GRAMMAR IN THE SCRIPT

METEOR SHOWERS IN THE SCRIPT: PART 2

by
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Introduction

This essay is the second part of a series describing possible encounters that the Maya may have had with meteor showers. Given the large number of Maya screen-fold books that the Spanish burned during their incursion beginning in the 1500's (Gates, 1937:iii), it seems likely the Maya astronomers recorded actual annually-occurring meteor showers and occasional meteor outbursts. Since none of these simple observations seemed to have survived, this author believes and has recently provided evidence for date-specific meteor showers embedded in the Maya hieroglyphic codices (Kinsman, in press). In this essay the author will discuss certain results from that study in detail, mainly the probable recording of the Perseid meteor shower in the codical almanacs, the strongest annual shower that the Maya would have observed. As in previous publications, the author will follow the 584286 correlation constant in correlating Maya dates to the European calendar following recent literature (Kennet et al, 2013:1-5; Martin and Skidmore, 2012:3-16), although see footnote below explaining how 584283 correlation constant could be acceptable for a solution of the cognate Dresden and Madrid almanacs.

Review

Important points to remember from the previous essay include the connection of the scarlet macaw and fire to meteors (incantations from the Ritual of the Bacabs [Roys, 1965:xviii-xix, 51, 100]); a scarlet macaw's tail feather was used as a torch in Maya mythology (Christenson, 2007:131). Karl Taube interprets the twisted cords shown on Kerr vase K688, a scene from Na Ho' Chan as fire-drilling in addition to birth and creation (2000:292). Fire-drilling is specifically mentioned in incantation XXVII, *the words for fire biting on wood* (Roys, 1965: 51, 100), which Schele and MacLeod relate to the sky and first fire of Creation (Schele, 1993:7). Schele and MacLeod also note that the phrase in traveler-seizure, *ho ti munyal,* "five in/into/from the clouds" may refer to the same general area as *Na Ho Chan,* the Gemini-Orion junction (Schele, 1993:5); Tzab, the snake-rattles or Pleiades constellation is found in the fifth layer of the sky (Roys, 1965:7) and the Pleiades is flanked by the Perseid radiant.

Meteor showers occur on an annual basis (sidereal, i.e. in relation to the stars), and solar longitude is basically the bearing of the planet Earth to the Sun, measured from the intersection of the Earth's equatorial plane and the Earth's orbital plane (ecliptic) at the vernal (spring) equinox. Solar longitude, measured in degrees from 0° to 360° in a circle about the Sun (the Earth's orbital plane), is representative of a specific position in space of the Earth in its orbit. For instance, the Perseid meteoroid stream of dust particles exists in space positioned nearly perpendicular to and passing through the Earth's orbital plane at about a 140° bearing to the Sun. The stream's position has changed very little in the past two thousand years (Hughes and Emerson, 1982:39-42). As time passes, the calendar date increases where the Earth passes 140° solar longitude because the Earth's axis precesses. Specific meteor showers occur annually but meteor outbursts[1] occur occasionally for different reasons. Since the Maya could track the sidereal Earth year (Kinsman, in press:119-120; Grofe, 2011:85), they possibly could have been tracking the annual meteor showers (Kinsman, 2014:9-13, 17).

