K'in in the Hieroglyphic Record: Implications of a Pattern of Dates at Copán, Honduras[1]

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According to recent studies, Nuun Ujol Chaak, 23rd king of Mutul, laid siege against Balaj Chan K'awiil, first ruler of Ch'ok Mutul,[2] at the maximum elongation of Venus in the morning sky on 9.12.0.8.3 *4 Ak'bal 11 Muwan*.[3] Such celestial timing, the story goes, was warranted since Chak Ek' (the Maya name for Venus) was the patron of war. Hence the implication is that the timing of this battle should have proven auspicious for Nuun Ujol Chaak. Besides the fact that Balaj Chan K'awiil would likely have read the same omen and yet one of the two kings would have lost the battle, there exists a more readily contestable issue here. The association of Chak Ek' with this type of warfare—along with many other proposed Maya astronomical practices—is based on the day-for-day correlation of Maya Long Count dates to the Christian chronology. And while considered a closed case by many (if not most) Mayanists, the problem of correlating the two chronologies actually has not yet been solved.

At present, a "family" of solutions has been used to generate the Christian equivalents of the Long Count dates published extensively in the popular literature—and now quite frequently in the scholarly literature as well—which include Balaj Chan K'awiil's "star war". Family here, though, does not imply that the three men who provide the name of the generally accepted correlation are related. Instead, the family is necessary to compensate for the shortcomings of the original postulated solution. The correlation was born in 1905, when J. T. Goodman proposed the correlation of 584,280. His work was corroborated by that of Juan Martínez Hernandez in 1926 with an adjustment to 584,281.[4] While neither of these solutions form part

[1] By no means do I mean to imply by the title that I am even a measurable fraction of the scholar that Tatiana Proskouriakoff was, nor that this paper is again of a measurable fraction of the quality of hers. Rather, I find the parallel valuable in an aesthetic sense worthy of running the risk of pretense. Special thanks are due to Shannon Plank for pointing out the several instances of the *k'alk'in* glyph at Chich'en Itza, and for her assistance with Postclassic epigraphy. I am also indebted to William Fash, David Stuart, and Owen Gingerich who read and commented on early versions of this paper.

[2] I use deciphered names whenever secure for Maya cities. For the splinter faction of Mutul known in the literature as Dos Pilas, I use Ch'ok Mutul.

[3] Although not all studies noted this explicitly, all have argued that Chak Ek' (Venus) was used to time the "star war" events and included this date in their data set. See especially Aveni and Hotaling (1994:S26, Table 1, line 37); Nahm (1994:9, Table 1); and Schele and Grube (1994:131). For more on the series of wars between these two kings and the demonstration that the "star war" verb does *not* implicate Venus, see Aldana (2001).

[4] See David Kelley (1983) for a recent recap of correlation attempts.

of the family, the two men are credited with the initial insight that sustained J. E. S. Thompson's proposal. Thompson incorporated ethnohistoric data into the argument, which resulted in the Goodman-Martínez-Thompson (GMT) calendar correlation constant of 584,285.[5]

The family per se was generated much more recently in an attempt to fit colonial Yucatec data with Highland Guatemalan and Aztec sources. The fit necessitated an adjustment of 2 days such that a modified GMT of 584,283 was proposed next.[6] In 1992, though, Floyd Lounsbury showed that a study of the Venus and Eclipse Tables of the Dresden Codex recommend that an Ajaw equation of 584,284 should also be considered a real possibility.[7] Hence the "family" is this last set of three correlation constants differing by a maximum of two days used to compensate for whatever type of source data one considers primary.

Conventional wisdom, therefore, tells us that the answer should lie somewhere within this family; it will require only the services of an investigator with either new data or a new approach to determine which is the proper day-for-day solution.

I do not pretend to qualify as either of these two possible investigators. But in this paper, at the risk of becoming unpopular, I show that the resolution of the GMT correlation does not concern a matter of a couple of days, but at the *very* least a matter of months. The critical data that I bring to bear on this issue derives from the record pertaining to that celestial body most obviously important to Classic Maya ritual and cosmovision, yet most neglected in creating a calendar correlation. Here I consider *K'in*, the Maya Sun.

This paper demonstrates that there are sufficient solar data within the inscriptions of the Classic and Postclassic periods to derive a secure solar anchor in the Gregorian year for the Maya Long Count. The derivation of the anchor begins with the so-called "valley stelae" of Copán, and ends with the always troublesome (to the GMT) Group-E complex at Waxaktun. Along the way, the paper considers the *k'alk'in* verb instanced at Copán but more extensively recorded at Chich'en Itza. In all cases, I endeavor to insure that the astronomical data conform to the unique historical circumstances that generated them. Together, these data tie down the Long Count within the tropical year and pull it away from its GMT correlate. While this paper does not provide a new solution to the calendar correlation problem, it does demonstrate that the GMT cannot be considered as accurate as conventional wisdom has suspected.

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[5] The correlation constant is the number that is to be added to the integer representation of a Long Count date to yield a Julian date. For a nice explanation, see Aveni (1980:204-10).
[6] Floyd Lounsbury (1992:200).
[7] Ibid, pp. 203-04.

The Copán Solar Stelae

Anthony Aveni originally argued that two members of the "valley stelae" of Copán (Stelae 10 and 12) were commissioned by Ruler 12 to commemorate the partitioning of the solar year into 20-day periods. In a paper recently submitted to the *Journal for the History of Astronomy*, I have demonstrated that the partitioning is far more extensive than proposed by Aveni.[8] This demonstration was built upon the re-interpretation of the date on St. 12. Here I review the argument briefly and then add new data that has recently come to light.

Copán Ruler 12 raised the valley stelae on hillocks to the east and west of the civic-ceremonial center, along with two others (Stelae 2 and 3) within the center, in preparation for the end of the eleventh *k'atun* of the tenth *bak'tun*.[9] As noted by Sylvanus Morley and by Aveni, though, the relative orientation of two of these stelae belies an astronomical function.[10] Morley's measurements in 1916 revealed that the azimuth of St. 10 relative to St. 12 corresponded to that of the setting sun on 12 April and again on 1 September.[11] (See Figure 1.) Morley himself foresaw that the recovery of this orientation might prove useful in determining relative chronologies. In *The Inscriptions at Copán*, he wrote:

> … the writer believes these two monuments may yet be found to record important and recoverable astronomical data, possibly even sufficient to permit an exact correlation of Maya and Christian chronology.[12]

It was Morley's hope that the inscriptions—once read—would reveal some connection of the dates on the monuments to their solar orientation, thus binding the Long Count to the solar year.

