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Rules for interpolation in the Thai calendar: *Suriyayatra* versus the *Sasana*

It is not known when the Thai first adopted their Indian-based luni-solar calendar, but it is known with absolute certainty that the epoch of the calendar dates to 25 March 638 AD. It has probably been in operation for about 700 years and is still partly in use at the present time. Over this long period and a wide area there were local variations in the way the calendar was implemented; but part of its brilliance was its overal stability.

In his volume of essays *Ngan charuk lae prawatisat* (*งานจารึกและประวัติศาสตร์*), Prasert na Nagara gives some rules for determining whether a given year is normal, adhikawan, or adhikamat. He concludes, however, that the question has to be left open, "since if you go to the past, the determination of adhikawan (อธิกวาร) and adhikamat (อธิกมาส) does not appear to have any fixed principles".[1]

His source is partly the major handbook on Thai astronomy and astrology, Luang Wisandarunkon's *Khamphi Horasasat Thai* (*คัมภีร์โหราศาสตร์ไทย*),[2] but with some elisions and one useful correction.

The first matter concerns adhikamat alone, where Prasert cites the *suriyayatra*[3] principle which says that "if the day of *thaloengsok* (เถลิงศก, astronomical New Year) lies either within 25 to 29 (in Caitra) or 1 to 5 (in Vaisakha), then the year is adhikamat".[4]

We know that there is a New Year period during which one or more days are *wan nao* (วันเน่า, empty days), the principle being that this period begins with *mahasongkhan* (มหาสงกรานต์, the time at which the True sun enters Aries and is at 0: 00 degrees. At this time of year, however, the Mean sun lags behind the True sun by about two and a half degrees, such that there are a couple of days before the Mean sun reaches 0: 00 degrees and thereby defines *thaloengsok*. (also called *phaya wan*, พญาวัน).

A manuscript calendar from Chiang Rai routinely indicates the dates: for CS 1284 (1922 AD) it reads:

> songkhan comes in month 6 [Caitra] waning 1 . . . the main day comes in month 6 waning 3,

whereas for CS 1282 (1920 AD) it reads:

> songkhan comes in month 6 waning 8 . . . the main day comes in month 6 waning 11.[5]

The day value of 26 (11 waning) in this latter case *ipso facto* defines the year as adhikamat.

The statement of the rule in Wisandarunkon takes a different form. He distinguishes between normal solar years (365 days), leap solar years (366 days), normal lunar years (354 days) and adhikawan lunar years (355 days). The purpose here (though not clear in Wisandarunkon) is to determine how the date of *thaloengsok* varies from one year to the next. This may best be expressed in a table:

solar days	365	365	366	366	365	366
lunar days	354	355	354	355	384	384
difference	+11	+10	+12	+11	-19	-18

This table indicates (col. 4), for instance, that in a solar leap year of 366 days and a normal lunar year of 354 days, the position of *thaloengsok* will increase by 12 days in the year following. What Wisandarunkon's exposition does not indicate is the decrease in the value (last two cols. above) when the number of lunar days exceeds the number of solar days. Instead, he cites a "rule" (which he later says is no longer observed) stating that if the difference (line 3, cols 2-7, above) is added to the New Year day, when the total is 30 or more, the following year will be adhikamat.

He did well to discount the rule because it does not work. In CS 1319, for instance, the New Year *tithi* was 16, the lunar year was normal (354 days) and the solar year was leap (366 days). The increase in the day value was therefore 12, meaning that it reached only to (16 + 12 =) 28 in the year following. This is less than 30 but nonetheless CS 1320 was adhikamat. The rule as expounded by Prasert, on the other hand, defines CS 1320 immediately as an adhikamat year because the day value is greater than 24.[6]

The second and more complex rule involves not normal or adhikamat years but the years that have an extra day (are adhikawan). Here, supposedly, the value of the *rœk* (naksatra) at the start of wassa is used as the indicator. Prasert outlines the rule as follows: If in the 8th month on 1 waning the *rœk* (ฤกษ์) lies between 20 and 22 [Purvashadha to Sravana], then the year is normal. And when thereby adding an extra day you would arrive at *rœk* 20, then there will be an adhikawan". As is often the case the position is clearer if presented in tabular form:

date in year:	*rœk* value:	year type:
Ashadha 1 waning	20-22	normal
Ashadha 1 waning + 1	= 20	adhikawan
Ashadha 1 waning + 1	< 20	adhikamat

There are three problems of interpretation here.