Discussion of Dresden D.38b-D.41b and Madrid M.10a-M.13a Eclipse Almanacs

Two examples of the Perseid meteor shower possibly appear in two cognate (very similar) almanacs, the Dresden codex, pages 38b to 41b and the Madrid codex, pages 10a to 13a[2]. The two 540 day or "double Tzolk'in" (twice the 260 day calendar) almanacs are considered cognate for length, subject matter and intervallic sequence (intervals of counted days between frames) (references below). For discussion purposes the author refers the reader to Table 1 and Figure 1. Table 1 has the mechanics, dates and numbers of each almanac compared frame-by-frame, side-by-side in vertical fashion while Figure 1 shows the beginning frame of each almanac followed by frame 8 (also known as frame H) for each almanac. Bricker and Bricker discuss Dresden codex D.38b-D.41b and Madrid codex M.10a-M.13a in detail and note that each relates the cycle of eclipse seasons with meteorological phenomena and the agricultural cycle (2011:342-351, 351-357). Aveni compares both almanacs to one another focusing on the intervallic sequences (2004:158-168). In fact, Aveni asks the following questions that this author's study may serve to answer: 1. Can subtle differences among cognates (e.g., shifts of starting points, days added or subtracted…) offer any indication of relative chronology? 2. Can astronomy be shown to be a motivating factor in altering the intervals based on events in the seasonal calendar? Specifically, can astronomical knowledge incorporated in one almanac be used to date its cognate? (Page 152).

[1] This author follows Jenniskens (1995:206) in the use of the term "outburst or meteor outburst" to mean "all those events of enhanced meteor stream activity that stand out significantly above the random variation of annual activity (if any)." Other terms used such as "storm", "rain" or "blizzard" are somewhat vague and popular usage can be ambiguous. In this essay the author will use the term "shower" or "meteor shower" to mean the normal activity of a particular meteoroid stream.

[2] The *a* and *b* suffixes to the page numbers refer to the registers (rows) of the frames on each page of the almanac as lettered from top to bottom.

9.17.4.6.19 **19/20 May**
6 Kawak 775
(12 Xul) **+ 16**

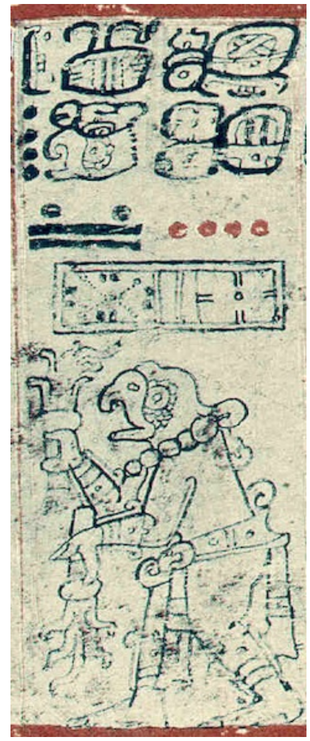
A **B**

u-K'AHK'

NAL
4-MO'

ti-CHAN
-na

K'IN HAAB'
TUN



22/23 July
775

140.20º
23.5 July
(UT)
Perseids

9.17.4.10.3
5 Ak'bal
(16 Ch'en) **+ 12**

10.5.4.12.19 **29/30 May**
6 Kawak 933
(2 Ch'en) **+ 16**

10.5.4.15.15
10 Men
(18 Sak) **+ 12**

24/25
July
933

141.50º
25.5 July
(UT).
Perseids

Figure 1. Top: Dresden almanac D.38b-D.41b, Frames 1 (A) and 8 (H). (Forstemann, 1880). Bottom: Madrid (Tro-Cortesianus) almanac M.10a-M.13a, Frames 1 (A) and 8 (H) (Graz edition).

Prior to the painting of the vulture in the first frame of each almanac is a column of five day signs with a red bar and dot at the top. The day signs, listed in order from top to bottom, identical in each almanac, are Kawak, Ak'bal, Manik', Chuwen and Men. The red bar and dot, the number 6, is the coefficient of the first day sign to begin the sequence in each almanac. Thus the first day of each almanac is "6 Kawak." At this point, we do not have any more information on when this 6 Kawak occurred in the Long Count or what the associated month and its coefficient in the Calendar Round might be. The picture of the vulture and the associated text, with two columns of glyphs (referred to as A and B) above however, apply to the day 6 Kawak. Now the sequence of counting begins by adding the black number 16, that is the three bars representing 5 per bar and one dot representing one, to the red 6 coefficient to obtain the red number nine immediately to the right of the black 16. The number 16 is shown as a "plus 16" in the caption below each picture in Figure 1 and in the first block in Table 1. The count of the coefficients starts at one, runs to 13, and then starts over again at one and runs continuously; thus in the almanacs here the sequence starts in the middle with 6 and runs 6-7-8-9-10-11-12-13-1-2-3-4-5-6-7-8-9 and 9 is the red coefficient shown that applies to the next frame. The next frame is not shown in Figure 1 but the information for that frame, frame number two or frame B, is shown in Table 1 in the second row and also in figure 2.

