



## The Existing Suvannaphum at Wat Pra Yeun

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The reconstruction of the Vihara of Wat Pra Yeun in Lamphun, Thailand, has been keeping the main instrument for adjusting the “**Suvannaphum Lunar Calendar**” to the solar year in almost perfect condition (see Figure 1). The Vihara is the most ancient one of its kind in Suvannaphum (South East Asia) and is older than Angkor Wat by almost 500 years. Fifteen thousand years earlier, a long-forgotten race had domesticated plants and established humanity’s first agricultural civilization in this region called “**Suvannaphum**”, which is now also called “**The Rice Bowl of the World**”.

The Suvannaphum lunar calendar was also derived from this civilization and is still being used today. The details of the calendar are as follows:

### LUNAR YEAR AND SOLAR YEAR

The period of a complete revolution of the moon around the earth with respect to the sun (full moon to full moon) is called a “**Lunar Month**”, and its length is 29.530588 days. The period of 12 lunar months is called a “**Lunar Year**” and its length is 354.367056 days.

The time when the sun crosses the equator making the lengths of night and day equal in all parts of the earth is called “**Equinox**”. The equinox which occurs in spring is called the “**Vernal Equinox**”, while that in autumn is called the “**Autumnal Equinox**”. The time required for the sun (or apparently the earth) to pass from the vernal equinox back to the

vernal equinox is called a “**Solar Year**” (also called “**Equinoctial, Natural, Seasonal, or Tropical Year**”) and its length is 365.242199 days. The “**Star Year**” (or “**Sidereal Year**”) is the period of time during which the earth makes a complete revolution around the sun, with respect to a fixed star, and its length is 365.25636 days.

Regarding the fixed star mentioned above, it must be among the groups of stars (“**Constellations**”) surrounding the ecliptic plane of the earth’s orbit around the sun. With respect to observers from the earth, it appears that the sun, the moon, and the planets move against the background of these constellations and are said to be “in” a constellation when they pass by its area of the sky. The belt of these constellations is called the “**Zodiac**”. The zodiac is divided into 12 areas, or “**Signs**”, of 30° each. The sun, in its apparent path, is in each sign for about a month. Each sign is named after the constellation that occupied that area 2,000 years ago. These names are: Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius and Pisces.

The difference between the solar year and the lunar year is  $365.242199 - 354.367056 = 10.875143$  days per year, i.e.  $10.875143 \times 3 = 32.625429$  days per 3 years, which is greater than one lunar month. This is why it is necessary to adjust some lunar years to have 13 lunar months instead of 12 so as to coincide with the solar year. In contrast, the difference between the star year and the solar year is only

$365.25636 - 365.242199 = 0.014161$  day per year, which is very small and that is why it is sometimes called the “**Astronomical Year**”.

The system of dividing time into convenient periods of days, months, and years is called the “**Calendar**”. The earliest calendars were based on the lunar month and the lunar year but most of them have now been adjusted to coincide with the solar year. The only truly lunar calendar still in everyday use is the Moslem Calendar.

### **HINDU-CHINESE LUNAR YEAR**

Most of the Hindu-Chinese lunar years have 12 lunar months each, but some have 13 lunar months each. The new moon is the first day of the month. The waxing moon is the first half of the month, and the waning moon is the second half of the month. The **full moon** is the last day of the first half, and the **dark moon** is the last day of the second half. The month in which the dark moon occurs before midnight on the 29th day of the month has 29 days, while the rest have 30 days each.

The Hindu-Chinese lunar years which contain the sign of the zodiac such that the dark moon occurs twice while the sun is in that sign have 13 months each; the rest have only 12 months each. These events form the “**19-year Cycle**” so that the 3rd, 6th, 9th, 11th, 14th, 17th and 19th years of a cycle have 13 months each, while the rest have 12 months each. Thus, it is clear that **the Hindu-Chinese lunar year is adjusted to coincide with the star year.**

### **SUVANNAPHUM LUNAR CALENDAR**

The Suvannaphum calendar is the calendar which is used as the official calendar for the Buddhist religion in Thailand. It is also used as the Buddhist religion calendar in Cambodia, Laos, Burma and Xishuangbanna in Yunnan. The Calendar is based on the lunar month and the lunar year, with adjustment to

coincide with the solar year. In the 19-year cycle, the calendar has 7 years of 13 months each, and 12 years of 12 months each.

