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M. Sujit,

I Year, MEE.

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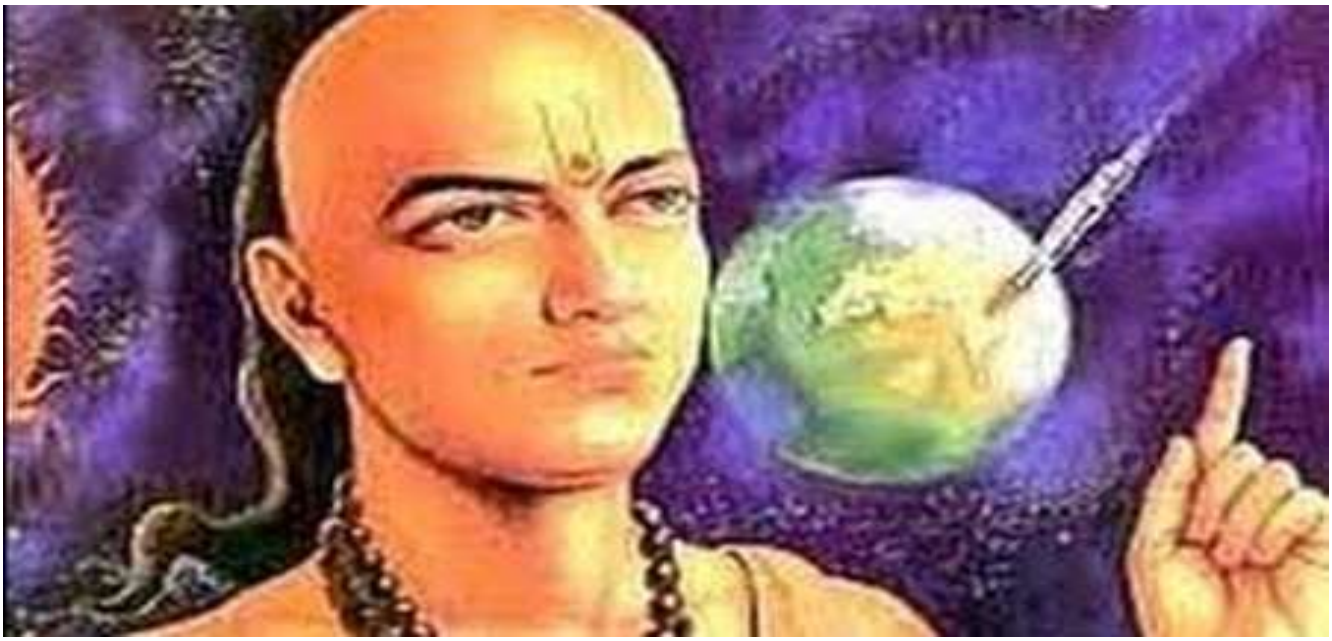
Introduction

You will be surprised to know that a lot of **scientific knowledge was evolved in ancient India**, so many years ago. During this period **Science and Mathematics** were highly developed and Ancient Indians had contributed immensely. Medical Science was also highly developed at that time. **Ayurveda** the science of good health and longevity of life is the indigenous system of medicine that was developed in Ancient Period. Even the science of Yoga was also developed as an allied science of Ayurveda for healing without medicine at the physical and mental level. So, in this project we will see the contributions of some scientists of ancient India.

1. Aryabhatta



He was a **fifth century** mathematician, astronomer, astrologer and physicist. At the age of 23, he wrote **Aryabhattiya** which is a summary of mathematics of his time. First time he had calculated the value of **pi** at 3.1416. **He showed that zero was not a numeral only but also a symbol and a concept**. Infact the discovery of zero enabled Aryabhatta to find out the exact distance between the earth and the moon. And zero discoveries opened a new dimension of negative numerals.

Do you know?

The aim behind the development of the science of astronomy was nothing but the need to have accurate calendars, a better understanding of climate and rainfall patterns for timely sowing and choice of crops, fixing the dates of seasons and festivals, navigation, calculation of time and casting of horoscopes for use in astrology.

Knowledge of astronomy, particularly knowledge of the tides and the stars, was of great importance at that time for trade, because of the requirement of crossing the oceans and deserts during night time.

Also, Aryabhatta contributed greatly to the field of science particularly Astronomy and so known as **Father of Astronomy**. As we all know that in ancient India, the science of astronomy was well advanced. It was called **khagolshastra**. Khagol was the famous astronomical observatory at Nalanda, where Aryabhatta studied. He also disregarded the popular view that our planet earth is 'Achala' i.e. immovable; **Aryabhatta stated its theory that** 'earth is round and rotates on its axis'. **He also explained that** the appearance of the sun moving from east to west is false by giving examples. Like when a person travels in a boat, the trees on the shore appear to move in the opposite direction. Scientific explanation of solar and lunar eclipse was also explained by him.

