History of ancient india

Indian culture is an ancient and dynamic entity, spanning back to the very beginnings of human civilization. Beginning with a mysterious culture along the Indus River and in farming communities in the southern lands of India, the history of the sub-continent is one puncuated by constant integration with migrating peoples and with the diverse cultures that surround India. Placed in the center of Asia, Indian history is a crossroads of cultures from China to Europe, and the most significant Asian connection with the cultures of Africa.

Indian history, then, is more than just a set of unique developments in a definable process; it is, in many ways, a microcosm of human history itself, a diversity of cultures all impinging on a great people and being reforged into new, syncretic forms

Indus Valley Civilization.

The earliest traces of civilization in the Indian subcontinent are to be found in places along, or close, to the Indus river. Excavations first conducted in 1921-22, in the ancient cities of Harappa and Mohenjodaro, both now in Pakistan, pointed to a highly complex civilization that first developed some 4,500-5,000 years ago, and subsequent archaeological and historical research has now furnished us with a more detailed picture of the Indus Valley Civilization and its inhabitants. The Indus Valley people were most likely Dravidians, who may have been pushed down into south India when the Aryans, with their more advanced military technology, commenced their migrations to India around 2,000 BCE. Though the Indus Valley script remains undeciphered down to the present day, the numerous seals discovered during the excavations, as well as statuary and pottery, not to mention the ruins of numerous Indus Valley cities, have enabled scholars to construct a reasonably plausible account of the Indus Valley Civilization.

Some kind of centralized state, and certainly fairly extensive town planning, is suggested by the layout of the great cities of Harappa and Mohenjodaro. The same kind of burnt brick appears to have been used in the construction of buildings in cities that were as much as several hundred miles apart. The weights and measures show a very considerable regularity. The Indus Valley people domesticated animals, and harvested various crops, such as cotton, sesame, peas, barley, and cotton. They may also have been a sea-faring people, and it is rather interesting that Indus Valley seals have been dug up in such places as Sumer. In most respects, the Indus Valley Civilization appears to have been urban, defying both the predominant idea of India as an eternally and essentially agricultural civilization, as well as the notion that the change from ‘rural’ to ‘urban’ represents something of a logical progression. The Indus Valley people had a merchant class that, evidence suggests, engaged in extensive trading.

Neither Harappa nor Mohenjodaro show any evidence of fire altars, and consequently one can reasonably conjecture that the various rituals around the fire which are so critical in Hinduism were introduced later by the Aryans. The Indus Valley people do not appear to have been in possession of the horse: there is no osteological evidence of horse remains in the Indian sub-continent before 2,000 BCE, when the Aryans first came to India, and on Harappan seals and terracotta figures, horses do not appear. Other than the archaeological ruins of Harappa and Mohenjodaro, these seals provide the most detailed clues about the character of the Indus Valley people. Bulls and elephants do appear on these seals, but the horned bull, most scholars are agreed, should not be taken to be congruent with Nandi, or Shiva’s bull. The horned bull appears in numerous Central Asian figures as well; it is also important to note that Shiva is not one of the gods invoked in the Rig Veda. The revered cow of the Hindus also does not appear on the seals. The women portrayed on the seals are shown with elaborate coiffures, sporting heavy jewelry, suggesting that the Indus Valley people were an urbane people with cultivated tastes and a refined aesthetic sensibility. A few thousand seals have been discovered in Indus Valley cities, showing some 400 pictographs: too few in number for the language to have been ideographic, and too many for the language to have been phonetic.

The Indus Valley civilization raises a great many, largely unresolved, questions. Why did this civilization, considering its sophistication, not spread beyond the Indus Valley? In general, the area where the Indus valley cities developed is arid, and one can surmise that urban development took place along a river that flew through a virtual desert. The Indus Valley people did not develop agriculture on any large scale, and consequently did not have to clear away a heavy growth of forest. Nor did they have the technology for that, since they were confined to using bronze or stone implements. They did not practice canal irrigation and did not have the

heavy plough. Most significantly, under what circumstances did the Indus Valley cities undergo a decline? The first attacks on outlying villages by Aryans appear to have taken place around 2,000 BCE near Baluchistan, and of the major cities, at least Harappa was quite likely over-run by the Aryans. In the Rig Veda there is mention of a Vedic war god, Indra, destroying some forts and citadels, which could have included Harappa and some other Indus Valley cities. The conventional historical narrative speaks of a cataclysmic blow that struck the Indus Valley Civilization around 1,600 BCE, but that would not explain why settlements at a distance of several hundred miles from each other were all eradicated. The most compelling historical narrative still suggests that the demise and eventual disappearance of the Indus Valley Civilization, which owed something to internal decline, nonetheless was facilitated by the arrival in India of the Aryans.

Acaranga Sutra

The Acaranga Sutra, or Book of Good Conduct, is one of the sacred books of Jainism. While not written by Nataputta Vardhamana (ca. 599-527 BC), also known as Mahavira, the Great Hero, it contains many of his teachings.

The Arhats [1] . . . of the past, present, and future, all say thus, speak thus, declare thus, explain thus: all breathing, existing, living, sentient creatures should not be slain, nor treated with violence, nor abused, nor tormented, nor driven away. This is the pure, unchangeable, eternal law [dharma], which the clever ones, who understand the world, have declared: among the zealous and the not zealous, among the faithful and the not faithful, among the not cruel and the cruel, among those who have worldly weakness and those who have not, among those who like social bonds and those who do not: "that is the truth, that is so, that is proclaimed in this."

Having adopted the law, one should not hide it, nor forsake it. Correctly understanding the law, one should arrive at indifference for the impressions of the senses and "not act on the motives of the world." "He who is not of this mind, how should he come to the other?"

* * *

Beings which are born in all states become individually sinners by their actions.

The Venerable One [2] understands thus: he who is under the conditions of existence, that fool suffers pain. Thoroughly knowing karma, the Venerable One avoids sin.

The sage, perceiving the double karma, proclaims the incomparable activity, he, the knowing one; knowing the current of worldliness, the current of sinfulness, and the impulse.

Practicing the sinless abstinence from killing, he did no acts, neither himself nor with the assistance of others; he to whom women were known as the causes of all sinful acts, he saw the true state of the world . . .

He well saw that bondage comes through action. Whatever is sinful, the Venerable One left that undone: he consumed clean food.

Knowing measure in eating and drinking, he was not desirous of delicious food, nor had he a longing for it . . .

The Venerable One, exerting himself, did not seek sleep for the sake of pleasure; he waked up himself, and slept only a little, free from desires . . .

Always well guarded, he bore the pains caused by grass, cold, fire, flies, and gnats; manifold pains.

He traveled in the pathless country of the Ladhas.[3] . . .

In Ladha natives attacked him; the dogs bit him, ran at him.

Few people kept off the attacking, biting dogs . . .

Such were the inhabitants. Many other mendicants," eating rough food . . . and carrying about a strong pole [to keep off the dogs], . . . lived there.

Even thus armed they were bitten by the dogs, torn by the dogs. It is difficult to travel in Ladha.

Ceasing to use the stick against living beings, abandoning the care of the body, the houseless, the Venerable One endures the thorns of the villages being perfectly enlightened.

As an elephant at the head of the battle, so was Mahavira there victorious . . .

The Venerable One was able to abstain from indulgence of the flesh . . .

Purgatives and emetics, anointing of the body and bathing, shampooing arid cleansing of the teeth do not behoove him, after he learned [that the body is something unclean] . . .

In summer he exposes himself to the heat, he sits squatting in the sun; he lives on rough food: rice, pounded jujube, and beans . . .

Sometimes the Venerable One did not drink for half a month or even for a month.

Or he did not drink for more than two months, or even six months, day and night, without desire for drink. Sometimes he ate stale food . . .

Having wisdom, Mahavira committed no sin himself, nor did he induce others to do so, nor did he consent to the sins of others.

Having entered a village or a town, he begged for food which had been prepared for somebody else. Having got clean food, he used it, restraining the impulses . . . The Venerable One slowly wandered about, and, killing no creatures, he begged for his food.

Moist or dry or cold food, old beans, old pap, or bad grain, whether he did or did not get such food he was rich . . .

Himself understanding the truth and restraining the impulses for the purification of the soul, finally liberated, and free from delusion, the Venerable One was well guarded during his whole life.

The Venerable Ascetic Mahavira endowed with the highest knowledge and intuition taught the five great vows.

* * *

The first great vow, Sir, runs thus:

I renounce all killing of living beings, whether subtle or gross, whether movable or immovable. Nor shall I myself kill living beings, nor cause others to do it, nor consent to it. As long as I live, I confess and blame, repent and exempt myself of these sins, in the thrice threefold way, in mind, speech, and body . . .

The second great vow runs thus:

I renounce all vices of lying speech arising from anger or greed or fear or mirth. I shall neither myself speak lies, nor cause others to speak lies, nor consent to the speaking of lies by others . . .

The third great vow runs thus:

I renounce all taking of anything not given, either in a village or a town or a wood, either of little or much, of small or great, of living or lifeless things. I shall neither take myself what is not given, nor cause others to take it, nor consent to their taking it.

The fourth great vow runs thus:

I renounce all sexual pleasures, either with gods or men or animals. I shall not give way to sensuality . . .

The fifth great vow runs thus:

I renounce all attachments, whether little or much, small or great, living or lifeless; neither shall I myself form such attachments, nor cause others to do so, nor consent to their doing so.

Indian Kingdoms &Indian Empires

From their original settlements in the Punjab region, the Aryans gradually began to penetrate eastward, clearing dense forests and establishing "tribal" settlements along the Ganga & Yamuna (Jamuna) plains between 1500 and ca. 800 B.C. By around 500 B.C., most of northern India was inhabited and had been brought under cultivation, facilitating the increasing knowledge of the use of iron implements, including ox-drawn plows, and spurred by the growing population that provided voluntary and forced labor. As riverine and inland trade flourished, many towns along the Ganga became centers of trade, culture, and luxurious living. Increasing population and surplus production provided the bases for the emergence of independent states with fluid territorial boundaries over which disputes frequently arose.

The rudimentary administrative system headed by tribal chieftains was transformed by a number of regional republics or hereditary monarchies that devised ways to appropriate revenue and to conscript labor for expanding the areas of settlement and agriculture farther east and south, beyond the Narmada River. These emergent states collected revenue through officials, maintained armies, and built new cities and highways. By 600 B.C., sixteen such territorial powers--including the Magadha, Kosala, Kuru, and Gandhara--stretched across the North India plains from modern-day Afghanistan to Bangladesh. The right of a king to his throne, no matter how it was gained, was usually legitimized through elaborate sacrifice rituals and genealogies concocted by priests who ascribed to the king divine or superhuman origins.

The victory of good over evil is epitomized in the epic Ramayana (The Travels of Rama, or Ram in the preferred modern form), while another epic, Mahabharata (Great Battle of the Descendants of Bharata), spells out the concept of dharma and duty. More than 2,500 years later, Mohandas Karamchand (Mahatma) Gandhi, the father of modern India, used these concepts in the fight for independence. The Mahabharata records the feud between Aryan cousins that culminated in an epic battle in which both gods and mortals from many lands allegedly fought to the death, and the Ramayana recounts the kidnapping of Sita, Rama's wife, by Ravana, a demonic king of Lanka (Sri Lanka), her rescue by her husband (aided by his animal allies), and Rama's coronation, leading to a period of prosperity and justice. In the late twentieth century, these epics remain dear to the hearts of Hindus and are commonly read and enacted in many settings. In the 1980s and 1990s, Ram's story has been exploited by Hindu militants and politicians to gain power, and the much disputed Ramjanmabhumi, the birth site of Ram, has become an extremely sensitive communal issue, potentially pitting Hindu majority against Muslim minority

Ashoka

Ashoka - the name translates to 'one without grief' - declared that all people were like his own children and he commanded his governors to administer the land accordingly. Stern measures were to be reserved for exceptional circumstances and ahimsa - non-violence - became the most important pillar of state policy. Humanitarian ethics of Buddhism influence all his actions. Ashoka got his edicts inscribed on monolithic stone pillars adorned with strikingly beautiful animal capitals. One of these - the lion capital found at Sarnath near Benaras - has been chosen as the state emblem of the Republic of India. Ashoka endeavoured to set up an enlightened government for a genuine welfare state

Chandragupta Maurya

India attained political unity for the first time under Chandragupta. He laid the foundations of a powerful empire. Chandragupta was, according to folklore, assisted by a Brahmin called Vishnugupta, also known as Kautilya or Chanakya, who is credited with the authorship of Arthashastra the famous work on ancient Indian statecraft. Meghasthenes, a Greek traveller visited India at this time and although only fragments of his travelogue - Indica are available to us, his account supplements the information provided by the Arthashastra and the other literary sources about governance and social life during the Maurya peri

Gupta Empire

Before the Guptas:

When the last of the Mauryan kings was assassinated in 184 BC, India once again became a collection of unfederated kingdoms. During this period, the most powerful kingdoms were not in the north, but in the Deccan to the south, particularly in the west. The north, however, remained culturally the most active, where Buddhism was spreading and where Hinduism was being gradually remade by the Upanishadic movements, which are discussed in more detail in the section on religious history. The dream, however, of a universal empire had not disappeared. It would be realized by a northern kingdom and would usher in one of the most creative periods in Indian history.

India- Gupta and Harsha the classical Age

Gupta age - The Classical Age refers to the period when most of North India was reunited under the Gupta Empire (ca. A.D. 320-550). Because of the relative peace, law and order, and extensive cultural achievements during this period, it has been described as a "golden age" that crystallized the elements of what is generally known as Hindu culture with all its variety, contradiction, and synthesis. The golden age was confined to the north, and the classical patterns began to spread south only after the Gupta Empire had vanished from the historical scene. The military exploits of the first three rulers--Chandragupta I (ca. 319-335), Samudragupta (ca. 335-376), and Chandragupta II (ca. 376-415)--brought all of North India under their leadership. From Pataliputra, their capital, they sought to retain political preeminence as much by pragmatism and judicious marriage alliances as by military strength. Despite their self-conferred titles, their overlordship was threatened and by 500 ultimately ruined by the Hunas (a branch of the White Huns emanating from Central Asia), who were yet another group in the long succession of ethnically and culturally different outsiders drawn into India and then woven into the hybrid Indian fabric.

