UNIT 4

Astronomy in India

- Indian astronomy was influenced by Greek astronomy beginning in the 4th century BCE and through the early centuries of the Common Era, for example by the Yavanajataka and the Romaka Siddhanta, a Sanskrit translation of a Greek text disseminated from the 2nd century.
- Aryabhata, also called Aryabhata I or Aryabhata the Elder, (born 476, possibly Ashmaka or Kusumapura, India), astronomer and the earliest Indian mathematician whose work and history are available to modern scholars. has long history in Indian subcontinent stretching from pre-historic to modern times.
- Some of the earliest roots of **Indian astronomy** can be dated to the period of Indus Valley civilisation or earlier.
- Astronomy later developed as a discipline of Vedanga, or one of the "auxiliary disciplines" associated with the study of the Vedas, dating 1500 BCE or older.
- The oldest known text is the *Vedanga Jyotisha*, dated to 1400–1200 BCE (with the extant form possibly from 700 to 600 BCE).
- Indian astronomy was influenced by Greek astronomy beginning in the 4th century BCE[6][7][8] and through the early centuries of the Common Era, for example by the Yavanajataka and the *Romaka Siddhanta*, a Sanskrit translation of a Greek text disseminated from the 2nd century.
- Indian astronomy flowered in the 5th–6th century, with Aryabhata, whose work, *Aryabhatiya*, represented the pinnacle of astronomical knowledge at the time.
- The Aryabhatiya is composed of four sections, covering topics such as units of time, methods for determining the positions of planets, the cause of day and night, and several other cosmological concepts.
- Later the Indian astronomy significantly influenced Muslim astronomy, Chinese astronomy, European astronomy, and others. Other astronomers of the classical era who further elaborated on Aryabhata's work include Brahmagupta, Varahamihira and Lalla.

Chemistry in India

- Chemical techniques in India can be traced back all the way to the Indus valley or Harappan civilisation (3rd millennium BCE). Following Acharya
- Prafulla Chandra Ray (1861-1944), the eminent Indian chemist of the last century and a historian of chemistry, five stages in its development in India can be recognised.
- They are: (i) the pre-Vedic stage upto 1500 BCE, including the Harappan period, (ii) the Vedic and the Ayurvedic period upto 700 CE, (iii) the transitional period from 700 CE to 1100 CE, (iv) the Tantric period from 700 CE to 1300 CE, and (v) the 'Iatro-Chemical period' from 1300 CE to 1600 CE. The dates cannot be considered definitive.
- Metallurgy was intimately linked with chemistry in India.
- We will discuss Indian metallurgy and metal-working in a later article, focussing our attention on chemical techniques for now.
- Pre-Harappan Indians were acquainted with the art of making baked or burnt clay pottery as well as painting the same with two or more colours.

- This implies the construction of open and closed kilns.
- The pottery of the Harappan culture consisted of mainly wheel-made ware, turned in various shapes, sizes and colours out of the well-levigated alluvium of the Indus.
- The colour and other characteristics of the wares depended upon the composition of the clay used and techniques of firing under either oxidising or reducing conditions.
- The Harappans also experimented with various mortars and cements made of burnt limestone, gypsum and mica, among other components.
- Finely crushed quartz, once fired, produced faience, a synthetic material; it was then coated with silica (perhaps fused with soda), to which copper oxide was added to give it a shiny turquoise glaze. Faience was then shaped into various ornaments and figurines.
- Addition of iron oxide, manganese oxide, etc., resulted in different colours. The Harappan artisans must have had an intimate knowledge of the processing and properties of several naturally occurring chemical substances.
- The craftsmen were highly skilled in the art of shaping and polishing the precious and semi-precious stones used for the production of beads. In the second stage, Rigveda (earlier than 1500 BCE) mentions many fermented drinks and methods of fermentation, apart from various metals.
- Soma juice from the stems of the soma plant was highly extolled and considered a divine drink. Madhu and suraa (brewed from barley grain) also find mention.
- Curd or fermented milk was an important food item. Cloths were mainly made of wool and the garments were often dyed red, purple or brown.
- Obviously, the Vedic Indians were acquainted with the art of dyeing with certain natural vegetable colouring matters.
- A type of pottery, now known as ‘Painted Grey Ware’, is associated with the Vedic period. This ceramic is a thin gray deluxe ware, mostly wheel-made, well-burnt, glossy and copiously painted.
- Later, ‘Northern Black Polished Ware’ also came into being in the eastern part of the Gangetic plains.
- Also, plenty of iron objects of the later period have been found throughout India.
- Glass beads dating back to the 10th century BCE have been discovered.
- In the succeeding centuries, the glass industry gained momentum and there were notable feats of excellence, as evidenced by the archeological finds in over 30 sites spread over India.
- The sites include Taxila in present Pakistan, Hastinapur, Ahichchhatra and Kopia in Uttar Pradesh, Nalanda in Bihar, Ujjain in Madhya Pradesh, Nasik and Nevasa in Maharashtra, Brahmagiri in Karnataka, and Arikamedu in Puducherry.
- The glass objects include beads of different colours, including gold foil ones, glass vessels in green and blue colours, flasks of agate-banded type, bangles, ear-reels, eye-beads, etc.
- There is no doubt that the glassmakers were skilful in controlling the temperature of fusion, moulding, annealing, blotching and gold foiling.

- The chemical composition of a typical glass specimen from Kopia is as follows: silica 66.6%, alumina 7%, alkalies (Na_2O) 21.7%, ferric oxide 1.6%, lime 2.4%, manganese oxide .07%, and traces of titania and magnesia.
- Kautilya’s Arthashaastra (3rd or 4th century BCE), a well-known text of governance and administration, has a lot of information on prevailing chemical practices.
- Apart from mines and minerals, it discusses the details of precious stones (pearl, ruby, beryl, etc.), and also of the preparation of fermented juices (sugarcane, jaggery, honey, jambu, jackfruit, mango, etc.) and oil extraction.
- It also has classifications such as sour fruit juices, liquids, spices, vegetables, etc., based on their chemical practices.
- The earliest versions of the two great Ayurveda classics, Charaka Samhitaa and Sushruta Samhitaa, may date back to a few centuries before the common era.
- They give accounts of several minerals, metals, metallic compounds, salts and fermented beverages.
- More importantly, they discuss the preparation of various alkalis (kshaara). Alkalis are of three types: mild (mridu), caustic (teekshna) and average (madhyama).
- They are prepared from some 25 plants that are mentioned in Sushruta Samhitaa.
- Hot alkaline solutions were used for treating thin sheets of metals like iron, gold or silver before incorporation into drugs.
- Caustic alkalis were also used for treating surgical instruments. Varahamihira’s Brihat-samhitaa (6th century CE) gives detailed information on the preparation of various perfumes and cosmetics.
- It also gives recipes for the preparation of glutinous material to be applied on the roofs and walls of buildings.

