# Kālacakra calendar using modern astronomy

Selection of calculated calendars is available here.
Software to calculate those calendars is here.

In the calendars presented here, each calendar starts with the month Caitra, the first month of the Kālacakra year. For example, for the start of the new year in 2013, in the calendar for London, UK, the following information is given for the new year:

> Kalacakra New Year: Vijaya/rnam rgyal, 2013.

As with other symbolic information, the name of the year from the 60-year cycle is given first in Sanskrit (Vijaya) and then in Tibetan (*rnam rgyal*). This is followed by the Gregorian year in which the new Kālacakra year starts.

> Month: 1, Caitra/nag pa, Mid-Spring/dpyid 'bring, Aries/lug.

For the months, three items are given for each month: the name of the month which is equivalent to the approximate lunar mansion in which full Moon occurs; the seasonal name of the month; and, the zodiacal sign that the Sun

When the Kālacakra calendar was first published on this web site, it was just that – based on the Kālacakra system and nothing else. However I was often asked to make it more useful. Fulfilling these requests seemed to consist in including Chinese symbolic information, and thereby making the calendar

enters during the month. For those last two, the English names are given rather than the Sanksrit. There are no month numbers in the original Kālacakra system, but a number is given at the beginning of the month line for convenience.

For the daily information, most entries contain three lines, although there are special cases with extra lines. In the example of the first day of the first month of the year starting in 2013, the following information is given:

> more like a full Tibetan one; it effectively became a Tibetan calendar with accurate astronomy. However, recent formal requests from Tibetans for software to create Tibetan calendars using accurate astronomy mean that it is now best to separate the two. The Kālacakra calendar published here, version 3.0, is based solely on the Kālacakra system and contains no Tibetan or Chinese symbolic content. The accurate Tibetan calendar will be published on this web site in due course.

> 1. Tue, 12 Mar 2013. Revati/nam gru, 15:41:5 (11h 16m 44s): Ashvini/tha skar; Indra/dbang po, Kintughna/mi sdug pa.
> Fire-Water -> Fire-Wind, lance -> nectar.
> rnam shes/Consciousness

On the first line, the first numeral "1" represents the lunar date. There then follows the weekday and the western date. Next, Revati/nam gru is the lunar mansion in which the Moon is positioned at daybreak. If the lunar mansion changes during the day, and on this day it does, then this is followed by a time, 15:41:5 (11h 16m 44s), and the name of the new lunar mansion, Ashvini/tha skar, that the Moon enters at that time. The time is given in terms of nāḍī, pala and breaths from mean daybreak. This is then followed by normal western timing (Local Mean Solar Time). As the civil day starts at 5.00am LMST, the time indicated can be towards the end of the civil day, after midnight. In that case, the number of hours given is 24 or more. For example, on 20 March, the lunar mansion changes at 58:40:3 – this is equivalent to 28h 28m 12s, or 4.28am the following morning. After the lunar mansion and any change to this, the next items are the yoga (Indra/dbang po) and karaṇa (Kintughna/mi sdug pa).

On the second line, symbolic information is given which is associated with the combination of the weekday and lunar mansion. Both of these items are considered important in considering the astrological significance of the day. As on the line above, the change of lunar mansion during the day is taken into account. First the pairings of the elements associated with the weekday and lunar mansion are given, and then one of a list of 28 combinations (yogas) between the weekday and mansion, independant of the elements concerned. A list of these is given on this page.

On the third line is the link (pratītyasamutpāda, *rten 'brel*) associated with the lunar day. For those occasions when there are more than three lines for a day entry, a couple of examples follow:

> 15. Wed, 27 Mar 2013. Citra/nag pa, 10:13:4 (9h 5m 28s): Svati/sa ri; Harshana/dga' ba, Vava/gdab pa.

Water-Wind -> Water-Wind, time-club -> control.
tshor ba/Sensation, bishti N.
  Revelation of the Kalacakra Tantra.
  Full Moon at 11:6:2 (9h 26m 32s).

The fourth line indicates that this is a special day, one of the main Buddhist festivals of the year. The fifth line gives the time of full Moon.

8. Wed, 20 Mar 2013. Pushya/rgyal, 58:40:3 (28h 28m 12s):
Ashlesha/skag; Sukarma/las bzang, Vava/gdab pa.
Water-Fire -> Water-Water, tigress -> exhaustion.
srid pa/Involvement, bishti S.
  Sun enters Aries at 15:16:3 (11h 6m 36s).
Duplicated lunar day.

In this example, the fourth line gives the time at which the true Sun enters one of the zodiac signs. It should be borne in mind that the mean Sun is used to define the months. The fifth line indicates that this is the second of a duplicated lunar date.

Since June 2005 eclipse information has been added to the details given in the calendar. (Thanks to Mingyur Rinpoche for pointing out that this should be included.) See the following example:

15. Thu, 25 Apr 2013. Vishakha/sa ga, 27:20:2 (15h 56m 8s):
Anuradha/lha mtshams; Variyas/mchog can, Vishti/vishti.
Wind-Wind -> Wind-Earth, increase -> joy.
sred pa/Attachment, bishti N.
  Enlightenment and Parinirvana of the Buddha.
  Full Moon at 37:20:5 (19h 56m 20s).
  Partial Lunar Eclipse, mag: 0.01

Basic information about the type of any eclipse that occurs and its magnitude is given on the last line of daily information. Naturally, eclipses can only occur on the 15th or 30th lunar day of a month. No details are given in this calendar regarding the visibility of any eclipse. Anybody needing more detailed information about any eclipse should look at other sources, such as the pages put together by Fred Espenak on the NASA web site. Notice here that the third line also indicates the occurance of Viṣṭi, one of the 11 karaṇas, together with its direction.