Under Harsha Vardhana (or Harsha, r. 606-47), North India was reunited briefly, but neither the Gupta Empire nor Harsha controlled a centralized state, and their administrative styles rested on the collaboration of regional and local officials for administering their rule rather than on centrally appointed personnel. The Gupta period marked a watershed of Indian culture: the Guptas performed Vedic sacrifices to legitimize their rule, but they also patronized Buddhism, which continued to provide an alternative to Brahmanical orthodoxy.

The most significant achievements of this period, however, were in religion, education, mathematics, art, and Sanskrit literature and drama. The religion that later developed into modern Hinduism witnessed a crystallization of its components: major sectarian deities, image worship, devotionalism, and the importance of the temple. Education included grammar, composition, logic, metaphysics, mathematics, medicine, and astronomy. These subjects became highly specialized and reached an advanced level. The Indian numeral system--sometimes erroneously attributed to the Arabs, who took it from India to Europe where it replaced the Roman system--and the decimal system are Indian inventions of this period. Aryabhatta's expositions on astronomy in 499, moreover, gave calculations of the solar year and the shape and movement of astral bodies with remarkable accuracy. In medicine, Charaka and Sushruta wrote about a fully evolved system, resembling those of Hippocrates and Galen in Greece. Although progress in physiology and biology was hindered by religious injunctions against contact with dead bodies, which discouraged dissection and anatomy, Indian physicians excelled in pharmacopoeia, caesarean section, bone setting, and skin grafting (see Science and Technology, ch. 6).

The Southern Rivals

When Gupta disintegration was complete, the classical patterns of civilization continued to thrive not only in the middle Ganga Valley and the kingdoms that emerged on the heels of Gupta demise but also in the Deccan and in South India, which acquired a more prominent place in history. In fact, from the mid-seventh to the mid-thirteenth centuries, regionalism was the dominant theme of political or dynastic history of South Asia. Three features, as political scientist Radha Champakalakshmi has noted, commonly characterize the sociopolitical realities of this period. First, the spread of Brahmanical religions was a two-way process of

Sanskritization of local cults and localization of Brahmanical social order. Second was the ascendancy of the Brahman priestly and landowning groups that later dominated regional institutions and political developments. Third, because of the seesawing of numerous dynasties that had a remarkable ability to survive perennial military attacks, regional kingdoms faced frequent defeats but seldom total annihilation.

Peninsular India was involved in an eighth-century tripartite power struggle among the Chalukyas (556-757) of Vatapi, the Pallavas (300-888) of Kanchipuram, and the Pandyas (seventh through the tenth centuries) of Madurai. The Chalukya rulers were overthrown by their subordinates, the Rashtrakutas, who ruled from 753 to 973. Although both the Pallava and Pandya kingdoms were enemies, the real struggle for political domination was between the Pallava and Chalukya realms.

Despite interregional conflicts, local autonomy was preserved to a far greater degree in the south where it had prevailed for centuries. The absence of a highly centralized government was associated with a corresponding local autonomy in the administration of villages and districts. Extensive and well-documented overland and maritime trade flourished with the Arabs on the west coast and with Southeast Asia. Trade facilitated cultural diffusion in Southeast Asia, where local elites selectively but willingly adopted Indian art, architecture, literature, and social customs.

The interdynastic rivalry and seasonal raids into each other's territory notwithstanding, the rulers in the Deccan and South India patronized all three religions--Buddhism, Hinduism, and Jainism. The religions vied with each other for royal favor, expressed in land grants but more importantly in the creation of monumental temples, which remain architectural wonders. The cave temples of Elephanta Island (near Bombay, or Mumbai in Marathi), Ajanta, and Ellora (in Maharashtra), and structural temples of Kanchipuram (in Tamil Nadu) are enduring legacies of otherwise warring regional rulers. By the mid-seventh century, Buddhism and Jainism began to decline as sectarian Hindu devotional cults of Shiva and Vishnu vigorously competed for popular support.

Although Sanskrit was the language of learning and theology in South India, as it was in the north, the growth of the bhakti (devotional) movements enhanced the crystallization of vernacular literature in all four major Dravidian languages: Tamil, Telugu, Malayalam, and Kannada; they often borrowed themes and vocabulary from Sanskrit but preserved much local cultural lore. Examples of Tamil literature include two major poems, Cilappatikaram (The Jewelled Anklet) and Manimekalai (The Jewelled Belt); the body of devotional literature of Shaivism and Vaishnavism--Hindu devotional movements; and the reworking of the Ramayana by Kamban in the twelfth century. A nationwide cultural synthesis had taken place with a minimum of common characteristics in the various regions of South Asia, but the process of cultural infusion and assimilation would continue to shape and influence India's history through the centuries.

The Gupta Dynasty (320-550):

Under Chandragupta I (320-335), empire was revived in the north. Like Chandragupta Maurya, he first conquered Magadha, set up his capital where the Mauryan capital had stood (Patna), and from this base consolidated a kingdom over the eastern portion of northern India. In addition, Chandragupta revived many of Asoka's principles of government. It was his son, however, Samudragupta (335-376), and later his grandson, Chandragupta II (376-415), who extended the kingdom into an empire over the whole of the north and the western Deccan. Chandragupta II was the greatest of the Gupta kings; called Vikramaditya ("The Sun of Power"), he presided over the greatest cultural age in India.

This period is regarded as the golden age of Indian culture. The high points of this cultural creativity are magnificent and creative architecture, sculpture, and painting. The wall-paintings of Ajanta Cave in the central Deccan are considered among the greatest and most powerful works of Indian art. The paintings in the cave represent the various lives of the Buddha, but also are the best source we have of the daily life in India at the time. There are forty-eight caves making up Ajanta, most of which were carved out of the rock between 460 and 480, and they are filled with Buddhist sculptures. The rock temple at Elephanta (near Bombay) contains a powerful, eighteen foot statue of the three-headed Shiva, one of the principle Hindu gods. Each head represents one of Shiva's roles: that of

creating, that of preserving, and that of destroying. The period also saw dynamic building of Hindu temples. All of these temples contain a hall and a tower.

The greatest writer of the time was Kalidasa. Poetry in the Gupta age tended towards a few genres: religious and meditative poetry, lyric poetry, narrative histories (the most popular of the secular literatures), and drama. Kalidasa excelled at lyric poetry, but he is best known for his dramas. We have three of his plays; all of them are suffused with epic heroism, with comedy, and with erotics. The plays all involve misunderstanding and conflict, but they all end with unity, order, and resolution.

The Guptas tended to allow kings to remain as vassal kings; unlike the Mauryas, they did not consolidate every kingdom into a single administrative unit. This would be the model for later Mughal rule and British rule built off of the Mughal paradigm.

The Guptas fell prey, however, to a wave of migrations by the Huns, a people who originally lived north of China. The Hun migrations would push all the way to the doors of Rome. Beginning in the 400's, the Huns began to put pressure on the Guptas. In 480 they conquered the Guptas and took over northern India. Western India was overrun by 500, and the last of the Gupta kings, presiding over a vastly dimished kingdom, perished in 550. A strange thing happened to the Huns in India as well as in Europe. Over the decades they gradually assimilated into the indigenous population and their state weakened.

Harsha, who was a descendant of the Guptas, quickly moved to reestablish an Indian empire. From 606-647, he ruled over an empire in northern India. Harsha was perhaps one of the greatest conquerors of Indian history, and unlike all of his conquering predecessors, he was a brilliant administrator. He was also a great patron of culture. His capital city, Kanauj, extended for four or five miles along the Ganges River and was filled with magnificent buildings. Only one fourth of the taxes he collected went to administration of the government. The remainder went to charity, rewards, and especially to culture: art, literature, music, and religion.

Because of extensive trade, the culture of India became the dominant culture around the Bay of Bengal, profoundly and deeply influencing the cultures of Burma, Cambodia, and Sri Lanka. In many ways, the period during and following the Gupta dynasty was the period of "Greater India," a period of cultural activity in India and surrounding countries building off of the base of Indian culture. This medieval flowering of Indian culture would radically change course in the Indian Middle Ages. From the north came Muslim conquerors out of Afghanistan, and the age of Muslim rule began in 1100.

HARSHAVARDHANA

The rule of Harshavardhana from (606-647AD) being the only consolidated rule after the Guptas is described in details through various sources like

The accounts of pilgrims

Official Chinese documents

Coins and inscriptions

Writings by well known personalities of that period

The predecessors of Harshavardhana was from Thaneshwar. Harshavardhana was the younger son of Prabhakara Vardhana, Raja of Thaneshwar. Prabhakaravardhana died in 605 AD. Prabhakaravardhana's daughter Rajyasri was married to the king Maukhari King Grahavarman. Sasanka the king of Gauda, with the help of the king of Malwa defeated and killed Grahavarman of Kannauj and

imprisoned Rajyasri. Rajyavardhan who then ruled Kannauj advanced against Sasanka to avenge his sisters fate. But he was killed by Sasanka. Thus the throne of Kannauj became vacant and Harshavardhana had to ascend the throne. Harshavardhana pursued a policy of conquest to consolidate his authority over north India. Punjab, Kannauj, parts of Bihar and Bengal formed a part of his kingdom as a result of his conquests. By 612 Harshavardhana consolidated his kingdom in northern India. The problems caused by the small independent kingdoms who were engaged in conflicts among themselves was overcome after the subjection of these petty states extending from the east to west. In 620AD Harshavardhana invaded the Chalukya kingdom in the Deccan which was then ruled by Pulakesin II. But the Chalukya resistance proved tough for Harshavardhana and he was defeated. Thus his kingdom in the south was upto the limit of the Narmada. His alliance with king Bhaskaravarman the ruler of Kamrupa (Assam) also prove advantageous in establishing a strong rule.

Harshavardhana is well known for his religious toleration, able administration and diplomatic relations. This gives him a position among the other monarchs of the later period whose role in the construction of the Indian history is significant .

Harshavardhana maintained diplomatic relations with China and sent envoys who exchanged ideas of the Chinese rulers and developed their knowledge about each other.

Prehistoric Period: ca. 3000-1200 BC

ca. 3000-2600: Indus Valley civilization: Harappan civilization

2600-2500: Harappan Civilization at its height

2000-1900: Harappan Civilization collapses

c. 1300: Aryans migrate into the Indus Valley

c. 1000: Aryans migrate into Ganges Valley

ca. 1200-500 BC: Vedic Era

ca. 1200-900: Rig-Veda

ca. 900-500: Later Vedas and early Upanishads

ca. 550-100 BC: Rivals to Hinduism

ca 550: Birth of Mahavira

ca. 563-483: Siddhartha Gautama Buddhism Chronology

ca. 322-185 BC: Mauryan Empire

321-297 BC: Chandragupta Maurya

ca. 273-237: Asoka

ca. 185-100: The Laws of Manu

ca. AD 320-540: Gupta Era

ca. 320-335: Chandragupta I

ca. 335-376: Samudragupta

ca. 376-415: Chandragupta II

ca. 454-500: Hun Invasions

ca. 540: End of Gupta Dynasty

ca. AD 500-1001: Period of Political instability

ca. 540: Rise of Chalukyas at Vatapi

ca. 606-646: Harsha of Kanauj

ca. 700-800: Buddhism spreads to Tibet and Nepal

711: Arabs invade Sind

ca. 750: Rise of imperial Pratiharas and Rashtrakutas

760: Palas in Bengal

ca. 846: Rise of Cholas and defeat of Pallavis

ca. 970: Revival of Chalukyas and defeat of Rashtrakutas

1000-1750: Period of Muslim dominance

1001: Raids by Mahmud of Ghanzi

1206-1290: Slave Dynasty and Beginning of Delhi Sultanate

1290-1320: Khalji Sultanate

1320-1413: Tughlug Sultanate

1414-1451: Sayyid Sultanate

1451-1526: Lodi Sultanate

1498: Vasco da Gama arrives in India

1483-1757: The Mughal Empire

1502: Portuguese establish colony at Cochin

1526-1530: Reign of Babur

1556-1605: Reign of Akbar

1600: British East India Company is chartered

1605-1627: Reign of Jahangir

1628-1658: Reign of Shah Jahan

1658-1707: Reign of Aurangzeb

1744-1748: War between French and British

1750-1947: India under British Rule

1857: Indian (Sepoy) Mutiny

1886: First Meeting of the Indian National Congress.

1921: First Meeting of the Indian Parliament.

1930: Gandhi leads the Salt March against British rule.

1932: Indian National Congress is declared illegal; Gandhi is arrested.

1947-present: The Indian Republic

1947: The British colony of India achieves independence and is divided into India and Pakistan.

1949: Indian constitution is adopted.

1966: Indira Gandhi is elected prime minister of India.

The Chronology of Kings

The kingdom of Indraprastha was ruled by Indians for 124 generations for a period of 4157 years, 9 months and 14 days between the event of Mahabharat and the begining of the Mughal era in 1193 AD.

