

CYCLICAL TIME AND ASTRONOMY IN HINDUISM

*Kālah pacati bhūtāni sarvāṇy evātmanātmani
Yasmiṃs tu pacyate kālas taṃ na vedeha kaścana*

*Time cooks all beings by itself in itself,
but no one here knows him in whom time is cooked.*

- Mahābhārata (12.231.25)¹

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¹ González 2002:35

Time in South Asia is an ominous being, always-moving forward, stronger than any force. Hinduism, Buddhism, and Jainism all contain long accounts detailing cyclical time. The Hindu system is based on four main time cycles: yugas (periods of dharma), manvantaras (periods of man), kalpas (periods of the universe), and lives of Brahmā (periods of the supreme universe). The Buddhist notion of time is based on a similar structure of antarakalpas, asaṅkhyeyakalpas, and mahākālpas. Slightly different from these two are the Jainist idea of a wheel of time; with each spoke marking a period of increasing or decreasing happiness. The amounts of time described by these systems are vast, from periods as short as ten years to oceans of time lasting billions of years. Very precise calculations are given in the texts to find these durations.

The main focus of this paper is the cyclical time of Hinduism. Specifically, the calculations needed to find the durations of the different levels of ages. By comparing the numbers for different levels, it is possible to draw conclusions on how they are related to each other during their development. Once the lengths of these different ages are calculated, it is then possible to find how much time has elapsed within the given system. This can be done by finding the starting point of a yuga using astronomy from the Gupta period. Lastly, once all these calculations are made, an interesting observation can be made by comparing these numbers to that of modern science. The first step in this is exploring the core system of time.

The Hindu system of time is very detailed and contains many levels. What will be discussed in this paper are mainly the Purāṇic concepts, specifically what is described in the Vishṇu Purāṇa.

Twelve thousand divine years, each composed of (three hundred and sixty) such days, constitute the period of the four Yugas, or ages. They are thus distributed: the Kṛta age has four thousand; the Tretā three thousand; the Dvāpara two thousand; and the Kali age one thousand: so those acquainted with antiquity have declared. The period that precedes a Yuga is called a Sandhyā, and it is of as many hundred years as there are thousands in the Yuga.²

² Wilson 1840:21

Time is divided into four different yugas (ages). The names of these yugas come from a dice game popular in the Vedic period. These yugas are known as the (4) Kṛta Yuga, (3) Tretā Yuga, (2) Dvāpara Yuga, and (1) Kali Yuga. The Kṛta Yuga is named after the best roll and the Kali Yuga after the worst. The current age of course is the worst, the Kali Yuga. The length of each yuga is based on its dice roll. In other words, the lengths of the Kṛta, Tretā, Dvāpara, and Kali Yugas are in the ratio 4:3:2:1. Each yuga contains a small time period before and after the yuga known as sandhi. These periods are also in the ratio of 4:3:2:1.

Years will now be applied to these ratios. Traditionally the Kali Yuga is 1,000 years plus two sandhi periods of 100 years each, giving an age of 1,200 years. Applying the 4:3:2:1 ratio, the lengths of each yuga are 4,800 (Kṛta), 3,600 (Tretā), 2,400 (Dvāpara), and 1,200 (Kali). The four yugas together make a mahāyuga (great age). The length of the mahāyuga is 12,000 years. For reasons discussed later, it was decided that these years are not mortal years, but divine years. A divine year or a year of the gods is 360 mortal years. So the above numbers must be multiplied by 360. This produces yugas of the lengths 1,728,000 (Kṛta), 1,296,000 (Tretā), 864,000 (Dvāpara), 432,000 (Kali) and a mahāyuga of 4,320,000 years. These numbers are summarized in the table below.

