	AREA OF META DATA	TO BE FILLED BY CONTENT GENERATOR
1	THEME	Developments in Science and Mathematics in Ancient India
2	SUBJECT	History
3	CHAPTER	
4	CLASS/LEVEL	VI
5	OBJECTIVES	• To be able to explain important developments in Science and Mathematics in the ancient period. • To appreciate India's contribution in the fields of Science and Mathematics.
6	DESCRIPTION	India made important contributions to Science and Mathematics. The brick constructions at Harappa show that the people possessed a good knowledge of measurement; town planning of some Harappan cities reveal attention to sanitation and waste water management. In ancient times religion and science were inextricably linked together. Astronomy made great progress because planets came to be regarded as deities, and their movements began to be closely observed. Their study became important on account of their connections with changes in seasons and weather conditions which were important for agricultural activities. Knowledge of medicine improved, largely due to the efforts of Charaka and Sushruta. By the third century BCE, medicine mathematics and astronomy began to develop separately. The most renowned scholars of astronomy were Aryabhata and Varahamihira. *Romaka Siddhanta* is an important work on astronomy. In the field of mathematics the ancient Indians made three distinct contributions-the notation system, the decimal system and the use of zero. Ancient physicians studied anatomy; they devised methods to diagnose diseases and prescribed medicines for cure. The earliest mention

		of medicines is in the *Atharva Veda.*
7	KEY WORDS	Science. Mathematics, Astronomy, Medicine, Charaka, Sushruta Aryabhata, Varahamihira. *Romaka Siddhanta,* notation system, decimal system , zero.
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DRAINAGE SYSTEM OF HARAPPAN CIVILIZATION