The 1st, 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup>, and 11<sup>th</sup> months of the year have 29 days each, whereas the 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>, 8<sup>th</sup>, 10<sup>th</sup>, and 12<sup>th</sup> months of the years have 30 days each. This means that the average length of the month of 29.5 days, shorter than the (real) lunar month by  $29.530588 - 29.5 = 0.030588$  day per month, i.e.  $0.030588 \times 33 = 1.009404$  days per 33 months. This is why most of the dark and full moons of the Suvannaphum calendar occur before the real dark and full moons in the sky (also before the dark and full moons of the Hindu and Chinese calendars).

The above conditions determine that **the Suvannaphum calendar is adjusted not only to the solar year but also necessarily to the lunar month**, which is different from either the Hindu or Chinese calendars. The calendar also has the waxing moon in the first half of the month and the waning moon in the second half of the month, as in the Hindu and Chinese calendars.

The adjustment of the Suvannaphum calendar is intended to make each month fall during the same season for every year in Suvannaphum (Burma, Cambodia, Laos, Xishuangbanna, Central Thailand, Northern Thailand, North-Eastern Thailand and Vietnam) so that the end of the first month is in mid-winter, the waning moon of the 3rd month is the end of winter and the start of summer, the waning moon of the 5th month is in mid-summer, the waning moon of the 6th month is the start of the rainy season, the waning moon of the 8th month is the start of the heavy rains, and the waning moon of the 12<sup>th</sup> month is the end of the rainy season and the start of winter.

The above conditions can only be fulfilled if the dark and full moons are detected as follows:

(i) The dark moon of the 1st month must be the first dark moon after the “**South Solstice**” (December 22). The south solstice is the time at which the sun’s rays are perpendicular to the surface of the earth at the Tropic of Capricorn ( $23\frac{1}{2}^{\circ}\text{S}$ ).

(ii) The dark moon of the 4<sup>th</sup> month must be the first dark moon after the vernal equinox (March 21).

(iii) The full moon of the 8th month must be the first full moon after the “**North Solstice**” and also at least 11 days after that (after July 2). The north solstice is the time at which the sun’s rays are perpendicular to the surface of the earth at the Tropic of Cancer ( $23\frac{1}{2}^{\circ}\text{N}$ ).

The planar projection diagram of the sun’s rays at the Vihara of Wat Pra Yuen, Lamphun, Thailand, is given in Figure 1 and can be compared with that for the Vihara of Wat Xieng Thong, Luang Prabang, Laos, in Figure 2. The warning signs which can tell us in advance if the conditions (i)-(iii) will be contradicted in some years are as follows:

(1) The full moon of the 12<sup>th</sup> month occurs before the sun’s rays are at  $11.75^{\circ}\text{S}$  after the autumnal equinox (before November 9, see Figure 1). This will force the dark moon of the coming 1st month to be on or before the south solstice, and the full moon of the next 3<sup>rd</sup> month to be before the start of the summer. This is why “**Makha Bucha Day**” used to move to the full moon of the 4<sup>th</sup> month in some years.

(2) The dark moon of the 4<sup>th</sup> month is before or on the vernal equinox. This will force the waning moon of the 6<sup>th</sup> month to be before the start of the rainy season. This is why “**Visakha Bucha Day**” used to move to the full moon of the 7<sup>th</sup> month in some years.

(3) The full moon of the 8<sup>th</sup> month is on or before 11 days after the north solstice, which will be before the heavy rains start.

This is why “**Asalha Bucha Day**” used to move to the full moon of the next month in a year having 13 months, referred to as an “**Atigamas Year**”. An Atigamas Year has two 8th months, the “**Double-8th Months**”; the earlier one is called the “**First-8th Month**” while the later one is called “**Second-8th Month**”.

These latter conditions (1)-(3) are the conditions by which (1) implies (2), (2) implies (3), and the condition (3) that doubles the 8th month makes the full moon of the coming 12<sup>th</sup> month obey the rule and also makes the former three conditions ((i)-(iii)) come true.

All of the above conditions are depend on whether the full and dark moon days of the Suvannaphum calendar coincide exactly with the full and dark moons in the sky or not. This is the origin of the tradition to worship the full moon in the 3<sup>rd</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> months which have been carried on in Suvannaphum since the ancient times. This tradition also includes checking whether the full moon would really be the full moon or not.

The criteria for checking the full moon and the dark moon in Suvannaphum are as follows:

(a) The really full moon must be a complete circle.