30 generations of Raja Yudhisthir ruled Indraprastha for a total of 1770 years, 11 months and 10 days as follows:

King/Queen	Years	Month	Days
1 Raja Yudhisthir	36	8	25
2. Raja Parikshit	60	0	0
3 Raja Janmejay	84	7	23
4. Ashwamedh	82	8	22
5. Dwateeyram	88	2	8
6. Kshatramal	81	11	27
7. Chitrarath	75	3	18
8. Dushtashailya	75	10	24
9. Raja Ugrasain	78	7	21
10 Raja Shoorsain	78	7	21
11 Bhuwanpati	69	5	5
12 Ranjeet	65	10	4
13 Shrakshak	64	7	4
14 Sukhdev	62	0	24

15 Narharidev 51 10 2

16 Suchirath 42 11 2

17 ShoorsainII 58 10 8

18 Parvatsain 55 8 10

19 Medhawi 52 10 10

20 Soncheer 50 8 21

21 Bheemdev 47 9 20

22 Nraharidev 45 11 23

23 Pooranmal 44 8 7

24 Kardavi 44 10 8

25 Alamamik 50 11 8

26 Udaipal 38 9 0

27 Duwanmal 40 10 26

28 Damaat 32 0 0

29 Bheempal 58 5 8

30 Kshemak 48 11 21

Vishwa, the prime minister of Kshemak, killed Kshemak and took over the Kingdom. Fourteen generations of Vishwa ruled for 500 years, 3 Month and 17 dyas as follows:

1 Vishwa 17 3 29

2 Purseni 42 8 21

3 Veerseni 52 10 7

4 Anangshayi 47 8 23

5 Harijit 35 9 17

6 Paramseni 44 2 23

7 Sukhpatal 30 2 21

8 Kadrut 42 9 24

9 Sajj 32 2 14

10 Amarchud 27 3 16

11 Amipal 22 11 25

12 Dashrath 25 4 12

13 Veersaal 31 8 11

14 Veersaalsen 47 0 14

Veersaalsen was killed by his prime minister Veermaha whose 16 generations

ruled for 445 years, 5 months and 3 days as follows:

1 Raja Veermaha 35 10 8

2 Ajitsingh 27 7 19

3 Sarvadatta 28 3 10

4 Bhuwanpati 15 4 10

5 Veersen 21 2 13

6 Mahipal 40 8 7

7 Shatrushaal 26 4 3

8 Sanghraj 17 2 10

9 Tejpal 28 11 10

10 Manikchand 37 7 21

11 Kamseni 42 5 10

12 Shatrumardan 8 11 13

13 Jeevanlok 28 9 17

14 Harirao 26 10 29

15 VeersenII 35 2 20

16 Adityaketu 23 11 13

Raja Dandhar of Prayaag killed Adityaketu of Magadh. 9 generations of Dhandhar ruled Indraprastha for 374 years, 11 month and 26 days as follows:

1 Raja Dhandhar 23 11 13

2 Maharshi 41 2 29

3 Sanrachhi 50 10 19

4 Mahayudha 30 3 8

5 Durnath 28 5 25

6 Jeevanraj 45 2 5

7 Rudrasen 47 4 28

8 Aarilak 52 10 8

9 Rajpal 36 0 0

Rajpal was killed by Samant Mahanpal who ruled for 14 years. Later Mahanpal was killed by Vikramaditya of Ujjain (called Avantika). Vikrmaditya ruled for 93 years. He was later killed by Samudrapal yogi of Paithan. 16 generations of Samudrapal ruled for 372 years, 4 months and 27 days as follows:

1 Samudrapal 54 2 20

2 Chandrapal 36 5 4

3 Sahaypal 11 4 11

4 Devpal 27 1 28

5 Narsighpal 18 0 20

6 Sampal 27 1 17

7 Raghupal 22 3 25

8 Govindpal 27 1 17

9 Amratpal 36 10 13

10 Balipal 12 5 27

11 Mahipal 13 8 4

12 Haripal 14 8 4

13 Seespal 11 10 13 Also mentioned as Bhimpal in some literature

14 Madanpal 17 10 19

15 Karmpal 16 2 2

16 Vikrampal 24 11 13

Raja Vikrampal attacked Malukhchand Bohra in the west. Vikrampal was killed by Malukhchand Bohra (from west) in the war. 16 generations of Malukhchand ruled for 191 years, 1 month and 16 days as follows:

1 Malukhchand 54 2 10

2 Vikramchand 12 7 12

3 Manakchand 10 0 5

4 Ramchand 13 11 8

5 Harichand 14 9 24

6 Kalyanchand 10 5 4

7 Bhimchand 16 2 9

8 Lovchand 26 3 22

9 Govindchand 31 7 12

10 Rani Padmavati1 0 0

Rani Padmavati was the wife of Govindchand. She had no child. So her advisors appointed Hariprem Vairagi for the throne. 4 generations of Harimprem ruled for 50 years, 0 month and 12 days as follows:

1 Hariprem 7 5 16

2 Govindprem 20 2 8

3 Gopalprem 15 7 28

4 Mahabahu 6 8 29

Mahabahu took sanyas. Hearing the news of his sanyas, Adhisen of Bengal attacked and took over the kingdom of Indraprastha.

1 Raja Adhisen 18 5 21

2 Vilavalsen 12 4 2

3 Keshavsen 15 7 12

4 Madhavsen 12 4 2

5 Mayursen 20 11 27

6 Bhimsen 5 10 9

7 Kalyansen 4 8 21

8 Harisen 12 0 25

9 Kshemsen 8 11 15

10 Narayansen 2 2 29

11 Lakshmisen 26 10 0

12 Damodarsen 11 5 19

Damodarsen mistreated his umrao Deepsingh who with the help of army revolted and killed Damodarsen. 6 generations of Deepsingh ruled for 107 years, 6 months and 22 days as follows:

1 Deepsingh 17 1 26

2 Rajsingh 14 5 0

3 Ransingh 9 8 11

4 Narsingh 45 0 15

5 Harisingh 13 2 29

6 Jeevansingh 8 0 1

Jeevansingh sent his army to the north for some reason. Hearing this news, Prithviraj Chauhan of Vairat attacked Indraprash and killed Jeevansingh. 5 generations of Prathviraj ruled for 86 years, 0 month and 20 days as follows:

1 Prathviraj 12 2 19

2 Abhayapal 14 5 17

3 Durjanpal 11 4 14

4 Udayapal 11 7 3

5 Yashpal 36 4 27

Sultan Shahbuddin Gauri from Garh Gazni attacked raja Yashpal and imprisoned him in the fort of Prayaag in Vikram Sanvat 1249 (1193 AD). 53 Gauri

generations ruled for 745 years, 1 Month and 17 days as documented in most

history books.

Deccan and South Indian Kingdoms

Deccan Indian Kingdoms: During the Kushana Dynasty, an indigenous power, the Satavahana Kingdom (first century B.C.-third century A.D.), rose in the Deccan in southern India. The Satavahana, or Andhra, Kingdom was considerably influenced by the Mauryan political model, although power was decentralized in the hands of local chieftains, who used the symbols of Vedic religion and upheld the varnashramadharma. The rulers, however, were eclectic and patronized Buddhist monuments, such as those in Ellora (Maharashtra) and Amaravati (Andhra Pradesh). Thus, the Deccan served as a bridge through which politics, trade, and religious ideas could spread from the north to the south.

Farther south were three ancient Tamil kingdoms--Chera (on the west), Chola (on the east), and Pandya (in the south)--frequently involved in internecine warfare to gain regional supremacy. They are mentioned in Greek and Ashokan sources as lying at the fringes of the Mauryan Empire. A corpus of ancient Tamil literature, known as Sangam (academy) works, including Tolkappiam , a manual of Tamil grammar by Tolkappiyar, provides much useful information about their social life from 300 B.C. to A.D. 200. There is clear evidence of encroachment by Aryan traditions from the north into a predominantly indigenous Dravidian culture in transition.

Dravidian social order was based on different ecoregions rather than on the Aryan Varna paradigm, although the Brahmans had a high status at a very early stage. Segments of society were characterized by matriarchy and matrilineal succession--which survived well into the nineteenth century--cross-cousin marriage, and strong regional identity. Tribal chieftains emerged as "kings" just as people moved from pastoralism toward agriculture, sustained by irrigation based on rivers, small-scale tanks (as man-made ponds are called in India) and wells, and brisk maritime trade with Rome and Southeast Asia.

Discoveries of Roman gold coins in various sites attest to extensive South Indian links with the outside world. As with Pataliputra in the northeast and Taxila in the northwest (in modern Pakistan), the city of Madurai, the Pandyan capital (in modern Tamil Nadu), was the center of intellectual and literary activities. Poets and bards assembled there under royal patronage at successive concourses and composed anthologies of poems, most of which have been lost. By the end of the first century B.C., South Asia was crisscrossed by overland trade routes, which facilitated the movements of Buddhist and Jain missionaries and other travelers and opened the area to a synthesis of many cultures

Islam chronology

The Life of the Prophet: c. 570 to 632

c. 570: Birth of Muhammad

622: The Hegira: Muhammad flees to Medina

630: Muhammad captures Mecca

632: Muhammad dies.

Orthodox Caliphate (Mecca and Medina): 632-661

Omayyad Caliphate (Damascus): 661-750

680: Death of Mu'awiya, who is succeeded by his son, Yazid.

685-687: Shi'ite revolt in Iraq.

711: Conquest of Spain.

717-718: Attempt to conquer Constantinople.

732: Battle of Tours.

Abbasid Caliphate (Baghdad): 750-1258

751: Battle of Talas: Arabs learn papermaking from Chinese prisoners of war

765: A school of medicine is established in Baghdad.

750-850: The Four orthodox schools of law are established.

850-875: The Tradition is formalized.

1010: Firdawsi completes his Epic of Kings, the great epic poem of Persia.

1055-1250: Expansion of Islam under the Seljuks and Christian responses.

1258: Mongols sack Baghdad. Abbasid Caliphate ends.

756-1031: Omayyad emirate in Spain (Cordova)

910-1171: Fatimid Caliphate in Egypt (Cairo)

1379-1401: Tamerlane establishes an empire in Persia, Iraq and Syria

1501-1723: Safavid Empire in Persia

The Ottoman Empire: 1350-1918.

ca. 1243: Turkish nomads settle in Asia Minor

1299-1326: Osman I

1402: Tamerlane defeats Ottomans at Ankara

1453: Constantinople is conquered.

1520-1566: Suleiman II the Magnificent

1571: The Battle of Lepanto

1703-1730: Cultural revival under Ahmed III

1774: Treaty of Kucuk Kaynarca

1822-1830: Greek War of Independences

1853-1856: The Crimean War

1876: The Ottoman Constitution is promulgated

1914: The Ottoman Empire enters World War I

 Since it’s founding in the seventh century AD, the religious

The Ka'aba in Mecca

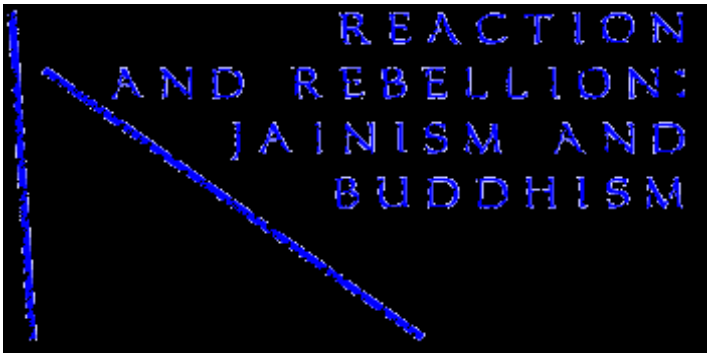
System Known as Islam has come to dominate much of the world. Followers of the Islamic faith are referred to as Muslims, a title meaning, "one who submits to the will of Allah (God) or "believer". Islam is also referred to by synonymous titles which include Hanifism and Mohommedanism, the second attributing credit to the founder of the religion, Mohammed. Considered the apostle and final prophet of Allah, Mohammed is the central human figure of Islam.

According to Islamic beliefs, the angel Gabriel visited Mohammed in order that Mohammed might know and declare the will of Allah. The sacred text of the Muslims, called the Koran, is a record of the meditative utterances of Mohammed that his followers complied after his death in 632 AD. Mohammed never claimed to be divine and is not worshipped as such. In fact, the strict monotheism of Islam will not allow for the worship of any other being but Allah. This monotheistic view took root with Abraham, the great patriarch of the nation of Israel who is considered the first Muslim. Though the Muslims adhere to the authority of the prophets of Judaism and Christianity, they do not look upon Jesus Christ as the divine Son of God, but as a man like any other prophet. Interestingly, followers of Islam do not consider their religion to be completely separate from Christianity and Judaism. Muslims claim to worship the God of the Bible, professing Islam as the ultimate revelation of God.

Dome of the Rock in Jerusalem Without any concept of a church or priesthood, Muslims reject any kind of hierarchy within their belief system. Rather, the basis of the Islamic faith is the fulfillment five pillars of Islam. The first pillar insists that each Muslim at least once in his lifetime recite the profession of faith, "There is but one God and Mohammed is His prophet. Allah is great and Mohammed is His prophet". The second pillar is participation in the public prayers that occur corporately five times a day. The third pillar is the payment of the "zakat" which is a tax to help the poor. The fourth pillar requires fasting from daybreak until sunset during the month of Ramadan. The fifth pillar requires a hajj, or a pilgrimage, to the holy city of Mecca.

 **Dome of the Rock in Jerusalem**

Jainism and Budhism



During the Axial Age, enlightened thinkers, throughout the known world, were developing new explanations of existence, and man's place within the order of the universe. In India, the Upanishads redefined the Aryan religious tradition. Led by ksatriya ascetics, this new development rebelled against the ritual superiority of the brahman class proliferated during the Vedic period. This movement gradually led to an integral transformation of Hindu thought. But, while these new thinkers quietly transmuted the Aryan belief system, two other luminaries, not only challenged the ritualism of the former tradition, but openly rejected the rigidity of class distinction, forming new religions.

Similar to the seekers, who reformed Hinduistic thought, the individuals responsible for the growth of these new religions came from the ksatryia caste that sought a release from the brahman's domination of ritual. Also significant, in this quest for change, were the members of the vaishya caste. With the collapse of tribalism, India experienced great material and economic growth from which this class, which included an increasing number of merchants, craftsmen, and professional, benefited. Many of the vaishya, therefore, resented the privileges afforded the upper two castes, which invariably prepared them for religious ferment.

Most prominent of the two individuals seeking answers to the orthodox Vedism, and the injustice of the caste system was Siddhartha Gautama(c. 563 BC-483 BC) who founded the religion known as Buddhism. Although this tradition significantly diminished in the land of its birth, it remained a powerful force in the rest of the world. Central to Buddhist thought are the Four Noble Truths: that all life is suffering (dukkha); the cause of suffering is desire; escape from dukkha can be attained by ending desire; the path to the cessation of desire can be achieved through the Noble Eight-Fold Path comprised by right views, motives, speech, conduct, livelihood, effort, thought and meditation.

Although Buddhism became more important because of its spread outside of India, Jainism, at least within the confines of the subcontinent, gathered equal support. Western scholars frequently list Vardhamana Mahavira (c. 540 BC- 468 BC), as the founder of Jainism. According to Jain legend, however, Mahavira was the last in line of twenty-four Tirthankaras, or those who had successfully crossed the river of suffering and attained enlightenment.

Like Siddhartha Gautama, Mahavira came from the ksatriya caste, and eventually abandoned his family and earthly possessions to become a wandering ascetic in search of spiritual enlightenment. After an extended period of meditation, Mahavira attained full enlightenment and became a kevalin (completed soul), and a jina (conqueror). Mahavira continued his teachings for a number of years accompanied by a band of naked monks. Purportedly he died at the age of seventy-two as a result of starvation.