Besides the counting sequences of 13 numbers, the day signs are counted in the same manner, following a sequence of 20 days. Those 20 day signs are, in order, Imix-Ik'-Ak'bal-K'an-Chikchan-Kimi-Manik'-Lamat-Muluk-Ok-Chuen-Eb-Ben-Ix-Men-Kib-Kaban-Ets'nab-Kawak-Ajaw. Since we started with Kawak, a count of 16 brings us to Men. Thus the red coefficient 9 applies to the day name Men in the following frame, frame 2 (B).

Refer to Table 1 to see how the black numbers count and the red coefficients match with the correct count until the last frame—11 or K for the Dresden and 10 or J for the Madrid, but both count a total of 104 days. At this point the reader or priest returns to the beginning of the almanac, only this time to the second row down, Ak'bal, with the same red six coefficient. The Almanac counts all five rows for a total of 104 times 5, or 520 days, or twice the normal 260 day Tzolk'in calendar.

Frame 8 (H) is the frame of interest in both almanacs concerning the Perseid meteor shower. Although the first two frames of each almanac count the same interval, 16 followed by 8, a crucial part of the equation is the change in the count in the third frame, the Dresden counting 11 but the Madrid only counting 3. Since the Madrid started 10 days later than the Dresden from the beginning, after this unequal advancement as discussed below, the Madrid is now only two days ahead of the Dresden.

Fr	Dresden	Date (Julian)		Madrid	Date (Julian)
1 A	9.17.4.6.19 6 **Kawak** (12 Xul) **+ 16**	**19/20 May** 775		10.5.4.12.19 6 **Kawak** 2 Ch'en **+ 16**	**29/30 May** 933
2 B	9.17.4.7.15 9 **Men** (8 Yaxk'in) **+ 8**	**4/5 June** 775		10.5.4.13.15 9 **Men** (18 Ch'en) **+ 8**	**14/15 June** 933
3 C	9.17.4.8.3 4 **Ak'bal** (16 Yaxk'in) **+11**	**12/13 June** 775		10.5.4.14.3 4 **Ak'bal** (6 Yax) **+ 3**	**22/23 June** 933
4 D	9.17.4.8.14 2 **Ix** (7 Mol) **+ 10**	**23/24 June** 775		10.5.4.14.6 7 **Kimi** (9 Yax) **+ 10**	**25/26 June** 933
5 E	9.17.4.9.4 **12 K'an** (17 Mol) **+ 1**	**3/4 July** 775		10.5.4.14.16 **4 Kib'** (19 Yax) **+ 1**	**5/6 July** 933
6 F	9.17.4.9.5 13 **Chikchan** (18 Mol) **+ 12**	**4/5 July** 775		10.5.4.14.17 5 **Kaban** (0 Sak) **+ 12**	**6/7 July** 933
7 G	9.17.4.9.17 12 **Kaban** (10 Ch'en) **+ 6**	**16/17 July** 775		10.5.4.15.9 4 **Muluk** (12 Sak) **+ 6**	**18/19 July** 933
8 H	9.17.4.10.3 **5 Ak'bal** (16 Ch'en) **+ 12**	**22/23 July** **775** **140.00°** **23.44 July** (UT) **Perseids**		10.5.4.15.15 **10** Men (18 Sak) **+ 12**	**24/25 July** **933** **141.43°** **25.44 July** (UT). **Perseids**
9 I	9.17.4.10.15 4 **Men** (8 Yax) **+ 11**	**3/4 Aug** 775		10.5.4.16.7 9 **Manik'** (10 Keh) **+ 19**	**5/6 Aug** 933
10 J	9.17.4.11.6 2 **Kimi** (19 Yax) **+ 11**	**14/15 Aug** 775		10.5.4.17.6 2 **Kimi** (9 Mak) **+ 17**	**24/25 Aug** 933
11 K	9.17.4.11.17 13 **Kaban** (10 Sak) **+ 6**	**25/26 Aug** 775			