So, now we come to know that why the first satellite that was sent into the orbit by India has been named after Aryabhatta.

2. Bhaskara

Bhaskara II, also called **Bhaskaracarya** or **Bhaskara the Learned**, (born 1114, Biddur, India—died *c.* 1185, probably Ujjain), the leading mathematician of the 12th century, who wrote the first work with full and systematic use of the decimal number system.

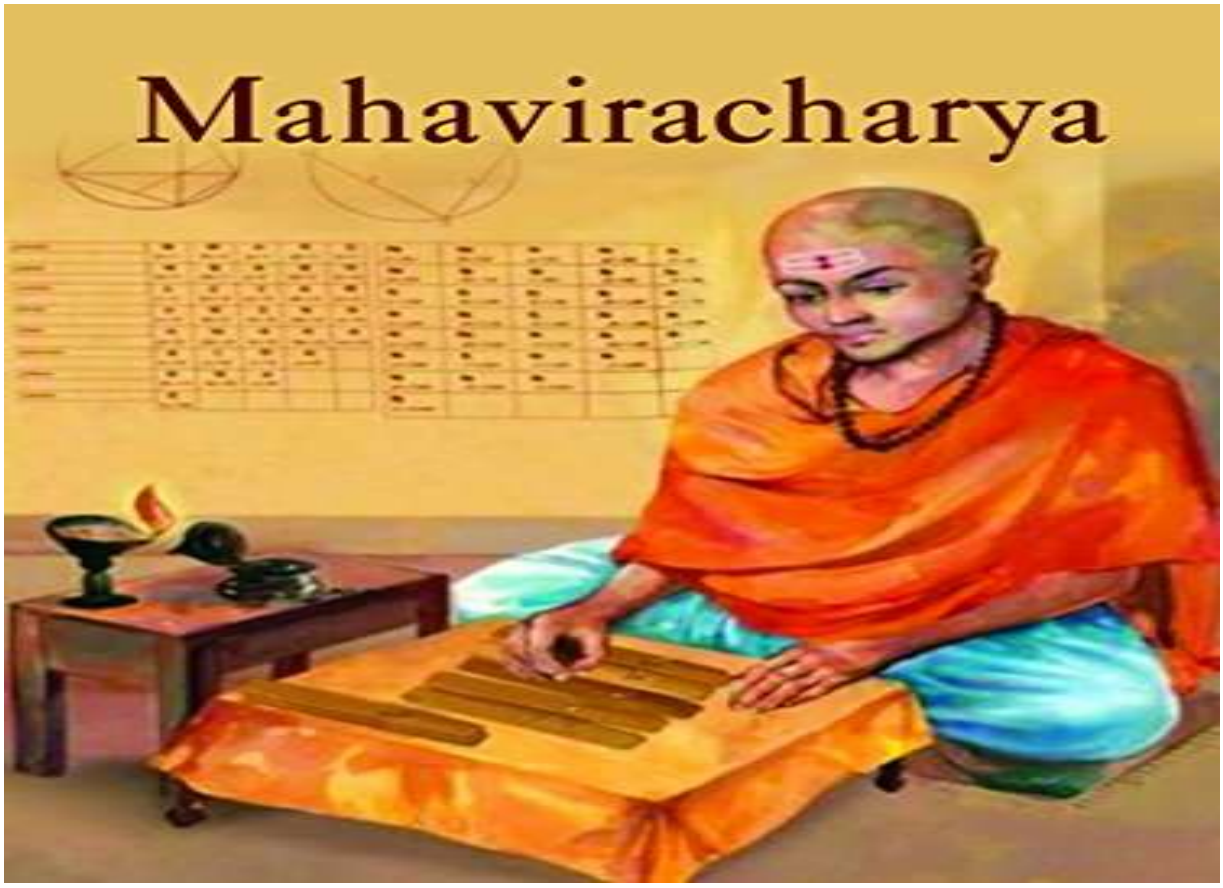
Bhāskara II was the lineal successor of the noted Indian mathematician Brahmagupta (598–*c.* 665) as head of an astronomical observatory at Ujjain, the leading mathematical centre of ancient India. The II has been attached to his name to distinguish him from the 7th-century astronomer of the same name.

