GRAMMAR IN THE SCRIPT

GLYPH Y AS LORDS OF THE NIGHT G6 GLYPH AND ITS POSSIBLE ASSOCIATION WITH METEOR OUTBURSTS AND BIRTHS OF NOBLE PERSONS
by
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In a tomb discovered deep in the Guatemalan jungle in the early 1960's, ornate artwork covers plastered walls. The birth date of an unknown governor from the site of Rio Azul was recorded prominently in a painting covering the entire east end of the tomb (Figures 1, 2). Within this inscription, other glyphs known as the Supplementary Series record additional important information about this date such as lunar and possibly other astronomical data. One such glyph included in this inscription, known as glyph G, follows a continuous sequential cycle of a count of nine days known as the "Nine Lords of the Night." Any inscribed Long Count then might contain a particular G glyph assigned to it in tracking this count, known as G1 through G9. In our case, the painted date of 8.19.1.9.13, 4 Ben 16 Mol (AD 417 September 29[1]) (Adams, 1999: Plate 3) calls for a G glyph of G4. Why then, is G6 painted in an unmistakably clear scribal hand instead of G4? A blunder like this would be the equivalent of having a spelling error engraved on the granite headstone of an important figure, so how could this happen? That is the question that we will be discussing in this essay.

(Figure 1 omitted due to file size limitations).

Figure 1. Interior of the east end of Tomb 1, Rio Azul, displaying the drawing referred to in Figure 1. (From the website http://www.latinamericanstudies.org/rio-azul.htm)

Yasugi and Saito call this error "perplexing" and note that glyph G6 is composed of two elements, the number nine (9) [one bar and 4 circles] and the enigmatic "Y" glyph (1991:7, 8). There are only a handful of cases in the entire corpus of inscriptions where G6 physically appears in the Supplementary Series in the Classic Period (see ibid., figure 4), even though there is no shortage of recorded dates that call for G6. Eric Thompson initially misidentified the glyph for G7 as the glyph for G6 because of the dearth of examples (1950: Figure 34). Interestingly nearly all of the identified Long Count dates containing painted or inscribed G6 glyphs are associated with birth as the main event (figure 4; discussed later).

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[1] All dates converted to the Christian calendar are Julian Dates using the Martin-Skidmore correlation (Martin and Skidmore, 2012).

Initial Series Introductory Glyph (ISIG)	
8 B'ak'tuns	19 Winikhaab'
1 Haab'	9 Winik
13 K'in	4 Ben
9 Y (G6 [G4 is required])	glyph F
11 days since it (new moon) arrived	2nd JGU lunation
29 day lunation	16 Mol
(after) he was born	Governor "X"

Figure 2. Inscription at east end of Tomb 1, with Long Count 8.19.1.9.13, 4 Ben 16 Mol, 417 September 29 (Drawing by Mary Jane Acuña after photo by George F. Mobley). (JGU = Jaguar God of the Underworld).

Glyph Y has been classified into four categories by Yasugi and Saito: the first as one of the Nine Lords of the Night, called G6 as mentioned above; the second representing a continuous count of seven (7) where a numbered coefficient between zero and six (most likely, instead of 1 through 7) is usually included as a coefficient for Y, located between glyphs F and E; the third in miscellaneous positions; the fourth within the 819 day count clause usually following the 29 or 30 day lunation glyph block of the Supplementary Series (1991:1). The first three are found within the Supplementary Series. When glyph Y is found in the Lords of the Night as G6 in the Supplementary Series, it is prefixed or superfixed by a nine coefficient. Although Grofe believes the number nine may be related to the Draconic month (related to lunar nodes) (2014:147-149), in the author's opinion, the reason for the 9 coefficient is to label the Y glyph as being part of the Lords of Night 9 count and to visually set it apart from the count of seven, since 9 is an impossible coefficient for the count of 7.

The Supplementary Series was so-called because it represented a series of glyph [blocks], "collocations"/clusters of glyphs with seemingly little connection to the main body of the text. Because the numbers of these glyph blocks varied but all seemed to end with a glyph collocation representing the number 29 or 30, Morley labeled that glyph block A and then worked backwards ending with G, just prior to the Initial Series date, so that the normal reading order follows Glyphs G, F, E, D, C, X, B and A (1916). Two other glyphs occasionally appeared between Glyphs F and E, which Andrews IV called Glyphs Z and Y (1938:30), and which Yasugi and Saito found to be a count of 7 (1991). Glyph G was labeled the Lords of the Night due to its seeming connection to the Aztec cosmology by Thompson (1929).