Yuga	Life Span	<i>Divine Years</i>			<i>Mortal Years</i>		
		Length	Sandhi	Total	Length	Sandhi	Total
Kṛta	400	4,000	400	4,800	1,440,000	144,000	1,728,000
Tretā	300	3,000	300	3,600	1,080,000	108,000	1,296,000
Dvāpara	200	2,000	200	2,400	720,000	72,000	864,000
Kali	100	1,000	100	1,200	360,000	36,000	432,000
		<i>Mahāyuga</i> 12,000			<i>Mahāyuga</i> 4,320,000		

It is important to take a step back and note the importance of several numbers. The first is the yuga ratio of 4:3:2:1. If this ratio is used, a mahāyuga will have a length of 10 (4+3+2+1) in respect to the duration of the Kali Yuga. This can be seen as symbolic because the number 10 is often used to represent perfection.³ The length of

³ Lienhard 1996:524

the mahāyuga in divine years is also interesting, 12,000. Twelve is often a desired number because it represents the number of months in a year.

Curious is the use of 360 for the length of the year. During the late Vedic period, it was known that the solar year had a length of 365 and a fraction.⁴ This can be seen in the Kṛṣṇa Yajurveda: Taittiriya Samhita sections 7.2.6 and 7.1.10. The latter mentioning, “5 days more were required over the Sāvana year of 360 days to complete the seasons, adding that 4 days are too short and 6 days too long.”⁵

Of great importance is the number 432. It can be reached in a number of ways. The simplest is 108×4 . This begs the question, why is 108 significant? It is an expanded version of 18, which is another lucky number. Examples of the use of 18 are the 18 chapters in the Mahābhārata and that Kṛṣṇa lives for 36 (18×2) years after Parkṣit is born. 108 can also be seen as:

$$\prod_{i=1}^n i^i$$

For $n = 3$, we get $1^1 \times 2^2 \times 3^3 = 108$.⁶ There are also 108 beads on prayer necklace. Another interesting interpretation of 432 involves the use of an alternate numerical base. The Babylonians used base-60 (also known as the sexagesimal system). Their use of base-60 is why there are 60 seconds to a minute and 60 minutes to an hour. In this system, 432,000 can be simply expressed at 2,0,0,0 (2×60^3). It is also known as the period of the kings who reigned before the Flood.⁷

The next level of time is the kalpa. While the yugas mark the rise and fall of dharma, the kalpas mark the creation and destruction of the worlds.⁸ It is said that 1,000 mahāyugas form a kalpa (or a day of Brahmā).⁹ A day of Brahmā can also be

⁴ Sastry 1985:11

⁵ Sastry 1985:11

⁶ Lienhard 1996:525

⁷ Pingree 1990:275

⁸ González 2002:3

⁹ Wilson 1840:23; “The most simple, and probably the original calculation of a Kalpa, is its being 1000 great ages, or ages of the gods.”

reached through the use of manvantaras, as the following passage from the Viṣṇu Purāṇa illustrates:

Seven Rishis, certain (secondary) divinities, Indra, Manu, and the kings sons, are created and perish in one period; and the interval, called a Manvantara, is equal to seventy-one times the number of years contained in the four Yugas, with some additional years: this is the duration of Manu, the (attendant) divinities, and the rest, which is equal to 852,000 divine years, or to 306,720,000 years of mortal, independent of the additional period. Fourteen times this period constitutes a Brahmā day.¹⁰

A manvantara is period of Manu. Seventy-one mahāyugas make up a manvantara. Fourteen manvantaras make up a kalpa. A simple multiplication shows a problem. Using this method, a kalpa contains 994 mahāyugas (71 x 14). However, above it was noted that 1,000 mahāyugas make up a kalpa. This is a difference of six mahāyugas. To make up the difference, it is said that each manvantara contains one sandhi period equal in length to the Kṛta Yuga (1,728,000 years). In addition to this, another sandhi period (also equal in length to the Kṛta Yuga) is added at the beginning of the kalpa. This is a total addition of fifteen Kṛta Yugas (15 x 4 x 432,000). In the method with no additional sandhi periods, the length of a kalpa is 4,294,080,000 years. Using the method with additional sandhi periods, the length of a kalpa is 4,320,000,000 years, which agrees with the previous calculations.