Morley's hunch was in fact correct, though his bias against non-*tun*-ending Initial Series

[8] Aldana (in press).
[9] For time periods I employ the method used by the Maya themselves such that the period from 9.0.0.0.0 to 10.0.0.0.0 is the tenth *bak'tun*; from 9.0.0.0.0 to 9.1.0.0.0 is the first *k'atun*, etc. For a discussion of the valley stelae, see Fash (1991:101-104); Schele and Mathews (1998:135); and Herbert Spinden (1913).
[10] Morley (1920) and Aveni (1980).
[11] Morley has these dates as 12 April and 6 September. The latter must be a typographical error since he explains that the numbers come from Robert Wheeler Wilson (of the Harvard Astronomy Department) and reflect differences of 20.3 and 20.6 days from the equinoxes. According to an ephemeris produced by JPL, the autumnal equinox of 1916 (the year of the calculations) occurred on 21 September. Thus the revised number given in the text.
[12] Morley (1920:134).

dates prevented him from seeing it.[13] The problem confronting him and the modern epigrapher is that the date on St. 12 is heavily eroded. Given that which is legible, though, (the *bak'tun* coefficient of 9; the *k'atun* coefficient of 10; the *chol k'ij*[14] of *6 Ajaw*; and the coefficient of the month, 13) one can constrain the date to the possibilities listed in Table 1.

Table 1. '*6 Ajaw 13* [month] dates during the eleventh *k'atun.*

Long Count	*Chol k'ij*	*Lunar Information*		*Coefficient*	*Month*
9.10.6.6.0	6 Ajaw	16D	5Cj	13	Sip
9.10.18.11.0	6 Ajaw	6D	5Cs	13	Tzek
9.10.10.12.0	6 Ajaw	11D	4Cj	13	Mol
9.10.2.13.0	6 Ajaw	15D	3Cm	13	Sak
9.10.15.0.0	6 Ajaw	6D	3Cj	13	Mak
9.10.7.1.0	6 Ajaw	10D	2Cm	13	Pax
9.10.19.6.0	6 Ajaw	0D	2Cj	13	Kumk'u

Morley and most (if not all) scholars since him have taken 9.10.15.0.0 as the best reconstruction of the date. In some work that I had done on Lunar Series records, though, I recognized that 9.10.19.6.0 and 9.10.18.11.0 were equally good possibilities—all possessed the information given explicitly, and all deviated by 3 days from the inscribed moon age of 3D.[15] Rather than assume, as Morley did, that the Maya recorded *tun*-ending dates whenever possible, we may turn to the dates inscribed on the other valley stelae to see which date "fits" best. These are listed in Table 2.

Table 2. Secure dates of the valley stelae.

Copán Monument	*Long Count Date*
St. 2	9.10.15.13.0
St. 23	9.10.18.12.8
St. 3e	9.10.19.5.0
St. 3w	9.10.19.5.11
St. 10	9.10.19.13.0
St. 19	9.10.19.15.0
St. 13	9.11.0.0.0

[13] Again see Aldana (2001:53).
[14] As *tzolk'in* is a hypothetical construction by Thompson that is not attested in the hieroglyphic record, I prefer the K'iche *chol k'ij*.
[15] Since these dates occur before John Teeple's (1931) Period of Uniformity, we cannot use the lunar semester information to determine which is the best choice.

While Morley's date fits well with the date on St. 2, the other monuments implicate a later date: 9.10.18.11.0 by St. 23, and 9.10.19.6.0 by the five latest dates. In fact if we take the latter date—indicated by the preponderance of evidence—we confront an intriguing result: 9.10.19.6.0 *6 Ajaw 13 Kumk'u* occurred seven *winal*—140 days—before the date on St. 10. Given the tolerance of Morley's measurement of the St. 10-12 baseline, 140 days is perfectly commensurate with the separation in time between the two sunsets behind St. 10 viewed from St. 12.[16] Therefore, an observer at St. 12 could have witnessed the sun setting behind St. 10 on the Long Count date given on St. 12, and then again by returning on the Long Count date recorded on St. 10. This connection provides us with the beginnings of our solar anchor, which is borne out in far greater detail by referring to Aveni's work of the 1970s.

In *Skywatchers of Ancient Mexico*, Aveni interpreted the construction of the St. 10-12 baseline to be part of a twenty-day partitioning of the tropical year.[17] Four periods of (nearly) 20 days each were created by relating the sunsets behind St. 10 (viewed from St. 12) to important solar events. Between Spring Equinox and the first sunset behind St. 10, on April 12, are 19 days; between this sunset and the zenith passage of the sun are 21 days. Likewise, the second zenith passage of the sun in a given year at Copán occurred 19 days before the second sunset behind St. 10, 1 September, and 40 days before the Autumnal Equinox. Thus, Aveni argued, the Copaneco astronomers appear to have positioned the monuments to allow an observer to partition the solar year into twenty-day periods as an observational analog to the partitions of the *haab*.

I concur with Aveni's argument but, with the acceptance of the 9.10.19.6.0 reconstruction for the date on St. 12, demonstrate that the partitioning was even more detailed than he proposed. (See Figure 2.) With the seven-*winal* (140-day) interval between the dates on St. 10 and St. 12 corresponding to the interval between 12 April and 1 September, the following pattern results: The date on St. 3 was one *winal* before that on St. 12, and so would have commemorated the Vernal Equinox. Next, the date on St. 2 corresponded to the Autumnal Equinox of three-and-a-half years before the St. 3 date, thus explicitly marking four of Aveni's six observational markers. Finally, the date on St. 19 picks up the partition 20 days after the Autumnal Equinox,

[16] From his work in 1916, Morley published his own dates of 9 April and 10 September, but also those of Gordon, which corresponded to 23 days after the Spring Equinox and before the Fall Equinox. Aveni cited Morley's 1925 study for the dates of 12 April and 1 September, and these are the nominal numbers I use in the text.
[17] Aveni (1980:240-44).

which could have been observed as sun*rise* behind St. 12 viewed from St. 10. We therefore have five of the seven stelae in this group accounting for six partitions of the solar year. Since four of these partitions correspond to annual solar phenomena (zenith passages and equinoxes), we now have a firm anchoring of the Long Count to the solar year.

