Principle of Jupiter calendar

> "A further refinement of the calendar was the introduction into dating of the place of a year according to its position in relation to the orbital revolution of the planet Jupiter, called *brhaspati* in Sanskrit. Jupiter has a sidereal period (its movement with respect to the "fixed" stars) of 11 years, 314 days, and 839 minutes, so in nearly 12 years it is back into conjunction with those stars from which it began its orbit. Its synodic period brings it into conjunction with the Sun every 398 days and 88 minutes, a little more than a year. Thus, Jupiter in a period of almost 12 years passes about the same series of *nakshatra*s that the Sun passes in one year and, in a year, about the same *nakshatra*s as the Sun in a month. A year then can be dated as the month of a 12-year cycle of Jupiter, and the date is given as, for example, grand month of Caitra. This is extended to a unit of five cycles, or the 60-year cycle of Jupiter (*brhaspaticakra*), and a "century" of 60 years is formed. This system is known from the 6th century AD onward."

From:
"calendar." Encyclopædia Britannica. Encyclopædia Britannica 2009 Ultimate Reference Suite.
Chicago: Encyclopædia Britannica, 2009.

The 60-years cycle mentioned in the excerpt from "Britannica" was used to measure the precession's rate. The following table shows the advance of the tropical Jupiter calendar with respect to the sidereal Jupiter calendar. This advance is a measurement of the precession's rate.

Tropical and sidereal Jupiter calendars
Dates: Julian calendar
Blue colour: moving equinox (tropical calendar)
Red colour: fixed equinox (sidereal calendar)

Dates of the (approximate) 60 years cycle of Jupiter corresponding to a difference of **A x 30°** between Jupiter and precessed zeta Piscium	**Longitude of zeta Piscium with precession** *(longitude of Jupiter at date indicated to the left)*	Angular distance between Jupiter and zeta Piscium with **or** without precession	**Longitude of zeta Piscium without precession** *(longitude of Jupiter at date indicated to the right)*	Dates of the (approximate) 60 years cycle of Jupiter corresponding to a difference of **A x 30°** between Jupiter and **not** precessed zeta Piscium	Advance of tropical Jupiter calendar (with respect to the sidereal) due to precession
20/04/967 **AD**	**5.45°** *(5.45°)*	0	**5.45°** *(5.45°)*	**20/04/**967 AD	0
06/08/1087 **AD** δ = 120 years	**7.17°** *(67.17°)*	60° (A = 2)	**5.45°** *(65.45°)*	**27/07/**1087 **AD** δ = 120 years	10 days
08/09/1980 **AD** δ = 1013 years	**19.62°** *(169.62°)*	150° (A = 5)	**5.45°** *(155.45°)*	**27/06/**1980 **AD** δ = 1013 years	73 days
21/02/2994 AD δ = 2027 years	**33.85°** *(333.85°)*	300° (A = 10)	**5.45°** *(305.45°)*	**14/02/2993 AD** δ = 2026 years	7 days (should be nil) but difference of **1 year**
31/01/1064 BC δ = - 2030 years	**337.3°** *(277.3°)*	300° (or – 60°) (A = 10)	**5.45°** *(305.45°)*	**02/02/1063 BC** δ = - 2029 years	2 days (should be nil) but difference of **1 year**

Method:

The column 1 (blue) provides the date **D1** when a difference of ecliptic longitude of 60°, for example, was **directly observed** between Jupiter and precessed (true) zeta Piscium. The column 5 (red) provides the date **D2** when the same difference of 60° **could have been** observed between Jupiter and the supposedly not precessed zeta Piscium. The date D2 could be easily determined by watching the crossing of Jupiter through a tropical longitude equal to the longitude of zeta Piscium in 967 plus 60°.

Advance of tropical Jupiter calendar = date of tropical calendar – date of sidereal calendar = D1 – D2

Results:

Each time the advance of the tropical Jupiter calendar is nil (with a difference of 1 year between the tropical and sidereal Jupiter calendars), the equinox has crossed approximately a zodiacal sector. The latter should be equal to 30° (it is between 28° and 29° in this case) but the inaccuracy of the method and, to a lesser extent, the proper motion of the reference star can create the observed errors. Moreover, the ancients calculated the longitude of the "mean planet" (Mercier) while we calculated the longitude of the true planet. We wonder if the ancients were able to watch the motion of Jupiter during such a large span (theoretical period = 2028 years).