Table 1. Side-by-side, frame-by-frame comparison of Dresden almanac D.38b-D.41b and Madrid almanac M.10a-M.13a. Local date 24 hour period indicated by two consecutive dates separated by a slash; sunrise to midnight first day and midnight to sunrise second day (all dates calculated using cc 584286).

How Are the Almanacs Dated?

Using what are called "eclipse glyphs" at A1 and B1 (the first and second glyphs in the top row) in frame one of the Dresden almanac (figure 1), Bricker and Bricker interrelate historical eclipse data, rainy and dry seasons, and near conjunctions of the Moon and Venus to determine possible corresponding dates to the Tzolk'in day names. Four possible solutions correlate to specific dates in the years AD 775, 822, 869 and 906 (Bricker and Bricker, 2011:349). Using similar data to date the Madrid almanac Bricker and Bricker determine three possibilities, in the years AD 795, 842 and 933 (page 356). There are other frames that may indicate the occurrence of a meteor shower iconographically and/or hieroglyphically; however when all frames and possible meteor showers are considered in relation to the possible dating solutions, frame 8 (H) is the only frame that will "fit" combined prospective dates and then *only in combination of the AD 775 solution of the Dresden and the AD 933 solution of the Madrid.*[3] The starting dates and frames 8 (H) for each of these solutions are shown in Table 1 and Figure 1. Frame 1 (A) of the Dresden equates to 9.17.4.6.19, 6 Kawak (12 Xul), May 19/20[4], 775 and the Madrid equates to 10.5.4.12.19, 6 Kawak (2 Ch'en), May 29/30, 933. In fact, *the Perseid meteor shower is the only possible solution for each of those dates represented by frame 8 in each almanac.*

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[3] The reason for this dating solution is that there simply were not any historical showers during the time frames of both almanacs that would have occurred in identical frames in each almanac in any of Brickers' solutions (Imoto and Hasegawa, 1958:134-137, Table 1; Jenniskens, 2006:598-611, Table 1). Although this solution is calculated for a correlation constant of 584286, theoretically cc 584283 could be possible, moving the solar longitudes up to 137.0° and 138.4° for the dates of AD 775 July 20.4 and 933 July 22.4 (UT) respectively, which as can be seen from Table 2 falls within the historically observed range. For example the solar longitude for one of the 933 observations was 136.8° and the 841 observation was 138.4°. In fact China observed the Perseids on 933 July 20.7, two days before the Maya may have observed the shower on July 22.4, which has occurred on other occasions as the author has discussed. Although this variation of a few days could be acceptable for a Halley-type or Jupiter-family meteoroid stream, it would most likely not be possible with a long-period shower, such as is part of the solutions in other situations as discussed by the author.

[4] The author expresses a local date by two adjacent dates separated by a slash, meaning from dawn of the first day up to midnight, followed by midnight to dawn of the next day. For instance July 24/25 means from dawn to midnight of the 24th followed by midnight to dawn of the 25th. Since Universal Time (UT) is six hours ahead, the last 12 hour time period, i.e., darkness from sunset to dawn would be expressed in UT as 25.0--25.5, basically indicating hours of darkness locally in the Maya region. There is evidence that the Maya may have advanced the day name at sunset, at least in some cases, possibly indicating an event that occurred during the hours of darkness (paper in possession of author).