Drainage in Lothal

Water Reservoir in Dholavira

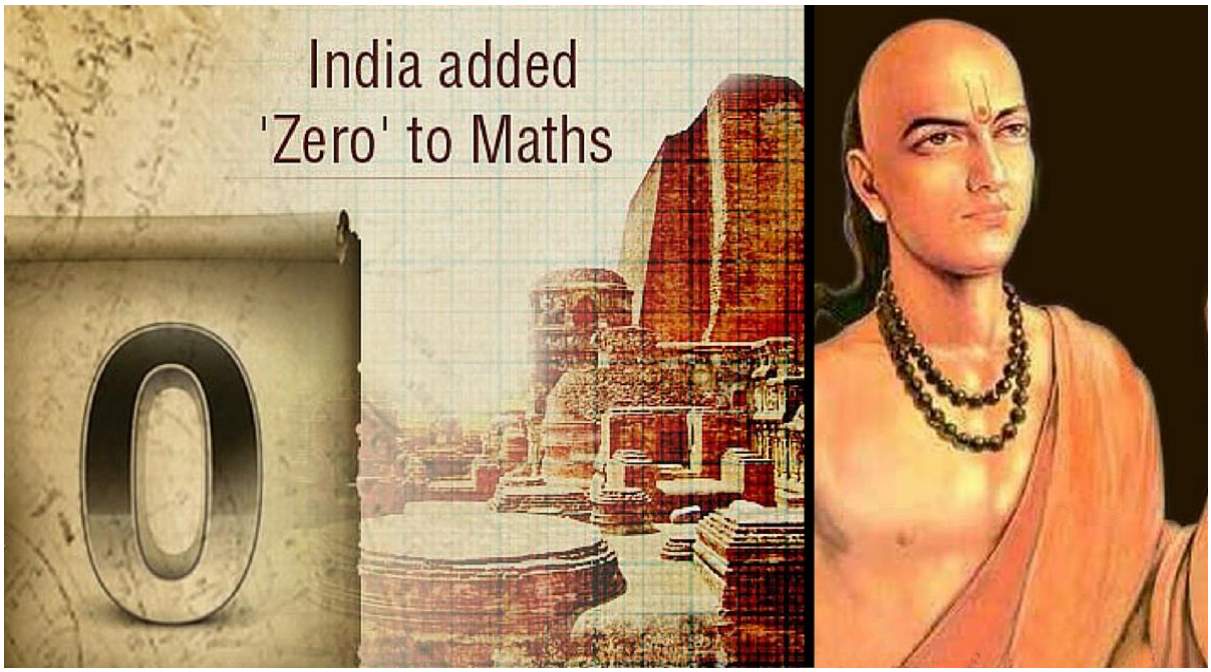
Water Tank at Mohenjodaro

Drainage In Lothal

DISTINCTIVE FEATURES OF DRAINAGE SYSTEM OF HARAPPAN CIVILIZATION

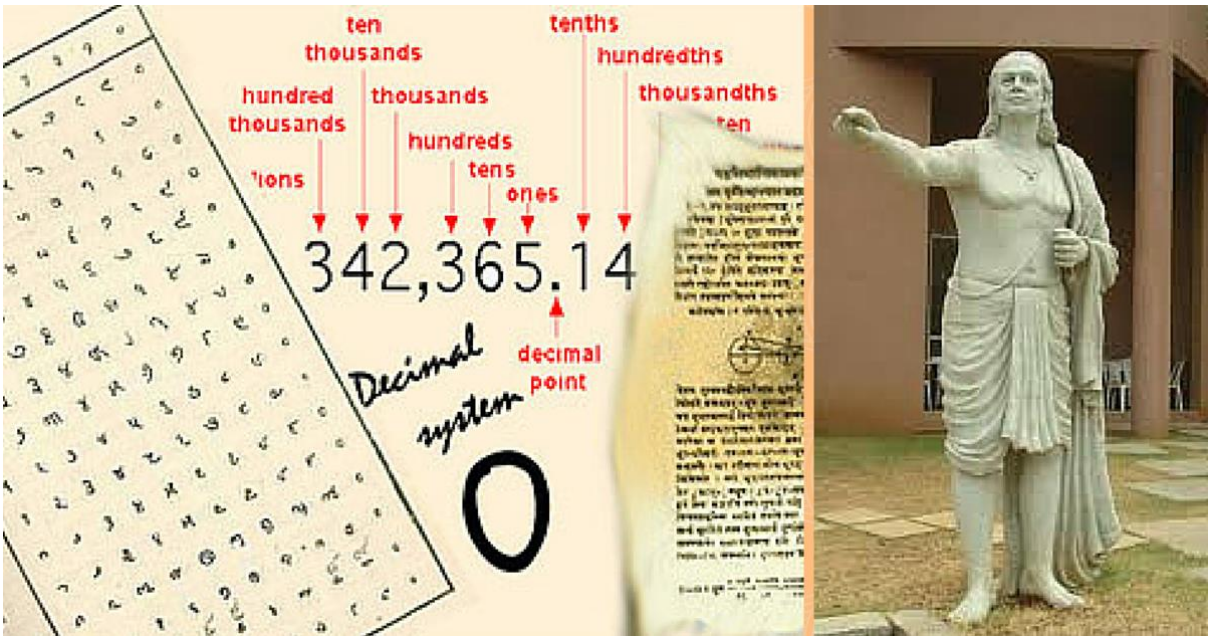
- **The Harappan Civilization had one of the most sophisticated urban water supply and sewage systems in the world.**
- **A significant aspect of planning was the system of underground drainage.**
- **The main sewer connected to other other sewers. The sewer was kept water tight.**
- **A wooden screen at the end of the drains held back solid wastes.**
- **Water flowed from houses to the streets which had drains.**
- **Dirty water from houses drained through a pipe out through the wall into the drain in the street.**
- **Sometimes drains were covered with bricks and sometimes with slabs.**
- **Sophisticated water conservation system of channels and reservoirs as seen in Dholavira.**
- **City walls functioned as a barrier against floods.**
- **The urban areas of the cities were provided public and private baths.**
- **Each fort in the area had its own water harvesting and storage system in the form of rock-cut cisterns, ponds, tanks and wells.**