Mathematics In India

- **Indian mathematics** emerged in the Indian subcontinent[1] from 1200 BCE[2] until the end of the 18th century.
- In the classical period of Indian mathematics (400 CE to 1200 CE), important contributions were made by scholars like Aryabhata, Brahmagupta, Bhaskara II, and Varāhamihira. The decimal number system in use today was first recorded in Indian mathematics.
- Indian mathematicians made early contributions to the study of the concept of zero as a number, negative numbers, arithmetic, and algebra.
- In addition, trigonometry was further advanced in India, and, in particular, the modern definitions of sine and cosine were developed there These mathematical concepts were transmitted to the Middle East, China, and Europe and led to further developments that now form the foundations of many areas of mathematics.
- Ancient and medieval Indian mathematical works, all composed in Sanskrit, usually consisted of a section of *sutras* in which a set of rules or problems were stated with great economy in verse in order to aid memorization by a student.
- This was followed by a second section consisting of a prose commentary (sometimes multiple commentaries by different scholars) that explained the problem in more detail and provided justification for the solution.

- In the prose section, the form (and therefore its memorization) was not considered so important as the ideas involved.
- All mathematical works were orally transmitted until approximately 500 BCE; thereafter, they were transmitted both orally and in manuscript form.
- The oldest extant mathematical *document* produced on the Indian subcontinent is the birch bark Bakhshali Manuscript, discovered in 1881 in the village of Bakhshali, near Peshawar (modern day Pakistan) and is likely from the 7th century CE.
- A later landmark in Indian mathematics was the development of the series expansions for trigonometric functions (sine, cosine, and arc tangent) by mathematicians of the Kerala school in the 15th century CE.
- Their remarkable work, completed two centuries before the invention of calculus in Europe, provided what is now considered the first example of a power series (apart from geometric series)
- However, they did not formulate a systematic theory of differentiation and integration, nor is there any *direct* evidence of their results being transmitted outside Kerala.

Physics in India

- C.V. Raman (Chandrasekhara Venkata Raman) was awarded the Nobel Prize in Physics in 1930 for his revolutionary work on light scattering. Born in Tiruchirapalli on November 7, 1888, he was the first Asian and non-White beneficiary of the Nobel Prize in the Science field.
- USA. The USA is already way ahead as compared to other countries in the field of technology, education & research.
- The country is home to the number #1 University in the world. Listed below are the top universities in the USA offering physics programs along with their QS World University Rankings 2022.
- In information and communication technology (ICT), China has over five times the number of scientists from India among the top scientists in the world.
- In the list, China has 1,084 scientists in the top two percent compared to just 198 Indian scientists.
- saac Newton: The Father of Modern Physics

  Sir Isaac Newton, associated with Cambridge University as a physicist and mathematician, became famous after propounding three laws of motion that established a connection between objects and motion.
- Quantum mechanics is deemed the hardest part of physics. Systems with quantum behavior don't follow the rules that we are used to, they are hard to see and hard to “feel”, can have controversial features, exist in several different states at the same time - and even change depending on whether they are observed or not.
- He was a recipient of Padma Vibhushan, India's second highest civilian decoration, in honour of his services to build India's nuclear programme. Ramanna died in Mumbai in 2004 at the age of 79.
- Physics is the king of all sciences as it helps us understand the way nature works.
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Agriculture in India

- world agriculture statistics India is the world's largest producer of many fresh fruits like banana, mango, guava, papaya, lemon and vegetables like chickpea, okra and milk, major spices like chili pepper, ginger, fibrous crops such as jute, staples such as millets and castor oil seed. India is the second largest producer of wheat and rice, the world's major food staples.
- India is currently the world's second largest producer of several dry fruits, agriculture-based textile raw materials, roots and tuber crops, pulses, farmed fish, eggs, coconut, sugarcane and numerous vegetables.
- India is ranked under the world's five largest producers of over 80% of agricultural produce items, including many cash crops such as coffee and cotton, in 2010.
- India is one of the world's five largest producers of livestock and poultry meat, with one of the fastest growth rates, as of 2011.
- One report from 2008 claimed that India's population is growing faster than its ability to produce rice and wheat.
- While other recent studies claim that India can easily feed its growing population, plus produce wheat and rice for global exports, if it can reduce food staple spoilage/wastage, improve its infrastructure and raise its farm productivity like those achieved by other developing countries such as Brazil and China.
- In fiscal year ending June 2011, with a normal monsoon season, Indian agriculture accomplished an all-time record production of 85.9 million tonnes of wheat, a 6.4% increase from a year earlier.
- Rice output in India hit a new record at 95.3 million tonnes, a 7% increase from the year earlier.
- Lentils and many other food staples production also increased year over year. Indian farmers, thus produced about 71 kilograms of wheat and 80 kilograms of rice for every member of Indian population in 2011.
- The per capita supply of rice every year in India is now higher than the per capita consumption of rice every year in Japan.
- India exported $39 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide, and the sixth largest net exporter.
- This represents explosive growth, as in 2004 net exports were about $5 billion.[7] India is the fastest growing exporter of agricultural products over a 10-year period, its $39 billion of net export is more than double the combined exports of the European Union (EU-28).
- It has become one of the world's largest supplier of rice, cotton, sugar and wheat. India exported around 2 million metric tonnes of wheat and 2.1 million metric tonnes of rice in 2011 to Africa, Nepal, Bangladesh and other regions around the world.
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Medicine in India

- Medicinal plants based traditional systems of medicines are playing important role in providing health care to large section of population, especially in developing countries. Interest in them and utilization of herbal products produced based on them is increasing in developed countries also.
- To obtain optimum benefit and to understand the way these systems function, it is necessary to have minimum basic level information on their different aspects. Indian Systems of Medicine are among the well known global traditional systems of medicine.
- In this review, an attempt has been made to provide general information pertaining to different aspects of these systems.
- This is being done to enable the readers to appreciate the importance of the conceptual basis of these system in evolving the material medica.
- The aspects covered include information about historical background, conceptual basis, different disciplines studied in the systems, Research and Development aspects, Drug manufacturing aspects and impact of globalization on Ayurveda. In addition, basic information on Siddha and Unani systems has also been provided.