The codification of Jain religious doctrines did not occur until nearly two hundred years after Mahavira's death, but contained many of his teachings. According to Mahavira, all living things are divided into five categories and are delineated by the number of senses they posses. The highest class, which have five senses include men, gods, and animals with higher intelligence. The second class, with four senses (touch, smell, taste, and sight), include most larger insects. The third classification, supposedly devoid of sight, contains smaller insects such as fleas and ants. Included in the second group, with only touch and taste, are worms, some shellfish, and leeches. The final class of one sensed creatures, not only includes plants, but such inanimate objects such as minerals, fire, and water. In this respect, then, everything in nature contains karmic matter, and karma is the cause of bondage. Thusly, all Jains are instructed to respect all things unconditionally, and to practice ahimsa, or nonviolence, towards all things. Salvation, or enlightenment, according to Jain principles, can only be attained by freeing one's soul from karmic matter to reach a level of purity

Development of Philosophical Thought and Scientific Method in Ancient India

Contrary to the popular perception that Indian civilization has been largely concerned with the affairs of the spirit and "after-life", India's historical record suggests that some of the greatest Indian minds were much more concerned with developing philosophical paradigms that were grounded in reality. The premise that Indian philosophy is founded solely on mysticism and renunciation emanates from a colonial and orientalist world view that seeks to obfuscate a rich tradition of scientific thought and analysis in India.

Much of the evidence for how India's ancient logicians and scientists developed their theories lies buried in polemical texts that are not normally thought of as scientific texts. While some of the treatises on mathematics, logic, grammar, and medicine have survived as such - many philosophical texts enunciating a rational and scientific world view can only be constructed from extended references found in philosophical texts and commentaries by Buddhist and Jain monks or Hindu scholars (usually Brahmins).

Although these documents are usually considered to lie within the domain of religious studies, it should be pointed out that many of these are in the form of extended polemics that are quite unlike the holy books of Christianity or Islam. These texts attempt to debate the value of the real-world versus the spiritual-world. They attempt to counter the theories of the atheists and other skeptics. But in their attempts to prove the primacy of a mystical soul or "Atman" - they often go to great lengths in describing competing rationalist and worldly philosophies rooted in a more realistic and more scientific perception of the world. Their extensive commentaries illustrate the popular methods of debate, of developing a hypothesis, of extending and elaborating theory, of furnishing proofs and counter-proofs.

It is also important to note that originally, the Buddhist world view was an essentially atheistic world view. The ancient Jains were agnostics, and within the broad stream of Hinduism - there were several heterodox currents that asserted a predominantly atheistic view. In that sense, these were not religions as we think of today since the modern understanding of religion presumes faith or belief in a super-natural entity.

That so many scholars from each of these philosophical schools felt the imperative to prove their extra-worldly theories using rationalist tools of deductive and inductive logic suggests that faith in a super-natural being could not have been taken for granted. This is borne out by the memoirs of Hieun Tsang (the Chinese chronicler who traveled extensively in India during the 7th C. AD) who describes the merchants of Benarasas being mostly "unbelievers"! He also wrote of intense polemics and debates amongst followers of different Buddhist sects.

Similiarly, there is other evidence that suggests that amongst the intellectuals of ancient India, atheism and skepticism must have been very powerful currents that required repeated and vigorous attempts at persuasion and change. Nevertheless, over centuries, the intellectual discords between the believers and non-believers became more and more muted. The advocates of mystic idealism prevailed over theskeptics, so that eventually, (at the popular level) each of these philosophies functioned as traditional religions with their pantheon of gods and goddesses enticing and lulling most into an intellectual stupor. But at no point were the advocates of "pure faith" ever powerful enough to completely extinguish the rationalist current that had so imbued Indian philosophy.

Early Rationalist Schools

One of the most ancient of India's rationalist traditions is the "Lokayata". Maligned and discredited by the evangelicals of mystical Buddhism and Vedantic Hinduism, their world view was sharply atheistic and scientific for their time. Unlike those who believed in reincarnation or an after-life, and in the indestructibility of the human soul - they refused to make artificial distinctions between body and mind. They saw the human mind as part and parcel of the human body - not as some separate entity that could have an independent existence from the human body. They acknowledged nothing but the material human body and the material universe around it. They rejected sacrificial gifts and offerings for the after-life as was common amongst followers of Brahmanical Hinduism during the time of Medhatithi in A.D 900 (a commentator on the writings of Manu who acknowledges that the Lokayatas were atheists or non-believers.)

For instance, they ridiculed the Brahmanical rituals of animal sacrifice: "If a beast slain in the Jyotistoma rite itself goes to heaven, Why then does not the sacrificer also offer his father?"

"If beings in heaven are gratified by our offerings made here, Then why not give the food down below to those who stand on the housetop?"

"If offerings produce gratification to beings who are dead, why make provisions for travellers when they start on a journey?"

"If he who departs from the body goes to another world, How is it that he comes not back again, restless for love of his kindred?"

The Lokayatas dismissed the Vedic priests and their Vedic mantras as nothing but a means of livelihood for those lacking in genuine physical or mental abilities. Instead, they gave primacy to human sense-perception, and through the application of the inferential process - they developed their theories of how the world worked.

One of the most notable aspects of the Lokayata belief system was their intuitive understanding of dialectics in nature. Many argued the mind-body separation as follows: Since the body is made up of things lacking consciousness - but the mind is a conscious entity - mind and body must necessarily be different - and consciousness must imply the existence of something else akin to the "soul". The Lokayatas countered this by citing the example of fermentation - how an intoxicating drink could be produced from something that was not itself an intoxicant. In essence they had discovered the principle that the whole was greater than the sum of it's parts. That physical and chemical processes could lead to dramatic changes in the properties of the substances combined. They were able to understand how special transformations could produce new qualities that were not evident in the constituent elements of the newly-created entity.

As keen observers of nature, they were probably amongst the first to understand the nature of different plants and herbs and their utility to human well-being. As such, it is likely that Indian medicine gradually evolved from the early scientific knowledge and understanding of the Lokayatas. Since the Lokayatas believed that consciousness emerged from the living human body, and ended with it's death - it is more than likely that the widely prevalent Indian custom of cremating the dead also originated amongst them.

This is not to say that the Lokayatas' understanding of the world was as elaborate and precise as that provided by today's science. By the standards of the 20th century, some of their formulations could be consideredprimitive and inadequate. That is only to be expected. Knowledge of science has expanded considerably since their times. But what is more important is that their world view was driven by a rational and scientific approach.

For instance, some later philosophical schools countered the Lokayata arguments concerning mind-body unity by bringing up the evidence of memory. Nyaya-Vaisesika philosophers like Jayanta and Udayana pointed out that the process of daily eating meant that the human body was constantly changing. The process of ageing also pointed to how the human body was ever-changing. Yet, an old person could remember in detail an incident from childhood. In other words - they tried to argue that memory was evidence of a human soul that existed beyond the mere physical body. Yet, we know today that memory is but a combination of proteins that can survive the length of human existence. There is both continuity and change in nature. The Lokayata world view howsoever sketchy and incomplete was not in contradiction with modern science.

If some of their characterizations required later revisions or refinement, or even corrections, it didn't take away from their fundamentally scientific approach. Their inadequacies were a consequence of incomplete knowledge and the understandable inability

to see all the complexities of nature that we are now able (through advanced scientific instruments and centuries of accumulated knowledge). Their errors did not, however, stem from stubborn faith or deliberate rejection of reality and real-world phenomenon.

In practice, (according to some historians) India's ancient Tantric followers may have also had a largely rationalworld view, which sprang from a practical mindset and was impaired only by the limited amount of scientific knowledge available to humanity at that time. Critics of the tantrics dismissed them as sexually obsessed hedonists. But they failed to acknowledge that the early tantrics had an intuitive scientific streak and their understanding of sexual reproduction is probably what may have also impelled them to develop basic agricultural tools and other implements. In that sense, they were India's early technologists.

The Age of Science and Reason

But even amongst those Indian philosophers who accepted the separation of mind and body and argued for the existence of the soul, there was considerable dedication to the scientific method and to developing the principles of deductive and inductive logic. From 1000 B.C to the 4th C A.D (also described as India's rationalistic period) treatises in astronomy, mathematics, logic, medicine and linguistics were produced. The philosophers of the Sankhya school, the Nyaya-Vaisesika schools and early Jain and Buddhist scholars made substantial contributions to the growth of science and learning. Advances in the applied sciences like metallurgy, textile production and dyeing were also made.

In particular, the rational period produced some of the most fascinating series of debates on what constitutes the "scientific method": How does one separate our sensory perceptions from dreams and hallucinations? When does an observation of reality become accepted as fact, and as scientific truth? How should the principles of inductive and deductive logic be developed and applied? How does one evaluate a hypothesis for it's scientific merit? What is a valid inference? What constitutes a scientific proof?

These and other questions were attacked with an unexpected intellectual vigour. As keen observers of nature and the human body, India's early scientist/philosophers studied human sensory organs, analyzed dreams, memory and consciousness. The best of them understood dialectics in nature - they understood change, both in quantitative and qualitative terms - they even posited a proto-type of the modern atomic theory. It was this rational foundation that led to the flowering of Indian civilization.

This is borne out by the testaments of important Greek scientists and philosophers of that period. Pythagoras - the Greek mathematician and philosopher who lived in the 6th C B.C was familiar with the Upanishads and learnt his basic geometry from the Sulva Sutras. (The famous Pythagoras theorem is actually a restatement of a result already known and recorded by earlier Indian mathematicians). Later, Herodotus (father of Greek history) was to write that the Indians were the greatest nation of the age. Megasthenes - who travelled extensively through India in the 4th C. B.C also left extensive accounts that paint India in highly favorable light (for that period).

Intellectual contacts between ancient Greece and India were not insignificant. Scientific exchanges between Greece and India were mutually beneficial and helped in the development of the sciences in both nations. By the 6th C. A.D, with the help of ancient Greek and Indian texts, and through their own ingenuity, Indian astronomers made significant discoveries about planetary motion. An Indian astronomer - Aryabhata, was to become the first to describe the earth as a sphere that rotated on it's own axis. He further postulated that it was the earth that rotated around the sun and correctly described how solar and lunar eclipses occurred.

Because astronomy required extremely complicated mathematical equations, ancient Indians also made significant advances in mathematics. Differential equations - the basis of modern calculus were in all likelihood an Indian invention (something essential in modeling planetary motions). Indian mathematicians were also the first to invent the concept of abstract infinite numbers - numbers that can only be represented through abstract mathematical formulations such as infinite series - geometric or arithmetic. They also seemed to be familiar with polynomial equations (again essential in advanced astronomy) andwere the inventors of the modern numeral system (referred to as the Arabic numeral system in Europe).

The use of the decimal system and the concept of zero was essential in facilitating large astronomical calculation and allowed such 7th C mathematicians as Brahmagupta to estimate the earth's circumferanceat about 23,000 miles - (not too far off from the current calculation). It also enabled Indian astronomers to provide fairly accurate longitudes of important places in India.

The science of Ayurveda - (the ancient Indian system of healing) blossomed in this period. Medical practitioners took up the dissection of corpses, practised surgery, developed popular nutritional guides, and wrote out codes for medical procedures and patient care and diagnosis. Chemical processes associated with the dying of textiles and extraction of metals were studied and documented. The use of mordants (in dyeing) and catalysts (in metal-extraction/purification) was discovered.

The scientific ethos also had it's impact on the arts and literature. Painting and sculpture flourished even as there were advances in social infrastructure. Universities were set up with dormitories and meeting halls. In addition, according to the Chinese traveller, Hieun Tsang, roads were built with well-marked signposts. Shade trees were planted. Inns and hospitals dotted national highways so as to facilitate travel and trade.

India's rational age was thus a period of tremendous intellectual ferment and vitality. It was a period of scientific discovery and technological innovation. Accompanied by challenges to caste discrimination and rigidity and religious obscurantism - it was also a period of great social upheaval that eventually led to society becoming more democratic, allowing greater social interaction between members of different castes and expandingopportunities for social mobility amongst the population. Social ethics drew considerable attention in this period. Rules of engagement during war were constructed so as to eliminate non-military casualties and destruction of pasture-land, crop-land or orchards. The notion of chivalry in war was popularized - it meant not attacking fleeing or injured soldiers. It also required warring armies to provide safe passage to women, children, the elderly and other non-combatants.

The rational period thus saw progress on several fronts. Not only did it create an enduring foundation for India's civilization to develop and mature -it has also had it's impact on the growth of other civilizations. In fact, India's rational period served as a vital link in the long and varied chain of human progress. Although colonial history has attempted to usurp this collective heritage of the planet and make it exclusively euro-centric, it is important to note that fundamental and important discoveries in science and innovations in technology have come from many different parts of the globe, albeit at different times and stages of world civilization. India made significant contributions in this regard. If India is to fully recover from the depredations of colonial rule, it is imperative that we don't forget the achievements of this inspiring epoch.

History of the Physical Sciences in India

In all early civilizations, the study of the physical sciences was neither formalized nor separated from other branches of knowledge. And at least initially, there were few conscious attempts to study the theory of science independently of the practical innovations and technologies that required some application of scientific principles. In most cases, technological discoveries took place without any knowledge of the underlying scientific principles, through hit and trial, and by experience. Sometimes there was a vague or approximate awareness of the science, but the predominant focus remained on the utilitarian aspects of the technique, on practical efficacy, as opposed to howand why something worked or didn't work.

In India, the earliest applications of chemistry took place in the context of medicine, metallurgy, construction technology (such as manufacture of cement and paints) and in textile production and dyeing. But in the process of understanding chemical processes, there alsoemerged a concomitant interest in attempting to describe the basic elements of matter - what they were composed of, and how they interacted with each other to produce new substances. Natural phenomenon were studied in the context of tides, rainfall, appearance of the sun, the moon and stellar formations, changes in season, weather patterns and agriculture. (For instance, Vedic literature mentions the condensation of water vapour from seas and oceans due to evaporation (caused by the sun's heat) and the

subsequent formation of clouds and rain.) This naturally led to theories about physical processes and the forces of nature that are today studied as specific topics within the fields of chemistryand physics.