(1) In normal circumstances it would automatically be supposed, in a Thai context, that the time of day involved would be 24:00 hours on the given date. It does not take much investigation, however, to see that in this particular instance the time boundary must be that between Full Moon and 1 waning, not that between 1 waning and 2 waning; i.e. it falls 24 hours earlier than one might assume: if the time were taken to lie at the end of 1 waning not at the start of it, the rule would have little chance of ever working at all.

(2) How does one interpret what the numerical values of the *rœk* are taken to represent? It is universally agreed that the counting of the *rasi* (ราศี, signs of the zodiac) begins with Aries (Mesa) = 0; but the "r" at 0. It is therefore necessary to see whether the rule will work under either of the modes of reckoning the *rœk*.

(3) If the supposed rule proves not to work, how does one in fact determine what years should be adhikawan?

Two components of the *suriyayatra* are known as the *kammacubala* (กัมมัชผล) and the *avoman* (อวมาน), and it is the values of these two elements at the start of the year that determine the matter:

if the kammacubala value is 207 or less, then the year is a leap year.

in a leap year, if the *avoman* is 126 or less, the year will have an extra day

in a normal year, if the *avoman* is 137 or less the year will have an extra day.

A subsidiary rule complicates matters in Thailand because years with an extra month are not allowed also to have an extra day. Thus at the start of CS 1320 the *kammacubala* was 787 (normal; solar) and the *avoman* was 43; but the *tithi* was 28, theoretically making the year adhikamat. Consequently the adhikawan passed to CS 1321, even though the avoman was 598 in that year.

Armed with this technical information we can test the *Sasana* rule and examine the period 1958 to 1978 (CS 1320-1340), using "m" for adhikamat, "d" for adhikawan, and "n" for normal.

year:	type:	Ashadha	2nd Ashadha
1320	**m**	**19:42**	**22:24**
1321	d	21:05*	
1322	n	20:40	
1323	**m**	**19:12**	**22:00**
1324	n	20:38	
1325	d	19:34*	
1326	**m**	**19:38**	**22:05**
1327	n	21:15	
1328	**m**	**19:20**	**22:55**
1329	n	21:48	
1330	d	20:26*	
1331	**m**	**19:59**	**22:50**
1332	n	21:20	
1333	n	20:02	
1334	**m**	**19:03**	**21:33**
1335	d	20:40 *	
1336	n	20:44	
1337	**m**	**19:44**	**22:19**
1338	n	21:11	
1339	**m**	**19:45**	**22:35**
1340	d	21:05 *	

It will be seen that the eight occurrences of "m" (adhikamat) all satisfy the criterion that the *rœk* has not achieved a value of 20 by the start of Ashadha 1 waning. It is also true that in the eight cases of "n" (normal years) the *rœk* value lies between 20 and 22.

The problem lies with the five cases of adhikawan years ("d"):

year	type	1Ash. 14-15
1321	d	21:05
1325	d	19:34
1330	d	20:26
1335	d	20:40
1340	d	21:05

Since one has to use data in which an extra day has indeed been added, it is necessary to examine the *rœk* value for Ashadha 14-15, not 15-16, in order to cancel the effect of the extra day. It will be seen (a) that even with this modification, only one year of the five succeeds in obeying the rule; (b) even if the *rœk* count were consistently reduced by one, the years 1321 and 1340 would still not fall below 20.[7]

South East Asian calendrical calculation is nothing if not complex to the layman and patently erratic to those who do understand its procedures. This being so, the best we can hope for is to use an understanding of the theoretical basis of the system as a benchmark to detect and assess deviations from it. We have to conclude that the *Sasana* rule is inoperable, false, and also that we have no guarantee that the precise and accurate *suriyaytara* rule will be obeyed.