In Bhāskara II's mathematical works (written in verse like nearly all Indian mathematical classics), particularly *Līlāvatī* ("The Beautiful") and *Bījagaṇita* ("Seed Counting"), he not only used the decimal system but also compiled problems from Brahmagupta and others. He filled many of the gaps in Brahmagupta's work, especially in obtaining a general solution to the Pell equation ($x^2 = 1 + py^2$) and in giving many particular solutions (e.g., $x^2 = 1 + 61y^2$, which has the solution $x = 1{,}766{,}319{,}049$ and $y = 226{,}153{,}980$; French mathematician Pierre de Fermat proposed this same problem as a challenge to his friend Frenicle de Bessy five centuries later in 1657). Bhāskara II anticipated the modern convention of signs (minus by minus makes plus, minus by plus makes minus) and evidently was the first to gain some understanding of the meaning of division by zero, for he

specifically stated that the value of $^{3}/_{0}$ is an infinite quantity, though his understanding seems to have been limited, for he also stated wrongly that $^{a}/_{0} \times 0 = a$. Bhāskara II used letters to represent unknown quantities, much as in modern algebra, and solved indeterminate equations of 1st and 2nd degrees. He reduced quadratic equations to a single type and solved them and investigated regular polygons up to those having 384 sides, thus obtaining a good approximate value of π = 3.141666.

3. Mahaviracharya

Mahavira, (flourished *c.* 850, Karnataka, India), Indian mathematician who made significant contributions to the development of algebra. All that is known about Mahavira's life is that he was a Jain (he perhaps took his name to honour the great Jainism reformer Mahavira [*c.* 599–527 BCE]) and that he wrote *Ganitasarasangraha* ("Compendium of the Essence of Mathematics") during the reign of Amoghavarsha (*c.* 814–878) of the Rashtrakuta dynasty



Isn't it amazing that there is an elaborate description of mathematics in Jain literature (500 B.C – 100 B.C). **Jain gurus knew how to solve quadratic equations**. In a very interesting manner they have also described fractions, algebraic equations, series, set theory, logarithms and exponents. Mahaviracharya was 8th century Indian mathematician (Jain) from Gulbarga who asserted that the square root of a negative number did not exist.

In **850 A.D**, Jain Guru **Mahaviracharya** wrote **Ganit Sara Sangraha** which is the first textbook on arithmetic in present day form. It was translated into Telugu by Pavaluri Sanganna as Saara Sangraha Ganitam. He had also described the method of solving **Least Common Multiple** (LCM) of given numbers.

John Napier introduced the method of solving LCM to the world but Indians already knows about it.

He also gave a sum of series whose terms are squares of an arithmetic progression and empirical rules for area and perimeter of an ellipse and was patronised by the great king **Amoghavarsha Nrupatunga** of Rashtrakuta dynasty. Amazing is he had that time only established some terms for concepts like equilateral, isosceles triangle, rhombus, circles and semicircle.

He discovered algebraic identities like $a^3 = a\,(a + b)\,(a - b) + b^2\,(a - b) + b^3$. He also found out the formula for ${}^nC_r$ as $[n\,(n - 1)\,(n - 2)\,...\,(n - r + 1)]\,/\,[r\,(r - 1)\,(r - 2)\,...\,2 * 1]$. He devised a formula which approximated the area and perimeters of ellipses and found methods to calculate the square of a number and cube roots of a number. He asserted that the square root of a negative number does not exist. **He had also established equations** for the sides and diagonals of cyclic quadrilaterals. It is: let a, b, c and d are the sides and x, y are the diagonals of cyclic quadrilateral then equation will be as follows;