(b) At the time of sunset, the angle of elevation of the moon must be not more than a half of the quarter of the sky ( $22\frac{1}{2}^{\circ}$ ). This angle can be checked by a cart wheel.

(c) The really full moon must be the last day of the waxing moon.

(d) The day after the really full moon, the moon is not a complete circle and it appears in the sky after sunset.

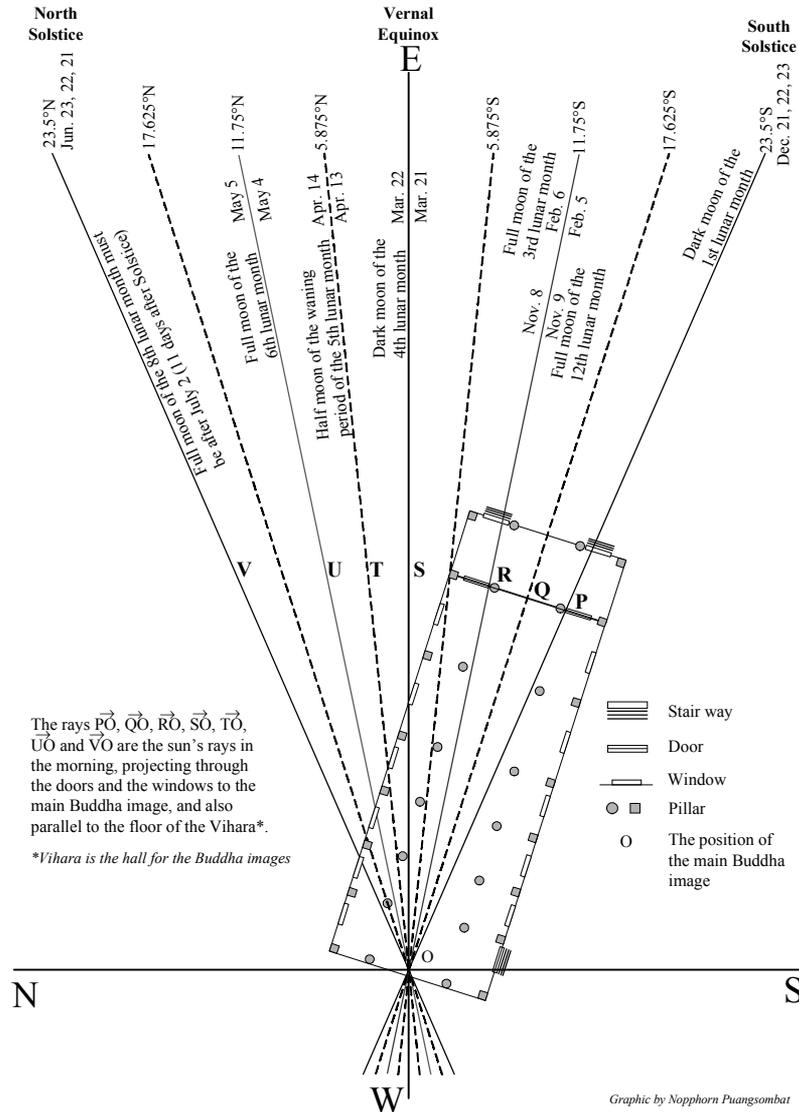
(e) The really dark moon is absolutely no moon after midnight of the day before the dark moon day or before midnight of the dark moon day.