Perhaps the easiest way to see how all this fits together would be to take an example with as many of the components as possible. Unfortunately there is only one example out of 23 counts of 7 where the G glyph is G6, and that is Yaxchilan Stela 6. There the coefficient glyph Z is 2, and Yasugi and Saito state that 2Y is found below the main text. Yaxchilan's Lintels 29 and 30, read sequentially, provide the best example overall; however instead of G6 the Initial Series date calls for G7.

In Figure 3, Yaxchilan Lintels 29, 30 and the first two glyphs of Lintel 31 are combined sequentially in their proper reading order in a horizontal fashion, read line by line, left to right. The Initial Series Introductory Glyph (ISIG) begins the reading in the top left corner, followed by the Long Count, 9.13.17.12.10 and then the day name with eight coefficient, 8 Ok. The first glyph block of the second line begins with the first two glyphs of the Supplementary Series, G and then F. As mentioned above, the G glyph is G7, as called for by the Long Count. In a Long Count calling for G6, this then is the position where we would find G6. Glyph Z (at coordinate B2 in Figure 3), the coefficient for Y in the count of 7, follows Glyph F. In this particular case and several others, a numeral classifier, *b'ix*, is used following the number and prior to the noun, glyph Y (Macri, 2000:21; Kinsman, 2007:18). Regarding the numeral classifier, Macri translates (from Barrera Vásquez et al, 1980:58), "when following a number it expresses time or period completed, such as *ho'b'ix* the fifth day" (ibid.).

More often than not Glyph Z is composed of just the number coefficient (Yasugi and Saito, 1991: figure 2); a classifier's use as an optional written element is noted by Stuart and Houston (1994:14). Following the Z glyph is the Y glyph, sometimes known as the "squashed beetle" because of its appearance, which is without satisfactory translation. There are several variants within the four different categories and can be seen in Yasugi and Saito (1991).
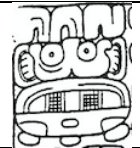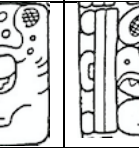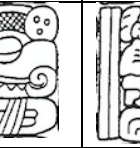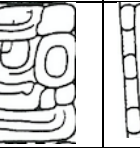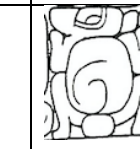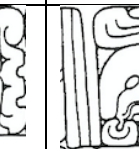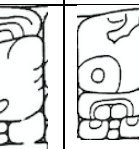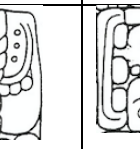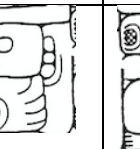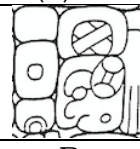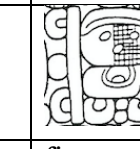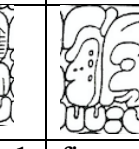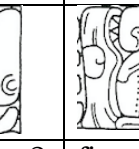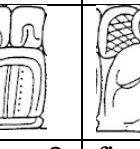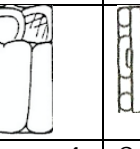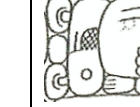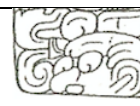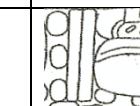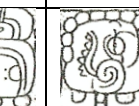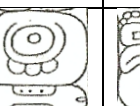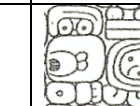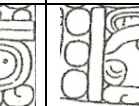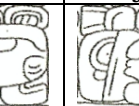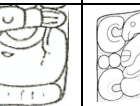
A	B	C	D	E	F	G	
ISIG	9 Bak'tun	13 K'atun	17 Tuns	12 Uinal	10 K'ins	8 Ok	1
G(7) F	Z=5	Y	E=15	D	C=5th	X	2
B	A=30	fire seq-1	fire seq-2	fire seq-3	fire seq-4	819-1	3
819-2	819-3	819-4	819-5	819-6	819-7	819-8	4
819-9	819-10	13 Yax	Predicate	Subject	Title	title-EG	5
DN-1	DN-2	11 Ajaw	8 Sek	Predicate	Subject	Titles	6

Figure 3. Combined Yaxchilan Lintels 29, 30 and first two glyph blocks of 31. Coordinates are strictly for this table and are not related to the individual lintels. (Drawings by Ian Graham).