Enough has been said to indicate clearly that a *suriyayatra* expert could not accept the *Sasana* rule. The question, which we have failed to resolve, is why the *Sasana* ever thought in the first place that the rule would work. We have attempted to bend the rule every which way and found no interpretation of it that would allow it to work. The curious thing, as our Appendix indicates, is that it takes only four stages to obtain the *kammacubala* and *avoman* values which are sufficient to indicate accurately whether or not a year is adhikawan. The *Sasana* rule, however, ignores this expedient and claims that the actual *rœk* value at the start of Ashadha 1 waning has to be found. Clearly the *Sasana* rule is not intended to work *ex post facto*—one cannot say by looking at a calendar already completed "the *rœk* value was made to be 20 this year because an extra day was inserted". The point of the rule is to determine *in advance* whether or not an extra day is going to be needed. One's ingenuity is taxed to find a way of implementing the rule that would allow it to work.

In this context it is interesting to consult the *Pa Daeng Chronicle* where one finds what amounts to a power struggle between the Red Forest Monks and the Garden monks. The question of orthodoxy in regulating the calendar is fiercely and sometimes rancorously debated. We read (sec. 156) that:

> This [unnumbered] moengplau year was an adhikamat year when the vassa should commence

> in month 10. Bikkhus of the Garden sect actually commenced the vassa in month 9: bikkhus of the Forest sect waited for the King to invite every monastery to commence the vassa on month 10 full moon.[8]

In a later passage (sec. 173) the Forest sect is asked what it takes as evidence for its position, to which it replies "We follow the profound text of the Vinaya called *Mahavagga* by the sentence 'one should observe the vassa with the king's permission'". In the same passage the Forest sect also asserts:

> We commence the vassa according to the orders of the Lord Buddha and according to the invitation of the King.

But what the *Mahavagga* says is

> There are two periods, O Bikkhus, for entering upon Vassa, the earlier and the later. The earlier time for entering upon Vassa is the day after the full moon of Ashadha; the later, a month after the full moon of Ashadha.[9]

The plain implication of this is that if the year is adhikamas, vassa must not commence until the full moon of 2nd Ashadha, whereas the *Pa Daeng Chronicle* says both that the year was adhikamat and that the vassa should then commence in (Northern) month 10, not in 2nd month 10. Either the scribe was in error or the text has later been falsely "corrected". In Northern month-reckoning month 9 equates with Jyestha, and no one is going to commence vassa in that month.[10]

The Forest sect implies that the orders of the Lord Buddha and the invitation of the King are not (will necessarily not be) at odds with each other, that the secular and the religious dictates will necessarily coincide. This is propagandist, to say the least. At best it is a rhetorical and political ploy by the Forest sect to make the Garden sect appear to be in the wrong. The calendar is being made a tool in a power struggle.

The dispute comes down to whether the year involved was in fact adhikamat; the Garden sect determining that it was not, and the Forest sect maintaining that it was. The Garden sect commenced vassa one month early by the lights of the Forest sect, because they did not regard that year as being adhikamat. Unfortunately we have insufficient evidence to determine whose side we should join. Instead we have to note that the dispute had no rapid resolution: even some ten years later (CS 945) according to the chronology of the text, we find the argument still flourishing with acrimonious consequences:

> the Bikkhus of the Forest sect commenced the vassa in month 9: bikkhus of the Yangong sect commenced the vassa in month 10. Phrakhru of Wat Salaeng said "We of the Garden sect commenced the vassa incorrectly: the Forest sect is correct." They drove him away and he came and lived with the Forest sect. A Bikkhu of Wat Chom Saeng said . . . "we of the Forest sect are not correct." They drove him out to Wat Yangong. (sec. 182)

A telling instance in which the calendar appears to be used as a political weapon comes two years earlier in the *Luang Prasoet Chronicle*, which records that a message came from Burma (Hansavati) declaring that CS 943 (1581 AD) would *not* have an extra month, would not be adhikamat—upon which the scribe records: "but it was [adhikamat] in Ayudhya".