<i>No additional sandhi</i>	
Mahāyuga Length	4,320,000
Manvantara Length (mahāyuga x 71)	306,720,000
Kalpa Length (manvantara x 14)	4,294,080,000

<i>With additional sandhi</i>	
Mahāyuga Length	4,320,000
Manvantara Length (mahāyuga x 71 + Kṛta Yuga)	308,448,000
Kalpa Length (manvantara x 14 + Kṛta Yuga)	4,320,000,000

The addition of a sandhi period shows another example of two traditions meeting. There clearly was a tradition of kalpas being based on 1,000 mahāyugas and a tradition of kalpas being based on 14 manvantaras. In an attempt to reconcile the differences between the two, the addition of a sandhi period was added.

¹⁰ Wilson 1840:22

The next level of time above the kalpa is lives of Brahmā. One kalpa is a day of Brahmā. A day and night for Brahmā is therefore two kalpas. Brahmā's life is understood to last for 100 years. A life of Brahmā must be $4,320,000 \times 1000 \times 2 \times 360 \times 100$ or 3.1104×10^{14} or 311.04 trillion years.

It is interesting to note that a life of Brahmā lasts 100 years. It is said that the lifespan of men varies according to the yuga. The life span is proportional to the dice roll of the yuga multiplied by 100 (which is also equal to the sandhi period of the yuga). According to this system, Brahmā's lifespan is as though he were living in a Kali Yuga (keeping in mind 100 years for him is still a vast ocean of time). Does this mean the gods are living in some sort of Kali state? I think that conclusion would be incorrect. In Vedic times, before the Purāṇic concepts of yugas developed, life spans of men were said to reach one hundred years.

For man has a life of a hundred (years)¹¹

It weighs a hundred (grains), for man has a life of a hundred (years), and a hundred energies¹²

Only a hundred autumns are before us, O gods, wherein you have allotted the aging of our bodies, wherein our sons become fathers¹³

May I attain a hundred winters, O Rudra, through the most comforting remedies given by you!¹⁴

It can therefore be assumed that if men live for 100 of their years, Brahmā would live for 100 of his.¹⁵ I believe that, as the Purāṇic ideas of time were forming and the idea of a kalpa being a day of Brahmā was created, it simply adopted the Vedic idea of Brahmā living 100 years. This is another perfect example of tracing how different myths develop and where they meet.

¹¹ Eggeling 1963:313

¹² Eggeling 1963:357

¹³ Maurer 1986:236

¹⁴ Maurer 1986:124

¹⁵ González 1988:122; "Este lapso de 100 años seguramente proviene de la idea que la vida humana dura 100 años, idea que encontramos ya en los Brāhmaṇas y que es preservada en los Purāṇas. Si la vida del ser humano es de 100 de sus años, resulta natural que la vida de Brahmā se prolongue a lo largo de 100 de los suyos.

We now know the lengths of yugas (durations of dharma), manvantaras (periods of manu), and kalpas (periods of partial destruction and creation), lives of Brahmā (periods of total destruction and creation). It would be interesting to find out where we are in the scheme of things. Because these numbers are so vast, of particular interest is to discover how much time is left until yugānta, which is the partial destruction at the end of a mahāyuga and marks the coming of a new Kṛta Yuga. If we could date the start of this Kali Yuga, it would be trivial to find how long until yugānta. This is precisely what Gupta period astronomers did.