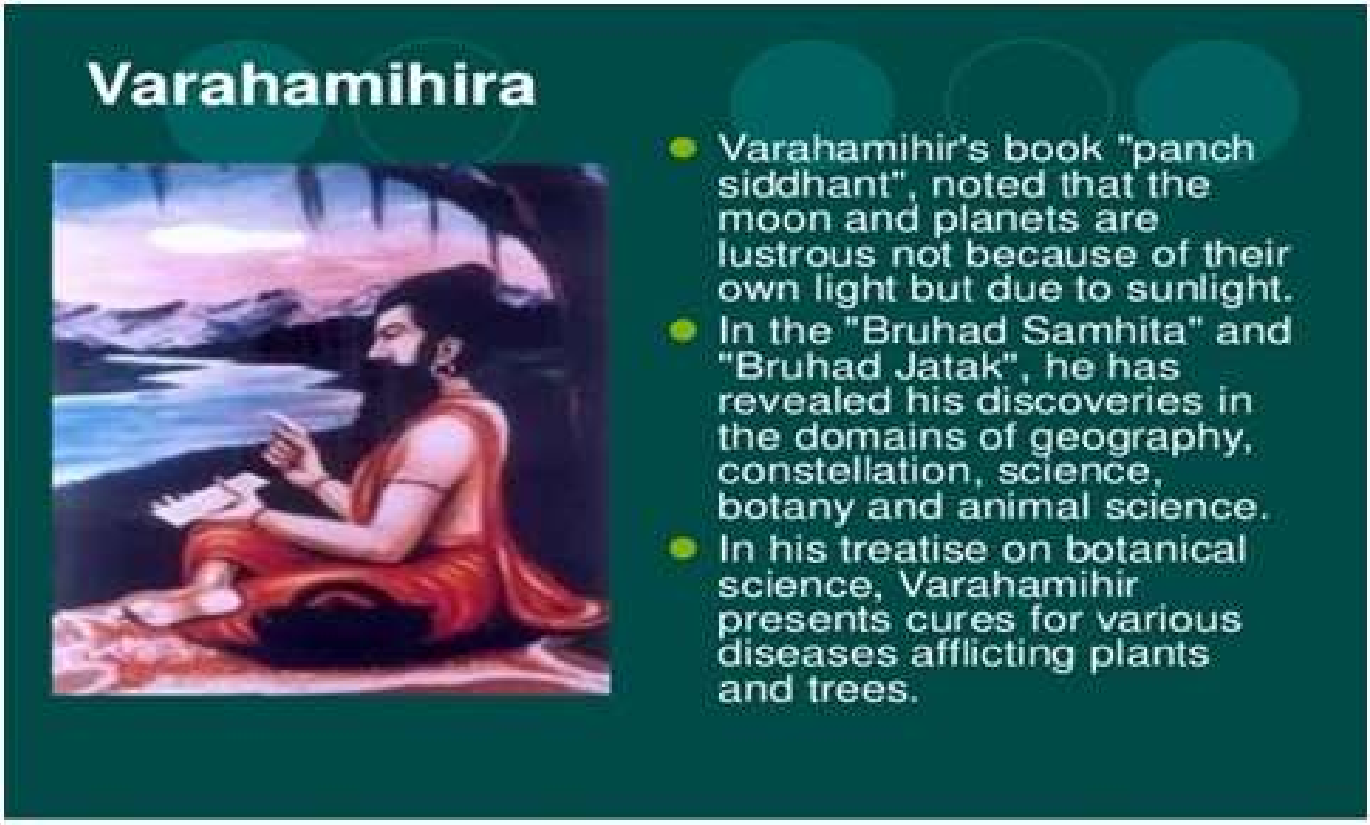
$$x = \sqrt{\frac{ad + bc}{ab + cd}(ac + bd)}$$

And

$$y = \sqrt{\frac{ab + cd}{ad + bc}(ac + bd)}$$

Then, $xy = ac + bd$

4. Varahamihira



Varahamihira (c. 505 - c. 587), also called **Varaha** or **Mihira**, was a Hindu astronomer and polymath who lived in Ujjain (Madhya Pradesh, India). He was born in the Avanti

He had made great contributions in the fields of hydrology, geology, maths and ecology. **First scientist to claim that** termites and plants could be the indicators of the presence of underground water. Infact he had given important information about termites (insects that destroy woods or dimak) is that they go very deep to the surface of water level to bring water to keep their houses wet. In his **Brhat Samhita** he had given **earthquake cloud theory** which has attracted the world of science.

Astrology or Jyotish a science of light was presented scientifically in a systematic form by Aryabhatta and Varahmihira.

Vrahamihira was one of the nine gems, who were scholars in the court of Vikramaditya. Even the predictions of Varahamihira's were so accurate that king Vikramaditya gave him the title **'Varaha'.** In the history of science he was the first to claim that some **"force"** might be keeping bodies stuck to

