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Ancient Indian Mathematics and Astronomy

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1. The Era of the Sulva Sutras

By 1000[1] BCE (4000 BCE)[2] the Vedas had assumed their present final form. To them, a number of prose treatises, called the Brahmanas, which contain instructions on ritual and explanations were added. At about the same time Aranyakas or speculations by persons living in the solitude of the forests were composed and these culminated in the theosophical treatises called the Upanishads. To all these, were added, as a sort of appendix, a series of aphorisms called the Sutras. 0ne set of such Sutras are *the* Kalpa Sutras which consisted of Srauta Sutras, Dharma Sutras, Grihya Sutras and Sulva Sutras. The Srauta Sutras give elaborate rules for the performance of Vedic sacrifices; the Grihya Sutras deal with domestic religious ceremonies; the Dharma sutras contain the rudiments of Hindu Law; and the Sulva Sutras form the earliest source of Hindu Mathematics. All the Sutras were composed between 800 BCE and 200 BCE(2500 BCE).

[1] This was the conventional dating prior to the discovery of the dried up Saraswati River bed .Astronomical dating has now confirmed that the Vedas are at least older than 4000 BCE. .Wherever there is a second date; it will refer to the now accepted chronology.

[2] Astronomical dating of the Vedas

Sulva Sutras means the Sutras of the Cord and they are so called because measurements are taken by stretching a cord between stakes. They deal mainly with geometry of a special kind for practical use in the construction of alters and places of sacrifice. They deal with the construction of squares and rectangles of equivalent squares and rectangles, construction of equivalent circles, and construction of squares equal to the sum of two given squares or the difference of the two given squares. This they were able to do, because they knew the theorem which is today attributed to Pythagoras. The number system of mathematics has evolved from +ve to –ve, and then to surds like $\sqrt{2}$ and thereafter to transcendental numbers like π and finally to complex numbers using the imaginary number 'I' or $\sqrt{-1}$ Before the Christian era, numbers such as $\sqrt{2}$, the most common surd, being the square root of the diagonal of a square of unit size, was giving trouble to the Greeks as well as the Hindus. For obtaining the diagonal , the rule given in the Sulva Sutras is to multiply the side of the square by

$1+1/3+1/(3\times4)-1/(3\times4\times34)$ Which is = 1.4142 approximately equal to $\sqrt{2}$

The 3 problems of antiquity were,

I Duplication of the cube

II Trisecting an angle

III Squaring the circle

It was said that when plague struck in Greece the Greeks went to the Delphic oracle, which with a cruel sense of humor , told them that if they constructed a cube of volume twice the volume of a given cube then the plague would stop. That is, if there is a cube of unit side and unit volume 1 one must construct a cube of volume = 2 units . . So, one must discover a number which is $\sqrt[3]{2}$. Now this was impossible for the Greeks with an alphabetical notation for numbers; and the plague ran its course. It was proved by Gauss (l777—1855 CE) that the first 2 problems cannot be solved by ruler and compass and Lindemann in 1882, proved that π π is transcendental and can only be expressed as an infinite series,

so that, finding $\pi\frac{22}{7}\sqrt{\pi}$ is out of question. The value $\frac{22}{7}$ usually used is only an approximation.

But the Sulva Sutras give the following solution, no doubt approximate, for the last problem

$$\frac{7}{8}+\frac{1}{(8.29)}-\frac{1}{(8.29.6)}+\frac{1}{(8.29.6.8)}$$

Some of these constructions are referred to in the Shatapatha Brahmana and the Taittiriya Samhita, which are admittedly before 7th century BCE [3]*and* therefore the methods described must be some centuries older then the Sulva Sutras. It is therefore conjectured ,not only by Chauvinistic Indologists, but also by Western scholars that Indian geometry developed independently, totally uninfluenced by Greek Geometry because, the Greeks had no tools for making the kind of calculations suggested, their number system being alphabetical.