In fact both parties were correct according to their own systems of reckoning: the year was normal for the Burmese but it was adhikamat for the Thai, and the Thai were not going to redesign their mode of reckoning in subservience to their neighbours. The Burmese failed to "give the calendar".

It is no wonder that Prasert and Wisandarukon both conclude that "if you go to the past, the determination of adhikawan and adhikamat does not appear to have any fixed principles". One would wish to modify this conclusion slightly by saying that over the long term the adhika principles were observed. Had they not been, then the various calendars would have parted company one from another and eventually have become chaotically at odds. That this did not happen indicates that whereas the local calendars frequently differ as to the particular times at which intercalation should be made, over time there was a compensation that brought them back into line.[11]

A more extreme example of calendrical difference may be seen with the Thai and the Burmese calendars. The Thai rule was that adhikamat years cannot also be adhikawan years: the Burmese rule was that only adhikamat years can also be adhikawan years. Clearly this different implementation of the adhika rules will create a dislocation between the Thai and the Burmese reckoning, but the compensation principle prevented them from growing ever further apart.

Appendix A

Having examined the *Sasana*'s adhikawan rule in some detail, we here outline (a) how easily the suriyayatra form of the rule could be implemented and (b) how laborious it would be to implement the *Sasana* rule. By strict methods the *Sasana* rule entails a minimum of 18 successive stages, whereas the New Year values of the *kammacubala* and the *avoman,* which are sufficient for suriyayatra purposes require only four stages.

The reader will observe that each successive value is carried forward to the next or to a later stage.[12]

A. Find the relevant values for the astronomical New Year in CS 1325:

1. Find (1325 * 292207) +373 / 800 + 1
   = **483969** (*horakhun*); remainder **248**
2. Find 800 - **248** = **552** (*kammacubala*)
   ** 552
3. Find (**483969** + 2611) / 3232
   = 150: **1780** (*uccabala*)
4. Find (**483969** * 11) + 650 / 692
   = **7694**: **61** (*avoman*) ** 61
5. Find (**7694** + **483969**) / 30
   = **16388** (*masaken*); remainder **23** (= New Year's day)
6. Find 103 - **23**
   =**80** (interval from 1 Caitra to Ashadha Full Moon, minus NY day).

B. Find the position of the Mean and the True Sun on Ashadha 15:

7. Find (**80** * 800) + **552** (552 carried from stage 2)
   = **64552**
8. Find ((**64552** / 292207) * 360) - 3 [13]
   = **2; 19:28** (Mean Sun)
9. Find abs (**2; 19: 28** - 2; 20:00)
   = **0:32**
10. Find 134 * sin (**0: 32**)
    = **0:01**
    2; 19: 28 + **0:01** = **2; 19: 29** (True Sun)

C. Find the Mean and True Moon on Ashadha 15

11. Find (**61** + **80***11) modulo 692 (61 carried from stage 4)
    = **249** (*avoman* of date)
12. Find **249** + integer (249 / 25)
    = 258 (or **0; 4, 18**)
13. Find **2; 19: 29** + **0; 4, 18** + (**14** * 12) - 0: 40
    = **8; 11: 07** (Mean Moon)
14. Find (**1780** + **80**) * 3 on base 808, and add 2
    = **6; 27: 12** (Mean *Uccabala*)
15. Find **8; 11: 07** - **6; 27 12** (mean moon minus mean *uccabala*)
    = **1; 03: 55**
16. Find 296 * sin (**1; 03: 55**)
    = **0; 3:24**)
17. Find **8; 11: 07** - **0; 3: 24**
    = **8; 7: 43** (True Moon)
18. Find (**8; 7: 43** / 13: 20) +1
    = **19:34** = Mula.

Even with the compression obtained here by the use of sine tables (B10, C 16), finding a *ræk* value lies irreducibly 18th in the calculation chain, whereas it took only 4 stages to find the *kammacubala* (A2) and the *avoman* (A4), whose values declare whether or not the year is adhikawan.

Notes

[1] Kamphaeng Saen, 2534, p. 134

[2] repr. Bangkok, 2540, p. 144.