The next six glyph blocks comprise the Lunar Series (Teeple, 1930). The coefficient 15 is glyph E and indicates the age of the moon in days ("15 days"), however the rest of the collocation is non-standard, **ni**-ANIMAL-HEAD-**ya**, and seems to function as a numeral classifier similar to the earlier *b'ix* collocation. The following collocation, the D glyph, *huliiy*, translates to "since it [new moon] arrived." (MacLeod,1990:339-343). The C glyph follows, a numbered lunation (one synodic cycle [time from any specific moon phase to the next same phase]) in three groupings of six lunations each, following the sequence of the 1st through the 6th lunation. Three different heads representing each of the three groups are found in the C glyph collocation, the Death God (God A), the Tonsured Maize God (Juun Ixiim) and the Jaguar God of the Underworld (JGU), indicating three separate lunar patrons for three separate "semesters" of 177 or 178 days each (see Zender and Skidmore, 2012:8-13). Glyph X is the name of the lunation (see Grube, 2018), noted as the B glyph "its young-sprout name", **u-[ch'o-ko]-K'ABA'**, *u ch'ok k'aba'*. The A glyph, the number of days of the

lunation is 30, **WINIK-ki**-10 [20 + 10 days], and ends the Lunar Series. After Zender and Skidmore, the author writes the translation of this lunar information, "It is (now) 15 days since the 5th Death God appeared. The child name of this 30 (day-long [lunation]) is 'X'" (Zender and Skidmore, 2012:9). For more information on the Lunar Series, see (Schele, Grube and Fahsen, 1992) where the three lunar patrons are noted by Female (Tonsured Maize God), Young Lord (Jaguar God of the Underworld) and Skull (Death God) and also Thompson (1950:236-246).

The next four glyph blocks, C3 through F3, make up a series of glyphs that Grube calls the Fire Sequence (abbreviated "fire seq"), a hieroglyphic formula that sometimes appears in the context of the Initial Series on Classic Period monuments (2000:93-109). In general the fire sequence is a clause made up of three separate glyph clusters, the verb, object and subject; in the case under discussion the first collocation is somewhat non-standard, 6-**B'IX(?)-ji-ya** (6 *b'ixjiiy*), where Stuart then reads the entire sentence that the birth of Bird Jaguar "occurred six days (?) after 'the fire of God N-Possum was drilled'" (1998:404). The fire sequence itself transliterates and transcribes, **jo-ch'o-ji-ya**, **u-K'AHK'**, God N-Possum, *joch'ajiiy u-k'ahk'* God N-possum.

The 819 (Maya 2.4.19) day station count (a continuous running cycle of 819 days) then continues with the distance number 1.1.17 (counts backwards to 9.13.16.10.13, the previous 819 day station); 1 Ben (819-3); 1 Ch'en (819-4); since it was stood up (819-5); (in the) east (819-6); red (819-7); glyph Y (819-8); K'awiil (819-9); 1 *ch'ok*, "young sprout" (819-10). The following collocation, 13 Yax, is the haab' date for the Initial Series Long Count, which ends the Initial Series. Then follows the actual verb of the predicate, is/was born; the subject, Bird Jaguar IV; and titles, he of 20 captives (coordinate F5); K'uhul Ajaw (divine lord) of Yaxchilan; distance number 2.3.5.10 (DN-2, DN-1) (counts forward from the initial Long Count to 9.16.1.0.0); and then it happened on 11 Ajaw 8 Sek; he tied on the headband in the ajawship (Predicate); Bird Jaguar IV (Subject); he of 20 captives, 3 K'atun Ajaw (Titles).