[3] If we accept the argument that the Rg was complete by 2000BCE,see for instance my manuscript on the Vedic Mathematicians, to precede the drying of the river Saraaswati , then2000 BCE is the latest possible date .Astronomical dating places it even earlier

2. Discovery of the Zero (cipher, nothing, cifra, sunya)

Here we come to one of the greatest discoveries of the Hindus. It is the use of *0* to indicate a number. Apropos this invention the famous French mathematician Pierre Simon de Laplace, a contemporary of Napoleon had this to say, and we quote

It is India that gave us this ingenious method of expressing every possible number using a set of ten symbols, each symbol receiving a place value and an absolute value . The idea seems so simple nowadays that its significance and profound importance is no longer appreciated. Its simplicity lies in the way it facilitated calculation and placed arithmetic foremost amongst useful inventions. The grandeur of this invention is more readily appreciated when one considers that it escaped the genius of the two greatest men of Antiquity, Archimedes and Apollonius.

The importance of the creation of the zero can never be exaggerated nor can it be attributed merely to luck, because, as Prof Halstead put it, 'This giving to airy nothing, not merely a local habituation and a name, a picture, a symbol but helpful power, is the characteristic of the Hindu race from whence it sprang. No single mathematical creation has been more potent for the general facilitation of mathematical intelligence and power. The Greeks and Romans had symbols like ' X' ,Multiplying a symbol 'X' by another symbol 'X' is almost inconceivable without assigning the specific properties of the numerical symbols from 1 to 9.They had to use a clumsy device called the Abacus which consisted of beads on wires in a frame. Zero has been in regular use ever since the 5th century by Aryabhatta.

H.G Wells in his Outline of History refers to the discovery of *0* by Arabs. He has always been reluctant to give any credit to the Hindus. He even made fun of Gandhi, that he merely borrowed from Ruskin and Tolstoy. But what he conveniently overlooked was that, Gandhi put these ideas to practical use with great couraqe which evoked the praise of Einstein. Actually, the Arabs transmitted and disseminated the present number system to the Europeans, but the place of *0* with the use of numbers was the discovery of Hindu genius. Incidentally, a Moroccan (an Arab belonging to the Maghreb) genius invented the present number system taking *zero* from the Hindus and noticing that it has no angles,

evolved symbols so that the other numbers have angles equal to the number of which is equal to the particular number thus

1 2 3 4 5 6 7 8 9 0

This use of zero has enabled the Hindus to refer to large numbers with ease. For example in the Ramayana in the Yaddha Kanda ,canto 4,sloka 67& 68.

The Jain text Lalita Vistara (1st century CE) gives names of numbers up to 10^{23}

The Jaina texts of this period and a little after give detailed calculations of the dimensions of the earth involving $\sqrt{10}$ and the relation between circumference and diameter, and there is mentioned the use of permutations and combinations.

3. Some notable names in Mathematics and Astronomy

Aryabhatta

Thereafter, the Indics had some brilliant mathematicians such as Aryabhatta (b. 476 CE) who wrote on algebra and astronomy in 499 CE, i.e., when he was only 23 years old. He was familiar with I +ve and –ve numbers, had rules for extracting square roots and for solving quadratic equations. His formula for π was

$$\frac{62833}{10000} = 3.1416$$

In the Bible in Kings 7.23 ,and II Chronicles 4.2 ,the value of π is given as three, and Tennessee, in the 19th century, passed an absurd law that henceforth π shall be equal = 3. Tennessee was then in the quip of fundamentalists the Government prohibited the teaching of the idea of evolution and compelled teachers to instill
the ideas in the Bible about creation of the earth and of Adam and Eve as the truth. When one teacher disobeyed the law he was prosecuted by a man named William Jennings

Bryan[4] and Clarence Darrow[5] a famous American lawyer, defended the teacher. When Bryan was in the witness box, Darrow asked Bryan whether he really believed that the sun and the moon were created on the 4th day as set out in Genesis, and his reply was yes . Darrow then asked Bryan to tell the court how the first 3 days were counted if there was no sun

Similarly he asked Bryan if he really believed that because the snake was cursed for enticing Eve to eat the forbidden fruit it crawls on its belly. When Bryan answered yes, Darrow asked him to tell the court, how snakes moved about before the curse.