- It is a well-known fact that Traditional Systems of medicines always played important role in meeting the global health care needs.
- They are continuing to do so at present and shall play major role in future also.
- The system of medicines which are considered to be Indian in origin or the systems of medicine, which have come to India from outside and got assimilated in to Indian culture are known as Indian Systems of Medicine (Prasad, 2002).
- India has the unique distinction of having six recognized systems of medicine in this category.
- They are-Ayurveda, Siddha, Unani and Yoga, Naturopathy and Homoeopathy.
- Though Homoeopathy came to India in 18^{th} Century, it completely assimilated in to the Indian culture and got enriched like any other traditional system hence it is considered as part of Indian Systems of Medicine (Prasad, 2002).
- Apart from these systems- there are large number of healers in the folklore stream who have not been organized under any category. In the present review, attempt would be made to provide brief profile of three systems to familiarize the readers about them so as to facilitate acquisition of further information.
- Most of the traditional systems of India including Ayurveda have their roots in folk medicine. However what distinguishes Ayurveda from other systems is that it has a well-defined conceptual framework that is consistent throughout the ages. In conceptual base, it was perhaps highly evolved and far ahead of its time.

Metallurgy in India

- The **history of metallurgy in the Indian subcontinent** began prior to the 3rd millennium BCE.
- Metals and related concepts were mentioned in various early Vedic age texts.
  The Rigveda already uses the Sanskrit term Ayas(आयस) (metal). The Indian cultural and commercial contacts with the Near East and the Greco-Roman world enabled an exchange of metallurgic sciences.
- With the advent of the Mughals (established: April 21, 1526—ended: September 21, 1857) further improved the established tradition of metallurgy and metal working in India.
- During the period of British rule in India (first by the East India Company and then by the Crown), the metalworking industry in India stagnated due to various colonial policies, though efforts by industrialists led to the industry's revival during the 19th century.
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- During the period of British rule in India (first by the East India Company and then by the Crown), the metalworking industry in India stagnated due to various colonial policies, though efforts by industrialists led to the industry's revival during the 19th century.
- Recent excavations in Middle Ganga Valley done by archaeologist Rakesh Tewari show iron working in India may have begun as early as 1800 BCE.

- Archaeological sites in India, such as Malhar, Dadupur, Raja Nala Ka Tila and Lahuradewa in the state of Uttar Pradesh show iron implements in the period between 1800 BCE - 1200 BCE.
- Sahi (1979: 366) concluded that by the early 13th century BCE, iron smelting was definitely practiced on a bigger scale in India, suggesting that the date the technology's inception may well be placed as early as the 16th century BCE.
- The Black and Red Ware culture was another early Iron Age archaeological culture of the northern Indian subcontinent.
- It is dated to roughly the 12th – 9th centuries BCE, and associated with the post-Rigvedic Vedic civilization.
- It extended from the upper Gangetic plain in Uttar Pradesh to the eastern Vindhya range and West Bengal.
- Perhaps as early as 300 BCE, although certainly by 200 CE, high quality steel was being produced in southern India by what Europeans would later call the crucible technique.
- In this system, high-purity wrought iron, charcoal, and glass were mixed in crucibles and heated until the iron melted and absorbed the carbon.
- The resulting high-carbon steel, called ***fūlāḏ*** □□□□□ in Arabic and ***wootz*** by later Europeans, was exported throughout much of Asia and Europe.
- Will Durant wrote in *The Story of Civilization I: Our Oriental Heritage*:
- "Something has been said about the chemical excellence of cast iron in ancient India, and about the high industrial development of the Gupta times, when India was looked to, even by Imperial Rome, as the most skilled of the nations in such chemical industries as dyeing, tanning, soap-making, glass and cement... By the sixth century the Hindus were far ahead of Europe in industrial chemistry; they were masters of calcinations, distillation, sublimation, steaming, fixation, the production of light without heat, the mixing of anesthetic and soporific powders, and the preparation of metallic salts, compounds and alloys.
- The tempering of steel was brought in ancient India to a perfection unknown in Europe till our own times; King Porus is said to have selected, as a specially valuable gift for Alexander, not gold or silver, but thirty pounds of steel.
- The Moslems took much of this Hindu chemical science and industry to the Near East and Europe; the secret of manufacturing "Damascus" blades, for example, was taken by the Arabs from the Persians, and by the Persians from India."

Geography of ancient India

- Ancient India was bounded to the north by large mountains and to the south by the Indian Ocean. Major rivers flowed from the northern mountains: the Indus River and the Ganges River. India's climate was diverse, consisting of deserts and tropical areas.
- Ancient India was home to one of the earliest civilizations in the world: the **Indus Valley Civilization**. This civilization included two key centers of culture and power: **Mohenjo-Daro** and **Harappa**, both large cities. Other cities were also present in this ancient civilization.
- Geography was important to the Indus Valley Civilization because it drove its history and provided the environment necessary for civilization to rise in the Indian subcontinent.
- The term **Indian subcontinent** refers to the geographical area stretching east of the Hindu Kush mountains of Afghanistan, south of the Himalayan Mountains, and west of the Arakan Mountains of Myanmar.

- Today, the Indian subcontinent is home to several countries, including Pakistan, India, Nepal, Bhutan, Bangladesh, and Sri Lanka.
- This area is considered a subcontinent because of its unique culture and history, aside from being its own continental plate.
- The Indian subcontinent is a land of extremes. In the north are all the highest mountains in the world: the Himalayas.
- Land in the northern half of the subcontinent is temperate, with a dry winter and a hot summer.
- Much of the southern half of the subcontinent is tropical savannah, with the western coast having monsoons.
- However, the subcontinent is also home to dry extremes. The south has a hot, arid steppe (the Deccan Plateau), while the northwest is home to the hot Thar Desert.
- Ancient India is home to one of the oldest civilizations in human history: the Indus Valley Civilization.
- Arising in 3300 BCE, the Indus Valley Civilization has a similar origin to other early civilizations, such as Sumer and Egypt.
- That is, all three arose in hot environments which provided the warmth necessary for plants to grow fast.
- They also arose along rivers, which provided the hydration and fertility also necessary for agriculture.
- While Egypt arose along the Nile and Sumer along the Tigris and Euphrates, the Indus Valley Civilization arose along the **Indus River**, which flows south from the Himalayan Mountains.
- Harappa was one key site of the Indus Valley Civilization.
- The earliest Harappan people constructed their homes out of clay and tended farms along the banks of the Indus.
- These farms produced a surplus of food, allowing some Harappan people to focus on other pursuits, such as city planning, making art, and trading. Meanwhile, increased food.
- production allowed the population of Harappa to grow, so that at its peak, it was inhabited by perhaps 24,000 people. This ancient society was advanced, with many homes equipped with indoor plumbing. This was a gargantuan advancement in city planning.
- Harappa was benefitted by natural resources; its people grew cotton, wheat, rice, and domesticated various animals, including cows.
- However, the ancient Indian climate and geography were not perfect. Harappa was located in the arid Thar Desert, whose droughts might have ultimately brought down the city.
- Harappa was also forced to confront other environmental challenges, such as flash flooding caused by monsoons.
- In order to balance out the threat of floods, the Harappan people developed a network of canals. Some archaeologists have suggested that changes in the monsoon season might have driven the Harappan society to collapse.