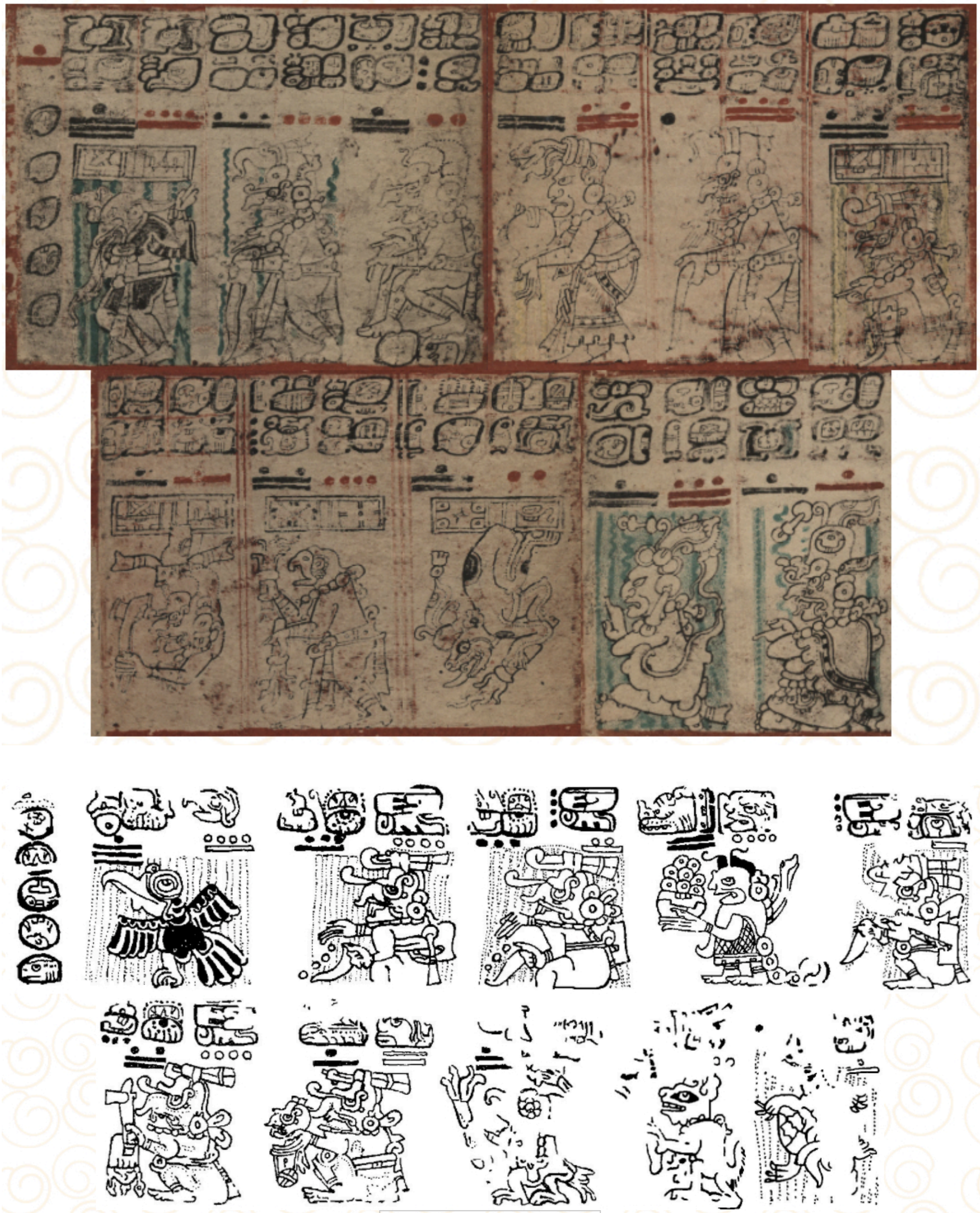

Figure 2. Top: Dresden almanac pages D.38b-D.41b, Frames 1-11 (A-K). (After Forstemann 1880). Bottom: Madrid Alamanac pages M.10a-M.13a, Frames 1-10 (A-J) (Drawing after Villacorta C. and Villacorta). (Frame combinations for both almanacs courtesy of Vail and Hernández, 2013).