While considering this pattern recently, I was reminded of Annegrete Vogrin's mapping project of the 1970s. In that project, she found a peculiar alignment between St. I, its associated altar, and two structures sitting on either side of the pair: Structures 3 and 4.[18] These four monuments, she found, lined up relative to each other, and their alignment pointed toward the rise of the sun along the natural horizon on the date of zenith passage of the Sun. Vogrin argued that this was not coincidental but a planned architectural alignment.[19]

Naturally Vogrin's work is pertinent here since one of the stations that is not explicitly recorded as a date of the Solar Stelae is that of zenith passage, even though it comprises one of the important divisions. Of course, we must then look to the inscription of St. I in order to see if anything turns up. The Initial Series date is suggestive iconographically in its own right. First of all, the *k'in* element of the Long Count is represented by the personified Sun God. This of course is no great anomaly, but it bears mentioning at least because the full-size portrait on the front of the stela is that of GI, the Sun god, complete with his securely identifiable hat.[20] Further, the *k'in* element is of interest because of its coefficient: rather than a number, it bears the verb *k'al*. As a verb, *k'alk'in* will be addressed shortly. For now, we take it as representing the number zero (which we know since the day sign is identifiable as *Ajaw*) and check the position against our new solar anchor.

9.12.3.14.0 – 9.10.19.5.0 = 8,820 days = 24 years 54 days

At first blush, this appears to be off expectation. That is, we might have expected this stela to commemorate a date of zenith passage, which would have required a remainder of 40 days. In fact, if we use *haab* instead of tropical years, we find that:

9.12.3.14.0 – 9.10.19.5.0 = 8,820 days = 24 *haab* 60 days

The 60 days are much easier to explain than are 54 since they would place the Initial Series date at a partition precisely one *winal* after zenith passage. Hence the pattern would have been

[18] Vogrin (1976:10-11).
[19] Ibid, p. 11.
[20] The identification of the hat comes from Janahb Pakal's funerary temple at Bakal. On the Middle Tablet, the inscription portrays the sacrificial bowl iconographically, and then states that "it is the hat of GI." See Aldana and Fash (in press).

propagated from the Solar Stelae pattern.

On the other hand, there is another option. Stelae 2 and 3 are the members of the Solar Stelae that were erected within the limits of the ceremonial center. Stela 3, though, possesses an interesting piece of information that deviates from the partitioning pattern. On the west side of the stela, the date *9 Ok 3 Kumk'u* had been inscribed corresponding to the Long Count date 10 days after the Initial Series date of the east side, or 9.10.19.5.10. What is interesting about this date is that between it and the date of Ruler 12's inauguration, which was inscribed on St. 2, there were exactly 24 tropical years (8,766 days). Thus, Ruler 12 would be commemorating the end of the eleventh *k'atun* after 24 years in office, and he would be commemorating it by honoring the Sun, the head variant for the number 4, with 20 day periods. There seems to be some interesting numerology here, more so when we consider that the date on St. I occurs 24 years after the date on St. 3, plus 20 plus 24 days. Thus, Ruler 12 seemed to be reactivating the Solar Stelae in time for the end of the thirteenth *k'atun*, though in a subtle and complex way. (See Table 3.)

Table 3: Solar numerology amongst the ceremonial center members of the Solar Stelae.

	St. I
St. 2	2 x 24 years + 2 winal + 4 days
St. 3e	24 haab + 3 winal
St. 3w	24 years + 2 winal + 4 days

Historical Context

Although the above pattern is quite robust, I contend that we must always remain suspicious of astronomical arguments that only consider mathematical consistency. In order to be really convincing, I believe, we must also find something in the inscriptional or architectural record that demonstrates historical intent. I argue that for Copán Ruler 12, this intent comes through in the inscription on St. 23. Further, through a treatment of the inscription on this stela, we are able to make sense of its anomalous date relative to those of the other Solar Stelae.

The only surviving record of Copán St. 23 is in Morley's *The Inscriptions at Copán.* The drawing he made of it is not of the highest quality, but it does prove faithful enough to the original to provide valuable information. As shown in Figure 3, most of the Initial Series information has been obliterated. Temporarily skipping the text associated with this Initial Series date, then, one encounters a string of three Calendar Round dates. The first is that of the *k'atun* end, *12 Ajaw 8 Keh*, which marks the monument clearly as a member of the valley stelae. The next date is that of "Creation", 13.0.0.0.0 *4 Ajaw 8 Kumk'u*.[21] This Calendar Round is followed by the familiar "setting of the hearthstones" passage ensuring that it be understood as the mythical Calendar Round, and not as the more recent *4 Ajaw 8 Kumk'u* occurring on 9.9.16.0.0.[22] Next one encounters the Calendar Round of interest to this study: *8 Lamat 1 Yaxk'in*.[23] Morley reconstructed the Initial Series date based on the month patron and the scant information still legible to argue that it also corresponded to *8 Lamat 1 Yaxk'in*. One odd feature that seems to support his reconstruction is that in both cases the coefficient of the month as written seems to be a '2' rather than a '1'. This follows the pattern of Stelae 2 and 3, wherein the *haab* date is advanced one day relative to the position it is mathematically constrained to take.[24]

While Morley's reconstruction is not untenable, I find the verb accompanying the Initial Series date to provide the better argument for the equivalence of the two dates. (See Figure 3.) Here, it appears, we have the remains of a verb that works analogously to a verb very common throughout the inscriptional record: that of the period end, *k'altun*. In the case of St. 23, however, the *tun* element has been replaced by *k'in*, the glyph for the sun, producing a probable reading of *k'alk'in*.[25] (See Figure 4.) Since the *k'altun* glyph marks the completion of *tuns* (periods of 360 days) it makes sense for the *k'alk'in* glyph to mark the completion of solar periods. This is, in fact, precisely what we find, and it resonates with the anomalous Long Count just considered on St. I. The difference between the *1 Yaxk'in* date, 9.10.18.12.8 and 13.0.0.0.0 is 1,374,728 days, which is in turn 3,764 years, if one were to compute a tropical year as 365.2308 days.[26] This approximation comes from a practice of counting 4,748 days as 13 years.