THE IDEA OF ZERO



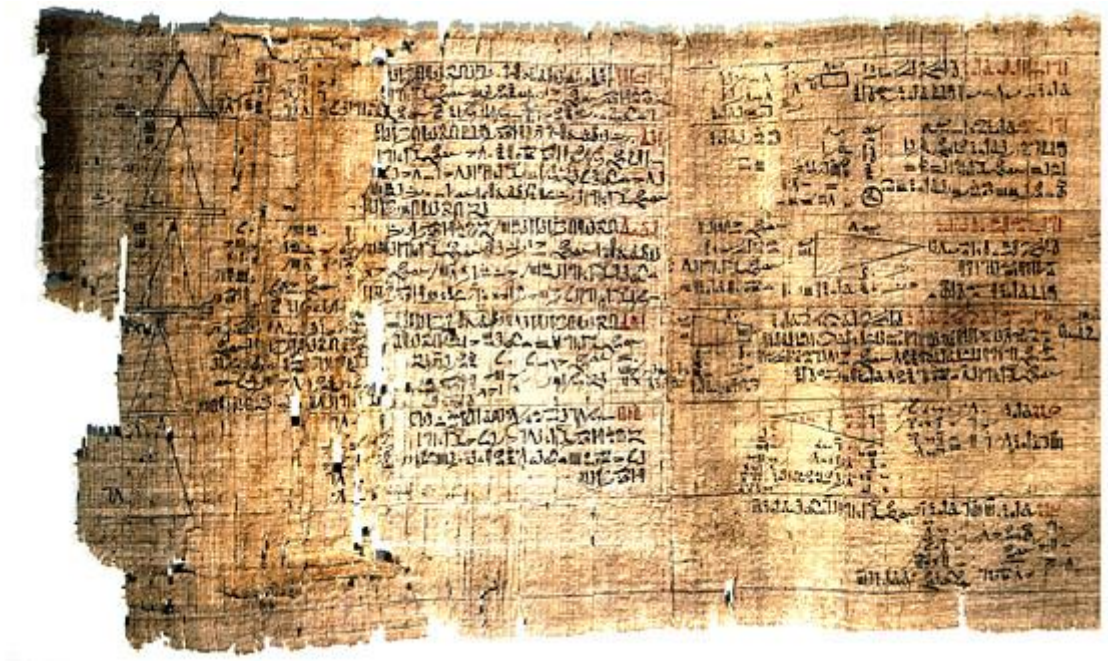
Little needs to be said about the mathematical digit "Zero" which is one of the most important discoveries all time. Zero was first discovered by IndIans in about second century BCE. Since the time of its discovery the Indian mathematicians considered zero as a separate numeral, and it was used in this sense in arithmetic sums. In Arabia the earliest use of zero apperas in 873 BCE. The Arabs learnt it and adopted it from India and spread it to Europe. Although both the Greeks and Indians contributed to the discipline of Algebra, in Western Europe its knowledge was borrowed from the Arabs who had acquired it from India.

THE DECIMAL SYSTEM



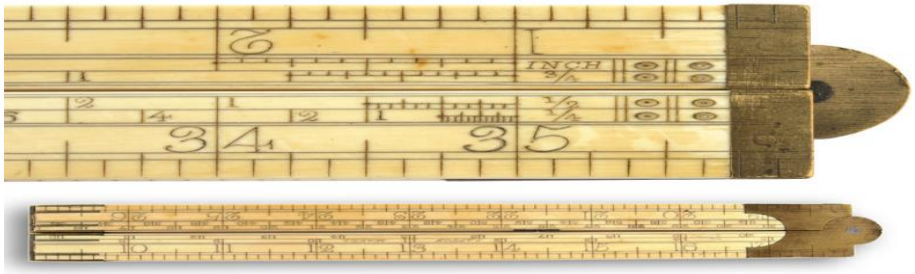
The earliest epigraphic evidence for the use of the decimal system is in the beginning of the fifth century BCE. India gave the indigenous method of expressing all numbers by means of ten symbols- the decimal system. In this system each symbol received a value of position as well as an absolute value. Due to the simplicity of the decimal rotation, which facilitated calculation, this system made the uses of arithmetic in practical inventions much faster and easier. The famous mathematician Aryabhata was acquainted with it.