There are five main periods of Astronomy in India.¹⁶ They are: (1) Vedic (lasting from ca. 1000 BCE to 400 BCE), (2) Babylonian (lasting from ca. 400 BCE to 200 CE), (3) Greco-Babylonian (lasting from ca. 200 CE to 400 CE), (4) Greek (lasting from ca. 400 CE to 1600 CE) and (4) Islamic (lasting from ca. 1600 CE to 1800). Of particular interest to us are the Vedic, Greco-Babylonian, and Greek periods. The first provides astronomers a basis for their theories and the latter two coincide with the development of the Viṣṇu Purāṇa (fifth century CE) and the rise Gupta Empire (fourth century CE).¹⁷

During the Vedic period, ideas were being formed which would be greatly exploited during the Gupta period. One such idea was the significance of the conjunction of planets.¹⁸ The following is a passage from the Jyotiṣa Vedāṅga:

*Svar ākramete somārkau yadā sākaṃ savāsavau
Syāt tadādi yugam māghaḥ tapaḥ śuklo 'yanam hy udak
(R-VJ 5; Y-VJ 6)*

*When the Sun and the Moon occupy the same region of the zodiac together with the asterism Śraviṣṭha, at that time begins the yuga, and the (synodic) month of Māgha, the (solar seasonal) month called Tapas, the bright fortnight (of the synodic month, here Māgha), and their northward course (uttaram ayanam).
(R-VJ 5; Y-VJ 6)¹⁹*

¹⁶ Pingree 1981a:534

¹⁷ González 2002:128

¹⁸ Planets meaning the classical celestial bodies: Saturn, Jupiter, Mars, the Sun, Venus, Mercury, and the Moon.

¹⁹ Sastry 1985:45

In this Vedic passage, only a simple conjunction of two planets, the Sun and the Moon are required to mark the start of a new yuga. A short discussion is necessary on the history of the term yuga. In the evolution of the term, there were four main stages (1) early Vedic, (2) middle Vedic, (3) late Vedic and (4) Purāṇic. During the early Vedic period, the term yuga was originally used to mean one human lifespan.²⁰ In the middle Vedic period, this idea was changed to being just a period of two, three, four, five or six years. As the late Vedic period approached, it became more common for the term yuga to be a “five-year, soli-lunar intercalation cycle.”²¹ So in the Jyotiṣa Vedāṅga, the term yuga is referring to this five-year cycle, not the Kṛta, Tretā, Dvāpara, Kali, or mahāyugas of the Purāṇas. However, this text does show a basis for later more complex ideas of conjunctions of planets marking beginnings of yugas.

The idea of conjunctions of planets being significant was very popular in the Mediterranean. This came down to India during the Greek period of influence (early fifth century) and mixed with the Vedic ideas described above.²² The old theory was heavily expanded upon. It was now said that the beginnings and ends of a kalpa are marked by a conjunction of the planets at the beginning of Aries. This was later simplified so that the beginnings and ends of a mahāyuga are marked by a mean conjunction of the seven planets.²³ The last such conjunction was at 6 AM on February 18, -3101 Julian (3102 BCE)²⁴. This is believed to be that start of the current Kali Yuga.

Knowing the start of the Kali Yuga allows for some interesting calculations. The four that will be examined here are: (1) the age of the current mahāyuga / how long until yugānta, (2) the age of the current manvantara, (3) the age of the current day of Brahmā, and (4) the age of the life Brahmā.

²⁰ González 2002:6

²¹ González 2002:7

²² Pingree 1981a:555

²³ Pingree 1981a:555

²⁴ Pingree 1981a:555, positive Julian years correspond directly to CE years (i.e. +2002 = 2002 CE), negative Julian years correspond to BCE years with the drop of the negative sign and the addition of one year (i.e. -4 = 5 BCE, -3101 = 3102 BCE).