A correlation based on a thirteen-year cycle would have appealed to the Maya numerologist since 13 were the number of levels to the daytime sky,[27] and the thirteenth *bak'tun* was the seating of the Maya epoch.[28] Moreover, the scribe seems to have included a telling pun

[21] I use "Creation" as a convenient term popularized by Schele (Freidel et al 1993) although the process of Maya creation occurred over a long time span involving many protagonists and antagonists. (See, e.g., *Popol Vuh*.)
[22] For the hearthstones passage, see, e.g., Freidel et al. (1993). For an updated reading of the event glyph, see Chapter 0 of Aldana (2001).
[23] Morley (1920:136).
[24] This may simply be the result of a non-coincidence between the two counts, but it may also designate a ritual break in the normal progress of time. At this point we cannot say definitively.
[25] This is also the opinion of David Stuart. Personal communication, September 2000.
[26] The straight computation 3,764 x 365.2308 = 1,374,728.7 which rounds up to 1,374,729 days. The Maya did not use fractions, though, so they would have had a set algorithm determining when to intercalate extra days, and when not. For example, 1,374,728 = 289 x 4,748 + 7 x 365 + 1; hence during the first seven years there would have been one intercalated day, with the next two coming over the next 6 years.
[27] Following Miguel León-Portilla (1988:183).
[28] Also, it would have been convenient computationally since 13 *haab* are 13.3.5 and 13 tropical years are 13.3.8.

here, for the interval was framed by the day *1 Yaxk'in* ('1 First-sun') and the first *k'in* date of the epoch (13.0.0.0.0). In the end, though, we do not need to appeal to puns for our historical intent since we can now read the opening passage as "9.10.18.12.8 *8 Lamat 1 Yaxk'in* it is the sun binding", demonstrating an explicit statement commissioned by Ruler 12 of an interest in capturing something of the sun's observational character. So too do we find the reason for the "outlying date" on St. 23. The astronomers wanted to commemorate a solar anniversary of the day of Creation, yet if they were to use the last one before the end of the eleventh *k'atun* (9.10.19.12.13), they would have to have disrupted the *winal*-ending pattern of the later Solar Stelae. (See Table 2.) Therefore, they chose the next best date: the anniversary one year earlier.

K'in at Chich'en Itza

The *k'alk'in* glyph of Copán St. 23 shows up much more frequently in the inscriptional record of Chich'en Itza. Here the verb was inscribed into various lintels to record house dedication rituals.[29] In all, some seven instances of this verb can be found at Chich'en Itza. On Copán St. 23, we have seen that the *k'alk'in* event was used in reference to two dates on the same monument. At Chich'en, though, we have different monuments referencing the same event for different dates. If our conclusions about the function of the glyph at Copán were correct, we should expect, therefore, to find some solar periodicity amongst the dates referencing this glyph at Chich'en. Unfortunately, only one of these dates is firmly associated with a Long Count date. The (appropriately named) Initial Series Lintel bears the inscription: 10.2.9.1.9 *9 Muluk 7 Sak* G2 25D 5Cm X? B ? [PSSIG] *k'al-aj-k'in 9 Muluk k'in u-'bat'-lu-na-aj-ki u-pakab-ti-il y-oto:t*, the text of which may be loosely translated as 'it was the *9 Muluk* sun-binding; it was the carving of the lintel of his house'.[30] This is the most secure of the *k'alk'in* events at Chich'en.

The other instances are not explicitly anchored in the Long Count as they reflect a significant change in the method of recording dates amongst the inscriptions at Chich'en Itza. The Initial Series Lintel carries this name, for Initial Series Long Count dates are relatively rare at this city. Instead, scribes used the Primary Standard Sequence Introductory Glyph (PSSIG) followed by the Calendar Round. Occasionally, this would be followed by the placement of the Calendar Round within a *k'atun* cycle: *i.e.* the date would be referenced as occurring in the *nth tun*

[29] These were pointed out to me by Shannon Plank, personal communication 2001.
[30] S. Plank (2001) provides the technical transcription and transliteration that led to this loose translation.

of *k'atun m Ajaw*. We will see that this change in style of recording dates probably was not accompanied by a "reform" or shift in the calendar itself, although the possibility should be left open.

The Temple of Four Lintels contains two clear records of the *k'alaj k'in* event, and one that is insecure. Lintel 1 possesses an inscription along the edge that reads (in full): [PSSIG] *k'alaj k'in tu/u-wojil yotot Yax Chit Jun Kan Ajaw Chanal K'uh* – 'it was the sun binding in the writing of the house of Yax Chit Juhn Kan Ajaw Chanal K'uh'.[31] Thus, there is no date unequivocally anchoring this event to a day. On the other hand, the face of the lintel begins with the date *9 Lamat 11 Yax*. This date is further constrained by the passage 13 *tun 1 Ajaw*, implying that this Calendar Round was the one occurring on 10.2.12.1.8.[32] The same Calendar Round turns up a total of three times, one each on three of the four lintels (1, 3, and 4). Lintel 2, however, differs in bearing the date *12 K'an _ Sak*. Yet after a short passage, the text again records 13 *tun 1 Ajaw*, which is followed by a verb and then the *k'alaj k'in* verb. Since there was a *12 K'an 7 Sak* occurring on 10.2.12.2.4, we are well within reason to conclude that the actual date of the *k'alaj k'in* event inscribed on the edge of Lintel 1 and on the face of Lintel 2 was 10.2.12.2.4 *12 K'an 7 Sak*.