Many people have requested that the meaning of these various symbolic attributes should be given with this calendar, and over time these details will be added. In the meantime, please refer to this page for an initial list of the symbolic information.

## Problems with the calendar

There are three unresolved concerns with the calendar published on this site. They all relate to the definition of the months.

The months are defined by the Sun entering one of the signs of the zodiac. This is also the case in the Chinese calendar, and it appears that the Chinese were influenced in this by Indian Buddhist calendrical experts.

However, the texts that survive that describe the Kālacakra calendar make use of the mean motion of the Sun for determining months, not the true Sun. It is possible that if the tradition had continued in use in India, it would have evolved to have used the true Sun. Some other Indian systems did eventually use the true Sun, as did the Chinese calendar since the reform of 1645 C.E. But use of the true Sun introduces problems.

If the mean Sun is used to determine the months, then there is a fairly regular occurance every 32 or 33 months of an intercalary month – a month during which the Sun does not change sign. If the true Sun is used however, there are years when this regularity breaks down, and months can occur when the Sun changes sign twice, and years can occur when during two non-consecutive months the Sun does not change sign.

The Chinese system has devised some rules for coping with this problem. See the excellent article by Helmer Aslaksen on the mathematics of the Chinese calendar in general and this problem in particular.

As there is no discussion in the Kālacakra literature on this topic, the calendar published on this site uses the mean Sun for the month definitions. For comparison purposes, a version of the software is also available here that uses the true Sun for the month definitions. This is not used for the calculation of the calendars published here.

The second unresolved issue concerns the definitions that are applied to the intercalary, or extra, month. The calendar published here follows the method in which the intercalary month takes the name and qualities of the month before it. In the normal Tibetan tradition, the opposite is the case, and the intercalary month has the number and other attributes of the month that follows it. However, some Tibetans favoured the other method where the intercalary month has the name and number of the month that preceeds it.

The mathematics of the calendar devised by Zhonnu Pal strongly suggests that he also used this method, which is also the same method used in China. Unfortunately the Kālacakra literature does not spell this out unambiguously, although it does certainly seem that the Kālacakra system followed the previous month naming convention. Assuming this to be the case, then the question remains just why the Tibetans changed this. For now, at least, the calendar published here follows the "preceeding month" system (earlier versions on the web site followed the main Tibetan system).

There is a very strong logic to the method of naming the intercalary month after the previous month. If a month is defined by entry into a particular sign, if the next month is intercalary, then the Sun does not change sign and remains in that same sign for the whole of that month. It would make sense for that intercalary month to be named after the sign that the Sun is actually in during the month, rather than the sign that it will move into during the following month. However, the latter method is in general use in Tibet.

It is possible that the Tibetan system was influenced by other, non-Buddhist, Indian systems. It appears that some defined the months by the sign that the Sun is in at the time of the new Moon that begins the month. This means that the new Moon at the beginning of an intercalary month would happen when the Sun is at the very beginning of a particular sign, and the following new Moon would occur when the Sun is at the very end of that same sign. This is not how the months are defined in the Kālacakra literature, but this kind of definition reverses the logic and suggests that the intercalary month should have the same name and characteristics as the month following it. This logic would be similar to that used with the lunar dates – just as the lunar day at the beginning of a solar day gives its number to the solar day, so the sign the Sun is in at the beginning of a month would give its name to the month. Perhaps the Tibetans originally followed such a system.

There is one final small point worth mentioning. A month is defined by the change of sign of the Sun. For this definition, is the month taken as the period between exact true new Moon and the next true new Moon, between one mean new Moon and the next, or is it daybreak immediately following one new Moon until daybreak immediately following the next new Moon? A few of the months will have different names depending on which of these methods are used.

The Kālacakra literature again does not spell this out unambiguously, but the calculations make the definition reasonably clear. The month name is defined by the change of Sun sign between two mean new Moons, but the months themselves consist of whole solar days, and the first day is the one following true new Moon – new Moon occurs on the last solar day of any month. This is sufficiently clear in the literature, and so the calendars on this site follow this method, but it is worth bearing in mind that this is yet another factor that could change the structure of the final calendar.

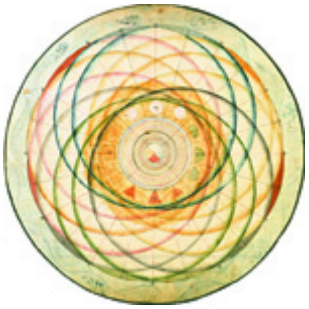
## Accuracy of the calendar

The structure of the Kālacakra calendar depends upon the calculation of the longitudes of the Sun and the Moon at mean daybreak (5.00am Local Mean Solar Time) for the chosen geographical location. The calculations used for the longitude of the Sun are the VSOP87 solution, devised by P. Bretagnon and G. Francou. The data used for these calculations are to be found here.

These calculations are an algebraic solution to the modern numerical integration

techniques developed by the Jet Propulsion Laboratory, as are the calculations used for the longitude of the Moon. These were based in earlier versions of this software on algebraic methods given in "Lunar Tables and Programs from 4000 B.C. to A.D. 8000", by Michelle Chapront-Touzé and Jean Chapront. The calculations were again a C language implementation of these algorithms and were a little less accurate than those for the Sun. They have now been replaced by the more recent, and more accurate, solution, ELP/MPP02. Further information is available here.

The results of calculations for both the Sun and the Moon have been extensively checked against examples given by NASA and by Chapront-Touzé and Chapront. In checking the error during the last 3,000 years it was found that the error in deltaT – the difference between Dynamical Time and Universal Time – was greater than the error in the calculations themselves. It seems therefore that further precision, if such becomes possible in the future, would have little meaning in this context.



E. Henning.
Last updated 27 July 2013.
Return to calendar introduction.