Philosophy and Physical Science

While it is hard to say which precedes which - theory or practice - clearly there is a dialectical relationship between both, and the neglect of either leads to the death of science. Religious beliefs, particularly religious taboos and irrational indoctrination towards mystical or magical phenomenon, or adherence to false superstitions can often pose as serious impediments to the advance of science, and play an important role in whether the why and the how of physical causes can be safely and usefully explored.

Societies that believed that only the "gods" knew the secrets of nature, and that it was futile for humans to attempt to unravel the mysteries of the universe were naturally incapable of making any substantial progress in the realm of the sciences. Even in societies where there were no formal religious taboos in understanding real-world phenomenon in a scientific way, the power and the influence of the priests could serve as an obstacle to scientific progress. For instance, in a society where ritual practices alonewere considered sufficient in achieving desired goals, there would naturally be little scope for serious investigation into the properties and laws of nature.

While ancient India did not generally suffer from the first affliction (of religious opposition to science), it did suffer from the second (the proliferation of rituals and superstitions). The progress of science in India was thus inextricably linked to challenges to the domination of the priests, and resistance to the proliferation of rituals and sacrifices. It was necessary to at least argue that rituals alone were insufficient in producing desired results, and that some measure of rational observation of the world was necessary in shaping human destiny. It is therefore no accident that, by and large, developments in science and technology came in parallel with the advance of rational philosophy in India. (See Development of Philosophical Thought and Scientific Method).

In the earliest scientific texts such has those of the Vaisheshikas (6th C BC or possibly earlier), (see Philosophical Development from Upanishadic Theism to Scientific Realism), there was a rudimentary attempt at recordingthe physical properties of different types of plants and natural substances. There was also an attempt at summarizing and classifying the observations made about natural phenomenon. Intuitive formulations and approximate theories about the composition of matter and physical behavior followed. Thus, although the earliest applications of physics and chemistry in India (as in other ancient societies), took place without involving much theoretical knowledge or insight into these branches of science, there were elements of basic scientific investigation and scientific documentation in these early rational treatises. Primitive and tentative as these steps were, they were neverthelesscrucial to humanity reaching it's present stage of knowledge in the fields of physics, chemistry, botany, biology and other physical sciences.

Particle Physics

Although particle physics is one of the most advanced and most complicated branches of modern physics, the earliest atomic theories are at least 2500 years old. In India, virtually every rational school of philosophy (whether Hindu, Buddhist or Jain - see Philosophical Development from Upanishadic Theism to Scientific Realism) had something to say on the nature of elementary particles, and various schools of thought promoted the idea that matter was composed of atoms that were indivisible and indestructible. Later philosophers furtherelaborated on this notion by positing that atoms could not only combine in pairs (dyads) but also in threes (triads) - and that the juxtaposition of dyads and triads determined the different physical properties of substances seen in nature. The Jains also postulated that the combinations of atoms required specific properties in the combining atoms, and also a separate "catalyst" atom. In this way, theearlier atomic theories became converted into a molecular theory of matter. While many details of these theories no longer stand the test of scientific validity, there was much in these formulations that was conceptually quite advanced and sophisticated for it's time.

{Although it may be just a coincidence, but the development of the Jain molecular theory appears to parallel practical developments in other fields such as medicine or metallurgy where the vital role of catalysts had been observed and carefully documented. Indian medical texts had postulatedthat proper human digestion and the successful absorption of medicinal pills and potions also required the presence of "catalytic" substances. The requirement of catalytic substances relating to the manufacture of acids and alkalis (relevant to medicinal and surgical applications) had also been documented, as had the role of suitable catalysts in metallurgical processes, and in the manufacture of color-fast dyes. (Today, much more is known about catalytic processes, as a variety of minerals, vitamins and enzymes have been identified as playing a key role (as catalysts) in a range of essential chemical processes that take place in our bodies, as do catalytic compounds in other physical processes).}

Atomic/molecular theories were also utilized in (albeit speculative) explanations of chemical changes caused by heat. Prasastapada proposed that the taijasa (heat) factor affected molecular groupings (vyuhas), thus causing chemical changes. Two competing theories attempted to provide a more detailed explanation of the process (as applied to the baking/coloring of a clay pot through firing): the Pilupakavada theory, as proposed by the Vaisesikas held that the application of heat (through fire, for instance) reduced the molecules of the earthen pot into atoms; and the continued application of heat caused the atoms to regroup creating new molecules and a different color. The Pitharapakavadatheory offered by the Nyayikas (of the Nyaya school) disagreed, suggesting that the molecular changes/transformations took place without a breakdown of the original molecules into basic atoms, arguing that if that happened, there would also have to be a disintegration of the pot itself, which remained intact, but only changed color.

An intuitive understanding of kinetic energy appears in the texts of Prasastapada and the the Nyaya-Vaisesikas who believed that all atoms were in a state of constant activity. The concept of parispanda was propounded to describe such molecular/atomic motion, whether it be whirling, circling, or harmonic.

Optics and Sound

The earliest of the Indian rationalists also attempted to provide theories on the nature of light and sound. Like the ancient Greeks, the eye was assumed to be a source of light by the early Indian philosophers, and this error wasn't corrected until the 1st C AD when Susruta posited that it was light arriving from an external source at the retina that illuminated the world around us. (This was reiterated by Aryabhatta in the 5th C). In other respects, the earlier philosophers were more on the mark, with Cakrapani suggesting that both sound and light traveled in waves, but that light traveled at a much higher speed. Others like the Mimamsakasimagined light to comprise of minute particles (now understood to be photons) in constant motion and spreading through radiation and diffusion from the original source.

The wave character of sound was elaborated on by Prastapada who hypothesized that sound was borne by air in increasing circles, similar to the movement of ripples in water. Sound was understood to have its own reflection - pratidhvani (echo). Musical pitches (sruti) were seen as caused by the magnitude and frequency of vibrations. A svara (tone) was believed to consist of a sruti (fundamental tone) and some anuranana (partial tones or harmonics). Musical theory was elaborated on the basis of concepts such as jativyaktyoriva tadatamyam (genus and species of svara), parinama (change of fundamental frequency), vyanjana(manifestation of overtones), vivartana (reflection of sound), and karyakaranabhava (cause and effect of the sound).

In the 6th C. Varahamihira discussed reflection as being caused by light particles arriving on an object and then back-scattering (kiranavighattana, murcchana). Vatsyayana referred to this phenomenon as rasmiparavartana, and the concept was adapted to explain the occurrence of shadows and the opacity of materials. Refraction was understood to be caused by the ability of light to penetrate inner spaces of translucent or transparent materials and Uddyotakara drew a comparison with fluids moving through porous objects - tatra parispandah tiryaggamanam parisravah pata iti.

(Al Haytham (b, Basra, worked in Cairo, 10th C) who may have been familiar with the writings of Aryabhatta, expounded a more advanced theory of optics using light rays, diagrammatically explaining the concepts of reflection and refraction. He is particularly known for elucidating the laws of refraction and articulating that refraction was caused by light rays traveling at different speeds in different materials.)

Astronomy and Physics

Just as the study of Mathematics in India received an impetus from the study of astronomy, so did the study of Physics. As mentioned in the essay on mathematics, Aryabhatta(5th-6th C) made pioneering discoveries in the realm of planetary motion. This led to advances in the definition of space and time measuring units and better comprehension of concepts such as gravitation, motion and velocity.

{For instance, Yativrasabha's work Tiloyapannatti (6th C) gives various units for measuring distances and time and also describes a system of infinite time measures. More significantly, Vacaspati Misra (circa AD 840) anticipated solid (co-ordinate) geometry eight centuries before Descartes (AD 1644). In his Nyayasuchi-nibandha, he states that the position of a particle in space could be calculated by assuming it relative to another and measuring along three (imaginary) axes.

The study of astronomy also led to a great interest in quantifying very large and very small units of time and space. The solar day was considered to be made up of 1,944,000 ksana(units of time), according to the Nyaya-Vaisesikas. Each ksana thus correspnded to .044 seconds. The truti was defined as the smallest unit of time i.e. 2.9623*10-4. The Silpasastra records the smallest measure of length as the paramanu i.e. 1/349525 of an inch. This measurement corresponds to the smallest thickness of the Nyaya-Vaisesika school - the trasarenu, which was the size of the smallest mote visible on a sunbeam as it shone into a dark room. Varahamihira (circa AD sixth century) posited that 86 trasarenu were equal to one angulii.e. three-fourths of an inch. He also suggested that 64 trasarenu were equal to the thickness of a hair.}

The Laws of Motion

Although the earliest attempts at classifying different types of motion were made by the Vaisesikas, Prasastapadatook the study of the subject much further in the 7th C AD, and it appears from some of his definitions that at least some of the concepts he enunciated must have emerged from a study of planetary motion. In addition to linear motion, Prasastapada also described curvilinear motion (gamana), rotary motion (bhramana) and vibratory motion. He also differentiated motion that was initiated by some external action from that which took place as a result of gravity or fluidity.

He was also aware of motion that resulted from elasticity or momentum, or as an opposite reaction to an external force. He also noted that some types of actions result in like motion, and others in opposite motion, or no motion at all - the variations arising from the internal and inherent properties of the interacting objects.

Prasastapada also noted that at any given instance, a particle was capable of only a single motion (although a body such as a blowing leaf composed of multiple particles may experience a more complex pattern of motion due to different particles moving in different ways) - an important concept that was to facilitate in later quantifications of the laws of motion.

In the 10th C. Sridhara reiterated what had been observed by Prasastapada, and expanded on what he had documented. Bhaskaracharya (12th C), in his Siddhanta Siromani and Ganitadhyaya, took a crucial first step in quantification, and measured average velocity as v=s/t (where v is the average velocity, s is distance covered, and t is time).

For their time, Prasastapada's work, and Sridhara and Bhaskaracharya's later elaborations ought to be considered quite significant. However, one of the weaknesses of later Indian treatises was a failure to follow up with further attempts at quantification and conceptual elaboration. For instance, several types of motion had been earlier assigned to unseen causes. There was no subsequent attempts to solve these mysteries, nor was there the realization that the invisible cause behind various types of motion could be conceptually generalized and formally characterized and expressed in an abstract way, through a mathematical formula as was done by Newton a few centuries later.

Experimentation versus Intuition

In fact, the next major step in the study of motion was to take place in England, when the ground for scientific investigation was prepared by the likes of Roger Bacon (13th C) who described the great obstacles to learning as regard for authority, force of habit, theological prejudice and false concept of knowledge. A century later, Merton scholars at Oxford developed the concept of accelerated motion (an important precursor to the understanding that force=mass*acceleration) and took rudimentary but important steps in the measurement and quantification of heat in a rod. One of the hallmarks of British (and European) science thereafter was the fusion of theory and practice, unlike the generally intuitive approach followed by Indian scientists when investigating fields other than astronomy.

For instance, right up to the 16th C, Indian scientists continued to record useful scientific observations, but without serious attempts at quantification, or deeper investigation into the physical and chemical causes of what they observed. Magnetism is referred to by Bhoja (10th-11th C) as well as by Sankara Misra later. Udayana (10th-11th C) recognized solar heat as the heat-source of all chemical changes, and also that air had weight in a discussion of balloons in his Kiranawali. Vallabhacharya (13th C) in his Nyaya-lilavati pointed out the resistance of water to a sinking object, but did not go on to discuss the principle any further. Sankara Misra (15th-16th C) noted the phenomenon of electrostatic attraction after he had observed how grass and straw were attracted by amber. But the cause was deemed adrishta (unseen cause). He also recorded some awareness of the concept of kinetic energy and in his Upaskara dwelt on the properties of heat, and tried to relate the process of boiling to evaporation. In the same treatise, Sankara Misra also gave examples of capillary motion citing the ascent of sap from root to stem in a plant and the ability of liquids to penetrate porous vessels. He also wrote about surface tension, and posited sandrata (viscosity) as the cause behind the cohesion of water molecules and the smoothness of water itself.

The Social Milieu

Yet, unlike in astronomy, where many Indian scientists got very intensely involved, and were driven to work towards a considerable degree of accuracy, no such compulsions appeared to guide Indian scientists in other fields. Whereas Indian astronomers were compelled to develop useful mathematical formulae and explore the mysteries of the universe in greater depth - in other fields of scientific investigation, Indian scientists seemed to remain content with intuitive and general observations, tolerating a far greater degree of vagueness and imprecision. The answer to this apparent inconsistency may lie in the social milieu. The study of astronomy was triggered partly by practical considerations such as the need for accurate monsoon prediction and rainfall mapping, but perhaps even more so, by the growing demand for "good" astrologers. The obsession with astrological charts - both amongst the royalty and mercantile classes led to considerable state patronage of intellectuals who wished to pursue the study of astronomy. Patronage was also available for alchemists - for those attempting to discover the "elixir" of life. But support for modern scientific research as was beginning to take shape in 14th C Oxford was generally lacking.

The situation prevalent in 15th-16th C Italy was not significantly different, and Leonardo DaVinci (1452-1519) was particularly frustrated that there was not sufficient interest in his many inventions and how those with means failed to distinguish genuine scientific activities from quackery and the work of charlatans. But Da Vinci was convinced that dedication to scientific truth would eventually prevail. "For nature, as it would seem, takes vengeance on such as would work miracles and they come to have less than other men who are more quiet. And those who wish to grow rich in a day shall live a long time in great poverty, as happens and will to all eternity happen to the alchemists, the would-be creators of gold and silver, and to the engineers who think to make dead water stir itself into life with perpetual motion, and to those supreme fools, the necromancer and the enchanter."

Although Raja Bhoja's Somarangana-sutradhara (circa AD 1100) describes many useful mechanical inventions, and the use of levers and pulleys is described in numerous other Urdu, Persian and Arabic texts in India and the Middle East, DaVinci's notes on mechanics, the study of levers of different kinds, cantilevers, pulleys and gears in combination, varied gadgetry, bridges, and studies of flight were of a truly pioneering nature, and exceeded in complexity and breadth any civil and mechanical engineering treatise that had preceded him.

And even though in his time, Da Vinci's works were not especially appreciated, Western Europe was in the midst of a monumental change in it's attitude towards science and technology. A century later, the momentum towards the modern scientific era was to gather considerable pace, and eventually the European Renaissance created an environment where the ideas of DaVinci and Francis Bacon (15-16th C England - who stressed the importance of the experimental method in science) were able to blossom and flourish.