The Y Glyph at G position, known as G6

Having seen the how the Y glyph works in the Lords of Night G, 7-count and 819 positions, we now return to the Y glyph as G6. As noted above, there are only a small number of the actual G6 glyphs painted or inscribed in the corpus; Yasugi and Saito note eight examples (1991:8, Figure 4), and the author notes one more possibility from Itzan Stela 17, all of which are reproduced in Figure 4.

#	Location	G	IS Date	Event	Y glyph	Met Showr	Outburst
1	Rio Azul Tomb 1(A5)	G 4	8.19.1.9.13 4 Ben 16 Mol 417 Sep 29 209.5°	Birth "Governor X" Rio Azul (A8)		Orionids 202.4°-207.5° (vy hi prob)	417 Sep 24 Stela date 5d after strong OB.
2	El Resbalon HS1 (22a)	G 6	9.4.14.10.4 5 K'an 12 K'ayab 529 Feb 24 358.7°	Dedication ?(1 k'atun anni acc?) eroded		none known	Unknown.
3	Tikal St 17 Left (B4)	G 6	9.6.3.9.15 10 Men 8 Ch'en 557 Sep 16 195.7°	eroded		Orionids 202.4°-207.5° (vy hi prob)	Unknown. Stela date ~ 7d prior ORI.
4 a	Caracol St 3 back (A6a)	G 6	9.6.12.4.16 5 Kib 14 Wo 566 Apr 23 54.8°	Birth Lady B'atz' Ek' (A8b)		Eta Aquar. 41.0°-43.3° (vy hi prob)	566 Apr 10 Stela date 13d after mod OB
4 b	Caracol St 3 back (A6a)	G 1	9.7.14.10.8 3 Lamat 16 Wo 588 Apr 19 51.3°	Birth K'an II (B17a)		Eta Aquar. 41.0°-43.3° (vy hi prob)	588 Apr 11 Stela date 8d after OB.
5	Moral Reforma St 4 back (F6a)	G 6	9.11.3.5.14 10 'Ix 7 K'ayab 656 Jan 19 321.1°	Birth Muwan Jol? Pakal (A9)		SH-33 324.3°-324.9° (med prob)	Unknown. Stela date ~ 3d prior SH-33
6	Yaxchilan St 6 (temple side) (A6)	G 6	9.11.16.10.13 5 Ben 1 Wayeb 669 Feb 18 351.8°	2 K'atun Anni Bird Jaguar III acc (C6)		SH-34 343.0°-345.4° (low prob)	Unknown. Stela date ~ 6 days after SH34
7	Edzna St 18	G 9	9.12.0.0.0 10 Ajw 8 Yaxk'in 672 Jun 29 118.6°	Birth? (eroded D3) [lunar age eroded?		SH-7 111.0°-111.9° (low prob)	Unknown. Stela date ~ 6d after SH-7
8	Naranjo St 22 (F4)	G 6	9.12.15.13.7 9 Manik'0 K'yab' 688 Jan 4 305.6°	Birth K'ahk' Tiliw Chan Chaak (F6)		SH-32 299.7°-304.1° (hi prob)	Unknown. Stela date ~1-2d after SH-32
9	Itzan St 17 (A4a)	G 6	9.15.4.15.3 5 Ak'bal 11 Xul 736 May 27 86.8°	Birth U-[eroded] (A9)		SH-5 83.1°-84.1° (med prob)	Unknown. Stela date~ 2-3d after SH-5.

Figure 4. Known examples of G6 in the corpus. G6, Itzan Stela 17 is not certain due to erosion of the G glyph, however, the glyph resides in the G position and does not resemble any of the other G numbers. Shower (SH) probability abbreviations: vy = very; hi = high; med = medium; prob = probability. OB = outburst; mod = moderate; d = day; acc = accession (Solar longitudes are in degrees and are based on a J2000 reference [see appendix C]). (Photo of G6 glyph for Edzna taken from Andrews, 1969: Plate 66). (Drawings by various authors, see Yasugi and Saito, 1991:8, figure 4).

Of the nine examples (4b not included), the main event is only able to be confirmed on 6 of them, and the birth event makes up five of these: Rio Azul Tomb 1, Caracol Stela 3, Moral Reforma Stela 4, Naranjo Stela 22, and Itzan Stela 17 (excludes Yaxchilan Stela 6). As a matter of note, the date of 9.12.0.0.0 on Edzna Stela 18 requires G9, however G6 is carved; since the main verb is eroded, no explanation for this error can be given.