As for the inscriptions in the Temple of the Hieroglyphic Jambs, the date on the west jamb is *9 Ben ? Sak*. If we assume continuity in calendar between the Long Count on the Initial Series Lintel and this inscription, then we are confronted here with four possibilities. The day *Ben* can occur on month days with coefficients of 1, 6, 11, or 16. The most likely possibilities are listed in Table 4. If the *9 Ben* date corresponds to the day of the *k'alaj k'in* event recorded on the east jamb of the temple, then the date of *6 Sak* would correspond extremely well with commemoration of a solar station. While we cannot say for certain, we assume with reasonable justification that the *k'alaj k'in* event occurred early in the month of *Sak*, and so could not have been too far from commemorating the same solar station as that referenced on the Initial Series Lintel (transpiring on *7 Sak*).

Table 4: Possibilities for a 9 Ben date in the month Sak.

10.2.15.2.13	9 Ben	1 Sak
10.2.10.1.13	9 Ben	6 Sak
10.2.5.0.13	9 Ben	11 Sak
10.1.19.17.13	9 Ben	16 Sak

31 Ibid.

32 *1 Ajaw* refers to the fact that the end of the *k'atun* occurred on this *chol k'ij* date.

Las Monjas Lintel 4 bears the date *9 Manik 15 Wo* clearly, and on its edge is mention of the eleventh *tun*. Together, these data argue convincingly for the Long Count date of 10.2.10.11.7. The date and *k'alaj k'in* event are combined three times in the four lintels of this structure, so the association here is also secure.

Finally, Yula Lintel 2 bears a date directly preceding the *k'alaj k'in* event glyph, although in ill-preserved state. One proposed reconstruction is *2 Imix 4 Mak*, which might correspond to 10.2.4.2.1. I find the identification of the coefficient of the *chol k'ij* and that of the month to be questionable, however. For one, the coefficient appears to have the cross eyes of the number '6'. Also, the month looks more like Tzek, although even this is tentative. Fortunately, there is another date on this lintel that might assist in reconstructing this date. Near the end of the text, one encounters 3/13 [day] 10 Pop, which is marked as occurring in the fifth *tun* of *k'atun 1 Ajaw*. The only 10 Pop date that might match the tun designation is that of 10.2.4.10.12 *4 Etz'nab 10 Pop*. Of course, the *chol k'ij* coefficient does not match that recorded, but that is a result of the structure of the Calendar Round itself. On the other hand, as we have seen in the Solar Stelae of Copán, precisely these types of mismatches are evidenced in the inscriptional record: cases in which the *haab* date is advanced one day from the corresponding *chol k'ij* date. Thus, it is within convention here to identify this as 10.2.4.10.11 *3 Chuwen 9 Pop.*

In fact, this has not proven extremely helpful, since the nearest date that combines *Imix* and a month coefficient of '4' occurred some 70 days earlier: 10.2.4.8.1 *5 Imix 4 Wayeb.* Table 5 lists all possible dates matching this constraint. While the cross eyes appear the distinctive feature, there was no *6 Imix* date possibility. The next closest iconographic match, I believe,

Table 5: All possibilities of within the fifth tun of k'atun 1 Ajaw having both a day sign of Imix, and a month coefficient of '4'.

10.2.4.8.1	5 Imix	4 Wayeb
10.2.4.7.1	11 Imix	4 Kumk'u
10.2.4.6.1	4 Imix	4 K'ayab
10.2.4.5.1	10 Imix	4 Pax
10.2.4.4.1	3 Imix	4 Muwan
10.2.4.3.1	9 Imix	4 K'ank'in
10.2.4.2.1	2 Imix	4 Mak
10.2.4.1.1	8 Imix	4 Keh
10.2.4.0.1	1 Imix	4 Sak

would have to be a *chol k'ij* coefficient of '10', yielding 10.2.4.5.1 *10 Imix 4 Pax* as the best compromise. Without a clear solution, however, this date should be left out of our solar anchor determination.

Thus, the only secure dates from the Chich'en Lintels are: 10.2.9.1.9 *9 Muluk 7 Sak*, 10.2.12.2.5 *13 Chikchan 8 Sak*, and 10.2.10.11.7 *9 Manik 15 Wo*. These have been compared in Table 6, along with those dates that are less than secure. While the *9 Manik 15 Wo* date is off by about ten days, the others all cluster around quarter-partitions of the solar year. This would imply that they were commemorating the equinoxes or solstices.

Table 6: Comparison of *k'alaj k'in* dates at Chich'en Itza against the tropical year.

Long Count	*Calendar Round*	*Difference (days)*	*Position in Tropical Year*
Secure *k'alaj k'in* dates at Chich'en Itza			
10.2.9.1.9	9 Muluk 7 Sak	0	0
10.2.12.2.5	13 Chikchan 8 Sak	1096	0.25
10.2.10.11.7	9 Manik 15 Wo	558	192.75
Less than secure dates			
10.2.4.5.1	10 Imix 4 Pax	-1728	98.25
10.2.10.1.13	9 Ben 6 Sak	364	364

To test secondarily if there is a solar connection here, we next compare the dates at Chich'en with those of the Copán Solar Stelae. Here, we are on most solid ground if we compare the Initial Series Lintel date with the Copán St. 19 date, the latter commemorating Vernal Equinox. The difference between 10.2.9.1.9 and 9.10.19.5.0 is 82,729 days, which in turn is 226.5 years exactly (counting years as 365.25 days). So Copán St. 19 commemorating Vernal Equinox puts the Chich'en Lintel's date on the Autumnal Equinox. This comparison will then also place all of the dates from Chich'en on or very near an equinox or solstice. Thus we have internal and external corroboration for the new solar anchor of the Maya Long Count.

We are not yet finished, however, with the solar information at Chich'en Itza. Shannon Plank has argued that one of the supernatural beings who participates in one of these ceremonies (and who shows up elsewhere at Chich'en Itza) is actually referenced elsewhere in the *corpus* *inscriptionum mayarum*[33] —poignantly, at Copán.[34] The name of the supernatural at Chich'en Itza is Yax Chit Juhn Kan Ajaw—Blue-Green *Chit Juhn* Snake Lord; at Copán, the creature was named Yax Chit Juhn Noh Kan—Blue-Green *Chit Juhn* Great Snake. It is no stretch to claim that these are local versions of the same entity.[35] Thus, at Chich'en the great snake played some role in a ceremony associated with a solar station. This should remind the reader familiar with Chich'en architecture of another major monument: El Castillo, or the Temple of K'uk'ulkan.