For the first set of calculations, I shall count the divine years as years of men. The Kali Yuga, including both sandhi periods, has a length of 1,200 years. This added to the start of the Kali Yuga, 3102 BCE, yields 1902 BCE. This marks (1) yugānta, (2) the end of the mahāyuga and (3) the start of the Kṛta Yuga. In the early fifth century when Gupta period astronomers made these very same calculations, they must have discovered something very odd. According to these numbers, a Kṛta Yuga had started approximately twenty-three centuries prior to them. This clearly could not be the case because it was firmly established that “this” was the Kali Yuga.²⁵ Where could there be an error? The text cannot be incorrect and neither were the calculations so the only room for error was in the interpretation of the text. I propose that this was one of the reasons the use of divine years was popularized. Using divine years, the length of the Kali Yuga is 432,000, and this added to 3102 BCE yields 428,899 CE. Using this new interpretation, it was shown that they were not living in a new Kṛta Yuga, but were still in just the sandhi period of the current Kali Yuga (the sandhi period lasts until 32,899 CE). Assuming that today is February 18, 2003, this Kali Yuga has an age of 5,104 years with 426,896 years remaining. While this is depressing because it shows there is a long way until the next Kṛta Yuga, it was an easier number to believe because it proved yugānta had not taken place. Knowing that start of the Kali Yuga, it is possible to find the age of the mahāyuga:

$$k = 432,000$$

$$\begin{aligned} &\text{Age of the mahāyuga} \\ &= (4 + 3 + 2) \times k + 5104 \\ &= 9k + 5104 \\ &= 3,893,104 \text{ or approximately } \mathbf{3.9 \text{ million years}} \end{aligned}$$

Knowing the age of the current mahāyuga, it is simple to find the age of the current manvantara. Twenty-seven complete mahāyugas have already taken place during

²⁵ González 2002:168

the current Vaivasvata Manvantara.²⁶ In addition to this is the partial mahāyuga calculated above.

$$k = 432,000$$

$$\begin{aligned} &\text{Age of the Vaivasvata Manvantara} \\ &= (27 \times 10 \times k) + (9k + 5104) \\ &= 279k + 5104 \\ &= 120,533,104 \text{ or approximately } \mathbf{120 \text{ million years}} \end{aligned}$$

The next calculation will be to find the age of the current day of Brahmā. Of the fourteen manvantaras that constitute a day of Brahmā, we are in the Vaivasvata Manvantara (or the seventh manvantara).²⁷ Of the Vaivasvata Manvantara, we are in the 28th mahāyuga. Of the current mahāyuga, we are in the Kali Yuga. Of the current Kali Yuga, 5,104 years have already passed. A simple addition of these numbers will provide the age of current day of Brahmā:

$$k = 432,000$$

$$\begin{aligned} &6 \text{ Manvantaras} \\ &= 6 \times 71 \times 10 \times k \\ &= 4260k \end{aligned}$$

$$\begin{aligned} &7 \text{ Manvantara Sandhis} \\ &= 7 \times 4 \times k \\ &= 28k \end{aligned}$$

$$\begin{aligned} &27 \text{ Mahāyugas} \\ &= 27 \times 10 \times k \\ &= 270k \end{aligned}$$

$$\begin{aligned} &Kṛta Yuga + Tretā Yuga + Dvāpara Yuga \\ &= (4 + 3 + 2) \times k \\ &= 9k \end{aligned}$$

$$\begin{aligned} &\text{Current Day of Brahmā} \\ &= (4260 + 28 + 270 + 9) \times k \\ &= 4,567k + 5104 \\ &= 1,972,949,104 \text{ or approximately } \mathbf{1.9 \text{ billion years}}^{28} \end{aligned}$$

²⁶ González 1988:125

²⁷ Jacobi 1908:201

²⁸ Pingree 1981b:14

It is interesting to point out that the current day of Brahmā, not including the Kali Yuga is 4,567 times the length of the Kali Yuga. As noted earlier, symbolic numbers occur often in these texts and this sequential sequence may be another example of such a number.