Biology of ancient India

Before the invention of microscope, and of course its super-cousin (SEM), the microscopic world was not visible to humans. Microscopes made it possible to study the vascular structures and their function in nutrient transport, as also cellular basis of growth. But minute and careful observation of plants in India dates back to a few thousand years. The ancient science of botany was quite developed in its understanding of the plant kingdom, as also in taxonomy. Below we give a glimpse of the various attempts in antiquity to classify plants according to their properties.

The beginning of relationship between humans and plants can be traced back to the prehistoric times. The Indus Valley people used to live in villages, cities and towns, wore clothes, cultivated crops including wheat, barley, millet, dates, vegetables, melon and other fruits and cotton; worshipped trees, glazed their pottery with the juice of plants and painted them with a large number of plant designs. They also knew the commercial value of plants and plant products. There are sufficient indications to show that Agriculture, Medicine, Horticulture, developed to a great extent during the Vedic Period. In the Vedic literature we find a large number of terms used in the description of plants and plant parts, both external features and internal structures; a definite attempt at classification of plants and evidence that use of manure and rotation of crops were practiced for the improvement of fertility of soil and nourishment of plants. Even *Rgveda* mentions that Vedic Indians had some knowledge about the food manufacture, the action of light on the process and storage of energy in the body of plants. In the post-Vedic Indian literature there is enough evidence to show that botany developed as an independent science on which was based the science of medicine (as embodied in the *Charaka* and *Susruta Samhitas*), Agriculture (as embodied in the *Krsi-Parasara*) and Arbori-Horticulture (as illustrated in the *Upavana-vinoda* as a branch of Botany). This science was known as the Vriksayurveda, also compiled by Parasara.

Plants in Vedas

The most celebrated plant that finds frequent mention in the *Rgveda* and later *Samhitas* is the Soma plant. The Vedic Indians hail *Soma* as the Lord of the forest (*vanaraja*). The botanical identity of Soma plant, however, has not been decided till today. The probable candidates are *Ephedra* (a Gymnosperm); *Sarcostemma* (flowering plant); and mushroom (a fungus).

The second most mentioned plant was *peepal* or the *Asvattha* (*Ficus religiosa*) during the Vedic period. The *Rgveda* refers to utensils and vessels fashioned out of the wood of the *Asvattha* tree.

Some of the other trees that find mention in the Vedas are: (i) Silk cotton (*Salmalia malabaricum*); (ii) *Khadira* (*Acacia catechu*) (iii) *Simsupa* (*Dalbergia sissoo*); (iv) *Vibhitaka* (*Terminalia bellerica*); (v) *Sami* (*Prosopis* sp.); and (vi) *Plaksa* (*Ficus infectoria*); *lksu* (sugar cane – *Saccharum offcinarum*) finds a mention as a cultivated plant in the *Atharvaveda, Maitaryani Samhita*, and other texts.

The Vedic Indians knew about many flower-bearing and fruit-bearing plants, like *Palasa* (*Butea monosperma*), two varieties of lotus – white (*pundarika*) and blue (*puskara*), white lily (*kumuda*), cucumber (*urvaruka*), *jujuba* (*Zizypus jujuba*), *udumbara* (*Ficus glomerata*), *kharjura* (*Phoenix dactylifera*) and *bilva* (*Aegle marmelos*), etc.

Written records, in the form of manuscripts, are available in Sanskrit and several other Indian languages. Sanskrit literature includes the *Vedas*, the *Upanisadas*, and epics like the *Ramayana* and the *Mahabharata*. The lay literature includes prose, poetry, and drama of a number of Sanskrit authors like *Kalidasa, Magha* and *Bhavabhuti*, in whose works the information on plants is incidental and given by way of comparison. Technical literature comprises medical works like the *Charaka* and *Susruta Samhitas*, lexicons like *Medininighantu* and *Amarakosa*, as well as the encyclopedic works like *Arthasastra* and *Brhatsamhita*. These works generally give excerpts of botany or what is known as *vrksayurveda*. In addition, there are a number of exclusive works under the title of *Vrksayurveda*. *Parasara's Vrksayurveda* is supposed to be the most ancient work in actual botany, to have been composed during first century BC and first century AD.

From the literary evidence it is clear that even in the First Millennium BC, botany was fully systematized and taxonomy well developed.

Plant Physiology

Udayana, in his *Prthviniraparyam*, says that in plants there is life, death, sleep, waking, disease, drugging, transmission of specific characters by means of ova, movement towards what is favourable and away from what is unfavourable. The Buddhist logician Dharmottara in his *Nyayavindutika* records the phenomenon of sleep in certain plants, in the form of contraction of their leaves during night. Gunaratna, in his *Saddarsana-samuccaya*, enumerates different characteristics of life: (1) the plant passes through three stages of infancy, youth and age; (2) they have regular growth; (3) their various kinds of movement are conditioned by sleep, walking, response to touch or need for support; (4) plants deal with wounds and laceration sustained by their organs and make use of drugs to overcome wounds as well as diseases; (5) assimilation of food from the soil is determined by requirements of plans for growth; (6) recovery from wounds and diseases by the application of drugs; (7) dryness or the opposite due to sap; and (8) special food favourable for impregnation.

Sankaramisra in his *Upaskara* mentions that after a wound or laceration, there is natural recuperation due to the growth of organs (*bhagnaksatasamrohana*). The *Santiparva of Mahabharata* enumerates several physiological principles including the sense of touch, hearing (response to sound), vision, smell, irritability, etc, in respect of plants.

Nourishment

As to the physiology of nourishment, scattered references amply indicate the knowledge that plants receive their nutrients from the soil in the form of solution through the agency of the root. The use of padapa for the root, as already pointed out, is significant. *Santiparva* explains the phenomenon of ascent of sap in the following lines, "the tree sucks water from its base (root) with the force, and along with air, water is drawn up the tree". Dixona and Joly explained this theory only in 1894.