4.Other Notable Indic Mathematicians from yester year

After Aryabhatta came Bhaskara I (522 CE) - He was followed by Brahmagupta (628 CE) Mahavira (9th century). The next great name in Hindu Math is that of Bhaskara II of 12th century His book on Arithmetic is known as Lilavati because all the problems are addressed to a girl named Lilavati . It is surmised that she must be the mathematician's

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[4] **William Jennings Bryan** (March 19, 1860 – July 26, 1925) was an American lawyer, statesman, and politician. He was a three-time Democratic Party nominee for President of the United States. Bryan was a devout Presbyterian, a strong proponent of popular democracy, an outspoken critic of banks and railroads, a leader of the silverite movement in the 1890s, a dominant figure in the Democratic Party, a peace advocate, a prohibitionist, an opponent of Darwinism, and one of the most prominent leaders of the Progressive Movement. He was called "The Great Commoner" because of his total faith in the goodness and rightness of the common people.

[5] **Clarence Seward Darrow** (April 18, 1857 – March 13, 1938) was an American lawyer and leading member of the American Civil Liberties Union, best known for having defended teenaged thrill killers Leopold and Loeb in their trial for murdering 14 year old Bobby Franks (1924) and defending John T. Scopes in the so-called "Monkey" Trial (1925), opposing the famous prosecutor William Jennings Bryan. He remains famous for his wit, compassion and agnosticism that have marked him as one of the most famous American lawyers and civil libertarians.

daughter. There are some mathematical works of later periods, one by Narayana, also in the l2th century and by Ganesha in the16th century.

Brahmagupta

Mahavira

Bhaskara I

Bhaskara II

Narayana

Ganesha

Srinivasa Ramanujan

5.Srinivasa Ramanujan

The last great Hindu Mathematician is of course Srinivasa Ramanujan whom Prof. Julian Huxley
has ascribed as the greatest mathematician of the 20th century. His biography is more interesting than any short story. He had failed in English in the Intermediate exam (which is usually taken in the 13th year of schooling, equivalent to the Abitur in Germany.) He joined as a clerk in the madras Port trust. While working there and even before, he had been working out problems in higher mathematics . When the Director General of Ports, a gentleman who had also studied mathematics at Cambridge, had come to Madras, Ramanujan showed him his work but the D.G. said he had forgotten his math, but if Ramanujan desired he would send his work to Prof. GH. Hardy, the professor of Pure Mathematics at Cambridge.

Soma of Ramanujan's work was sent and Hardy's reaction was to send this man immediately to Cambridge. He has solved problems, which European mathematicians have been. struggling with for the last 100 years.' So, Prof. P.V. Seshu Iyer, Professor of Mathematics in the Presidency College, S. Srinivasa Iyengar, a leading lawyer of Madras, V Ramaswami Iyer, a member of the Madras (Provincial) Civil Service a fine mathematician, and Vepa Ramesam a brilliant mathematician and Fellow of Madras University arranged for his trip to Cambridge with a suitable scholarship from Madras University. Hardy wrote later, that his problem was training Ramanujan. Ramanujan announced results intuitively and Hardy was nervous to make him deduce the results logically from known results, because he was afraid that such a rigorous procedure might affect his intuition. Ramanujam contracted TB, and when Hardy went to see him in the nursing home, he told Ramanujan that the number of the taxi in which he came was1729 and asked Ramanujam if there was anything special about that number. According to Hardy, Ramanujan was a friend of every number and could give the peculiar properties of any number, if it had any Ramanujan's answer to this query was, yes which gave after he thought about it for a minute. It is the smallest number, which can be expressed as the

sum of two cubes', in 2 different ways. The answer is $[1^3 + 12^3 \textit{ and } 9^3 + 10^3]$

In a book called Mathematicians Apology, Hardy paid Ramanujan the greatest tribute. He said: When I hear pompous people talking about their achievements, I console myself that whatever else I might not have done, I discovered Ramanujan and I had worked with him on almost equal terms.