Two of these five births were likely followed by significant meteor outbursts (Kinsman and Asher 2017; Kinsman and Asher, 2020), the other three occurred around the dates of ancient meteor showers of varying probability.

It is possible that the Maya may have reserved the use of G6 in the inscriptions to be included where a birth occurred as a serendipitous event shortly after a meteor outburst. Of course, the data samples are quite small, so this supposition cannot be confirmed at this time. However, the circumstances do suggest a possible link between birth, the use of 9Y as G6, and meteor showers.

Grofe has previously suggested a connection between glyph Y and Unen K'awiil ("Baby K'awiil") (2006). Noting that Thompson related god K to Kauil [K'awiil] (1970:226), Stuart determined that god K and K'awiil were one and the same entities (1987:15). Taube equates the fire serpent to the burning serpent foot of god K, in addition to alluding to lightning (1992:79) and furthermore, Taube equates the fire serpent to meteors as well (2000:289-301). Given that "A deity identified with lightning, rain, and fertile maize, god K epitomizes the vital, engendering force from which life comes" (Taube, 1992:79), it makes sense for the Maya to relate god K to birth. In fact, Houston and Stuart translate the 819 day cycle clause on the East Door, South Jamb of Copan Temple 11, "his foot [god K] is the *way* of god K" (1989:8, figure 6d) and suggest a relation of the serpent *way* to birth on Yaxchilan Lintel 14 (page 7, figure 4). The author discusses these connections in light of this new evidence.

1. The date painted on the wall in Rio Azul Tomb 1, 417 September 29, occurs five days after a highly probable strong meteor outburst [a meteor outburst yields a meteor rate of fall at least 2-3 times the normal rate), that likely occurred at about 01:30 AM on the morning of September 24 (Kinsman and Asher, 2020). As Kinsman and Asher discuss, orbital integrations revealed only two probable outbursts of the Orionid meteor shower (ORI, International Astronomical Union [IAU] #008) out of a total of 30 possible dates during the entire Classic Period, one in 417 and one in 585 (ibid.). This finding likely shows that Orionid outbursts during this period were rare and agree with only two similar sightings recorded by the Chinese, one in 288 and one in 585 (Pankenier et al, 2008:309, 313; Imoto and Hasegawa, 1958:136, Table 1). In fact, Kinsman and Asher were able to verify the historical Chinese AD 585 outburst. Furthermore, they were able to determine that the dust particles that caused the 585 China outburst came from the same compact stream of particles likely seen by the Maya (Kinsman and Asher, 2020: figure 2). If in fact the annual Orionid meteor shower was routinely observed by the Maya as the author believes likely, a strong and rare outburst would have been an event of significant magnitude and the Maya may have wanted to somehow note this event; that the birth of an important ruler followed was likely serendipitous. Thus the recording of G6 on the ruler's birth may have been an intentional error despite the fact that the Long Count called for G4. As a matter of note, the 11 day lunar age recorded in Tomb 1 for the same date is also erroneous; the

actual age of the moon on September 29 was 3 days, however on the previous 11 day old moon on September 8 there occurred a Venus superior conjunction (2009, Simulation Curriculum Corp.) Again, whether this error was intentional is unknown.

2. Lady B'atz' Ek's birth date, 566 April 23, carved on Caracol Stela 3 occurred 13 days after a probable moderate outburst of the Eta Aquariid meteor shower (IAU#031) on the morning of April 10 at about 04:00 AM local (Kinsman and Asher, 2017:118, Tables 1, 4). Assuming that the birth following the outburst was a serendipitous event, the Maya may have wanted to note the event by actually recording G6. Further down that same column on Stela 3 the birth of K'an II, the son of Lady B'atz Ek', is recorded on 588 April 19. A weak outburst likely occurred on April 11, (ibid., Table 1), eight days prior to the birth, although the G glyph, G1, not inscribed on the stela, corresponds to the birth date of K'an II.