But at the same time in India, several factors posed as hindrances to the development of modern science. In comparison to Europe, India enjoyed a relatively milder climate, and the production of necessities was deemed sufficient to satisfy the population of the time. The courts - whether Mughal or regional spent a good part of their rich treasuries on cultivating the fine arts and promoting the manufacture of luxury goods and decorative objects of exquisite beauty. Science and technology simply attracted little attention (except when it came to improving the tools of war).

The growing influence of religion - whether Quranic or Brahminical also had it's negative effect. While the Quran claimed that all the world's knowledge was already described in it, Brahminicalorthodoxy created a sharp divide between the mental and the physical and thus prevented scientists from going beyond passive observation and intuition to practical experimentation, active theorizing and quantification. Whereas Akbar and Jehangir were not averse to science, and the latter took an active interest in books on botany and zoology, it appears from anecdotal accounts that Aurangzeb had a decidedly skeptical attitude towards the sciences. Although some patronage was available in the regional courts, (and outside the courts), alchemy, astrology, study of omens, numerology and other semi-rational and irrational traditions drew much more attention, and thus distracted from genuine scientific pursuits.

On the other hand, European scientists drew on the best works produced in the East - studying foreign documents with due diligence, often accepting little at face value - but instead verifying the results with apparatus and scientific measuring tools of their own creation. There was a time when such had also been the case in ancient India - but over time (due to both internal and external factors) - India's scientific spirit got eroded. Thus Europe was not only able to catch up with the knowledge of India and the East, it was able to rapidly surpass it.

Since independence, Indian scientists have been provided the opportunity of narrowing the gap, and in some fields have done especially well. However, the quality of science education for the masses still needs considerable improvement. On the one hand, the study of the physical sciences in India needs to be accompanied with practical demonstrations and more experimentation as is common practice in the West. In many instances, tools and apparatus used to demonstrate and quantify scientific phenomenon need to be modernized or improved. On the other hand, there also needs to be somewhat greater appreciation of the intuitive approach that has been the hallmark of ancient and medieval Indian science. The conceptual elegance of some earlier formulations, and the facility to inform and educate through analogy is also something that can be learned from the Indian tradition.

It may also be noted that in terms of pedagogy, the standard Western texts are not always as useful. Often, the teaching of physics and chemistry becomes too esoteric for the average student. There is excessive abstraction in most text books, and undue theoretical complexity is thrust upon relatively young students. In contrast, the Indian approach with it's stress on observation of natural phenomenon, and epistemological approach to understanding each field are much easier to grasp for beginners and intermediate students. Once the student understands the basics, and develops a good intuitive way of perceiving scientific phenomenon - the complexities and mathematical abstractions can follow - and the world of the physical sciences can be opened up to more than just the few who are able to transcend the complexities and difficulties that accompany the study of these branches of science today.

History of Mathematics in India

In all early civilizations, the first expression of mathematical understanding appears in the form of counting systems. Numbers in very early societies were typically represented by groups of lines, though later different numbers came to be assigned specific numeral names and symbols (as in India) or were designated by alphabetic letters (such as in Rome). Although today, we take our decimal system for granted, not all ancient civilizations based their numbers on a ten-base system. In ancient Babylon, a sexagesimal(base 60) system was in use.

The Decimal System in Harappa

In India a decimal system was already in place during the Harappan period, as indicated by an analysis of Harappan weights and measures. Weights corresponding to ratios of 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, and 500 have been identified, as have scales with decimal divisions. A particularly notable characteristic of Harappan weights and measures is their remarkable accuracy. A bronze rod marked in units of 0.367 inches points to the degree of precision demanded in those times. Such scales were particularly important in ensuring proper implementation of town planning rules that required roads of fixed widths to run at right angles to each other, for drains to be constructed of precise measurements, and for homes to be constructed according to specified guidelines. The existence of a gradated system of accurately marked weights points to the development of trade and commerce in Harappansociety.

Mathematical Activity in the Vedic Period

In the Vedic period, records of mathematical activity are mostly to be found in Vedic texts associated with ritual activities. However, as in many other early agricultural civilizations, the study of arithmetic and geometry was also impelled by secular considerations. Thus, to some extent early mathematical developments in India mirrored the developments in Egypt, Babylon and China . The system of land grants and agricultural tax assessments required accurate measurement of cultivated areas. As land was redistributed or consolidated, problems of mensuration came up that required solutions. In order to ensure that all cultivators had equivalent amounts of irrigated and non-irrigated lands and tracts of equivalent fertility - individual farmers in a village often had their holdings broken up in several parcels to ensure fairness. Since plots could not all be of the same shape - local administrators were required to convert rectangular plots or triangular plots to squares of equivalent sizes and so on. Tax assessments were based on fixed proportions of annual or seasonal crop incomes, but could be adjusted upwards or downwards based on a variety of factors. This meant that an understanding of geometry and arithmetic was virtually essential for revenue administrators. Mathematics was thus brought into the service of both the secular and the ritual domains.

Arithmetic operations (Ganit) such as addition, subtraction, multiplication, fractions, squares, cubes and roots are enumerated in the Narad Vishnu Purana attributed to Ved Vyas (pre-1000 BC). Examples of geometric knowledge (rekha-ganit) are to be found in the Sulva-Sutras of Baudhayana (800 BC) and Apasthmaba (600 BC) which describe techniques for the construction of ritual altars in use during the Vedic era. It is likely that these texts tapped geometric knowledge that may have been acquired much earlier, possibly in the Harappan period. Baudhayana's Sutra displays an understanding of basic geometric shapes and techniques of converting one geometric shape (such as a rectangle) to another of equivalent (or multiple, or fractional) area (such as a square). While some of the formulations are approximations, others are accurate and reveal a certain degree of practical ingenuity as well as some theoretical understanding of basic geometric principles. Modern methods of multiplication and addition probably emerged from the techniques described in the Sulva-Sutras.

Pythagoras - the Greek mathematician and philosopher who lived in the 6th C B.C was familiar with the Upanishads and learnt his basic geometry from the Sulva Sutras. An early statementof what is commonly known as the Pythagoras theorem is to be found in Baudhayana's Sutra: The chord which is stretched across the diagonal of a square produces an area of double the size. A similar observation pertaining to oblongs is also noted. His Sutra also contains geometric solutions ofa linear equation in a single unknown. Examples of quadratic equations also appear. Apasthamba's sutra (an expansion of Baudhayana's with several original contributions) provides a value for the square root of 2 that is accurate to the fifth decimal place. Apasthamba also looked at the problems of squaring a circle, dividing a segment into seven equal parts, and a solution to the general linear equation. Jain texts from the 6th C BC such as the Surya Pragyapti describe ellipses.

Modern-day commentators are divided on how some of the results were generated. Some believe that these results came about through hit and trial - as rules of thumb, or as generalizations of observed examples. Others believe that once the scientific method came to be formalized in the Nyaya-Sutras - proofs for such results must have been provided, but these have either been lost or destroyed, or else were transmitted orally through the Gurukul system, and only the final results were tabulated in the texts. In any case, the study of Ganit i.e mathematics was given considerable importance in the Vedic period. The Vedang Jyotish (1000 BC) includes the statement: "Just as the feathers of a peacock and the jewel-stone of a snake are placed at the highest point of the body (at the forehead), similarly, the position of Ganit is the highest amongst all branches of the Vedas and the Shastras."

(Many centuries later, Jain mathematician from Mysore, Mahaviracharya further emphasized the importance of mathematics: "Whatever object exists in this moving and non-moving world, cannot be understood without the base of Ganit (i.e. mathematics)".)

Panini and Formal Scientific Notation

A particularly important development in the history of Indian science that was to have a profound impact on all mathematical treatises that followed was the pioneering work by Panini (6th C BC) in the field of Sanskrit grammar and linguistics. Besides expounding a comprehensive and scientific theory of phonetics, phonology and morphology, Panini provided formal production rules and definitions describing Sanskrit grammar in his treatise called Asthadhyayi. Basic elements such as vowels and consonants, parts of speech such as nouns and verbs were placed in classes. The construction of compound words and sentences was elaborated through ordered rules operating on underlying structures in a manner similar to formal language theory.

Today, Panini's constructions can also be seen as comparable to modern definitions of a mathematical function. G G Joseph, in The crest of the peacock argues that the algebraic nature of Indian mathematics arises as a consequence of the structure of the Sanskrit language. Ingerman in his paper titled Panini-Backus form finds Panini's notation to be equivalent in its power to that of Backus - inventor of the Backus Normal Form used to describe the syntax of modern computer languages. Thus Panini's work provided an example of a scientificnotational model that could have propelled later mathematicians to use abstract notations in characterizing algebraic equations and presenting algebraic theorems and results in a scientific format.

Philosophy and Mathematics

Philosophical doctrines also had a profound influence on the development of mathematical concepts and formulations. Like the Upanishadic world view, space and time were considered limitless in Jain cosmology. This led to a deep interest in very large numbers and definitions of infinite numbers. Infinite numbers were created through recursive formulae, as in the Anuyoga Dwara Sutra. Jain mathematicians recognized five different types of infinities: infinite in one direction, in two directions, in area, infinite everywhere and perpetually infinite. Permutations and combinations are listed in the Bhagvati Sutras (3rd C BC) and Sathananga Sutra (2nd C BC).

Jain set theory probably arose in parallel with the Syadvada system of Jain epistemology in which reality was described in terms of pairs of truth conditions and state changes. The Anuyoga Dwara Sutra demonstrates an understanding of the law of indeces and uses it

to develop the notion of logarithms. Terms like Ardh Aached , Trik Aached, and Chatur Aachedare used to denote log base 2, log base 3 and log base 4 respectively. In Satkhandagama various sets are operated upon by logarithmic functions to base two, by squaring and extracting square roots, and by raising to finite or infinite powers. The operations are repeated to produce new sets. In other works the relation of the number of combinations to the coefficients occurring in the binomial expansion is noted.

Since Jain epistemology allowed for a degree of indeterminacy in describing reality, it probably helped in grappling with indeterminate equations and finding numerical approximations to irrational numbers.

Buddhist literature also demonstrates an awareness of indeterminate and infinite numbers. Buddhist mathematics was classified either as Garna (Simple Mathematics) or Sankhyan (Higher Mathematics). Numbers were deemed to be of three types: Sankheya (countable), Asankheya (uncountable) and Anant(infinite).

Philosophical formulations concerning Shunya - i.e. emptiness or the void may have facilitated in the introduction of the concept of zero. While the zero (bindu) as an empty place holder in the place-value numeral system appears much earlier, algebraic definitions of the zero and it's relationship to mathematical functions appear in the mathematical treatises of Brahmagupta in the 7th C AD. Although scholars are divided about how early the symbol for zero came to be used in numeric notation in India, (Ifrah arguing that the use of zero is already implied in Aryabhatta) tangible evidence for the use of the zero begins to proliferate towards the end of the Gupta period. Between the 7th C and the 11th C, Indian numerals developed into their modern form, and along with the symbols denoting various mathematical functions (such as plus, minus, square root etc) eventually became the foundation stones of modern mathematical notation.

The Indian Numeral System

Although the Chinese were also using a decimal based counting system, the Chinese lacked a formal notational system that had the abstraction and elegance of the Indian notational system, and it was the Indian notational system that reached the Western world through the Arabs and has now been acceptedas universal. Several factors contributed to this development whose significance is perhaps best stated by French mathematician, Laplace: "The ingenious method of expressing every possible number using a set of ten symbols (each symbol having a place value and an absolute value) emerged in India. The idea seems so simple nowadays that its significance and profound importance is no longer appreciated. It'ssimplicity lies in the way it facilitated calculation and placed arithmetic foremost amongst useful inventions."

Brilliant as it was, this invention was no accident. In the Western world, the cumbersome roman numeral system posed as a major obstacle, and in China the pictorial script posed as a hindrance. But in India, almost everything was in place to favor such a development. There was already a long and established historyin the use of decimal numbers, and philosophical and cosmological constructs encouraged a creative and expansive approach to number theory. Panini's studies in linguistic theory and formal language andthe powerful role of symbolism and representational abstraction in art and architecture may have also provided an impetus, as might have the rationalist doctrines and the exacting epistemology of the Nyaya Sutras, and the innovative abstractions of the Syadavada and Buddhist schools of learning.

Influence of Trade and Commerce, Importance of Astronomy

The growth of trade and commerce, particularly lending and borrowing demanded an understanding of both simple and compound interest which probably stimulated the interest in arithmetic and geometric series. Brahmagupta's description of negative numbers as debts and positive numbers as fortunes points to a link between trade and mathematical study. Knowledge of astronomy - particularly knowledge of the tides and the stars was of great import to trading communities who crossed oceans or deserts at night. This is borne out by numerous references in the Jataka tales and several other folk-tales. The young person who wished to embark on a commercial venture was inevitably required to first gain some grounding in astronomy. This led to a proliferation of teachers of astronomy, who in turn received training at universities such as at Kusumpura (Bihar) or Ujjain (Central India) or at smaller local colleges or Gurukuls.

This also led to the exchange of texts on astronomy and mathematics amongst scholars and the transmission of knowledge from one part of India to another. Virtually every Indian state produced great mathematicians who wrote commentaries on the works of other mathematicians (who may have lived and worked in a different part of India many centuries earlier). Sanskrit served as the common medium of scientific communication.

The science of astronomy was also spurred by the need to have accurate calendars and a better understanding of climate and rainfall patterns for timely sowing and choice of crops. At the same time, religion and astrology also played a role in creating an interest in astronomy and a negative fallout of this irrational influence was the rejection of scientific theories that were far ahead of their time. One of the greatest scientists of the Gupta period - Aryabhatta (born in 476 AD, Kusumpura, Bihar) provided a systematic treatment of the position of the planets in space. He correctly posited the axial rotation of the earth, and inferred correctly that the orbits of the planets were ellipses. He also correctly deduced that the moon and the planets shined by reflected sunlight and provided a valid explanation for the solar and lunar eclipses rejecting the superstitions and mythical belief systems surrounding the phenomenon. Although Bhaskar I (born Saurashtra, 6th C, and follower of the Asmaka school of science, Nizamabad, Andhra) recognized his genius and the tremendous value of his scientific contributions, some later astronomers continued to believe in a static earth and rejected his rational explanations of the eclipses. But in spite of such setbacks, Aryabhatta had a profound influence on the astronomers and mathematicians who followed him, particularly on those from the Asmaka school.

