and warmth toward his colleagues and friends. Menon broadcasted widely the transformative power of science to bring about societal change and harmony. The fruits of his

labor are seen throughout and beyond India and stand as testimony to his remarkable life and achievements.

J.V.Narlikar

The great Indian astrophysicist, Dr Jayant Narlikar was born on July 19. 1938, in a highly educated and cultured family in Kolhapur district of Maharashtra. His father Prof. Vishnu Vasudev Narlikar was the Head of the Department of Mathematics at Benaras Hindu University. Thereafter he was Chairman of the Rajasthan Public Service Commission. Jayant Narlikar had his education in Varanasi. His mother was a graduate in Sanskrit from Mumbai (Bombay) University. Besides, she loved English literature.

Young Narikar was exceptionally talented and always topped at school and college examinations. Mathematics was his favorite subject. Besides, he enjoyed reading. In 1959, he cleared BSc Honors from Benaras Hindu University. He stood first in the University. His subjects were mathematics and astrophysics. For further studies his father wanted to send him abroad. Before leaving India, he was informed by those who had already been to England, not to be complacent. Life would be tough but having worked hard, he came out with flying colours. The advice he received from his father and particularly, his maternal uncle Dr. Vasantrao Hujurbazar really stood him in good stead,

Besides his parents, Fred Hoyle, his teacher and mentor had a great influence on him. Besides, his extraordinary result at the graduate level also fetched him a scholarship. He was sent to England, where he joined Cambridge University. Here he obtained MSc degree in just two years.

Incidentally of that time of world famous teacher of astrophysics was in Cambridge. He was, Frederick Hoyle, better known as Fred Hoyle. Hoyle was professor of Kings College. Cambridge and conducting research on the speed and condition of celestial bodies. Narlikar registered for PhD under Hoyle and began. Research work. Hoyle accepted him wholeheartedly, In 1963, Jayant Narlikar was awarded PhD by Cambridge University. He stayed in Cambridge from 1957 to 1962.

During his 15 years stay abroad Dr. Narlikar made many important researches. At the age of 22 years he became member of the Royal Astronautical Society. He was also appointed Fellow of Kings College, Cambridge. His father too, was member of this institute. His PhD thesis included research on principles of gravitation, gravitational pull between different celestial bodies, formation of the universe and others. He had also presented another view to the popular Big Bang theory. According to his theory the universe is not expanding but static (still). He had described it as steady state. This theory shed new light on the subject. With Fred Hoyle, he presented the famous Conformal Theory of Gravity, which became well known all over the world. Narlikar and Hoyle worked on cosmology, including the steady state theory, theory of gravitation, electrodynamic etc. They propounded that the force of other powers in space and the universe has an effect on the mass of matter. Besides, I also affects the shape and size of matter. It is generally believed that the gravitational pull depends on the mass of the object. He suggested that the gravitational pull on celestial bodies depends on its density. As the internal density of the object is more, so is the gravitational pull on celestial bodies depends on its density. As the internal density of the object is more, so is the gravitational pull. This is the

reason why such heavenly bodies try to devour other heavenly bodies. As the mass of these objects increases it becomes dense. Its density increase so much that such a pinch of mass is equivalent to several tons in weight. In the end it becomes a Black Hole. Such objects do not even allow light to escape from them.

Awards

His researches on gravitation of space objects are considered. Noteworthy. He received awards and medals from many institute in Europe. In 1969, the Union education Minstry invited Dr Narlikar and Hoyle to visit India and deliver lectures. In 1968, Cambridge University honored him by presenting him the Adam Award. Earlier, three Indian scientists had received this prestigious award: in 1944, Dr. Homi Bhabha; in 1948, Dr S Chandrasekhar, and in 1961, Dr Hujurbazar, This award is given every two years in the memory of Dr C Adams, astrophysics and natural science Adams was an outstanding astronomer, who has predicted the existence of planet Neptune in 1846.

Narlikar married Mangala Sadashiv Rajwade in 1966. In 1969, when he returned to India, he was conferred the Padma Bhushan by the Government of India, Mumbai's Tata Institute of Fundamental Research invited him to join as professor of astrophysics. Narlikar too had decided to offer his services to the country, in 1972, he joined TIFR as professor Besides research and teaching, he guided doctoral students. Here he continued research on tochyoris, Tachyons are particles that move faster than the speed of light. According to Dr Narlikar, Black Holes are bases of tochyons. They absorb light coming from outside and with tremendous pressure contracts the surface of the Black Hole. After coming here Narlikar developed one more activity.

To popularize science and especially astronomy among the people he wrote book Akashashi Jadle Nate (Related to the Sky) in his mother tongue Marathi. Besides he also wrote science stories His books have also been translated into Hindi and Gujarati. He is an accomplished science fiction writer.

Books

Besides scientific papers and books and popular science literature, Narlikar has written science fiction, novels, and short stories in English, Hindi, and Marathi. He is also the consultant for the Science and Mathematics textbooks of NCERT (National Council of Educational Research and Training, India).

In September 1988, the late Prime Minister Rajiv Gandhi encouraged him to start astronomy and nuclear physics inter university center. Through the university Grants Commission and central aid such a center has been made possible. Narlikar was its first director and worked as Homi Bhabha professor. In 1988, he attended an international conference on astronomy at Baltimore in America. On January 10 1989, the National Science Academy honored Narlikar with the Venu Bappu Memorial Award for 1988. This award includes Rs. 25000 in cash and a medal. In 1990 he was awarded the Indian Science Academy's Indira Gandhi Award and in

1996 UNESCO's 'Kalinga Award. Recently, on March 12, 2003, the Yashwantroa Chavan Rashtriya Puraskar 2002 was presented to Narlikar.