The above criteria (b) and (d) are

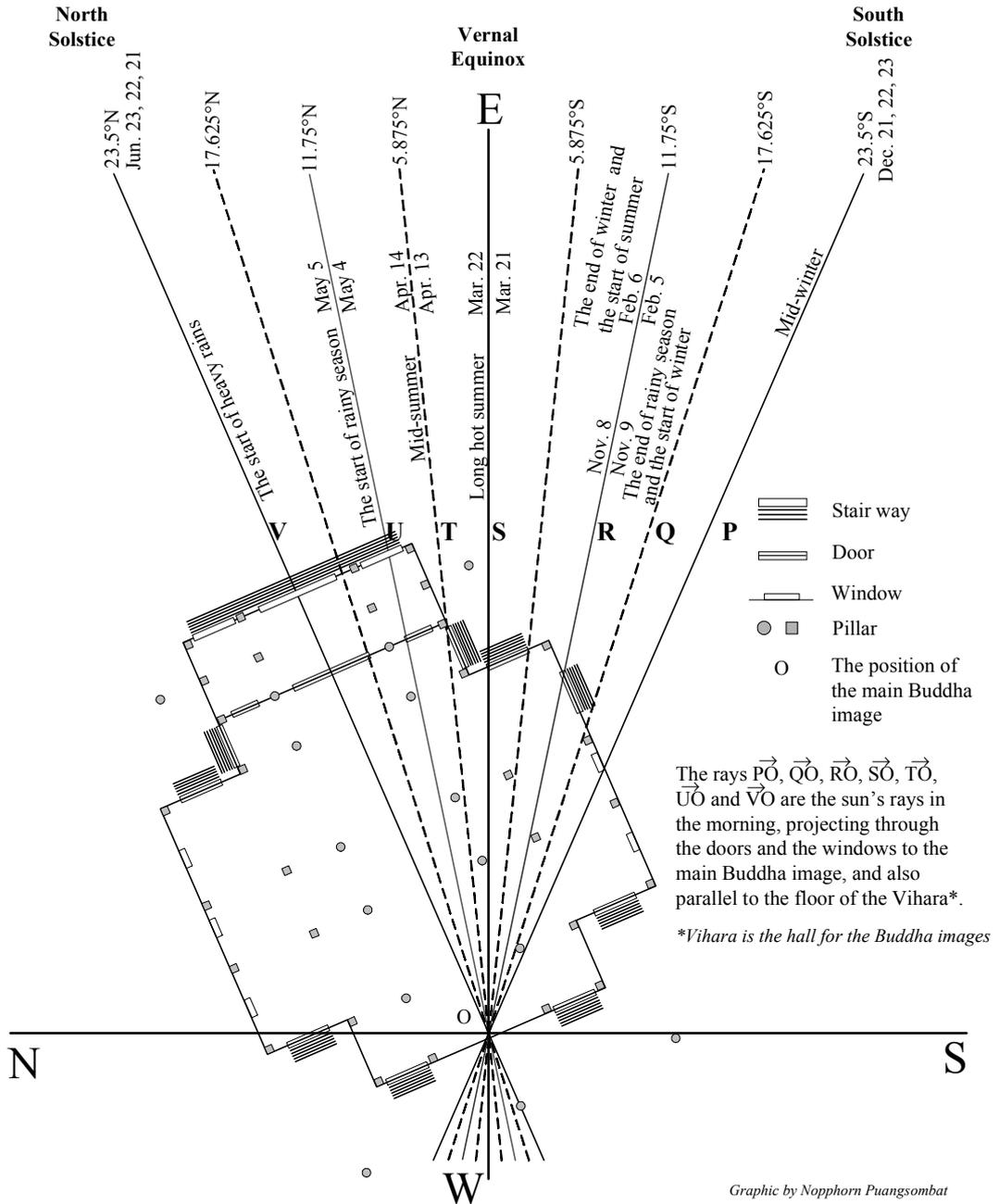
appropriate to Suvannaphum only.

Following these checks, if it is sure that the full or the dark moon days are not true, then the 7<sup>th</sup> month of the Suvannaphum calendar must be extended to have 30 days, which will adjust the full moon of the 8<sup>th</sup> month to be exactly the full moon, and this

year is called an “Atigavara Year”. If an Atigavara year happens to coincide with an Atigamas year, then the 7<sup>th</sup> month need not be extended because the double 8<sup>th</sup> months have 30 days each which replaces the role of the 7<sup>th</sup> month.



**Figure 1.** The above figure is the planar projection diagram of the sun’s rays at the Vihara of Wat Pra Yeun, Lamphun, Thailand. The Vihara was built in the year A.D.666 (B.E.1209) by the Empress Jam Dhevi, the founder of the Kingdom of Hariphunchai, A.D.661- A.D.1286, which is now in Northern Thailand. The diagram shows the Vihara before its reconstruction in the year A.D.2006. The reconstruction work added a middle door at Q and also reduced the number of stairways facing the middle door to only one.