Mathematics played a vital role in Aryabhatta's revolutionary understanding of the solar system. His calculationson pi, the circumferance of the earth (62832 miles) and the length of the solar year (within about 13 minutes of the modern calculation) were remarkably close approximations. In making such calculations, Aryabhatta had to solve several mathematical problems that had not been addressed before including problems in algebra (beej-ganit) and trigonometry (trikonmiti).

Bhaskar I continued where Aryabhatta left off, and discussedin further detail topics such as the longitudes of the planets; conjunctions of the planets with each other and with bright stars; risings and settings of the planets; and the lunar crescent. Again, these studies required still more advanced mathematics and Bhaskar I expanded on the trigonometric equations provided by Aryabhatta, and like Aryabhatta correctly assessed pi to be an irrational number. Amongst his most important contributions was his formula for calculating thesine function which was 99% accurate. He also did pioneering work on indeterminate equations and considered for the first time quadrilateralswith all the four sides unequal and none of the opposite sides parallel.

Another important astronomer/mathematician was Varahamira (6th C, Ujjain) who compiled previously written texts on astronomy and made important additions to Aryabhatta's trigonometric formulas. His works on permutations and combinations complemented what had been previously achieved by Jain mathematicians and provided a method of calculation of nCr that closely resembles the much more recent Pascal's Triangle. In the 7th century, Brahmagupta did important work in enumerating the basic principles of algebra. In addition to listing the algebraic properties of zero, he also listed the algebraic properties of negative numbers. His work on solutions to quadratic indeterminate equations anticipated the work of Euler and Lagrange.

Emergence of Calculus

In the course of developing a precise mapping of the lunar eclipse, Aryabhatta was obliged to introduce the concept of infinitesimals - i.e. tatkalika gati to designate the infinitesimal, or near instantaneous motion of the moon, and express it in the form of a basic differential equation. Aryabhatta's equations were elaborated on by Manjula (10th C) and Bhaskaracharya (12th C) who derived the differential of the sine function. Later mathematicians used their intuitive understanding of integration in deriving the areas of curved surfaces and the volumes enclosed by them.

Applied Mathematics, Solutions to Practical Problems

Developments also took place in applied mathematics such as in creation of trigonometric tables and measurementunits. Yativrsabha's work Tiloyapannatti(6th C) gives various units for measuring distances and time and also describes the system of infinite time measures.

In the 9th C, Mahaviracharya (Mysore) wrote Ganit Saar Sangraha where he described the currently used method of calculating the Least Common Multiple (LCM) of given numbers. He also derivedformulae to calculate the area of an ellipse and a quadrilateral inscribed within a circle (something that had also been looked at by Brahmagupta) The solution of indeterminate equations also drew considerable interest in the 9th century, and several mathematicians contributed approximations and solutions to different types of indeterminate equations.

In the late 9th C, Sridhara (probably Bengal) provided mathematical formulae for a variety of practical problems involving ratios, barter, simple interest, mixtures, purchase and sale, rates of travel, wages, and filling of cisterns. Some of theseexamples involved fairly complicated solutions and his Patiganita is considered an advanced mathematical work. Sections of the book were also devoted to arithmetic and geometric progressions, including progressions with fractional numbers or terms, and formulas for the sum of certain finite series are provided. Mathematical investigation continued into the 10th C. Vijayanandi (of Benares, whose Karanatilaka was translated by Al-Beruni into Arabic) and Sripatiof Maharashtra are amongst the prominent mathematicians of the century.

The leading light of 12th C Indian mathematics was Bhaskaracharya who came from a long-line of mathematicians and was head of the astronomical observatory at Ujjain. He left several important mathematical texts including the Lilavati and Bijaganita and the Siddhanta Shiromani, an astronomical text. He was the first to recognize that certain types of quadratic equations could have two solutions. His Chakrawaat method of solving indeterminate solutions preceded European solutions by several centuries, and in his Siddhanta Shiromani he postulated that the earth had a gravitational force, and broached the fields of infinitesimal calculation and integration. In the second part of this treatise, there are several chapters relating to the study of the sphere and it's properties and applications to geography, planetary mean motion, eccentric epicyclical model of the planets, first visibilities of the planets, the seasons, the lunar crescent etc. He also discussed astronomical instruments and spherical trigonometry. Of particular interest are his trigonometric equations: $\sin(a + b) = \sin a \cos b + \cos a \sin b$; $\sin(a - b) = \sin a \cos b - \cos a \sin b$;

The Spread of Indian Mathematics

The study of mathematics appears to slow down after the onslaught of the Islamic invasions and the conversion of colleges and universities to madrasahs. But this was also the time when Indian mathematical texts were increasingly being translated into Arabic and Persian. Although Arab scholars relied on a variety of sources including Babylonian, Syriac, Greek and some Chinese texts, Indian mathematical texts played a particularly important role. Scholars such as Ibn Tariq and Al-Fazari (8th C, Baghdad), Al-Kindi (9th C, Basra), Al-Khwarizmi (9th C. Khiva), Al-Qayarawani (9th C, Maghreb, author of Kitab fi al-hisab al-hindi), Al-Uqlidisi (10th C, Damascus, author of The book of Chapters in Indian Arithmetic), Ibn-Sina (Avicenna), Ibn al-Samh (Granada, 11th C, Spain), Al-Nasawi (Khurasan, 11th C, Persia), Al-Beruni (11th C, born Khiva, died Afghanistan), Al-Razi (Teheran), and Ibn-Al-Saffar (11th C, Cordoba) were amongst the many who based their own scientific texts on translations of Indian treatises. Records of the Indian origin of many proofs, concepts and formulations were obscured in the later centuries, but the enormous contributions of Indian mathematics was generously acknowledged by several important Arabic and Persian scholars, especially in Spain. Abbasid scholar Al-Gaheth wrote: " India is the source of knowledge, thought and insight". Al-Maoudi (956 AD) who travelled in Western India also wrote about the greatness of Indian science. Said Al-Andalusi, an 11th C Spanish scholar and court historian was amongst the most enthusiastic in his praise of Indian civilization, and specially remarked on Indian achievements in the sciences and in mathematics. Of course, eventually, Indian algebra and trigonometry reached Europe through a cycle of translations, traveling from the Arab world to Spain and Sicily, and eventually penetrating all of Europe. At the same time, Arabic and Persian translations of Greek and Egyptian scientific texts become more readily available in India.

The Kerala School

Although it appears that original work in mathematics ceased in much of Northern India after the Islamic conquests, Benarassurvived as a center for mathematical study, and an important school of mathematics blossomed in Kerala. Madhava (14th C, Kochi) made important mathematical discoveries that would not be identified by European mathematicians till at least two centuries later. His series expansion of the cos and sine functions anticipated Newton by almost three centuries. Historians of mathematics, Rajagopal, Rangachari and Joseph considered his contributions instrumental in taking mathematics to the next stage, that of modern classical analysis. Nilkantha (15th C, Tirur, Kerala) extended and elaborated upon the results of Madhava while Jyesthadeva (16th C, Kerala) provided detailed proofs of the theorems and derivations of the rules contained in the works of Madhava and Nilkantha. It is also notable that Jyesthadeva's Yuktibhasa which contained commentaries on Nilkantha's Tantrasamgraha included elaborations on planetary theory later adopted by Tycho Brahe, and mathematics that anticipated work by later Europeans. Chitrabhanu (16th C, Kerala) gave integer solutions to twenty-one types of systems of two algebraic equations, using both algebraic and geometric methods in developing his results. Important discoveries by the Kerala mathematicians included the Newton-Gauss interpolation formula, the formula for the sum of an infinite series, and a series notation for pi. Charles Whish (1835, published in the Transactions of the Royal Asiatic Society of Great Britain and Ireland) was one of the first Westerners torecognize that the Kerala school had anticipated by almost 300 years many European developments in the field.

Yet, few modern compendiums on the history of mathematics have paid adequate attention to the often pioneering and revolutionary contributions of Indian mathematicians. But as this essay amply demonstrates, a significant body of mathematical works were produced in the Indian subcontinent. The science of mathematics played a pivotal role not only in the industrial revolution but in the scientific developments that have occurred since. No other branch of science is complete without mathematics. Not only did India provide the financial capital for the industrial revolution (see the essay on colonization) India also provided vital elements of the scientific foundation without which humanity could not have entered this modern age of science and high technology.

HISTORIC ASPECTS OF CRAFT AND TRADE IN INDIA

Although the courtly culture of the Mughal rulers of the Indian subcontinent is the most well known, a cosmopolitan outlook was not new to India; several sources point to a thriving system of international trade that linked the ports of Southern India with those of Ancient Rome. The chronicles of the Greek Periplus reveal that Indian exports included a variety of spices, aromatics, quality textiles (muslins and cottons), ivory, high quality iron and gems. Considered items of luxury in those days, these were in high demand. While a good portion of Indo-Roman trade was reciprocal, (Rome supplying exotic items such as cut-gems, coral, wine, perfumes, papyrus, copper, tin and lead ingots), the trade balance was considerably weighted in India's favor. The balance of payments had to be met in precious metals, either gold or silver coinage, or other valuables like red coral (i.e. the hard currency of the ancient world). India was particularly renowned for its ivory work and its fine muslins (known in Roman literature as 'woven air'). However, these items must have been quite expensive since the Roman writer Pliny (AD 23-79) complained of the cost of these and other luxury commodities that were imported from India. "Not a year passed in which India did not take fifty million sesterces away from Rome", wrote Pliny. This trade surplus gave rise to prosperous urban centres that were linked to an extensive network of internal trade. Literary records from that period paint a picture of abundance and splendour . The Silappathikaarum (The Ankle Bracelet), a Tamil romance (roughly dated to the late second century AD), provides a glimpse of the maritime wealth of the cosmopolitan cities of South India. Set in the prosperous port city of Puhar (Kaveripattanam), the story refers to ship owners described as having riches 'the envy of foreign kings'. Puhar is portrayed as a city populated by enterpreneurial merchants and traders, where trade was well regulated: "The city of Puhar possessed a spacious forum for storing bales of merchandise, with markings showing the quantity, weight, and name of the owner." The Silappathikaarum suggests that the markets offered a great variety of precious commodities prized in the ancient world. Special streets were earmarked for merchants that traded in items such as coral, sandalwood, jewellery, faultless pearls, pure gold, and precious gems. Skilled craftspeople brought their finished goods such as fine silks, woven fabrics, and luxurious ivory carvings. Archealogical finds of spectacular burial jewellery in southern India appear to corroborate such accounts. Northern India also had its flourishing urban centres. This can be inferred from descriptions of an archealogical site in ancient Taxila. Vladimir Zwalf (in Jewelry, 7000 years - Hugh Tait, Editor) notes: "The site has yielded magnificent and well-preserved gold jewellery, notably necklaces, ear-pendants and finger-rings, characterised by a mastery of granulation and inlay." While most ornaments from that period have not survived, sculpture from several sites shows heavy adornment. Patliputra (now Patna) during the Mauryan period was described by travellers as one of the grandest cities of that period.

TEXTILES

The antiquity of Indian textile exports can be established from the records of the Greek geographer Strabo (63 BC - AD 20) and from the first century Greek source Periplus, which mentions the Gujarati port of Barygaza, (Broach) as exporting a variety of textiles. Archaeological evidence from Mohenjo-Daro, establishes that the complex technology of mordant dyeing had been known in the subcontinent from at least the second millennium B C. The use of printing blocks in India may go as far back as 3000 B.C, and some historians are of the view that India may have been the original home of textile printing. "The export of printed fabrics to China can be dated to the fourth century B C, where they were much used and and admired, and later, imitated." - (Stuart Robinson: 'A History of Printed Textiles'). The thirteenth-century Chinese traveller Chau Ju-kua refers to Gujarat as a source of cotton fabrics of every color and mentions that every year these were shipped to the Arab countries for sale. " The discovery at Broach of a hoard of gold and silver coins, mostly fourteenth-century and belonging to the Mamluk kingdom of Egypt and Syria, suggests the maintenance of the advantageous trading system recorded since Roman times whereby Indian textiles and other renewable resources were traded for precious metals". - (John Guy, 'Arts of India, 1550 - 1900') Also in the thirteenth century, Marco Polo recorded the exports of Indian textiles to China and South East Asia from the Masulipattinam (Andhra) and Coromandel (Tamil) coasts in the "largest ships" then known. It is conjectured that the initial development of this trade accompanied the spread of Indian cultural influence in South-East Asia. John Guy in the "Arts of India, 1550 - 1900", points out that "textile patterns on sculptures of Indian deities in central Java and elsewhere in the region very probably reflect the prestige cloths in circulation in the late first millennium". Chou Ta-kuan, the Chinese observer of life at the Khmer capital of Angkor at the end of the thirteenth century, wrote that "preference was given to the Indian weaving for its skill and delicacy." Robyn Maxwell (in Textiles of Southeast Asia) observes that elaborately decorated Indian textiles were the most highly valued and notes: " Many spectacular Indian trade cloths, most now two or three centuries old, have been treasured as heirlooms throughout Southest Asia into the twentieth century, making only rare appearances at important ceremonies or at times of crisis". Prestige trade textiles such as Patola (double ikat silk in natural dyes) from Patan and Ahmedabad, and decorative cottons in brilliant color-fast dyes from Gujarat and the Coromandel coast were sought after by the Malaysian royalty and wealthy traders of the Phillipines. The port city of Surat (in Gujarat) emerged as the major distribution point for patola destined for South-East Asia, and was frequented by the ships of the Dutch East India Company. "The right to wear patola was widely claimed as a prerogative of the Indonesian nobility , a practice encouraged by the Dutch East India Company who distributed patola to local rulers as part of the incentives offered to win local trading concessions and co-operation." (- John Guy, 'Arts of India') Textiles also comprised a significant portion of the Portuguese trade with India. These included embroidered bedspreads and wall hangings possibly produced at Satgaon, the old mercantile capital of Bengal, (near modern Calcutta). Quilts of embroidered wild silk (tassar, munga or eri) on a cotton or jute ground, combining European and Indian motifs were comissioned by the Portuguese who had been attracted to Bengal, (as traders had been since the early centuries AD), by the quality of the region's textiles. J.H. van Linschoten, who was based in Goa as secretary to the archbishop in the 1580s, observed that Cambay also produced silk embroidered quilts. Textiles from Golconda and further south also found favor in Europe and South East Asia. In the early 1600s, Dutch and English trading settlements were established in Golconda territory. Produced in the Golconda hinterland, kalamkaris - i.e. finely painted cotton fabrics were bought or commissioned from the port city of Masulipattinam. Buying at source enabled the Dutch and English merchants to procure these textiles at rates thirty per cent lower. 'Palampores' - painted fabrics based on the "tree of life" motif that had become popular in the Mughal and Deccan courts were also highly regarded. The attractiveness of fast dyed, multi-colored Indian prints on cotton (i.e. chintz) in Europe led to the formation of the London East India Company in 1600, followed by Dutch and French counterparts. By the late 1600s, there was such overwhelming demand for Indian chintz (whether from Chittagong in Bengal, or Patna or Surat, that ultimately French and English wool and silk merchants prevailed on their governments to ban the importation of these imported cottons from India. The French ban came in 1686, while the English followed in 1701. (Not all textile producing centres were associated with ports. Several textile producing centres that catered to the internal market, and to the overland international trade were located in Northern and Central India, in the kingdoms of the Rajputs and the Mughals, each with their own unique specialization. While Kashmir was well known for its woollen weaves and embroidery, cities like Benaras, Ujjain, Indore and Paithan (near Aurangabad) were known for their fine silks and brocades. Rajasthan specialized in all manner of patterned prints and dyed cloths. Fine collections of Indian Textiles can be seen in the Calico Museum in Ahmedabad and in the Crafts Museum in Delhi)

CARPETS

According to texts dating from the Buddhist era, woolen carpets were known in India as early as 500 B.C. References to woven mats and floor coverings are not infrequent in ancient and medieval Indian literature. By the 16th century, carpet-weaving centreswere established in all the major courts of the sub-continent. However, it is the output of the Mughal period that is now attracting international attention. Dismissed by earlier scholars as mechanical derivatives of Persian carpets, Indian carpets of the Mughalperiod are slowly gaining recognition as the most technically accomplished classical carpets of all times.