6.Ancient Indian Astronomy and Cosmology

The earliest astronomical texts are the Vedic Jyotisha Vedanga, authored by Lagadha and the Jain Suryaprajnapati. The first is part of the Rig Veda and is repeated in the Yajur

Veda. The Vedic idea of the universe is simple — the earth is flat and the celestial bodies move in the heavens above. The Universe is very old its evolution and decline are cyclic.. The Brahmanda is divided into 21 regions. Earth is the 7th from the top. Below are 7 stages of Patala and then 7 more stages of Naraka. The 27 Nakshatras are enumerated. The year is of 366 days. In every 5 years, one month is omitted to maintain 12 months of 30 days in a year. The *27* or sometimes 28 Nakshatras are found among the Arabs and Chinese and their origin is unknown. The first complete enumeration of the Nakshatras is in the Taittiriya Samhita of the 7th century BC.

	Western Zodiac name	Indian Nakshatras (Sidereal Zodiac)	Sector in deg,min deg,min
1.	Beta Arietis	Aswini	00 00 13 20
2.	41 Arietis	Bharani	13 20 26 40
3.	Eta Tauri	Karthika	26 40 40 00
4.	Alpha Tauri	Rohini	40 00 53 20
5.	Lamda Orionis	Mrigasira	53 20 66 40
6.	Alpha Orionis	Aridra	66 40 80 00
7.	Beta Geminorum	Punarvasu	80 00 93 20
8.	Delta Cancri	Pushya	93 20 106 40
9.	Alpha Cancri	Aslesha	106 40 120 00
10.	Alpha Leonis	Magha	120 00 133 20
11.	Delta Leonis	Pubba	133 20 146 40
12.	Beta Leonis	Uttara	146 40 160 00
13.	Delta Corvi	Hasta	160 00 173 20
14.	Alpha Virginis	Chitra	173 20 186 40
15.	Alpha Bootis	Chothi	186 40 200 00
16.	Beta Librae	Vishakam	200 00 213 20
17.	Delta Scorpi	Anuradha	213 20 226 40
18.	Alpha Scorpi	Jyeshta	226 40 240 00
19.	Lamda Scorpi	Moola	240 00 253 20
20.	Delta Sagittari	Poorvashad	253 20 266 40
21.	Delta Sagittari	Uthrashad	266 40 280 00
22.	Alpha Aquilae	Sravana	280 00 293 20
23.	Alpha Delphini	Dhanishta	293 20 306 40
24.	Lamda Aquar	Satabhisha	306 40 320 00
25.	Alpha Pegasi	Poorvabhadra	320 00 333 20
26.	Alpha Andromeda	Uttrarabhadra	333 20 346 40
27.	Zeta Piscium	Revathi	346 40 360 00

The real path of the earth around the Sun is called the Ecliptic.

9 degrees to either side of the Ecliptic is a belt of the Heavens known as the Zodiac. (Dante called it the Oblique Line that beareth all planets).

First 30 degrees of the Zodiac constitute the sign of Aries. The next 30 degrees Taurus and so on. The Zodiac counted from the first degree of Aries to the 360th degree of Pisces is called the Tropical Zodiac.

These 12 signs are the limbs of the Cosmic Man or Time Eternal (Kalapurusha- The Almighty Self as Time).

Aries is His head, Taurus His face, Gemini His neck, Cancer His heart, Leo the place beneath, Virgo His belly, Libra His generative organs, Scorpio the place beneath, Sagittarius His upper thigh, Capricorn his lower thigh, Aquarius His leg and Pisces His feet!
The Zodiac is tenanted by 27 constellations each of them spread over an arc of 13 degrees 20 minutes. The Zodiac counted from the first degree of Beta Arietis (Aswini) to the 360th degree of Zeta Piscium (Revathi) is known as the Sidereal[6] Zodiac.