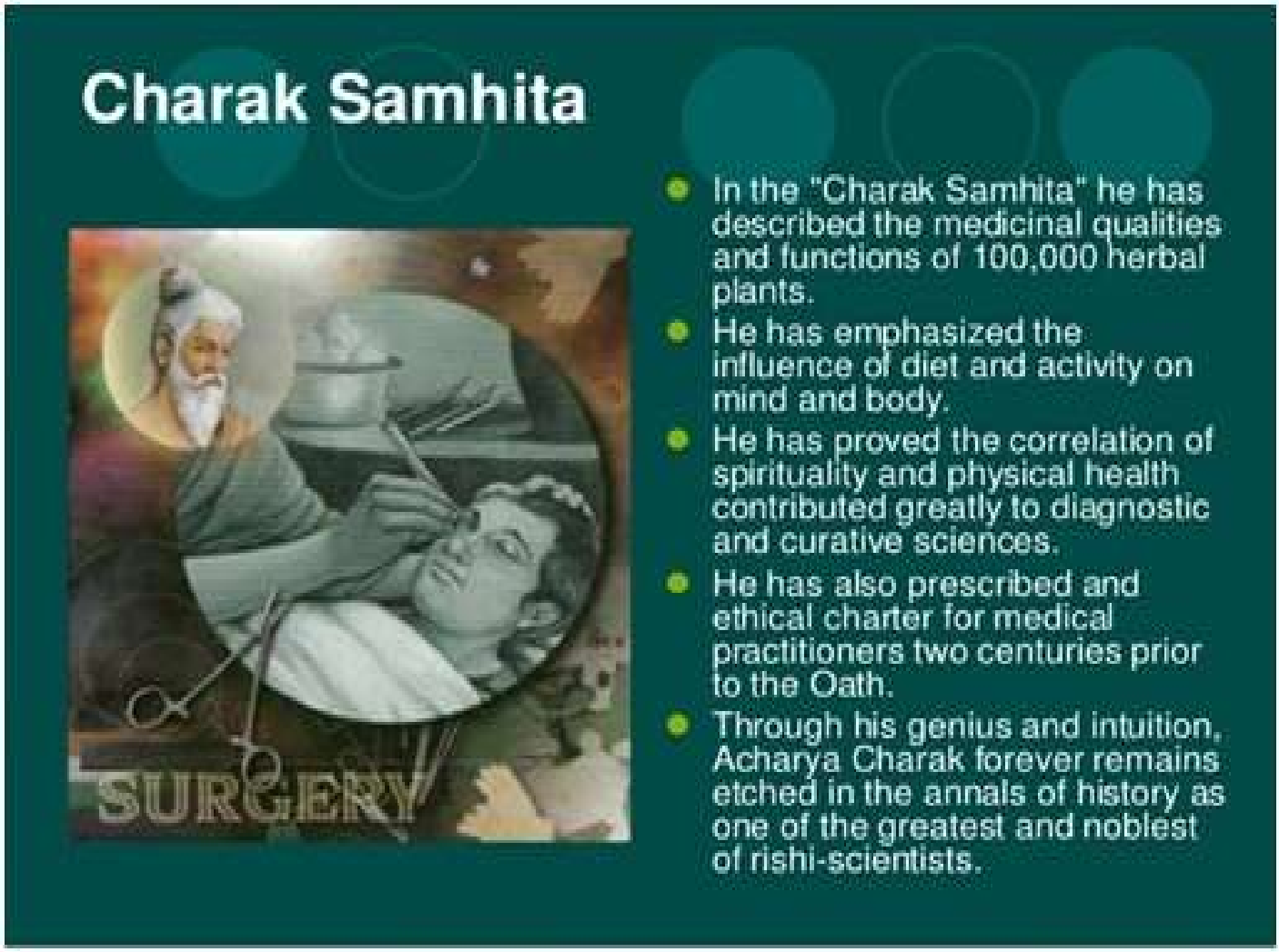
the round earth. And now it is known as gravity. **He also proposed that** the Moon and planets are lustrous not because of their own light but due to sunlight. **His mathematical work** included the discovery of trigonometric formulas. **Moreover, he was the first mathematician** to discover a version of what is now known as the **Pascal's triangle**. He used it to calculate binomial coefficients.

He was one of the first scientists to claim that termites and plants could be the indicators of the presence of underground water. He gave a list of six animals and thirty plants, which could indicate the presence of water.Another theory, which has attracted the world of science is the earthquake cloud theory given by Varahmihira in his Brhat Samhita. The thirty second chapter of this samhita is devoted to signs of earthquakes. He has tried to relate earthquakes to the influence of planets, undersea activities, underground water, unusual cloud formation and abnormal behaviour of animals.

Do you know that he had predicted the discovery of water in Mars around 1500 years ago?

5. Charak

Charaka (100 BCE – 200 CE[1]) was one of the principal contributors to Ayurveda, a system of medicine and lifestyle developed in Ancient India. He is known as the compiler or editor of the medical treatise entitled *Charaka Samhita* . Charaka has been identified as a native of Kashmir. The treatise that Charaka compiled is one of the foundational treatises of classical Indian medicine and is regarded one among the Brihat-Trayee (the Greatest - trio) of Ayurveda .