Daniel Walker, curator at the Metropolitan Museum of Art (New York) has described pile-woven carpets of the Mughal era as "among the most beautiful works of art ever created". He suggests that the large-scale production from the imperial workshops of Akbar "set

the tone for subsequent carpet weaving in India and resulted in carpets whose jewel-like beauty is still breathtaking". (Ref. Flowers Underfoot, Indian Carpets of the Mughal Era)

DECORATIVE CRAFTS

Under the patronage of the various royal clans that ruled India, particularly the Mughals, the Rajputs and the Deccani nawabs, the decorative arts and crafts reached unprecedented heights. (These traditions were continued, and even augmented by later regional nawabs in Bengal, Mysore, Central India, Punjab, Awadh and Kashmir). European traders did not fail to notice the relatively high quality of Indian craftsmanship and proceeded to set up their own "karkhanas" i.e factories, that rivalled the Mughal and Deccani establishments. Hardwood furniture was a major product of Portuguese patronage, usually richly decorated with inlaid woods and ivory. Catering to the European markets, the items preserved the general forms of European furniture, but were embellished with expensive inlays and carvings that took their inspiration from Indian styles, particularly the Mughal. Several production centres, principally in Sind, Gujarat and the Deccan serviced this trade based in Goa. Mother-of-pearl was one of the materials often used in the decoration of such items, particularly small storage chests. These were produced principally in Ahmedabad and Cambay, and later in Surat. Gujarati furniture with mother-of-pearl inlay is recorded in the Baburnama (early 16th century). The technique of setting mother-of-pearl in a black lac ground, had been employed on wooden tomb-covers of the early seventeenth century in Ahmedabad and Cambay, where a good proportion of such work catered to the Turkish market, as evinced by examples preserved in the Topkapi Saraye Museum of Istanbul. The craft of papier mache, extensively promoted by the Mughals and later the Rajputs, also found favor with 17th century European traders who commissioned Kashmiri artists to produce for the European market.

JEWELLERY

Since the Indian sub-continent invariably carried a trade surplus, precious and semi-precious stones, or gold and silver from the international trade complemented internally mined supplies, leading several visitors to India to note the enormous wealth of some of India's most well known kingdoms. They would describe overflowing treasuries, replete with a variety of precious metals and gems. Bazaars exclusively devoted to trade in precious metals and stones were not uncommon. As already mentioned, Tamil texts dating to the 2nd Century AD refer to them, as do the chronicles of the 14th century traveller Ibn Batuta of Tunisia, and Europeans who visited the Vijaynagar, or Golconda kingdoms. Vladimir Zwalf (in Jewelry, 7000 years - Hugh Tait, Editor) observes: "The ostentatious display of jewels at the Mughal court mentioned by all visitors to it is borne out by contemporary miniature paintings and a large quantity of extant pieces. Jewellery was worn by both men and women, and was also used in the ornamentation of arms and armour, furniture and vessels. Gems dominate Mughal jewellery. India was a major source and trading centre for precious stones." Shah Jahan was particularly knowledgeable about gems, and personally supervised some of the works executed in the "karkhanas". Several fine examples of jewelry from the courts of the Mughals and Rajputs, and other regional nawabs can be seen in the collection in the National Museum, including selections from Benaras, Bengal and Southern India.

METALLURGY

Two quotes well summarize the development of metallurgical skills prior to modern industrialization. Sir Thomas Holland, (chairman of the Indian Industrial Commission of 1916-18) reported in 1908: "The high quality of the native made iron, the early anticipation of the process now employed in Europe for the manufacture of high-class steels, and the artistic products in copper and bronze gave India a prominent position in the metallurgical world." D.H. Buchanan wrote in 'Development of Capitalist Enterprise in India, 1934': "In India, steel was used for weapons, for decorative purposes and for tools, and remarkably high grade articles were produced. The old weapons are second to none, and it is said that the famous damascus blades were forged from steel imported from Hyderabad in India. The iron column, called the Kutub pillar at Delhi, weighs over six tons and carries an epitaph composed about 415 A.D. No one yet understands how so large a forging could have been produced at that time." The craft of Bidri-ware which originated in the Deccan, in Bidar and spread northwards to centres like Lucknow, required not insignificant metallurgical skills. The delicate inlay work required discipline and expertise, and additionally, required the knowledge of extraction of zinc (a primary constituent of the Bidri alloy). Unlike copper or iron, zinc was not easily extractable from its ore. Consequently, in Europe, the metal could not be used on an industrial scale until an Englishman patented his zinc distillation process in 1738. However, in India, zinc was first produced in the 1st C BC (The Rasvatnakar mentions the distillation of Zinc in Zawar, Rajasthan, and excavations by the M.S. University verify the existence of kilns used in the distillation of the metal). In Rajasthan, it may have subsequently been used in the production of brass. In any case, by the seventeeth century, zinc was being absorbed in considerable quantity for the production of Bidri-ware which had acquired widespread patronage.

Jaigarh (near Jaipur) was home to one of Asia's largest canon factories. Cannons produced in the Rajput fort of Jaigarh (now on display at the Jaigarh Fort) played a crucial role in the expansion and consolidation of Mughal rule in India.

THE REGIONAL KINGDOMS

While much is known of the Moghuls, less is known of the regional kingdoms who were equally cultured, and also made their mark in manufactures and trade. Susan Stronge - (The Sultanates of the Deccan, Arts of India, 1550 - 1900) writes: " With the exception of architecture, little of the artistic production of the sultanates has survived, and that which has is usually uninscribed and undocumented. Nevertheless, the superb quality of some of the surviving artefacts provides a tantalising glimpse of a world of courtly splendour and cultural refinement, others indicating traditions which, though less elevated, are lively and appealing." Like their Mughal counterparts, the Deccani Nawabs were great patrons of the arts and music, and in portraitures are often depicted with fine jewellery and fine silks. What is of particular interest today is the secular administration of these sultanates. In their patronage of Ragamala paintings, the Deccani nawabs shared the tastes of the Rajputs, and later rulers of the Punjab hills and Punjab plains. Based on the romantic folk-lore of popular traditions, the ragamala painting became a highly sophisticated art form - its lyrical and expressive style appealing to Hindhu, Muslim and Sikh patrons alike. Asad Beg, who chronicled the court of Bijapur's Ibrahim Adil Shah II (1586-1627), mentions that Adil Shah spoke Marathi and his Kitab-i-Nauras, a collection of songs in Deccani Urdu were set to different ragas, some paying homage to Muslim saints, others recalling the Hindhu deities Saraswati and Ganesha. According to Asad Beg, under Ibrahim Shah, Hindhus had access to positions of political importance and economic power. Like Akbar, one of his most trusted officials was Antu Pandit. Another Hindhu, Ramji, was head of the Bijapuri guild ofjewellers and court adviser on matters of jewellery purchase and selection. And like in the 'karkhanas' of Akbar, skilled Hindhu craftsmen, were just as likely to find employment as skilled Muslims. Both courts strived towards perfection in their manufactures, and could not afford religious discrimination.

SHIPPING AND NAVY

Although several nations that traded in the Indian Ocean had merchant ships, India seems to have been the first country of the Indian Ocean to possess real battle-fleets. Reports Auguste Toussaint in 'History of the Indian Ocean', "The Mauryan emperor Chandragupta, who ruled from 321 to 297 B.C had even at that time, an actual Board of Admiralty, with a Superintendent of Ships at its head." References to it can be found in Kautilya's Arthasastra. From their voyages of conquest and trade, we can infer that although much later, the Pallavas, Pandyas and Cholas of South India must also have had an efficient naval organization. Prior to colonial rule, the most significant Navy in the Indian Ocean, was that of the Mughals. At its peak, during the reign of Akbar, it had over 3000 vessels, and was concentrated in the Bay of Bengal, although a good proportion of the fleet was also based in Gujarat. Described in the Ayeen-i-Akbari (Chronicle of the Reign of Akbar), the Navy controlled shipbuilding, conducted naval surveys, collected customs duties and ensured adequate crew recruitments. During Aurangzeb's reign, the Mughal fleet functioned only in the Bay of Bengal, and was heavily used against European traders (particularly the Portuguese) who challenged the Mughal authority and tried to avoid customs payments. In the Bay of Bengal, the kingdom of Assam had its own fleets, while the Marathas had theirs on the West coast. In this period, the trade within Asia was still largely conducted by Asians. The merchants of Surat, who relied upon ships built by the Wadias of Bombay (who had not taken long to copy prevailing European designs) were particularly rich - one of them Virji Vora (who died in the beginning of the 18th century) left a fortune of 22 million gold francs. "According to certain travellers, Surat was then the most beautiful city of India. One small detail will give an idea of the unparalleled luxury that prevailed there: certain streets were paved with porcelain. Francois Martin in his Memoires calls it 'a real Babylon'." - (Auguste Toussaint in 'History of the Indian Ocean'.)

THE DECLINE IN TRADE REVENUES

However, such prosperity was not to last long. In that same period, as the revenues to the Mughals from the overland trade dwindled due to heightened competition from the East India Company (which undercut prices for Indian exports offered by the Ottomans of Turkey), the Mughal state after Aurangzeb crumbled, and the strength of the Indian Navy diminished as a consequence. (Although the sea route around the African Cape was much longer than the overland route, the indirect profits from the African slave trade that accrued to the East India Company allowed it to out-compete the Ottomans and thus draw away badly needed revenues from the Mughal treasury). Although the kingdoms of Oudh and Bengal thrived for a while, by 1721 the East India Company had been prohibited from importing Indian textiles into Europe. This was a major economic blow for the entire sub-continent; in particular, the Bengal Nawabs, who were unable to invest sufficiently in maintaining an adequate Navy. At the same time, the East India Company had turned its attention to the contraband Opium Trade with China, which required military cover, for which contingents of the British Royal Navy were sent to the Indian Ocean and the South China Sea, enhancing British military power in the Bay of Bengal. The rapid depletion of the Mughal treasuries, thus started a chain reaction. Unable to supervise the vast regions under its authority, the Mughal state disintegrated. Craftspeople employed in the Mughal 'karkhanas' sought patronage from the regional courts of Awadh and Bengal, or Rajputana and Punjab, or the Marathas of Central India, all of whom experienced a short-lived, but often brilliant cultural renaissance. Mughal and Hindhu (or Sikh) styles were fused in the regions, producing several unique and syncretic traditions. However, after the textile bans and inability to enforce customs collections, the smaller Indian states simply lacked the economic and

military means to resist the onslaught of the now richer and more poweful East India Company. The defeat at Plassey in 1757 was thus a monumental turning point in history. A nation that had long enjoyed a trade surplus from its manufactures was soon to be reduced to penury. R. Mukerji describes this process in 'The Rise and Fall of the East India Company', noting that the defeat of the Moghuls and the political ascendance of the East India Company was accompanied by a decline of the Indian mercantile bourgeoisie. The great merchants of India, who had earlier derived protection from the Mughals, and had benefited from the naval patrols of Akbar and Aurangzeb, were by the end of the eighteenth century, practically extinguished in Bengal and elsewhere. Although it took another century for the conquest of India to be consolidated, and although a third of India escaped direct colonial rule, a long era had come to a close. The crafts of that era were either to be obliterated, or survive precariously. Remunerated at a much lower rate, they were unlikely to gain the prestige and respect they once enjoyed. It is important to note this difference between the British colonizers and earlier conquerers who made India their home. Whereas earlier conquerers had taken full advantage of India's manufacturing skills and either steered them in different directions, or attempted to augment and refine them, for the British, India's manufacturing strengths were unnecessary competition, and were best snuffed out, or left to languish . Those who attempt to treat the British as no different from India's previous Islamic rulers do great injustice to this ineffaceable reality. Several of India's previous rulers came as foriegners - as invaders and conquerers - but they lived and died in India. Consequently, the monuments they built, the artefacts they commissioned, the culture that they sponsored - all of it, is now the legacy of the people of the sub-continent. The riches that they acquired were recycled in the same land, but what the British took away may never be returned. Even in its faded glory, India's Islamic legacy has more authenticity than colonial rule. As Indians look to the future, they may gain from this history a justifiable pride in the dedicated pursuit of excellence that was practised by India's craftspeople. They can take note of the technological discoveries and adaptations that took place in an older era, and become inspired to contribute - even in some small way, towards the betterment of a land that is waiting to find its due place in the world once more.