Western Astrology is based on the Tropical Zodiac and the Vedic on the Sidereal.

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[6] Siderea The actual period of the Moon's orbit as measured in a fixed frame of reference is known as a sidereal month, because it is the time it takes the Moon to return to the same position on the celestial sphere among the fixed stars (Latin: sidus): 27.321 661 days (27 d 7 h 43 min 11.5 s) or about 27 ⅓ days. This type of month has appeared among cultures in the Middle East, India, and China in the following way: they divided the sky in 27 or 28 lunar mansions, characterized by asterisms (apparent groups of stars), one for each day that the Moon follows its track among the stars.l month

The Jain Suryaprajnapati is also of the pre-Christian era and is dated about 200 BCE. The cosmology described therein is as follows. In the center of the earth is Mt. Meru and the Pole star is directly above it. The heavenly bodies are equidistant from the earth, revolve from east to west around Menu. Their invisibility is caused by their going behind Meru . At the front of Meru are 4 quadrants of which India is the southern and the Jambudvipa. Around this continent are 7 oceans of water, ghee, butter, curds, milk, wine, and treacle.

7.Macaulay and his comments on Indian astronomy

This cosmology has drawn from Lord Macaulay a contemptuous comment,. He said When it is in our power to teach the English tongue. We will be teaching languages in which, by universal confession there are no books on any subject which deserve to be compared to our own, when we can teach European science, we shall teach systems, which by universal confession, whenever they differ from those of Europe, suffer *for the worse,* when we can patronize sound philosophy and true history, we shall countenance, at the public expense, medical doctrines which would disgrace an English farrier, astronomy which would move laughter in girls at an English Boarding School, history abounding with kings 30' high and reigning 30,000 years long , and geography made up of seas of treacle and oceans of butter.

Where Macaulay erred was in condemning Sanskrit literature and Hindu philosophy. His criticism of history, geography and science was justified but here again he assumed that what is ancient literature is accepted as practical science[7].

The Bible Is full of persons living over 900 years like Methuselah. In fact, the great Sir Isaac Newton took the Bible seriously and he calculated the origin of the earth as laid down there. It came to 4004 BCE. He knew it was absurd but was trying his best to reconcile the Bible and scientific knowledge. As late as the 1920's, a visitor to the cottage of Neils Bohr saw a horse shoe on the wall of the house and asked the scientist, 'Surely you, a modern

[7] Macaulay himself did not know Sanskrit.He had to rely on other translationsand did not comprehend the compzct style of the Vedic texts

scientist and a Nobel laureate do not believe that this horse shoe would bring you luck and Bohr said "Of course I don't believe it, but I am told it works.

Whether you believe it or not, Macaulay's introduction of English was right[8], but his reasons are all wrong.

8.The evolution of the Hindu Calendar

By the 5th century CE, the motion of the planets were studied by a system of epicycles, in which the earth was the centre, the planets moved around the sun, while the sun moved round the earth. This was the system of Ptolemy of Egypt who had evolved it in the 2nd century CE. The inclination of the ecliptic to the equator at 23° was known. The precession of the equinoxes was also known. Eclipses were calculated with great accuracy. All this was based on the Greek Astronomy of Ptolemy who developed it in Alexandria in Egypt.

There are 2 cycles known as the Metonic Cycle and the Saros. According to the Metonic cycle (Meton was a Greek of 430 BCE), every 3 years an extra lunar month, will have to be added to keep up to 365 days. In 19 years,7 lunar months are aided to make it more accurate, i.e. 19 x 12 + 7 = 235 lunar months. Since a lunar month is about 29.531 days which

gives a total of 235 x 29.531 = 6939.68.

Now 19 years consists of the solar calendar

Gives 19 x 365.2425 = 6939.61 days.