The nutritive value of absorbed water and its role in plant metabolism is clearly illustrated in the following lines of the *Santiparva* "the water absorbed by the plant is converted into food under the influence of *agni* (energy) and *maruta* (air), and due to this, plant can grow".

Vrksayurveda of Parasara, explained the food preparation in the leaf. According to Parasara, "the watery sap obtained from earth (*parthivarasa*) is transported from root up to the leaf through *syandana* (xylem). There it gets digested with the help of chlorophyll (*ranjakena pacyamanat*) into nutritive substance and a by-product (*malam*)".

Several Sanskrit texts also describe the movements of the plants. According to literature, plants show movements towards a direction, which is favourable to them, and move away from a direction unfavourable to them.

The sensitiveness property of the touch-me-not plant (*Mimosa pudica*) is also clearly described in some ancient texts.

The concept of flowering at different times during a day – morning or evening – has also been observed by the ancient botanists.

Plant Pathology

Many references to plant diseases and their treatment are also available in the Vedic literature. According to S. Sundara Rajan, the *Atharvaveda* explains the destruction of corn due to insect pests. *Vinaya*, the famous Buddhist text, describes the blight and mildew diseases. A much later text, *Sukraniti*, gives a detailed account of danger to grains from various agents such as fire, snow, worm, insect, etc. Gunaratna, in his *Saddarsanasamuccaya*, observes that plants are afflicted by diseases, displacement or dislocation of flowers, fruits, leaves and barks in the same way as the human body suffers from jaundice, dropsy, emaciation, stunted growth of finger, nose, etc., and respond to treatment like human bodies.

According to Varahamihira, plant diseases are caused by cold climate (low temperature), wind (dryness) and sun (heat) and indicated by the yellowness of the leaves, non-or under-development of buds, dryness of the branches and the exudation of the sap. He also described the treatment: the paste of *ghee, vidanga* (*Embelia ribes*) and mud kneaded in the infected parts and then diluted milk should be sprinkled over the area. *Agnipurana* prescribes a mixture of *vidanga* with rice, fish and flesh. *Agnipurana* and *Brhatsamhita* suggested following treatment when a tree is not producing flowers and fruits: the hot decoction prepared of *kulattha* (horsegram, *Dolichos biflorus*), *masa* (blackgram, *Phaseolus mungo*), *mudga* (greengram *Phaseolus radiatus*), *tila* (*Sesamum indicum*) and *yava* (barley) in milk. Cool the mixture and sprinkle it on trees.

Consciousness in Plants

Ancient Indians believed that plants as living organisms possess consciousness, but it remained dormant and was not comparable to Indian animals. Manu writes that the plant has a latent consciousness, which is capable of perceiving both pleasure and pain.

In *Mahabharata*, *Santiparva* explains that the plant has life, touch, feel, smell, vision, and hearing senses.

Germination

The technical term used for seed is *vija*. The seed is enclosed in a vessel called *vijakosa*. The endosperm is called *sasya* and the cotyledon *vijapatra*. Parasara used the term *vijamatrka* to denote cotyledon and recognizes monocotyledonous (*ekamatrkavija*) and dicotyledonous (*dvimatrkavija*) seeds.

Germination of a seed is called *ankurodbheda*, which means sprouting of the seed to life; *ankura* means seedling. According to *Susruta*, proper season, good soil, requisite supply of water and good seeds are required for germination of the seed.

Gunaratna observes in his commentary that the seeds of *vata* (*Ficus indicum*), *pippala* (*Ficus religiosa*), *nimbu* (*Melia azadirachta*), etc. are germinated during the rainy season under the influence of dew and air.

Parasara also gives the descriptive commentary on the process of germination in *Vrksayurveda*. According to Parasara, "during the sprouting up of the seedling (*praroha*), its body receives nourishment from the cotyledons. This nourishment enables the seedling to grow until its root develops and comes of its own. The cotyledons dry up as soon as the seedling is able independently to receive nourishment directly from the soil of the earth".

Reproduction, Sex and Heredity

Ancient Indian literature also deals with sex, genetics, and reproduction of plants by fruits, seeds, roots, cuttings, graftings, plant apices and leaves. Buddha Ghosa, in his *Sumangala-vilasini*, a commentary on the *Digha Nikaya*, describes some of these methods under such terms as *mula-vija* (root seed), *khandabija* (cuttings), *phaluvija* (joints), *agravija* (budding) and *bija-bija* (seed). *Atharvaveda* and *Arthasastra* describe the propagation by seed (*bija-bija* or *vijaruha*) and bulbous roots (*kandavija*), respectively. The method of cutting (*skandhavija*) is described in the *Arthasastra*, *Brhatsamhita* and *Sumangala-vilasini* in the case of sugar cane, jackfruit, blackberry, pomegranate, vine, lemon tree, *asvattha* (*Ficus religiosa*), *nyagrodha* (*Ficus bengalensis*), *udumbara* (*Ficus glomerata*) and several others. Some ideas related to sexuality in plants are noticeable in the *Harita* and *Charak Samhitas*. Charak recognized male and female individuals in the plant called *Kutaja* (*Hollerhina antidysenterica*), and the male categories of plants bearing white flowers, large fruit and tender leaves and the female categories characterized by yellow flowers, small fruits, short stalk, etc. The Rajanighantu mentions the existence of male and female plants in the plant *Ketaki* (*Pandanus odoratissimus*). The male plant is called *sitaketaki*, and the female is called *svarna ketaki*. Regarding heredity, *Charaka* and *Susruta* mention that the fertilized ovum contains in miniature all the organs of the plants, for example the bamboo seed containing in miniature the entire structure of the bamboo tree, and further that the male sperm cell have minute elements derived form each of its organs and tissues. Such ideas closely resemble Darwin's 'gemmules'.

Plant Taxonomy & Nomenclature

In ancient times, plants were named to mark:

1. Special associations, like *bodhidruma* (*Ficus religiosa*), *asoka* (*Saraca indica*) and *Sivasekhara* (*Datura*).
2. Special properties such as medicinal, domestically useful, etc., like *dadrughna* (*Cassia fistula*), *arsoghna* (*Amorphophallus campanulatus*), *kusthanasini* (*somaraji*), *dantadhavana* (*Acacia catechu*), *karpasa* (cotton) and *lekhana* (reed).
3. Morphological characteristics, e.g. shape of leaf, number of leaflets in a compound leaf, shape and colour of flowers, etc., like *kisaparni* (*Achyranthes* sp.), *asvaparnaka* (*Shorea robusta*), *pancangula* (*Ricinus* sp.), *tripatra, saptaparna, vakrapuspa* (*Sesbania grandiflora*) and *satamuli* (asparagus sp.).
4. Local association and environmental association, like *saubira* (*Zizyphus jujuba*), *magadhi* (Jasmine), *vaidehi* (Pepper), *jalaja*, *pankeruha* (lotus) and *maruvaka* (*Ocimum* sp.).
5. Other peculiarities, like *vakrapuspa* (plant having curved flowers), *vranari* (enemy of boils) for the plant *Sesbania grandiflora*; *kantaphala* (having spiny fruits), *ghantapuspa* (possessing bell-shaped flowers) and *mahamohi* (great intoxicator) for the plant *Datura alba*.