3. The birth of Muwan Jol? Pakal is recorded on the back of Stela 4 at Moral Reforma. His birth on 656 January 19 corresponds to a solar longitude of 321.1°, about three days prior to medium probability shower SH-33 (according to author's scale, see appendix C). Since current knowledge of the orbital mechanics of an ancient meteor shower seen only in the Classic Period (and not today as well) prevents analysis of the meteoroid stream, there is no way to scientifically analyze this shower for meteor outbursts. Therefore it is conjecture to intentionally connect a birth that occurs prior to a possible outburst of this meteor shower and thus any possibility in this category will not be included in the present analysis.

4. The Birth of K'ahk' Tiliw Chan Chaak on 688 January 4 recorded on Naranjo Stela 22 occurs only one or two days following the high probability shower SH-32. Aside from the Eta Aquariids and the Perseids, Shower 32 was the most active meteor shower (number of outbursts recorded) during the period of AD 250-900 (see Jenniskens, 2006: Table 1). Kresakova makes a possible connection between outbursts of this shower noted by Japan in January of 685 (Pankenier et al, 2008:314; Imoto and Hasegawa, 1958:137, entry 104) and a comet observed by Japan in the Pleiades seen in the month of 684 December 12 to 685 January 10 (Pankenier et al, 2008:78; Ho, 1962:170, entry 258) (Kresakova, 1987:77, 78; 1986:343, Table 1). Although as with Shower 33, there is currently not enough information to analyze the orbital mechanics for this shower and therefore we only have a similar solar longitude to associate this birth date with this shower.

5. The birth of [unknown subject, eroded] is recorded on Itzan Stela 17 and likely includes the Y glyph as G6, although the monument is somewhat eroded. If this is true, the date of the birth, 726, May 27 (86.8° solar longitude), is only 2-3 days following Shower 5 (later named as such by Jenniskens, 2006:599, Table 1), which was first seen in AD 466 (Pankenier, et al, 2008:312; Hasegawa, 1993:212, Table 1, entry 37; Imoto and Hasegawa, 1958:134, entry 19). Kresakova notes that outbursts [for Shower 5] may be associated with a comet in the year 1539 (the only comet for that year) now known as C1539 H1. The comet of 1539 was noted worldwide (Pankenier et al, 2008:216-217; see Kronk, 1999 [2013]:307, 308), perhaps even by the Aztecs (Codex Telleriano-Remensis, fo. 45v; Codex Vaticanus 3738 A, fo. 92v; see Köhler, 1989:291) (Figure 5). Furthermore, at least three royal accessions followed possible outbursts of Shower 5 by 1-4 days: Moon Jaguar, Copan, on 9.5.19.3.0, 553 May 25, solar longitude 85.5°; K'ahk' Tiliw Chan Chaak, Naranjo, on 9.13.1.3.19, 693

May 29, 88.4°; U Kit Kan Lek, Ek' Balam, on 9.16.19.6.1, 770 May 27, 86.1°. Kinsman and Asher proposed that some royal accessions were triggered by meteor outbursts in a scientific study of the Eta Aquariid meteor shower using orbital integrations (2017). With some parameters known to a certain degree, if the period or size of the orbit of comet C 1539 H1 can be determined then it may be possible to reveal possible Classic Period outbursts of this shower. Itzan Stela 17 Supplementary Series also includes the fire sequence, **ti-li-li u-K'AK' CHAK XIB CHAAK**(?) (Grube, 2000:103, Table 1), *tilil u-K'ak' Chak Xib Chaak* (?), "(it is) the burning of his fire, Chak Xib Chaak."

(Figure 5 omitted due to size limitations)

Figure 5. The possible sighting of the Comet of 1539 by the Aztecs as noted in the Codex Telleriano-Remensis, fo.45v. (From the website: http://www.famsi.org/research/loubat/Telleriano-Remensis/page_45v.jpg).

Comparison of births correlated to other Lords of Night G numbers

By perusing Appendix A, the Birth Data table, containing 52 births known in the corpus arranged according to glyph G number, one can see that the only grouping containing any possible significant meteor events is G6, except for the G1 as already noted for the birth of K'an II in 588 on Caracol Stela 3 (following the birth of Lady B'atz' Ek' in 566).