[8] This is debatable.It obviously opened up whole new worlds for a small numbers of the elite who had access to English education, but it created large numbers of illiterates among the mass of the people. The literacy rate bottomed out at 6% at theturnof the 20th century before reaching 11% at the time of independence

Therefore, at the end of 19 years the position of the moon and the sun with reference to the earth are repeated, that is if a new moon occurs on a particular day it is repeated 19 years later. Though the cycle is given a Greek name, Hindus are supposed to have borrowed it from the Babylonians and the Greeks borrowed it from Hindus. And that is why our Panchangas fix the dates of the Full (Poornima) and New Moons (Amavasya) so accurately.

The other cycle is Saros. The period of Synodic[9] revolution (nodes) is about 346.62 days Synodic revolutions = 6585.78 days 225 lunar months = 658532 days.

Therefore, in.6585 1/3 days or 18 years and 11 days the sun and Moon are in the same position relative to earth. If they had been at the nodes causing an ellipse, the eclipses are repeated every 18 years and 11 and 1/3 days. The Chaldeans knew it, and the Hindus are again supposed to have borrowed it from them and the Greeks from the Hindus. This is the method adopted for predicting eclipses in the Panchangas.

Varahamihira (505 CE) Panchasiddhantika summarizes 5 Siddhantas – The Paitamaha based on Jyotisha Vedanga, the Vasishta the Paulisa, (which is ascribed by Al Beruni to the Greek Paulus of Alexandria), the Romaka based on Ptolemy and the Surya Siddhanta The author of the last says that the Sun told him to go to the Romaka city obviously A1exandria – which by then had become the Centre of all learning because, the Sun

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[9] Synodic month

The cause of moon phases is that from the Earth we see the part of the Moon that is illuminated by the Sun from different angles as the Moon traverses its orbit. So the appearance depends on the position of the Moon with respect to the Sun (as seen from the Earth). Because the Earth orbits the Sun, it takes the Moon extra time (after completing a sidereal month, i. e. a full circle) to catch up and return to the same position with respect to the Sun. This longer period is called the *Synodic* month (from Greek *syn hodô* or σὺν ὁδῷ, meaning "with the way", i. e. the Moon traveling with the Sun). Because of the perturbations of the orbits of the Earth and Moon, the actual time between lunations may range from about 29.27 to about 29.83 days. The long-term average duration is 29.530 588 days (29 d 12 h 44 min 2.8 s), or about 29 ½ days

was born there as a Mleccha on account of a curse by Brahma and that he will teach Surya Siddhanta to him. The author went to the Romaka City The last which is the only one preserved is the basis of works of Aryabhatta (476 AD), Brahmagupta (7th century) and Bhaskara I (12th century) whose work Siddhanta Siromani is the last great work on Astronomy. Aryabhatta had conjectured that the earth rotates about its axis, but little use is made of this in astronomical calculations. Brahmagupta asserted the sphericity of the earth and gave the circumference as 5000 yojanas. Since a yojana is = 4 1/2 miles, the figure given by Brahmagupta IS remarkably approximate. By the 7th century CE Indian astronomers had been employed in Syria and Baghdad. The observatories in Jaipur and Delhi are of the 18th and the 19th centuries. v

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As regards the calendar, the lunar month of 29 1/2 days was adopted. It was divided into Suklapaksha and Krishnapaksha the bright and dark halves. The day was denoted the Tithi. The year consisted of 12 lunar months of Chaitra (March—April), Vaisakha, Jyesta, Asada, Sravana, Bhadrapada, Asveyuja, Karthik, Margasira, Pausa, Maghaa and Phalguna. A group of 2 months formed a season which is Vasanta, Grishma, Varsha, Sarad, Hementa, and Sisira. The 12 lunar months make only 354 days and so every 30 months an extra month is added generally after Asada or Sravana. While the *year* and months are the results of observation of natural phenomenon, the week of 7 days is purely man made. There is no mention of week day in the Bible. The earliest reference to days in the week in the West is in Catalos, 54 BCE. The days of crucifixion, ascension and the Sabbath were fixed much later at an ecumenical council of the 4th century CE. In North India the first reference is to an inscription of the 5th century CE and in South India in 631 CE. This was determined by Sir Vepa Ramesam an eminent Judge of the Madras High Court and an outstanding mathematician. The year of the Babylonians consisted of 360 days. When it did not tally with expected natural phenomena 5 days were added. A similar year was in use in Egypt. When Julius Caesar overran Egypt and adopted this calendar for the Roman Empire with alternate months of 31 and 30 days. Since that would make 366 days he cut of one day in February making it 29 days[10]. Augustus, his successor also wanted 1 day in the month named after him, namely August, and so he knocked off one more day in February, making it 28 days and added it to August. Since the year is approximately 365.25 days, to get the quarter day, February was allowed to have an extra day every 4 years. But in 1582, pope