According to S. Sundara Rajan, in the ancient Indian texts, the nomenclature of the plants was generally based on the plant's botanical characters (*paricaya prjnapikasamjna*) and their therapeutic properties (*guna prajnapikasamjna*).

Classification of Plants

Plants were classified in accordance with three distinct principles, botanical (*udbhida*), medicinal (*virecanadi*) and dietetic (*annapanadi*).

The *Rgveda* divides plants roughly into three broad classes, namely, *Vrska* (tree), *Osadhi* (herbs useful to humans) and *Virudh* (creepers). Plants are further subdivided into *Visakha* (shrubs), *Sasa* (herbs), *Vratati* (climbers), *Pratanavati* (creepers) and *Alasala* (spreading on the ground). All grasses are separately classified as *Trna*, flowering plants are *Puspavati*, and the fruit bearing ones are *Phalavati*. Leafless plants are placed under the group, *Karira*.
The *Atharvaveda* has classified plants into various categories based on their morphological characters and other properties, such as *Prasthanavati* (spreading), *Sthambini* (bushy), *Ekasugna* (with single whorl of calyx), *amsumati* (having many shoots), *Kandini* (jointed), *Visakha* (having extending branches), *Jiivala* (lively), *Nagharisa* (harmless) and *Madhumati* (very sweet).

Some ancient scientists, like Manu, Charaka and Udayana, etc. also classified the plants in various classes.

Manu divided plants under eight classes as follows:

1. *Osadhi* – plants bearing abundant flowers and fruits, but withering away after fructification, e.g. rice, wheat.
2. *Vanaspati* – plants bearing fruits without evident flowers.
3. *Vrksa* – tress bearing both flowers and fruits.
4. *Guccha* – bushy herbs
5. *Gulma* – succulent shrubs
6. *Trna* – grasses
7. *Pratana* – creepers which spread their stems on the ground
8. *Valli* – climbers and entwiners.

According to *Charaka* and *Susruta Samhita* the plants are categorized into four classes:
(1) *Vanaspati* – which bear fruits but not flowers, (2) *Vrksa* or *vanaspatya* – which bear both fruits and flowers, (3) *Virudh* – which creep on the ground or entwine, (4) *Osadhi* – annual herbs which wither away after fructification).

Susruta subdivides *Virudhs* into two groups, *pratanavatya* (creepers with spreading stem on the grounds) and *gulminya* (succulent herbs), and Charaka subdivides *Virudhs* into *lata* (creeper), *gulma* and *osadhis* into annuals or perennials bearing fruits and grasses which go without fruits. He further divided the plants into 50 groups based on their physiological actions and diseases they cure,and flowering plants into the following seven heads based on dietetic principles: 1) *Sukadhanya* (cereals), 2) *Samidhanya* (pulses), 3) *Saka varga* (pot herbs), 4) *Phala varga* (fruits), 5) *Harita varga* (vegetable), 6) *Ahayogi varga* (oils), and 7) *Iksu varga* (sugarcane).

The *Vaisesikas* classify plants under seven heads, e.g. *Vrksa, Trna, Osadhi, Gulma, Lata, Avatana* and *Vanaspati*. Defining the characteristics of the various groups Udayana's *Kiranavali*, remarks that *Vrksas* are plants with trunk, branches, flowers and fruits; *Trnas* are exemplified by ulupa like plant; *Osadhis* are plants like *kaluma* which die after fruition; *Gulmas* are plant like *bhata*, *latas* are represented by *kusmanda*, a species of *Cucurbita*; *Avatanas* are plants like *ketaki;i* and *Vanaspatis* are trees which produce fruits without flowers.

According S. Sundara Rajan, the *Vanausadhivarga* of *Amarakosa* identifies plants under three categories, mushrooms (*citra*, *aticatra* and *phalghna*), parasites (*Vanda* and *Vrksadani*) and epiphytes (*Vrksaruha* and *jivantika*).

In his *Vrksayurveda*, Parasara developed a more elaborate classification. Parasara mentions two types of plants: *Dvimatrka* (Dicotyledons) and *Ekamatrka* (Monocotyledons). He further classified plants into families (*gana vibhaga*), like:

1. *Samiganiya* (Leguminosea) – This family covers *samivrksa*, a plant bearing *simbiphala*, (legume or pod, compound leaves held on a common stalk and leaflets arranged like a feather). Flowers are hypogynous (*puspakrantabijadhara*) and five-petalled, with gamosepalous calyx and an androecium of 10 stamens. This family has three subtypes: *vakra-puspa*, *vikarnika-puspa* and *suka-puspa*.
2. *Puplikagalniya* (Rutaceae) – In this family the plants bear spines, odoriferous leaves and winged petioles, flowers are hypogynous (*tundamandala*) with free petals and stamens. Fruits formed of superior ovary (*puspa-krantaphala*) contain hairy succulent flesh and multiple seeds. Family has two subtypes: *kesaraka* and *maluraphala*.
3. *Svastikaganiya* (Cruciferae) – According to the name, the shape of the calyx looks like a *svastika*. The flower has four sepals, four petals and six stamens, and a superior ovary (*tundamandala*). In the inflorescence flowers are arranged in rows.
4. *Tripuspaganiya* (Cucurbitaceae) – The plant is epigynous (*kumbhamandala*), which are sometimes unisexual. The flower has five united sepals and petals and three stamens and a style with three-pointed stigma (*trisirsavarata*). The ovary is *trivartaka* (tri-locular).
5. *Mallikaganiya* (Apocynaceae) – Plants having mixed inflorescence and which are hermaphrodite (*samanga*), calyx and corolla are united having five stamens, epipetalous (*avyoktakesara*). The seeds having long fine hairs (*tulapucchasamanvita*).
6. *Kurcapuspaganiya* (Compositeae) – The flowers are sessile and borne on a common axis, surrounded by a common calyx and look like a brushy head (*kurcakara*). The ovary is inferior (*puspasirsakabijadhara*).