As well documented in the literature, and attested to by thousands of visitors to Chich'en Itza every year, the northern staircase of the Temple of K'uk'ulkan also reflects a solar alignment. At sunset on the equinoxes, the staircase is illuminated so as to form the body of a snake whose stone head sits at the foot of the stairs. Hence we appear to have two 'great' snakes affiliated with solar commemorations (equinoxes) at Chich'en.

The reader will object reasonably, however, that the snake on the Temple of K'uk'ulkan is in fact a representation of K'uk'ulkan—'Feathered Serpent', and *not* Yax Chit Juhn Kan Ajaw. Such a criticism is indeed quite germane if we consider the Maya culture to have been a static structure. Were the Maya (or any other Mesoamerican peoples) to have maintained a fixed pantheon of deities, then no such association is possible. On the other hand, we know that something fundamentally did change Maya culture between Classic and Postclassic times: the "arrival" of Quetzalcoatl. Perhaps Yax Chit Juhn Kan Ajaw was the deity who allowed for the more ready acceptance of the Toltec Feathered Serpent at the transition from Classic to Postclassic. Whether or not that was the case, the *k'alk'in* data provide Postclassic[36] support for the solar anchor derived at Copán.

The Neglected Problem of Waxaktun

In order to demonstrate that this solar anchor is not a phenomenon restricted to the Late and Terminal Classic periods, we turn now to the Early Classic, south to the city of Waxaktun,

[33] Morley's (1920) phrase.
[34] Plank says of "Yax Chit Hu:n": "he is a pan-Maya deity and appears not just at Copán, but at a number of sites and on pots. There are some deity impersonations of him at Dos Pilas and Yaxchilán" (2001). David Stuart first identified the name of this pan-Maya deity formerly known as the Waterlily Serpent; Plank identified the name at Chich'en and its association with the *k'alajk'in* events. (Letter dated 22 May 2001.)
[35] Plank (2001). See Susan Gillespie and Rosemary Joyce (1998) on local deities.
[36] My dissertation (Aldana 2001) treats a similar case regarding Venus in Chapter 5. The basic idea of change and appropriation within Maya culture and especially within Maya astronomy, though, is a theme that runs through the whole work.

to the famous Group-E complex. As has been discussed extensively elsewhere, in this group a cardinally-oriented pyramid sat to the west of a plaza, with its eastern stairway facing a set of three temples. These three structures sat on a single platform along a north-south axis at the eastern end of the plaza. The complex has been long recognized as affiliated with the sun, for the sun rises just off the corner of the southern structure on the winter solstice, out of the middle structure on the equinoxes, and off the corner of the northern structure on the summer solstice.[37]

Now, there were three stelae erected in front of the eastern platform recording two period-ending dates, 8.16.0.0.0 and 9.3.0.0.0. Intriguingly, these two dates are separated by an even number of tropical years (less 3 days).[38] Since both dates were *k'atun* ends (8.16.0.0.0, and 9.3.0.0.0), Aveni proposed that these stelae were erected here to commemorate the fact that they coincided with an important solar station. Because the GMT correlation placed these *k'atun*-endings in late February, however, Aveni supposed that the Waxaktunecos may have had some solar station in mind other than those observationally marked by the structures of the Group.[39]

Yet when we check for a relationship between the dates at Waxaktun and those at Chich'en and Copán, we find corroboration of the solar anchor. The dates on Copán Stela 3 and Waxaktun St. 18 are separated by:

9.10.19.5.0 - 9.3.0.0.0 = 57,340 days = 156 years 362 days

Six days total, then, separate the respective positions of the dates on these two monuments in the tropical year.[40] Given the visual tolerance of a sunrise, each of these events could have been commemorating the same solar position. That is, if one requires that the center of the sun rise directly behind the center of the designated monument, then there is only one day out of the year that this can happen.[41] On the other hand, if one is concerned with the *Ajaw* date (as implied by the *winal* ends of the stelae dates), or period-ending date commemoration of a solar station, then a tolerance of +/- 5 days is acceptable. The results of this exercise are compiled in Table 7.

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[37] Aveni (1980:277-280).

[38] 7 *k'atun* = 50,400 days = 137 years 362 days.

[39] Aveni (1980:280).

[40] Using the above approximation of 4,748 days = 13 tropical years, 7 *k'atun* would have been the closest integral number of *k'atun* one could get to an integral number of tropical years (7 x 7,200 = 50,400; 138 x 365.2308 = 50,401.85). If they were referencing the Waxaktun Group-E complex, 9.3.0.0.0 + 7.0.0.0 = 9.10.0.0.0 would have been the next commemoration of that solar station. 9.10.19.5.0 is 6,940 days after the end of the tenth *k'atun*, and 19 x 365.2308 = 6,939.4. Thus 9.10.19.5.0 could have been computed as the closest day to commemorating the same solar station.

[41] If one were really picky, one could say that this can only happen once every four years, but the Maya likely did not possess this level of accuracy.

Table 7: Solar stations in the inscriptions of the Group-E complex and the Valley Stelae.