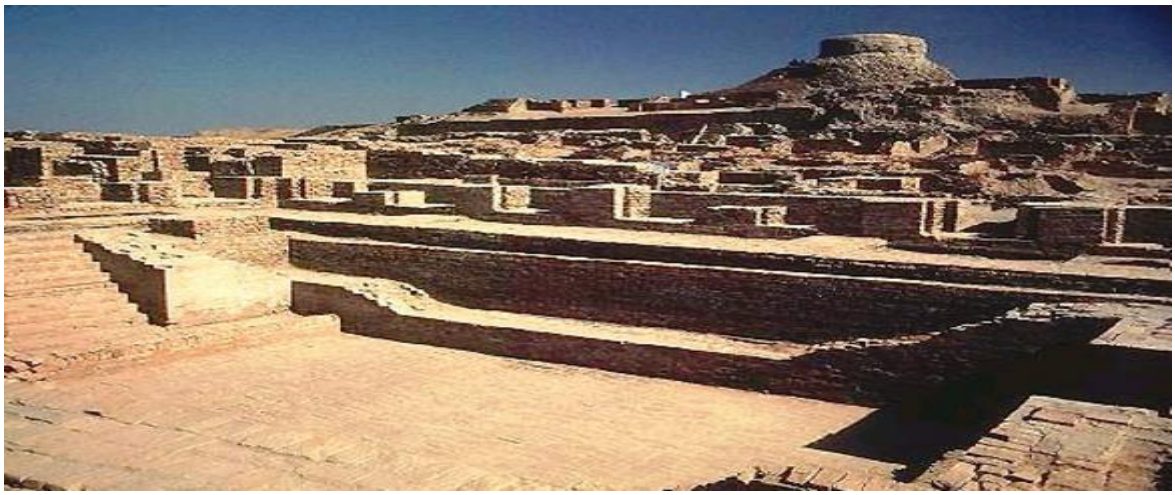
THE NOTATIONAL SYSTEM



The Indian notational system was adpopted by the Arabs who spread to the western world. The indian numerals are called Arabic in English, but the Arabs called their numerals *hindsa*. Befiore the numerals appeared in the West, they had been in use in India for centuries. They are found in the inscriptions of Asoka which were written in the third century BCE.

MEASRUEMENT AND GEOMETRY

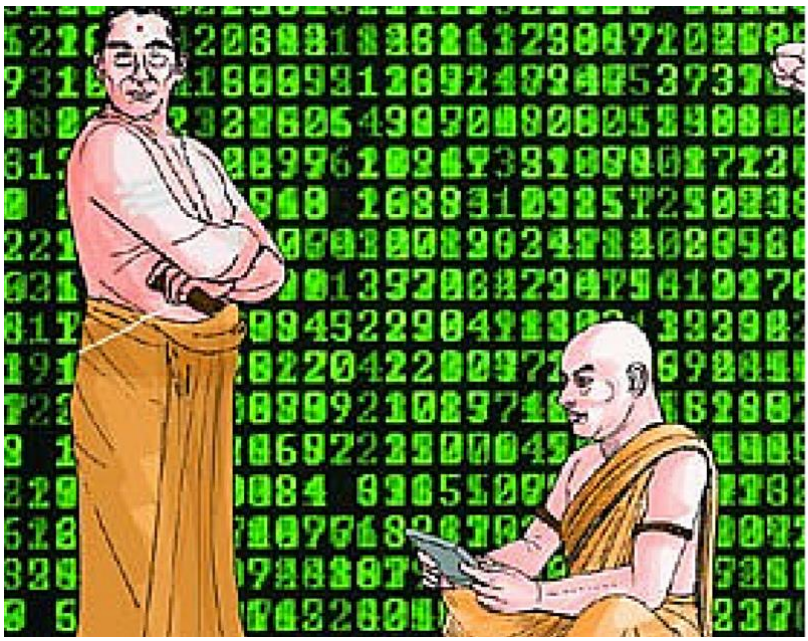


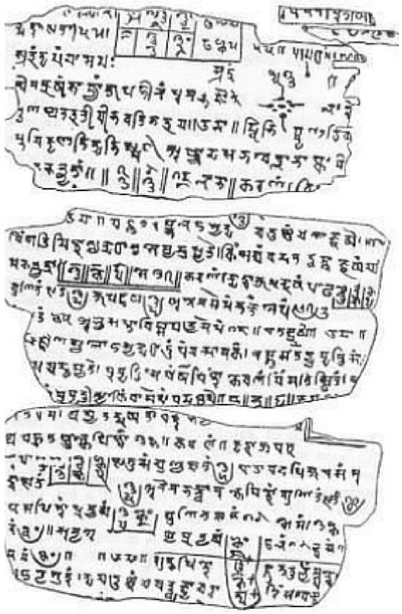


The brick constructions of Harappan cities show that in north-western India people possessed a good knowledge of measurement and geometry. Excavations at Harappans sites have yielded rulers or linear measures made from ivory and shell. Marked out in minute subdivisions with amazing accuracy, the calibrations correspond closely with the *hasta* increments of 1 3/8 inches, traditionally used in the ancient architecture of South India. Ancient bricks found at the excavation sites have dimensions that correspond to the units on these rulers.