In two cases there was a slight possibility of a very minor outburst, one in 750 related to the birth of Piedras Negras Ruler 7 on April 8, G3 (Throne One), and the other in 606 related to the birth of K'inich Bahlam Chapaaht on April 14, G9. In both cases the data was not sufficient to justify an outburst near those dates (Kinsman and Asher, 2017:115, Tables 2 & 3, data in possession of authors).

Possibilities related to all G values are (see Appendix A): G1, 1 out of 5 (one outburst of a very high probability shower, however this particular birth was a secondary event to the main birth event); G2, 3 out of 6 (all low probability); G3, 3 out of 4 (1 low, 1 very low probability, and a slight possibility of an ETA outburst); G4, 1 out of 3 (1 low probability); G5, 2 out of 4 (1 low, 1 very high probability); G6, 5 out of 9 (2 very high, 1 high, 1 medium and 1 very low, including 2 probable calculated outbursts); G7, 5 out of 9 (1 high, 2 medium and 2 low probability); G8, 2 out of 6 (1 medium and 1 low probability); G9, 3 out of 6 (1 very high, 1 medium and 1 low probability; in the case of the very high outburst, data was obtained but timing was off by about 7 hours).

Conclusion

Two significant probable meteor outbursts may have occurred with G6 included in the Supplementary Series when a birth was the subject of that Long Count. Given a conceivable meteor connection of the other examples then, when the glyph G6 is

inscribed in the supplementary Series accompanying the birth event, it may indicate that a meteor outburst has occurred (though not on the inscribed date). The question of whether G6 instead of G4 was painted as an intentional error in Tomb 1 at Rio Azul is not known for sure; however, this example remains a prime candidate for such a device that the Maya might have used. Furthermore, the question might be asked, if there was a meteor outburst, did the Maya "adjust" the birth date so that it fell on a G6 day?

Acknowledgment

Appendices

Appendix B. *Meteor showers possibly observed by the ancient Maya, with probabilities for each shower.* The author classifies the four showers seen today that were seen by the Maya, the Lyrids (LYR, IAU#006), Eta Aquariids (ETA, IAU#031), Perseids (PER, IAU#007) and Orionids (ORI, IAU#008) as very high probability showers, Shower 32 as high probability (because of high historical activity reported by China during the Maya Classic Period); Showers 5, 9, 12, 25 and 33 medium probability because of low historical activity but seen during most of the Classic Period; Showers 1, 7, 16, 17, and 34 low probability showers due to low activity and having only been seen during a small part of the Classic Period). Aurigids (AUR, IAU#206), Geminids (GEM, IAU#004), and alpha Monocerotids (AMO, IAU#246) are very low probability. L = Shower due to long period [period = time to complete one orbit] comet (>200 year period). H = Halley type comet (20-200 year period). J = Jupiter type comet, < 20 year period. lo = low; vl = very low; md = medium; hi = high; vh = very high; Obvr = place of observation; C = China; J = Japan; E = Europe; K = Korea. Solar Longitudes (Sol Ln, degrees) represent the lowest and highest of the observed outbursts, not necessarily on the adjacent dates. Julian Dates (Dt) reflect the first and last time the shower was observed (in the historical era or the Classic Period; the four major showers are still seen today as noted above), not necessarily by the adjacent observers in the Obvr column. Numbering system for meteor showers devised by Jenniskens (2006:598-611, Table 1. (Shower 1 previously labeled "A", Shower 15 previously B, Shower 17 previously C and Shower 25 previously D by Imoto and Hasegawa, 1958:134-140, Tables 1 and 2).