Monument	*Date*	*Solar Position*
Wax St. 19	8.16.0.0.0	Spring Equinox - 5 days
Wax St. 20	9.3.0.0.0	Spring Equinox - 2 days
St. 2	9.9.14.17.5	Spring Equinox + 12 days; Accession
St. 2	9.10.15.13.0	Fall Equinox - 2 days
St. 23	9.10.18.12.8	Fall Equinox - 29 days
St. 3e	9.10.19.5.0	Spring Equinox + 1 day
St. 3w	9.10.19.5.11	Spring Equinox + 12 days; 24 year anniversary of Accession
St. 12	9.10.19.6.0	April 12
St. 10	9.10.19.13.0	September 1
St. 19	9.10.19.15.0	Fall Equinox + 18 days
St. 13	9.11.0.0.0	None; *K'atun* end
St. I	9.12.3.14.0	Zenith passage + 16 days (*Ajaw* commemoration of 20 days after Zenith passage)
Chich'en I.S.L	10.2.9.1.9	Fall Equinox

The Error of the GMT

It bears mention that over the years, scholars have attempted to prove that the GMT is correct by appeal to the astronomical tables of the Dresden Codex.[42] In fact, these studies cannot prove a correlation, but only tentatively support one. The problem is that the information in the tables is underconstrained. While the celestial bodies involved might be securely identified, the anchors or base dates cannot be unequivocally identified without resort to a calendar correlation. Once a correlation is assumed, then a base date can be determined (or at least constrained), but this is precisely the point. Here we are trying to prove a calendar correlation, not bring one along by assumption. Therefore, in this study, I have appealed only to celestial references in the inscriptional record that are securely tied to Long Count dates. The end result is that the Solar Stelae at Copán, the *k'alaj k'in* events at Chich'en, and the Waxaktun Group-E dates all make Aveni's proposal that the Maya may have been commemorating some other partitioning of the solar year now seem untenable.

Specifically, according to the partitioning resolved here, St. 10 should correspond to 1 September. The GMT would place the date on St. 10 at 3 July, yielding a difference of 60 days.

[42] See, e.g. Lounsbury (1992:206).

Hence, the GMT is not 2 or 3 days off, nor even 20, but *at least* 60 days. I emphasize "at least" for two reasons. First, the most important assumption behind the GMT is that of continuity. Scholars have been willing to accept the criticisms of the GMT since the result is a continual Calendar Round count between ancient and colonial times.[43] Yet this continuity requires that we sacrifice the understanding that comes along with the ability to read the hieroglyphic script—namely, the inscriptions of the Solar Stelae at Copán, the architecture of Waxaktun, and the inscriptions of Chich'en Itza. Now, to accept the GMT is to accept that Balaj Chan K'awiil very well could have set his battle date by the appearance of Chak Ek', but the Early Classic rulers of Waxaktun, Copán Ruler 12, and the Terminal Classic kings of Chich'en Itza were all off on their solar calendar by 60 days! Second, simply pushing the correlation forward by 60 days would right the solar issue, but would violate most of the other associations that have been used to support the GMT.

Without continuity, the GMT loses its weight of argument and allows us to contemplate anew the criticisms that have been leveled against its acceptance in recent times. In particular, scholars of the Postclassic have noted that the GMT creates an ugly gap in the archaeological record.[44] Accepting these criticisms might revise the dating of Maya culture in the Christian calendar by up to 260 years.[45] This paper has not set out, however, to provide an alternative to the GMT correlation. Indeed, one cannot hope for an unseating of the GMT without treatment of the radiocarbon data that support it. While Arlen Chase has argued well that radiocarbon data alone are not sufficient to provide a calendar correlation, the weight that they bear is too great to be displaced by epigraphic and astronomically-based argumentation alone. It is now clear (to the author, at least) that a new alternative must be constructed through a concerted effort by epigraphers, archaeologists, and archaeoastronomers. In this age of "big science" in physics and biology, we might herein be confronting an issue that will require "big science" in the study of ancient Maya culture as well.

[43] Although see Arlen Chase's (1985) criticism of any kind of continuity thesis.
[44] Chase, *op. cit.*; Thompson (1971).
[45] See especially Chase (1985); also, see Aldana (in press).

Illustrations:

Figure 1: Morley's map of the Copán Valley with the locations of the valley stelae noted.
Figure 2: Solar partitions as recorded on the Solar Stelae.
Figure 3: Morley's drawing of Copán Stela 23. The *k'alk'in* glyph is in the middle text, in the right column, second block from the bottom.
Figure 4: *K'alaj k'in* from Chich'en Itza Las Monjas Structure, Lintel 4.

Works Cited:

Aldana, Gerardo. *Oracular Science: Uncertainty in the History of Maya Astronomy 500 - 1600.* Ph.D. dissertation, Harvard University: May 2001.

---------, "Solar Stelae and a Venus Window: Science and Royal Personality in Late Classic Copán", *Journal for the History of Astronomy* (Archaeoastronomy Supplement), in press.

Aldana and William Fash, "Art, Astronomy, and Statecraft of the Classic Maya", paper given at the symposium "Science, Art, and Religion in the Maya World", Copán, Honduras, 14 July, 2001; collection of papers in press.

Aveni, Anthony. *Skywatchers of Ancient Mexico*. University of Texas Press: Austin; 1980.

Aveni and Lorren Hotaling. "Monumental Inscriptions and the Observational Basis of Maya Planetary Astronomy" in *Archaeoastronomy*, no. 19, Supplement to the JHA, xxv, 1994.

Chase, Arlen. "Time Depth or Vacuum: The 11.3.0.0.0 Correlation and the Lowland Maya Postclassic", *Late Lowland Maya Civilization: Classic to Postclassic*, edited by Jeremy A. Sabloff and E. Wyllys Andrews V. Albuquerque: New Mexico; 1985.

Fash, William, *Scribes, Warriors, and Kings*. Thames and Hudson: London; 1991.

Freidel, David, Linda Schele, and Joy Parker, *Maya Cosmos: Three Thousand Years on the Shaman's Path.* New York: New York; 1993.

Gillespie, Susan and Rosemary Joyce. "Deity Relationships in Mesoamerican Cosmologies: The case of Maya God L" in *Ancient Mesoamerica* 9, 1998.

Kelley, David. "The Maya Calendar Correlation Problem" in *Civilization in the Ancient Americas: Essays in the Honor of Gordon R. Willey*. Richard Leventhal and Alan Kolata (eds). University of New Mexico Press: Albuquerque; 1983.

León-Portilla, Miguel. "Appendix B: Recent Contributions on the Theme of this Book." *Time and Reality in the Thought of the Maya.* Norman: Oklahoma; 1988.

Lounsbury, Floyd. "A Derivation of the Mayan-to-Julian Calendar Correlation from the Dresden Codex Venus Chronology" in *The Sky in Mayan Literature*. Oxford University Press: Oxford; 1992: pp. 184-206.