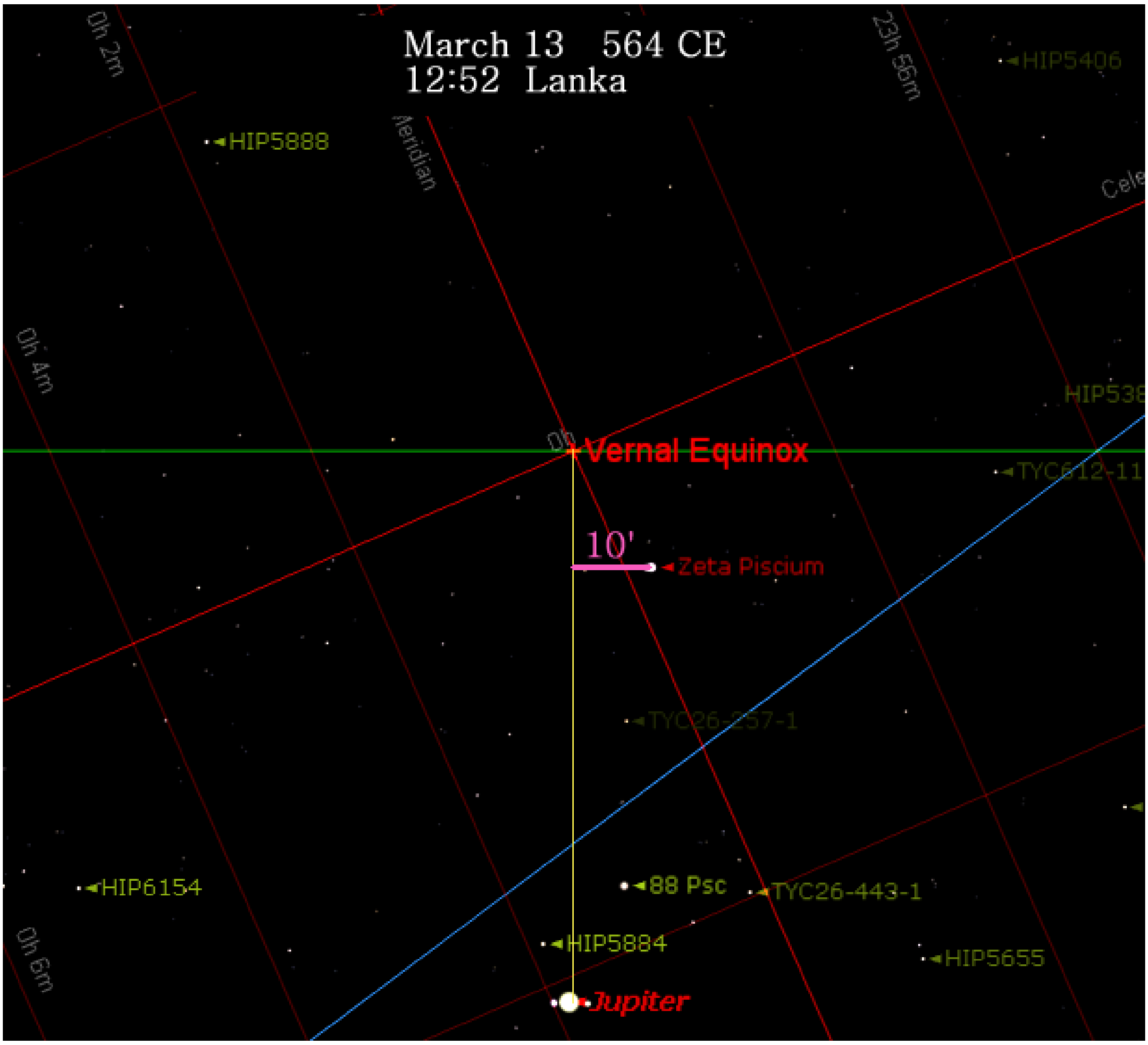
Anyway, the ancients have probably tried to use such a method. In the context of the Surya-Siddhanta, the reference star was probably zeta Piscium. This star, the degree zero of the Indian sidereal zodiac, was indeed near Jupiter at the vernal equinox of 564 AD (image below). The conjunction of Jupiter with zeta Piscium on 20 / 04 / 967 AD would have been a symbolic reminder of the particular method used to measure the precession's rate since the publishing of the Surya-Siddhanta.