Perseid Meteor Shower

The Perseid meteor shower is the most dominant of all showers that the Maya would have seen, counting around 84 -+ 5 meteors per hour at its peak (Jenniskens et al, 1998:941) on an annual basis and 2-3 times that during an outburst (Jenniskens, 2006:649, Table 5c). There would have been no doubt that the Maya would have observed this very strong shower (Jenniskens, personal communication, 2013). Visual counting of meteors by naked eye observers began in the first half of the 1800's (Hughes 1982, referenced in Jenniskens, 1994:991); the counting of individual meteors themselves is at the heart of determining where the peak of a shower would occur (see, for instance, Brown and Rendtel, 1996; Olson and Doescher, 1993:175-181; Jenniskens, 1994). Jenniskens discusses current observation techniques and meteor rates of count, "commonly expressed in terms of Zenith Hourly Rates (ZHR), which is the hourly rate of meteors seen by a standard observer in optimum conditions: the radiant [apparent origination point of the meteor shower, associated with the nearest constellation] in the zenith and a star limiting magnitude of 6.5[5]" (1994:991-997; 1995:207). Currently meteors are counted visually both with the naked eye and from videography, including airborne video (see for example Jenniskens et al. 2000) and also with radar (see for instance Poole, 1967; Jurkic and Pintaric, 2002). Both Halley-type and Jupiter-family meteoroid streams can be more than a few degrees wide—for example, Earth takes 2 and a half days (~2.5 degrees in solar longitude) to cross the middle portion of the [Perseid] meteoroid stream (Jenniskens et al, 1998:941), and thus meteor activity can be seen before and after the peak. With the Maya's penchant for counting things, it is easy to visualize the Maya counting meteors as well, perhaps comparing nightly counts to determine which night produced the most meteors and recording that night as being the most significant for a particular shower. In the Mayan language of Tzotzil Laughlin actually records the word *ch'ob* as a numeral classifier for "counting torches and falling stars" (1975:137); in other words, counting five meteors might be said as "*ho'-ch'ob*-METEOR," eight meteors would be "*waxak-ch'ob*-METEOR." *Ch'obch'ob* was the word for a single torch and *ch'obokil* was used for "many torches," (ibid.); *mankornal k'anal* (*mankornal,* "yoke, pair of oxen," and *k'anal,* "star") is the word for "pair of shooting stars," (page 229).

[5] A magnitude of 6.5 is about the faintest star that can be seen by the naked eye. As the number decreases, the magnitude becomes brighter. After a magnitude of zero, the number increases negatively, so that a bright planet such as Venus is a magnitude of -3 or -4.