- He is known as **Father of ancient Indian Science of Medicine**. In the court of Kanishka he was the Raj Vaidya (royal doctor). His remarkable book on medicine is **Charak Samhita** in which he had given various description of diseases and gives methods of identifying their causes as well as method of their treatment. **He was the first person who talked about** the digestion, metabolism and immunity. He also knew the fundamentals of genetics.

Charaka divided the treatise into eight parts, or *ashtanga sthanas*: *sutra*, *nidana*, *vimana*, *sarira*, *endriya*, *chikitsa*, *kalpa*, and *siddha*; each part contained multiple chapters.

While Charaka delved into all aspects of medicine, including the logic and philosophy behind the Indian medicinal system, he placed special emphasis on the diagnosis of disease and treated Ayurveda as a comprehensive system of health care that dealt with both preventive and curative aspects. He also dealt elaborately with subjects such as fetal generation and

development, anatomy of the human body, and function and malfunction of the body according to the *tridosha* (the three humours of the body)—*vata*, *pitta*, and *kapha*. He also discussed the classification of various diseases

Don't you find it fascinating that thousands of years back, medical science was at such an advanced stage in India?

6. Maharishi Patanjali

He is known as **Father of Yoga** who had compiled **195 Yoga Sutras.** He was the first who had systematically present Yoga the great science. In Patanjali's Yoga Sutras, **Aum** is spoken as a symbol of God. Besides Yoga Sutras, Patanjali also wrote a work on medicine and worked on Panini's grammar known as **Mahabhasaya.** Yoga was passed on by word of mouth from one sage to another. The credit of systematically presenting this great science goes to Patanjali. He refers to Aum as a cosmic sound, continuously flowing through the ether, fully known only to the illuminated.

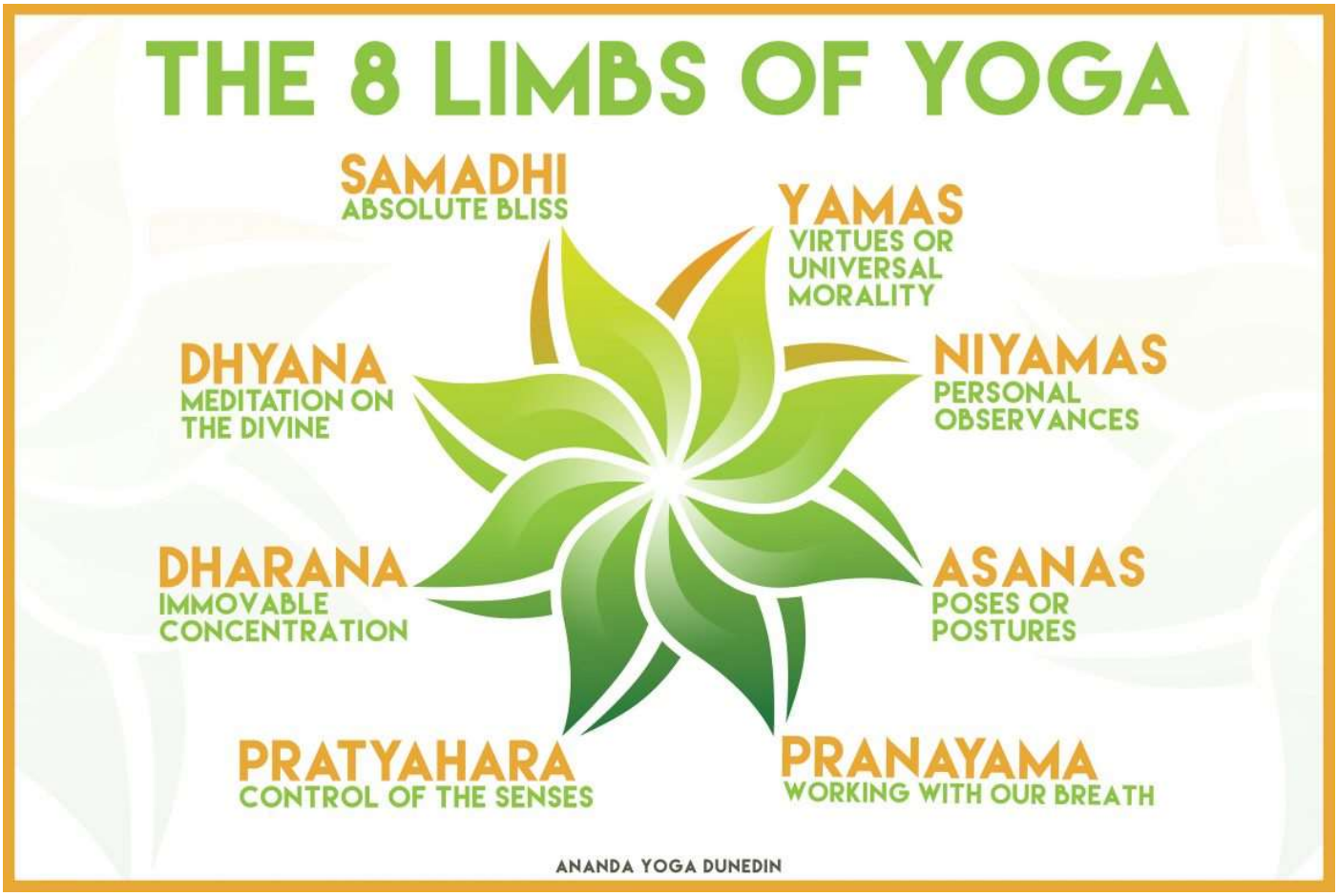
As per Patanjali, the meaning of Yoga is the restraint of the modifications of the mind-stuff. He has also written books on Ayurveda. It is believed that he must have had very little connection as far as social life is concerned, that is why there is no information available about any incidence of his life. But the world will always remain pleased with him for writing very useful books and giving the world the great tradition of Yoga.
Patanjali's teaching is a deep and inspiring scripture. Yet also a practical, accessible and applicable to any spiritual seeker. The Yoga sutra shows the peripheral way to lasting happiness and freedom. It's not just another intellectual exploration but a handbook for the true exercise of yoga