#	Sol Lnº	Julian Dt (UT)	Obvr	Shwr	#	Sol Ln	Julian Dt (UT)	Obvr	Shwr
1	21.9 22.2	36 mar 17.2 581 mar 20.7	China Korea	SH-1 H/lo	11	175.9 176.1	884 aug 29.7 1610 sep 13.7	Japan China	SH-16 L/lo
2	32.0 32.5	687bc mar 23.7 1803 apr 20.3	China	LYR L/hi	12	187.1 188.6	881 sep 11.2 1863 sep 25.7	China Korea	SH-17 H/lo
3	40.2 43.2	74bc apr 6.0 839 apr 13.7	China Korea	ETA H/vh	13	202.4 207.5	288 sep 25.3 585 sep 23.7	China	ORI H/vh
4	83.1 84.1	466 may 22.7 1539 may 30.7	China	SH-5 H/md	14	239.2	1885 nov 9.7	China	AMO L/vl
5	111.0 111.9	841 jun 23.9 1862 jun 1.7	China	SH-7 HL/lo	15	240.7 240.8	643 nov 1.7 1665 nov 17.9	Korea China	SH-25 HL/md
6	132.6 133.2	708 jul 14.6 714 jul 15.8	China	SH-9 J/md	16	264.3	685 nov 24.7	Japan	GEM J/vl
7	137.8 140.4	36 jul 17.9 841 jul 21.7	China	PER H/vh	17	299.7 304.1	609 dec 28.9 764 dec 31.2	Mecca C/J/E	SH-32 JH/hi
8	150.2 150.5	464 jul 31.7 1581 aug 7.7	China	SH12 H/md	18	324.3 324.9	308 jan 20.7 1869 feb 11.7	China	SH-33 L/md
9	157.9 159.0	1589 aug 25.7 1885 aug 30.7	China	AUR L/lo	19	343.0 345.4	913 feb 13.9 1410 feb 15.7	Italy K/E	SH-34 H/lo
10	166.1 167.4	1037 aug 21.7 1560 aug 24.7	China Korea	SH-15 L/vl					

Appendix C. *Explanation of Solar Longitude (Sol Ln) (from Kinsman, 2019: footnote 19).*
Meteor streams and outbursts are noted by their bearing to the Sun in terms of degrees of a circular orbit about the Sun known as "solar longitude". Based on a fixed reference point, the vernal equinox, which periodically readjusts due to the precession of the Earth's axis, currently is known as J2000 and the solar longitudes in degrees for given meteor showers and outbursts are based on this reference point. Since there are 360º in a circle and 365 days in a year, one degree roughly corresponds to one day. Although the bearing of a solar longitude relates to the Sun, the meteor streams themselves, some of whose orbits stretch far outside the orbits of our planets, are noted in relation to the background of stars, and thus fall under the realm of the Earth's sidereal year. Whereas the farmer, who relies on positions of the Sun, equinoxes and solstices for agricultural purposes, is concerned with the Gregorian calendar which maintains the same dates for these solar positions throughout the centuries, an astronomer who was concerned with the regularity of phenomena like meteor showers would be concerned with the Earth's sidereal cycles. A meteor stream such as the annual Perseid meteor shower maintains a fairly consistent position at about 139º-140º over a 2000 year period, varying by no more than about one degree (Hughes and Emerson, 1982). In reality then, it is in the course of the Earth revolving in its orbit about the Sun that it passes through a stream of particles (also in its own [elliptical] orbit) that is basically considered stationary in space and known by its

position in solar longitude. Jenniskens has numbered 34 (some of the numbers are current-named showers) of the ancient showers (2006:598-611, Table 1); 16 of these the author had selected as possibly being observed by the Classic Period Maya and earlier (Kinsman, 2014:92, Figure 4). In the current paper, the author considers 19 annual showers, four of which are named and seen today, listed by solar longitude in degrees (Appendix B).

Appendix D*. Site codes.* AML = La Amelia; AGT = Aquateca; CAY = El Cayo; CLK = Calakmul; CRC = Caracol; CRN = La Corona; DO pan = Dumbarton Oaks panel; DPL = Dos Pilas; ITZ = Itzan; MRL = Moral Reforma; NAR = Naranjo; NLP = Nim Li Punit; PAL = Palenque; PNG = Piedras Negras; PUS = Pusilha; TIK = Tikal; TNA = Tonina; TRT = Tortuguero; YAX = Yaxchilan; ZBL = Zapote Bobal; ZPT = Zac Peten.

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(Figure 6 omitted due to file size).

Figure 6. A green and red <u>Orionid</u> <u>meteor</u> striking the sky below <u>Milky Way</u> and to the right of <u>Venus.</u> <u>Zodiacal light</u> is also seen at the image The trail appears slightly curved due to edge distortion in the lens. (By Brocken Inaglory, CC BY-SA 3.0, <u>https://commons.wikimedia.org/w/index.php?curid=17776217</u>)