Plant Anatomy

Detailed study of internal structure of plants becomes possible only after the invention of the compound microscope. But in the *Rgveda*, *daru* or the wood is distinguished from the softer outer part of a tree. *Taittiriya Samhita* separates the outer part into *valka* (outer) and *vakala* (inner) bark. The *Brhadaranyaka Upanisad* shows more detailed picture in this field. According to *Brhadaranyaka Upanisad* the five regions present in a plant are: *tvak* (skin or bark), *mamsa* (soft tissues); *asthi* (wood or xylem), *majja* (pith), and *snayu* (fibres both xylem and sclerenchyma).

But the *Vrksayurveda* of Parasara gives more detailed and clearer description of the plant anatomy. According to Parasara, there are tissue systems meant for the transportation of nutrients and sap. The whole of the vascular system has been given the name *sarvasrotamsi* (that which helps in the flow). This is divided into two categories, first is *syandana* and second in *sirajala*, which is obviously xylem and phloem, respectively. He explains that the *syandana* is involved in the transportation of *rasa*, which is absorbed from the Earth (*Prthvi*) to all parts of the plant body and *sirajala* (pl. *sirajalani*) helps in the re-distribution of nutrition from the leaf to other parts of a plant.

But the most remarkable anatomical observation made by Parasara relates to a detailed description of the plant-cell. He gives a more detailed study than Robert Hooke who discovered the cell in 17th century. Parasara notes that the internal structure of the leaf consists of innumerable compartments, which are filled with the sap. They are the storehouse of sap (*rasasrayah*) and covered by a boundary-cell wall or cell-membrane (*kalavestana*). The structure has five elemental principles (*pancabhautika gunasamanvita*) as well as a colouring principle (*ranjakayukta*), and cant be visible to the naked eye. The thin boundary originates from a fluid (*kalaladupajayate*), which is called protoplasm by the modern botanists.

Medical Botany

The bulk of the Ayurvedic medicines belong to the plant kingdom. And all the Ayurvedic texts deal with botanical aspects, mainly the identification and categorization of plants as source of drugs. The *Charaka Samhita* has a chapter titled *Vibhagavidya*, dealing with the classification of plants and animals. The *Susruta samhita*, the second Ayurvedic classic, also deals with several aspects of botany such as morphology and taxonomy. *Susruta* also provides classification of plants on the basis of medicinal properties.

Water Management in India

- The Water Management program works with communities to harvest and store rainwater for direct use, and/or replenish groundwater by building and restoring infrastructure in villages.
- It supports revival of traditional water bodies, construction of water storage infrastructure, and safe disposal of wastewater.
- It promotes safe drinking water for all with innovative low-cost, sustainable technologies and WASH behavior.
- It creates awareness about the need for water conservation and builds capacities of local communities for better management and long-term sustainability of their water resources.
- The program seeks opportunities to collaborate for continuous improvement and replication of low-cost water management interventions.
- India has about 18 percent of the world's population and only 4 percent of the world's water resources.
- It is severely water-stressed, thereby making water management a national priority. India uses about 230 cubic kilometers of groundwater annually, which is more than a quarter of the global total, making it the world's largest user of groundwater.
- About 90 percent of the groundwater extracted is used for irrigation and over 60 percent of the irrigated land in India is supported primarily by groundwater supplies.
- For an agrarian country like India, water is a key driving force of agriculture and has a direct bearing on its productivity and sustainability. However, unregulated extraction and non-replenishment has reduced groundwater drastically and deteriorated its quality.
- The crisis has worsened further due to climate change, which causes erratic and intense rainfall.
- This, coupled with lack of sufficient runoff storage capacity, leads to the loss of precious freshwater into the sea.
- Furthermore, there is a serious lack of infrastructure for safe disposal of wastewater in villages, which further leads to contamination of water resources.
- Water contamination is a serious problem, giving rise to health and hygiene concerns.
- The Water Management program focuses on replenishing depleted underground aquifers and augmenting groundwater primarily with rainwater harvesting.
- This improves the availability and quality of groundwater in the long run, and provides water security to rural households.
- The program works with communities to revive traditional water bodies, and design and construct cost-effective recharge structures to harvest surplus monsoon runoff for either augmentation of groundwater and/or creation of surface water storage.
- Water resource augmentation structures include check dams, ponds, farm ponds, tanks, recharge wells, among others.

Textile Technology in India

- The **textile industry in India** traditionally, after agriculture, is the only industry that has generated huge employment for both skilled and unskilled labour. The textile industry continues to be the second-largest employment generating sector in India. It offers direct employment to over 35 million people in the country.

- India is the world's second largest exporter of textiles and clothing, and in the fiscal year 2022, the exports stood at US$ 44.4 billion.

- According to the Ministry of Textiles, the share of textiles in total exports during April–July 2010 was 11.04%. During 2009–2010, the Indian textile industry was pegged at US$55 billion, 64% of which services domestic demand.[1] In 2010, there were 2,500 textile weaving factories and 4,135 textile finishing factories in all of India.
- According to AT Kearney's 'Retail Apparel Index', India was ranked as the fourth most promising market for apparel retailers in 2009
- India is the second largest producer of fibre. The country is the world's largest producer of cotton and jute.
- India is also the world's second largest producer of silk.[7] Other fibres produced in India include wool, and man-made fibres.
- 100% FDI is allowed via automatic route in textile sector. Rieter, Trutzschler, Saurer, Soktas, Zambiati, Bilsar, Monti, CMT, E-land, Nisshinbo, Marks & Spencer, Zara, Promod, Benetton, and Levi's are some of the foreign textile companies invested or working in India.
- Between January and July 2021, India exported textile products worth Rs 1.77 lakh crore, which is 52.6% more than the same period last year.

Cotton

- In the early years, the cotton textile industry was concentrated in the cotton growing belt of Rajasthan, Maharashtra and Gujarat. Availability of raw materials, market, transport, labour, moist climate and other factors contributed to localisation.
- In the early twentieth century, this industry played a huge role in Bombay's economy but soon declined after independence.
- While spinning continues to be centralised in Maharashtra, Gujarat and Tamil Nadu, weaving is highly decentralised.
- As of 30 November 2011, there are 1,946 cotton textile mills in India,[24] of which about 80% are in the private sector and the rest in the public and cooperative sector.
- Apart from these, there are several thousand small factories with three to ten looms.there is a committee established in India under 'textile committee act 1963'.
- this commmitte sets the quality standards for textiles manufactured for sale in the internal market as well as for export.