Our last calculation is to find our location in respect to Brahmā's life. It is said that one half of Brahmā's life has already passed. We are living in the first day (the Varāha Kalpa) of Brahmā's second fifty-year period:

$$k = 432,000$$

$$\begin{aligned} & \text{50 Years of Brahmā} \\ & = 2 \times 10 \times k \times 1000 \times 360 \text{ Days} \times 50 \text{ Years} \\ & = 360,000,000k \end{aligned}$$

$$\begin{aligned} & \text{Age of Brahmā} \\ & = 50 \text{ Years of Brahmā} + \text{Current Day of Brahmā} \\ & = 360,000,000k + (4,567k + 5104) \\ & = 360,004,567k + 5104 \\ & = 155,521,972,949,104 \text{ or approximately } \mathbf{155 \text{ trillion years}} \end{aligned}$$

These are all very interesting numbers; they show the large cyclical timescales in which ancient Hindu philosophers and astronomers dealt. In Carl Sagan's book, Cosmos, he writes:

*[Hinduism] is the only religion in which the time scales correspond, no doubt by accident, to those of modern scientific cosmology. Its cycles run from our ordinary day and night to a day and night of Brahmā, 8.64 billion years long, longer than the age of the Earth or the Sun and about half the time since the Big Bang. And there are much longer time scales still.*²⁹

In this spirit I will now compare a few of the Hindu ages with modern science. The current mahāyuga started around 4 million years ago. This means a yugānta (and with it natural catastrophes) had also taken place 4 million years ago. According to modern geology, a major Ice Age is said to have taken place around that same time.³⁰ This is interesting but one must remember that the natural catastrophes involved with yugānta

²⁹ Sagan 1980:258

³⁰ Phillip

are ones found in India, such as heat, rain, floods, strong wind, and earthquakes, not extreme cold.³¹

The manvantara corresponds to the age of man and as calculated, it started roughly 120 million years ago. This is in sharp contrast with popular science where it is generally accepted that modern man (*Homo Sapiens*) evolved 100 thousand years ago.³²

During a day of *Brahmā*, he wakes up creates the universe and when he sleeps at night, the universe is dissolved. Therefore a day of *Brahmā* equals the age of the universe. As calculated earlier, the current age of the day of *Brahmā* is around 2 billion years. This is also off from popular science, which dates the start of the universe as 15 billion years ago.³³

The fourth calculation made, the age of *Brahmā* has no clear counterpart. Before the Big Bang occurred, it is theorized by Carl Sagan that “all the matter and energy in the universe was concentrated at extremely high density – a kind of cosmic egg ... the entire universe, matter and energy and the space they fill occupied a very small volume.”³⁴ Perhaps when our universe is in this egg it can be likened to when *Brahmā* is asleep and when he wakes up, the egg is cracked open and the universe is created.

The point of these connections must be understood. It would be ridiculous to look at all these numbers and think they mean more than they do. Man was not created 120 million years ago, nor was the universe created 1.9 billion years ago. Then what is the significance of working out these numbers? By analyzing the numbers from different calculations, it is possible to find how the myths were formed and how they relate to each other. But more importantly, these calculations offer perspective. We believe we know everything. Our science tells us when monkeys became men, it tells us how all energy was created from a single point, and it tells us this with such great certainty. There are many careful equations and practices to find this information. But

³¹ González 2002:140

³² Philip

³³ Philip

³⁴ Sagan 1980:246

looking back at the ancient astronomers, their tools were incredibly precise as well. They must have felt with great certainty that their conclusions were correct because all the numbers supported them, yet all that they believed is now considered incorrect.

Chapter 8, Verse 17 of the Bhagvadgīta:

*Sahasrayugaparyantam ahar yad Brahmāṇo viduḥ
Rātrim yugasahastrāntāṃ te 'horātravido janāḥ*

*Those who know the day of Brahmā,
Which is of duration of a thousand mahāyugas
And the night which is also of a thousand mahāyugas
They know day and night³⁵*

Perhaps knowing the day of Brahmā does not mean knowledge of the durations of periods, but of the fact that time is constantly being cooked, and that whatever one may know now may not exist tomorrow.

³⁵ Duneja 1998:188

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