[3] *Suriyayatra* is not a text but merely a name for the astronomical reckoning that determines the parameters for New Year. When Cassini analysed the data brought back by La Loubère's voyage to

Siam of 1687-8, he marked the end of his solar and lunar calculations as "fin de sauriat". Cf. *A New Historical Relation of the Kingdom of Siam* (Vol. 2, London, 1693; tr. of the French edn, Paris 1691), II. 199: "The end of the *Souriat*".

[4] Although this rule is commonly given an upper bound of Vaisakha 5, there is a complicated subsidiary rule which determines that not infrequently the year start is forced onto Vaisakha 6. But since this matter has to be determined by inspection, it reasonable not to include it in the general statement.

[5] *Tamnanphrayaint pathithin 100 pi,* (*ตำนานพระยาอินทร์ปฏิทิน 100 ปี*) Chiang Mai, 2528, pp. 30, 32.
The numeric value of 6 for the month of Caitra indicates that the reckoning is "Keng Tung" style, lying between Caitra=5 in the South and Caitra=7 in the North.

[6] For confirmation, see Thong Chua, *Pathith-indarasasat 2500–2519,* (*ปฏิทินดาราศาสตร์ 2500–2519*) under July 1958.

[7] This is to say that even with the expedient of beginning the *rœk* count with 0 not with 1, the supposed rule does not work satisfactorily. Thong Chua makes 1330 a normal year and assigns the adhikwan to 1329, despite the fact that the avoman for that year is 216.

[8] Reference to month 10 and vassa indicate that the mode of reckoning is Northern, not Keng Tung. Though it is not directly relevant to the present argument I note that the well-preserved inscription of Wat Tapotharam in Chiang Mai, dating to 1492 Mar 30 (CS 854 Vaisakha 3), expressly reads: "Two thousand and thirty-five years, CS eight hundred and fifty-four, year *tao cai*, month Visakha, Thai month seven, waxing three, Friday, Thai day *ka rao*, the day of the year's increase". By normal Chiang Mai reckoning Vaisakha would of course be month 8, causing Ashadha to be month 10; but by this Wat Tapotharam reckoning Vaisakha is month 7 (Keng Tung style), causing Ashadha to be month 9.

In my study *The Calendrical Systems of Mainland Southeast Asia* (E. J. Brill, Leiden, 1995), Appendix III, I list 30 examples in which this alternative "Keng Tung" style is in evidence in Lan Na.

[9] *Vinaya Texts*, tr. T.W. Rhys Davies and Hermann Oldenberg", Part I: *The Patimokkha, The Mahavagga, i-iv* (Delhi, 1881), pp. 299-300.

[10] It would seem that the chronicle's author did not understand the relation between the month names and the month numeration: Pratomashadha is Chiang Mai month 10; Toutyashadha is Chiang Mai month 10/10. The point of the dispute is that the Garden sect began vassa one month early (in Ashadha, not in Toutyashadha), and the author counted one back from month 10, not from month 10/10. In my view the fact that some calendrists in Lan Na would call Ashadha month 9 does not affect this particular issue.

[11] There is an interesting instance in *Jinakalamali* where an irregulat intercalation can be detected. The detailed evidence shows that whereas CS 878 "should" have been adhikamat it was treated as normal and where CS 879 should have been normal it was compensatingly treated as adhikamat. See my *Calendrical Systems*, Appendix Vb.

[12] Where desirable, values in arcmins are here converted to signs, degrees, and arcmins in order to make them compatible with following operations. Thus at stage C12, the value 258 arcmins becomes 0; 4, 18 to make it compatible with 2; 19, 28.
This working is deliberately concise, since it thereby reflects how the calculation would have been made by a South East Asian calendrist. Each stage is subjected to an operation learnt by rote, and the underlying theory disappears from view. The rote operations, however, will provide a valid answer for any date in any year. It seemed greatly preferable to set out the procedure thus starkly, rather than to give a detailed exposition of what is involved.

[13] The routine subtraction of 3 arcmins is a geographical longitude correction for the sun, as is the subtraction of 40 arcmins for the moon (sec. C13).