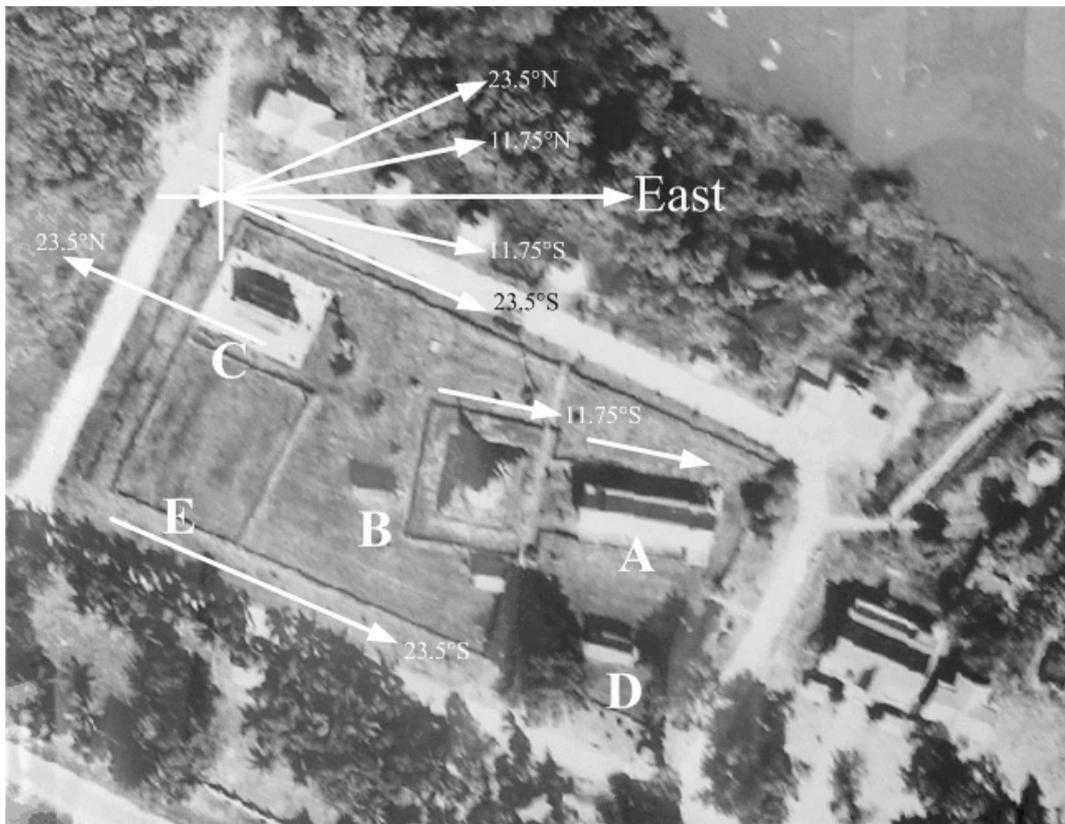


**Figure 2.** The above figure is the planar projection diagram of the sun's rays at the Vihara of Wat Xieng Thong (the Golden City Monastery), Luang Prabang, Laos. The Vihara was built by King Saisetthathirat in the year A.D.1560.

In Figure 3, the directions of the great Vihara (A) and the Ubosot (C) of Wat Pra Fang, Uttaradit, Thailand, are compared. The slight difference in their directions is definitely not an error in construction because their directions conform with the directions of the diagrams in Figures 1 and 2. The other directions in the Ubosot and the Vihara also conform. This conformity means that, in the olden days, the Vihara of Wat Pra Fang used to be an adjusting instrument similar to the Vihara of Wat Pra Yeun.

Nowadays, most of these adjusting instruments are not being used because our

present-day knowledge of the constellations and the zodiac can be adapted for this purpose instead for a period of about 100 years into the future. This adaptation must be revised every 150-200 years because the difference between the star year and the solar year over a period of 200 years is  $200 \times 0.014161 = 2.8322$  days. **This difference will cause the full moon of the Suvannaphum calendar to appear before the really full moon in the sky by about 3 days or more. This also widens the difference between the Suvannaphum lunar year and the solar year more and more as the years go by.**



Graphic by Nopporn Puangsombat

(Courtesy Wat Pra Fang Museum)

**Figure 3.** Photograph taken from the air of Wat Pra Fang, Uttaradit, Thailand, with details as follows:

- A : The great Vihara of Wat Pra Fang with its front facing a direction 11.75 °S of due east
- B : Ubosot (Ordination Hall or small Vihara)

- of Wat Pra Fang with its front also facing a direction  $11.75^\circ$  S of due east
- C : Ubosot of Wat Pra Fang with its front facing a direction  $23.5^\circ$  N of due west
- D : Ubosot of Wat Pra Fang with its front facing a direction  $17.625^\circ$  S of due east
- E : The wall surrounding the area of Wat Pra Fang with its longer sides at an angle  $23.5^\circ$  S of due east