Do you know that Patanjali is an avatar of Adi Shesha- the Infinite Cosmic Serpent upon whom Lord Vishnu rests?

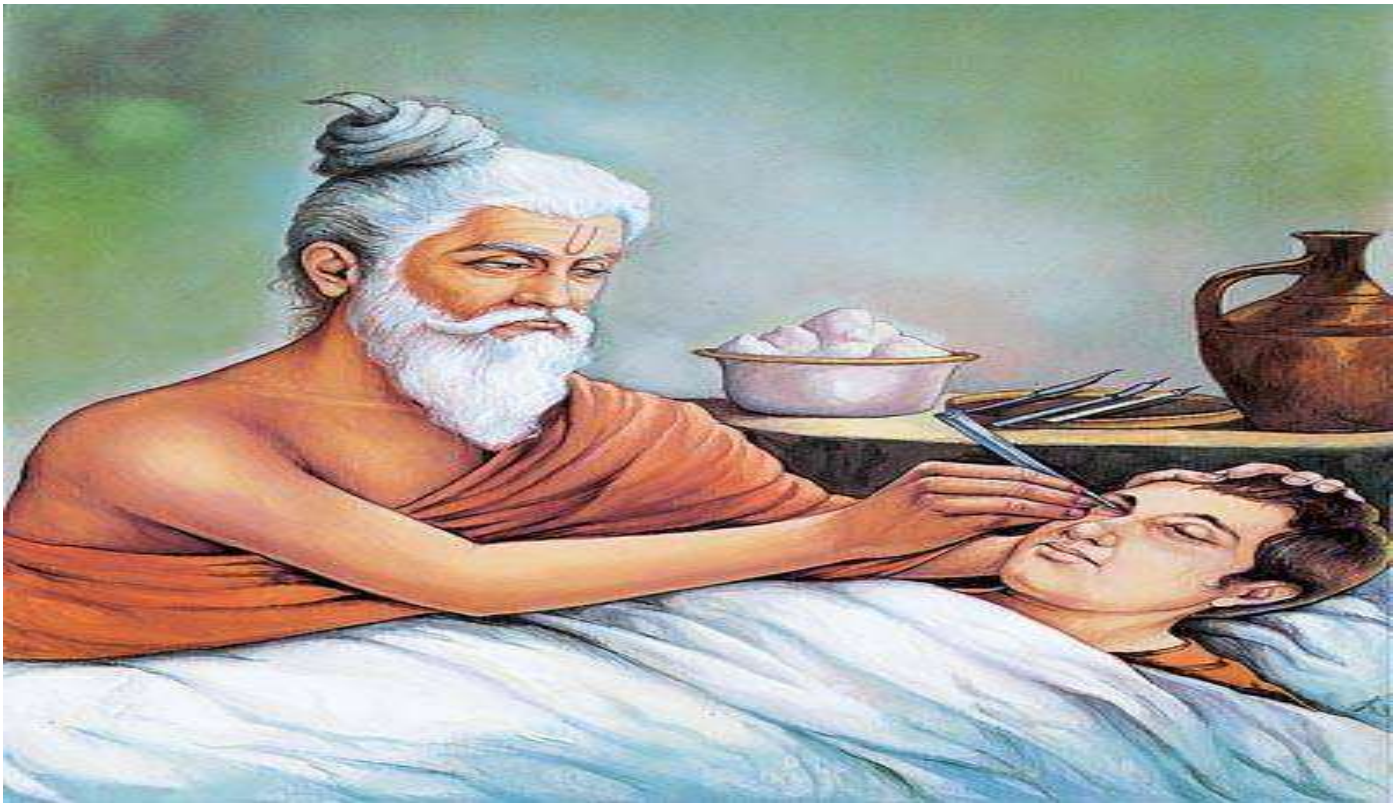
It is believed that he is an essayist who had written upon the ancient Indian medicine system i.e. Ayurveda. **Even the classical dancers in India** summons him and pays him their regards. It is believed that the **Jeeva Samadhi** of Patanjali is situated at **Tirupattur Brahmapureswara Temple**.