The Vedic people may have benefitted from this knowledge which appears in th rSulvasutras of aboput 5th century BCE. Apasthamba produced a practical geometry for constructuion of altars. It describes acute angle, obtuse angle and right angle. Aryabhata formulated the rule for finding the area of a triangle, which led to the origin of Trigonometry. The most famous work of this time is the *Suryasiddhanta.*

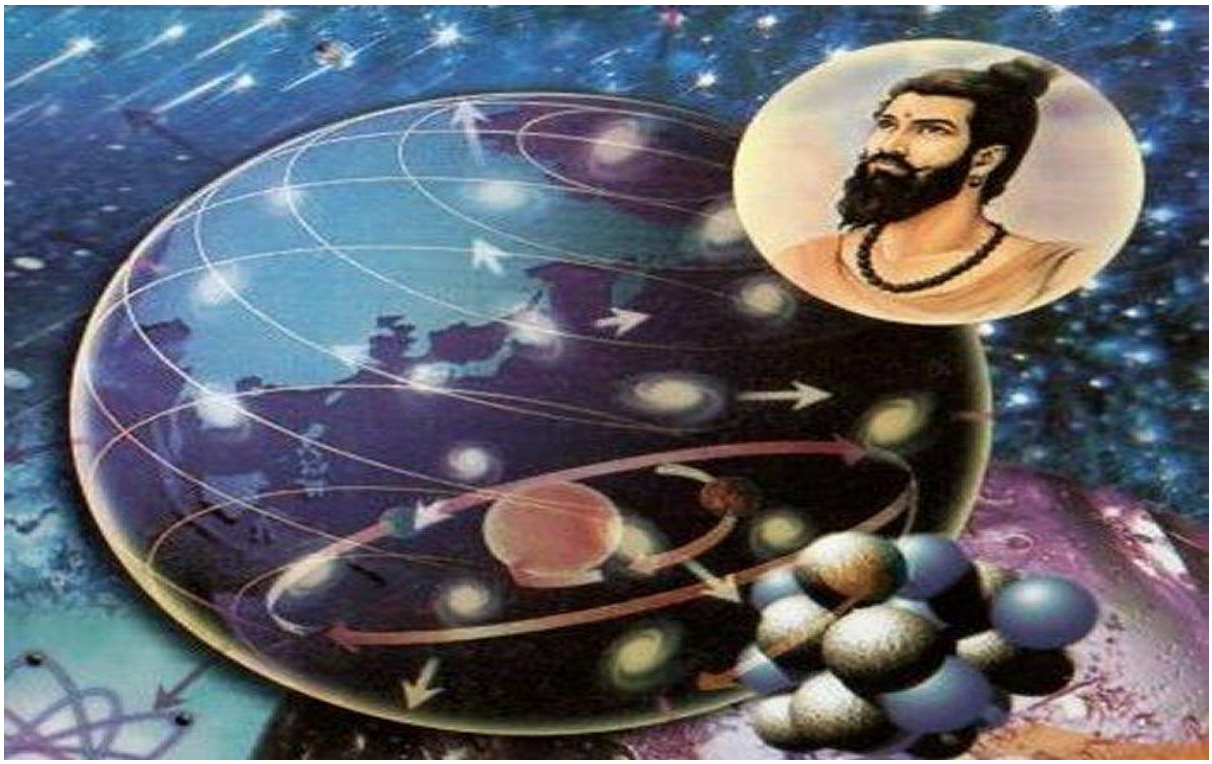
CHAKRAVALA METHOD OF ALGORITHMS





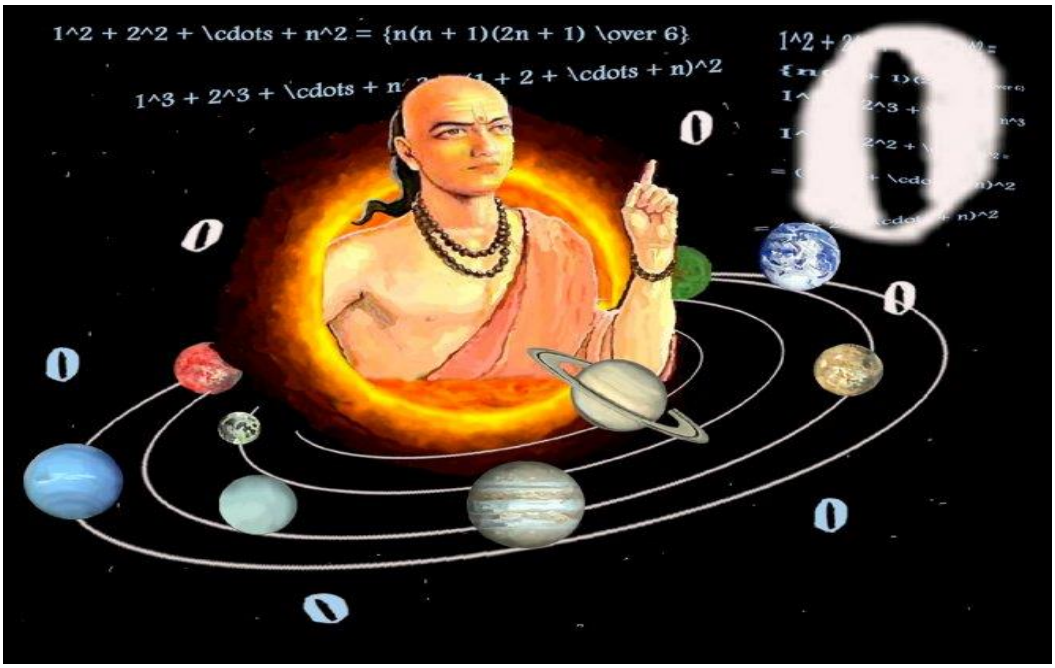
The *chakravala* method is a cyclic algorithm to solve indeterminate quadratic equations, including the Pell's equation. This method for obtaining integer solutions was developed by Brahmagupta, one of the well known mathematicians of the 7th century CE. Another mathematician, Jayadeva later generalized this method for a wider range of equations, which was further refined by Bhāskara II in his *Bijaganita* treatise.

A THEORY OF ATOM



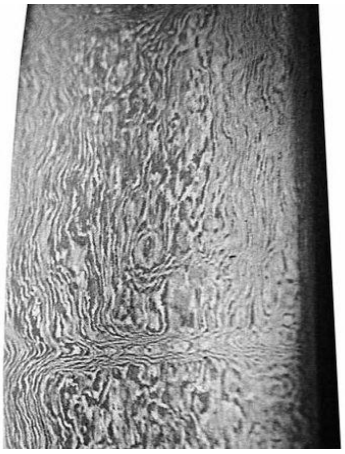
Kanad is believed to have devised the atomic theory centuries before John Dalton was born. He speculated the existence of *anu* or small indestructible particles, much like an atom. He also stated that *anu* can have two states — absolute rest and a state of motion. He further held that atoms of same substance combined with each other in a specific and synchronized manner to produce *dvyanuka* (diatomic molecules) and *tryanuka* (triatomic)

DEVELOPMENTS IN ASTRONOMY



Aryabhata(5th century CE) and Varahamihira(6th century CE) were the most renowned scholars who made significant contributions in the field of astronomy. Aryabhata's well known work is the *Aryabhatiya*. He calculated the position of planets and discovered the causes of lunar and solar eclipses. The circumference of the earth which he measured on the basis of speculation is considered correct even now. He also pointed out that the sun is stationary and the earth rotates around it. Varahamihira stated that the moon rotates around the earth and the earth rotates around the sun. He utilized several Greek works to explain movement of planets and some astronomical problems. He is known for his famous work *Brihatsamhita*. Although Greek knowledge influenced Indian astronomy, the Indians pursued the subject further and made use of it in their observation of planets.