Suggested event which could have been used as the beginning of a Jupiter calendar allowing to measure the precession's rate:

On 13/03/564 CE, Jupiter crossed the ecliptic meridian running through:

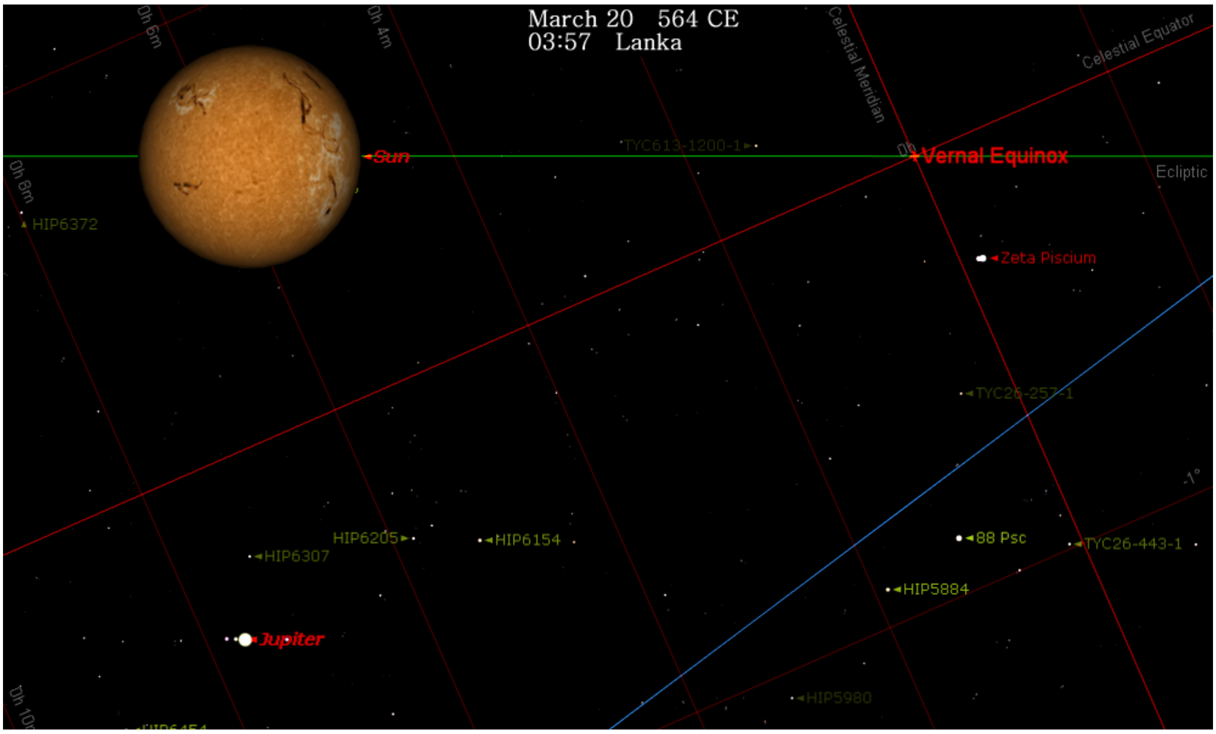
- The tropical zero point ie the vernal equinox
- The sidereal zero point ie a point located 10 arcminutes east of ζ (zeta) Piscium

The longitude of Jupiter was nil at 11:48 (Lanka time). At the same moment , the Moon was full (age = 14.28 days).



We think this conjunction of Jupiter with the two zero points was used as the beginning of a Jupiter calendar because it occurred one week before another event which was the origin of the Sassanian astronomical reform (Persia ; 6th century).

On 20/03/564 CE, indeed, Jupiter was in conjunction with the Sun almost exactly at the moment of the spring equinox. The Persian tables of 6th century (Zij al-Shah), the Arabic tables of 9th century (Khwarizmian tables) and 11th century (Toledan tables) and the Indian Surya Siddhanta used this particular moment as a reference.



Two relevant excerpts from "STUDIES IN THE MEDIEVAL CONCEPTION OF PRECESSION"
by Raymond Mercier.

Thus, the equinoctial point, to which longitudes were referred in the Toledan and Khwarizmian tables, is about 0 ;10 [10 arcminutes] of ζ Piscium. This, it must be emphasized, is not necessarily where the astronomers who used these Tables believed the origin of longitudes to be situated. Nevertheless a model of precession described in the Surya Siddhanta does indeed take the point in question to be just there. This was known since the researches of Colebrooke into the Indian accounts of the lunar mansions (naksatra),

The planet Jupiter was manifestly the key to this astrological system of *fardariyat*, as also to the reform of the *Zij al-Shah*. When the planet was observed in Aban 556 it was visible during much of the night, but at the termini of the *fardariyat*, in 552 and 564, it was in conjunction with the Sun almost exactly at the moment of the spring equinox…
Here we conclude that the true historical explanation of the use of the year A.D. 564 as a "canonical" point stems from this Sassanian reform, which happened to take place just when the equinoctial point coincided with the sidereal zero point …