Morley, Sylvanus. *The Inscriptions at Copán*. Carnegie Publication 219: Washington D.C.; 1920.

Nahm, Werner. "Maya warfare and the Venus year" in *Mexicon*, Vol. XVI, February 1994, No. 1.

Plank, Shannon. "Ownership and Political Significance of *oto:t* 'dwelling' Structures at Chichen Itza", manuscript in possession of the author. June 2001.

Schele, Linda and Nikolai Grube. *Notebook for the XVIIIth Maya Hieroglyphic Workshop at Texas.* March 12-13, 1994.

Schele and Peter Mathews. *The Code of Kings: The Language of Seven Sacred Maya Temples and Tombs*. Simon and Schuster: New York; 1998.

Spinden, Herbert. *A Study of Maya Art: Its Subject Matter and Historical Development*, Volume 6, 1913.

Teeple, John E. *Maya Astronomy* Contributions to American Archaeology, Volume I, Nos. 1 to 4. Carnegie Institution: Washington; 1931.

Thompson. J.E.S. *Maya Hieroglyphic Writing: An Introduction*. University of Oklahoma Press: Norman; 1971.

Vogrin, Annegrete. "Astronomical orientation of Stela I, Copán" in *Archaeoastronomy Bulletin*, no. 2, 1976: pp. 10-11.

MORLEY. PLATE 3

Map of the Copan valley showing the location of the main structure and the outlying monuments.

Figure 1: Morley's map of the Copán Valley with the locations of the valley stelae noted.

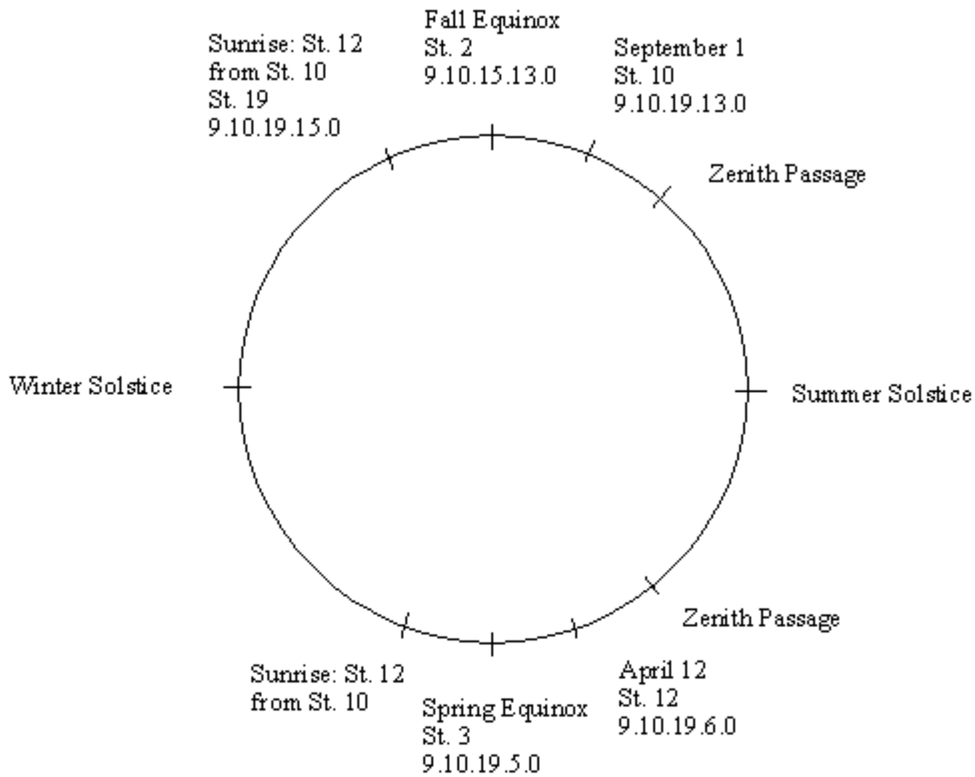

Figure 2: Solar partitions as recorded on the Solar Stelae.

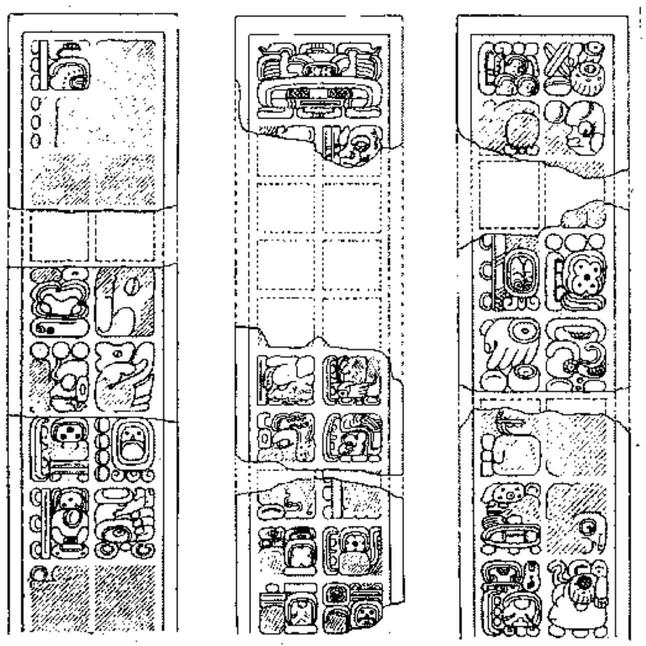

Figure 3: Morley's drawing of Copán Stela 23. The *k'alk'in* glyph is in the middle text, in the right column, second block from the bottom.

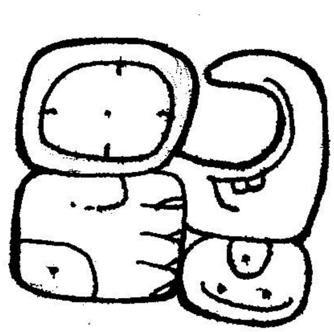

Figure 4: *K'alaj k'in* from Chich'en Itza...