[10] Hence the name Julian Calendar

Gregory[11] found that the calendar was far out from natural phenomena- — the reason being that the solar year is only 365.2425 days .(365 days, 5 hours 48 minutes and 46 seconds). So he suggested that only century years which are divisible by 4 should be leap years. While catholic countries adopted this, it was only in 1752 that Britain accepted it and 11 days, September 3 to September 13 were wiped out *of* history. Russia adopted it in 1917 after Lenin came to power and they had to knock off 18 days. That is why the 0ctober revolution is celebrated in November.

These are 2 Eras Vikrama and Saka 58 BCE and 78 CE. While the statement that the Vikram[12] year is not identified with any one is suspect, the Saka Year is identified with Gautamiputra Satakarni, an Andhra king of the period by Sri Vepa Ramesam

9.Kalpas, Manvantaras and Yugas in Indian Cosmology

First we have Kalpa, a day in Brahma's 'life' or 4320 million earthly years, and a night of equal length. During the day he creates and during the night he absorbs to begin the cycle each Brahma day . Each kalpa is divided into 14 Manvantaras[13] or 306.72 million years we are supposed to be in the seventh Manvantara of Vaivasvata Manu. Each Manvantara contains 71 Mahayugas and each Mahayuga is divided into 4 yugas — Krta, Treta, Dvapara and Kali of 4800, 3600, 2400 and 1200 years of the Gods, each of which = 360 human years. We are at present in the Kali yuga which began in 3102 BCE the traditional year of the Mahabharata war . it is interesting to speculate as some later Hindus have done that the Mahabharata war is of 1000 BC the date accepted by Western Indologists and that the 1200 years are human years in which case, the Kali yuga is due to end may be by a nuclear holocaust .•{ i

[11] It is now known as the Gregorian calendar

[12] This is suspect. Here is a calendar that is expressly named after one of the most important monarchs in Indian history, with a veritable treasure trove of not only trivia but tales galore and all we hear from the historians is that they do not know who the calendar is named after. That statement (that the Vikram era is not identified with anyone is simply lacking in credibility. The real reason for the obfuscation by the British is that the calendar is named after Vikramaditya the first, which would place him at 58 BCE and not as our eminent historians would want us to believe in The reason being the Sandrocottus-Chandragupta mix-up

[13] 1Kalpa- 14 Manus + Krita Yuga =14(Manvantara + Krita yuga) + Krita yuga = 14 * 71.4 Mahayuga + .4 Mahayuga = 1000 Mahayuga = 1.2millionDivine Years = 4.32 billion years

The 12 signs of the Zodiac with Sanskrit names are mentioned In Brihat Samhita and Laghu Bhaskariyam. The former is the work of Varahamihira 505 CE. He is supposed to have borrowed it from a Greek of the 4th century CE

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The Tropical Zodiac

Zodiac sign	Sanskrit Name	Sector begin	Sector end
Aries	Mesha	00	30
Taurus	Vrishabha	30	60
Gemini	Mithuna	60	90
Cancer	Karka	90	120
Leo	Simha	120	150
Virgo	Kanya	150	180
Libra	Tula	180	210
Scorpio	Vrishchika	210	240
Sagittarius	Dhanus	240	270
Capricorn	Makara	270	300
Aquarius	Kumbha	300	330
Pisces	Meena	330	360