Yoga

The term Yoga is derived from the Sanskrit word **Yoktra**. It is an allied science of Ayurveda which was developed in Ancient India for healing without medicine the physical and mental level. It has also its roots in the Vedas like other sciences. It also defines **Chitta** i.e. dissolving thoughts, emotions and desires of a person's consciousness and achieving a state of equilibrium. Yoga is physical as well as mental. Physical yoga is known as **Hathyoga** and mental yoga is known as **Rajayoga.**



7. Susruta Samhita



Sushruta (c. 7th or 6th century BCE) was a physician in ancient **India** known today as the "Father of Indian **Medicine**" and "Father of Plastic Surgery" for inventing and developing surgical procedures. His work on the subject, the *Sushruta Samhita* (Sushruta's Compendium) is considered the oldest text in the world on plastic surgery and is highly regarded as one of the Great Trilogy of Ayurvedic Medicine; the other two being the *Charaka Samhita*, which preceded it, and the *Astanga Hridaya*, which followed it.

Ayurvedic Medicine is among the oldest medical systems in the world, dating back to the Vedic Period of India (c. 5000 BCE). The term *Ayurveda* translates as "life knowledge" or "life **science**" and is the practice of holistic healing which incorporates "standard" medical knowledge with spiritual concepts and herbal remedies in treatment as well as prevention of diseases. It was practiced in India for centuries before the **Greek** physician **Hippocrates** (c. 460 - c. 379 BCE), known as the Father of Medicine, was even born.

The Great Trilogy of Ayurvedic Medicine describes surgical procedures, diagnostic techniques, and treatments for various illnesses and injuries and even provides instructions for physicians on determining how long a patient will live (in the *Charaka Samhita*). The work of Sushruta standardized and established earlier knowledge through careful descriptions of how a physician should practice the art as well as specific procedures including performing plastic surgery reconstructions and the removal of cataracts.

The *Astanga Hridaya* combines the works of Charaka (c. 7th or 6th century BCE) and Sushruta, presenting a comprehensive text on both surgical and medical approaches to treatment, while also offering its own unique perspective. Sushruta's work, however, offers the greatest insight into the medical arts of the three owing to the commentary he provides in-between or included in discussions of various ailments and treatment.

Learning Outcome

After going through this project one can clearly understand that Science and Mathematics were highly developed during the ancient period in India.

- Some famous ancient Indian Mathematicians were Baudhayan, Aryabhatta, Brahmgupta, Bhaskaracharya, Mahaviracharya.

- Some famous scientists were Kanad, Varahamihira, Nagarjuna. Scientists of Ancient India

- Medical Science was also highly developed in ancient India.

- Ayurveda is the indigenous system of medicine that was developed in Ancient India. The word Ayurveda literally means the science of good health and longevity of life.

- Charak is called the father of ayurvedic medicine and Susruta the father of surgery in ancient India.

- Susruta's greatest contribution was in the fields of Rhinoplasty (plastic surgery) and Ophthalmic surgery (removal of cataracts).

- Charak Samhita, written by Charak is a remarkable book on medicine.

- The science of Yoga was developed in ancient India as an allied science of Ayurveda for healing without medicine at the physical and mental level.

- Patanjali was the first scholar to present this great science systematically in his Yoga Sutras.

Reference links

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