Jute

- India is the largest producer of raw jute and jute goods and the third largest exporter after Bangladesh. There were about 80 jute mills in India in 2010–11, most of which are located in West Bengal , mainly along the banks of the Hooghly River, in a narrow belt (98 km long and 3 km wide).
- In 2010-2011 the jute industry was supporting 0.37 million workers directly and another 400,000 small and marginal farmers who were engaged in the cultivation of jute.
- Challenges faced by the industry include stiff competition in the international market from synthetic substitutes and from other countries such as Bangladesh , Brazil , Philippines , Egypt and Thailand. However, the internal demand has been on the rise due to Government policy of mandatory use of jute packaging. To stimulate demand, the products need to be diversified. In 2005, the National Jute Policy[27] was

formulated with the objective of improving quality, increasing productivity and enhancing the yield of the crop.

Ministry of Textile and Industry

- In 2000, the Government of India passed the National Textile Policy.
- The major functions of the Ministry of Textiles are formulating policy and coordination of man-made fiber, cotton, jute, silk, wool industries, decentralization of power loom sector, promotion of exports, planning & economic analysis, finance and promoting use of information technology.
- The Ministry of Textiles is currently led by Piyush Goyal. Darshanaben Jardosh is currently Minister of State .
- The advisory boards for the ministry include All India Handlooms Board, All India Handicrafts Board, All India Power looms Board, Advisory Committee under Handlooms Reservation of Articles for Production and Co-ordination Council of Textiles Research Association.
- There are several public sector units and textile research associations across the country.

Writing Technology in India

- Technical writing in India is new but upcoming profession. There are over 14000 jobs for "Technical Writing" on a job portal in India which is not very far behind other esteemed jobs like engineering and management. Technical writing in India is a lesser known profession which is fast gaining recognition.
- Looking at the technical writing job vacancies in India, majority of them are with the software companies and web development companies. Software companies require technical documentation to be done for their products and technical processes like user manuals, guides, online help etc. Web development companies expect their technical writers to write and edit content for their websites. Technical writers are also responsible for high website ranking in the various search engines for applicable key words. This sphere of technical writing is called SEO (Search Engine Optimization).
- There are other sectors also which hire technical writers like telecom, banking, energy, insurance etc. So broadly speaking, job of a technical writer is to develop broachers, user guides, reports and white papers for different types of products. These jobs are not new in, but their classification of these activities under technical writing in India is rather new.
- In the 1990s technical writing in India was practically unknown. But there were some IT giants who realized the need of technical documentation and started setting up teams for the same. It has literally become a key factor for an organization's growth and progress as technical writers have bridged the gap between a company's product and its users.
- Technical writing in India as well as in other countries has become a procedure to deliver information in the form of speech or document to a particular audience like programmers, technical support staff, end-users, potential customers and business partners. The process of getting or loosing a business deal depends on the efficiency of a technical writer as the technical documents and write-ups form the face of company.
- Consumers hardly buy a product (software or hardware) with high technology without proper documentation. They look at the documentation to understand the technology and configure, deploy, install and use these products. Hence, technical writing in India and other countries has a major role to play.
- With evolving technologies and new tools there should be some trends that should be kept in mind. Below mentioned are the trends in the field of technical writing that one can follow:

- Shared authoring – Technical writing in India as well as in other countries is no longer done by a single writer from a single point of view. Projects need inputs from various SMEs (Subject Matter Experts) who thrive in various locations and departments. A technical writer should know how to extract information from them and put together in one place.
- Social Networking Sites – There are so many social media sites like facebook, linkedIn etc. where discussions are taking place on the products and services you document. So to become successful companies participate in social media, take feedback and strengthen ties with their customers.
- Fusion technical writer – To be a successful technical writer it is not enough that you can write. One has to play various roles like web designer, motivational speaker or a QA tester etc.
- Multimedia – Small video tutorials embedded on youtube or other video sharing sites are quite narrative for visual learners.
- Globalization – A technical writer may have to work with peers distributed globally. And a product is also distributed globally often, which means you should write in plain and simple business English which everyone understands. It is important to be understood by people from various cultures across the globe.
- User-created content – Instead of users just being passive consumers of your product or service, you can encourage them to post comments, become forum moderators and post articles and participate actively.

Pyrotechnics in India Trade in Ancient India/,India's Dominance up to Pre-colonial Times

- Before the colonial period, India was a big player in the foreign trade. Having established itself well on the world map, pre-colonial India was blooming with opportunities. At the beginning of 19th century, the share of India in the world economy was around 20% which was steadily increasing. By the time British left India the share was reduced to around 4%. Thus the colonial rule paralyzed the foreign trade also by a large proportion.

- Pre-colonial India enjoyed a worldwide market for its manufactured products. The excellent levels of craftsmanship were held in high regard and enjoyed a global reputation. Notable ones are handicrafts and textile industries. Shawls and carpets from Kashmir and Amritsar, silk sarees of Benaras and silk cloth of Nagpur are some examples.

- Pre-British India also excelled in the artistic handicraft industry which includes jewellery made of gold and silver, brass, copper and bell metal wares, marble work, carving works in ivory, wood, stone, artistic glassware etc. All of the above-mentioned items including cinnamon, pepper, opium, indigo etc. constituted a major proportion of exports from India. Effectively, India was exporting high quality manufactured goods to European countries and owned a respectable share in the world economy.

- The Britishers aimed at diverting this large volume of trade for their benefits. In the light of British era, the foreign trade of India with rest of the world was cut off by the help of restrictive policies of commodity production, trade and tariff. As much as half of the foreign trade was restricted to Britain.

- Before colonial period, India was exporting manufactured goods which enjoyed worldwide demand. Under the colonial rule, India was reduced to a supplier of raw materials like jute, cotton, indigo, wool, sugar etc. and importer of finished consumer goods like silk and woollen clothes and light machinery manufactured in the factories of Britain. Additionally, the opening of Suez Canal intensified this control of Britishers over Indian foreign trade.

- The remaining volume of foreign trade was allowed with a handful of countries namely China, Ceylon (Sri Lanka) and Persia (Iran). Interestingly, even this trade was heavily monitored by the colonials. As a matter of fact, there was a large generation of export surplus under the British Raj.

- At the same time, this export came at the cost of low productions of essential goods like clothes, food grains, kerosene etc. Resources were heavily being used to produce items for export, leading to an acute shortage of civil goods.
- Additionally, there was no flow of gold or silver as a result of this surplus. Ironically, this export surplus never made its way to India. It was used to make payments for an office set up in Britain, war expenses of the British and import of invisible items. Such brutalities eventually led to the dawn of a rising foreign trade aspect of India.