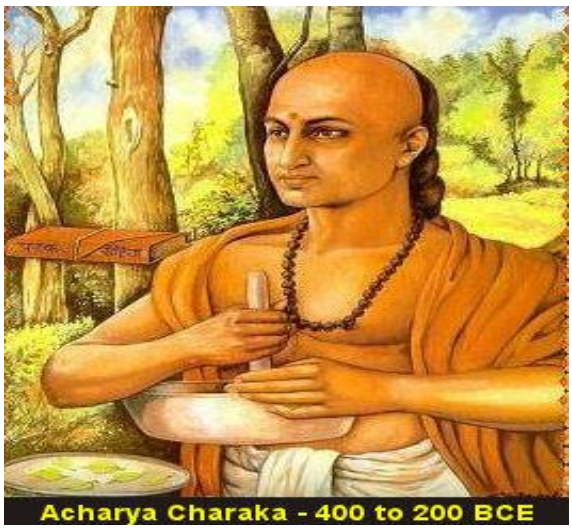
WOOTZ STEEL



Wootz steel is a crucible steel characterized by a pattern of bands that was known in the ancient world by different names such as *Ukku*, *Hindwani* and *Seric Iron* . The term *wootz*, is a corruption of the word *ukku* (for steel) in many languages of the states of Karnataka, and Andhra Pradesh. India has been known for its high quality iron and steel since ancient times. Literary and archaeological sources show that steel from southern India was rated as some of the finest in the world and was traded to Europe, China, the Arab world and the Middle East. Wootz steel is ultra-high carbon steel exhibiting properties such as super plasticity and high impact hardness. It was used to make the famed Damascus swords which were reputed to cut even gauze kerchiefs and were found to be of a very high carbon content of 1.5-2.0%.

DEVELOPMENTS IN MEDICINE

A statue dedicated to Suśruta at Haridwar



Artist's representation of Charaka

Ancient Indians studied anatomy.Thy devised methods to diagonise diseases and prescribed medicines for their cure. The earliest mention of medicines is in the *Atharva Veda*. In the second century CE , India produced two famous scholars of *Ayurveda,* Sushruta and Charaka . In *Susrutasamhita,* Sushruta describes the method of operating cataract, stone disease and several other ailments. He mentions as many as 21 implements to be used for operations. Charaka's *Charakasamhita* is like an encylopedia of Indian medicine. It describes various types of fever, hysteria a nd tuberculosis. It also contains names of plants and herbs which were to be used for medicinal purposes.

ACTIVITY 1

Match the following

CIET : Match the following

1. *Ukku*	**Varahamihira**
2. *Brihatsamhita*	**Brahmagupta**
3. *Susrutasamhita*	**Practical geometry for constructuion of altars**
4. Drainage system	**Sushruta**
5. Chakravala Method	**Wootz Steel**
6. Dholavira	**Sophisticated water conservation system**
7. Apasthamba	**Harappan Civilization**

Correct Answers

1. **Wootz steel**

2. Varahamihira

3. Sushruta

4. Harappan Civilization

5. Brahmagupta

6. Sophisticated water conservation system

7. Practical geometry for constructuion of altars

ACTIVITY 2

Tick the correct answer

CIET : TICK CORRECT ANSWER

1. Who discovered the causes of lunar and solar eclipses?

(a) Varahamihira

(b) Sushruta

(c) Kanad

(d) Aryabhata

KEY (d)

2. Indian numerals are found in which of the inscriptions?

(a) Asokan inscriptions

(b) Inscription of Raja Raja Chola

(c) Badami Chalukya pillar inscription

(d) Hathigumpa Inscription

KEY (a)

3. *Chakravala* method is a

(a) A method for predicting an eclipse

(b) A method of calculating measurement

(c) A method of cyclic algorithm

(d) A method of operating cataract

KEY (c)

4. The Harappans possessssed a good knowledge of

(a) Measurement and geometry

(b) Performing surgery

(c) Astronomy

(d) Atomic theory

KEY (a)

5. The earliest mention of medicines is found in the

(a) *Upanishads*

(b) *Dharmasastras*

(c) *Atharva Veda*

(d) *Sama Veda*

KEY (c)

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