	Date (UT, Julian)	Perseids (HT)	Description	Seen From
	36 July 17.9	**139.8°**	At dawn, >100 meteors flew in four directions	China
	466 July 21.7	**140.4°**	Over 100 going SW	China
	570 July 23.4	**141.4°**	Death (apotheosis?) of Ahkal Mo' Nahb II	Meso
	690 July 22.3	**139.7°**	Burning event; conjuring, night event	Meso
	736 July 24.3	**141.7°**	Blood-letting, GI, K'awiil (god K)	Meso
	775 July 23.4	**140.0°**	"Fire from the sky of 4 Macaw place" (torches)	Meso
	819 July 24.4	**140.5°**	Ritual decapitation of peccary/caiman monster	Meso
	830 July 22.6	**139.0°**	From dusk till 5th watch, uncountable stars fell	China
	833 July 23.7	**140.3°**	Over a hundred, all night	China
	835 July 21.1	**137.8°**	From dusk till 3rd watch > 20 meteors	China
	841 July 21.7	**138.4°**	From 1st until 5th watch, > 50 meteors scattered	China
	924 July 21.7	**138.1°**	Many stars flew chaotically across one another	China
	924 July 23.7	**140.0°**	Many stars flew crossing each other	China
	925 July 21.7	**137.9°**	After first watch, more than 70 stars to SW	China
	925 July 22.7	**138.8°**	Many stars flew at midnight	China
	925 July 23.7	**139.8°**	Many small stars flew in SW	China
	926 July 22.7	**138.6°**	Many small stars flew chaotically	China
	933 July 20.7	**136.8°**	Many stars flew across one another	China
	933 July 25.4	**141.4°**	Macaw with torches (Madrid Codex)	Meso
	933 July 25.7	**141.7°**	Many stars flew across one another	China
	989 July 24.7	**140.3°**	Several stars were scattered	Japan
	1007 July 20.6	**135.8°**	Meteors flew to N	Japan
	1007 July 24.6	**139.7°**	Many meteors flew till dawn	Japan
	1007 July 25.6	**140.6°**	Meteors appeared again	Japan

Table 2. Perseid Historical Observations (Jenniskens, 2006:601-602 [thru AD 1007]) and Possible Maya Observations ("Meso"= Mesoamerica, orange cells; "Meso" dates calculated using cc 584286).

Frame 8 (H)

The text associated with frame 8 (H) in the Dresden almanac seems clear, **u-K'AHK' ti-CHAN-na** 4-**MO'-NAL K'IN-TUN-HAAB',** *u-k'ahk' ti-chan 4-mo'-nal k'intunhaab',* "It is the fire in the sky of 4 macaw place. It is the summer [see discussion below]." See figure 1. Since the associated painting depicts an anthropomorphic macaw holding a flaming torch in each hand, "fire" in the text seems to be associated with the torches, and both torches and the macaw are directly related to meteors as previously discussed. In previous studies, the author draws a possible connection of meteor showers to the *dotted-X k'in* variant sign found in the sky-band (Kinsman, in press:116-118; 2014:14-15). The author calculated a solar longitude of 140.00º for 4:30 AM (one hour prior to sunrise) on the morning of July 23, 775 (July 23.44, 10:30 AM UT, i.e. almost half of 24 hours when referencing to Universal Time, 6 hours ahead of 4:30 AM local). At 4:30 AM local time the Perseus constellation, which is the apparent point of origination of the Perseid shower, is overhead at the zenith, which should give the best viewing for the shower (although the light of the last quarter Moon, also near the zenith, could slightly lower the magnitude of visible meteors. The solar longitude peak occurs at 140.19º (Jenniskens, personal communication 2013), therefore the Maya may have been recording a fairly strong shower. Frame 8 (H) in the Madrid almanac corresponds to a similar drawing of a macaw holding a flaming torch in each hand and a date that correlates to July 24/25 933. For 4:30 AM local time (July 25.44 UT), the author calculated a solar longitude 141.44º. Viewing of meteor showers would have been good because there was a new Moon on July 25. Interestingly, the historical tables show that *China observed what would have been this same Perseid only hours later, July 25.7, 933* (UT) (Imoto and Hasegawa, 1958:135, Table 1; Jenniskens, 2006:601, Table 1)(author's Table 2).

Observing the Perseid meteor or any Halley-type shower two nights in a row was not unusual as shown in the historical record and often an outburst, which is not responsible for the peak activity, was observed at a slightly different solar longitude than the peak (Imoto and Hasegawa, 1958: Table 1; Jenniskens, 2006:601-602). China observed the Perseids on three successive days in July of 925 and on two alternate days in 924 and Japan observed the Perseids on two successive days in 1007 (Table 2).

Previous interpretations of this frame in each almanac have thought that the flaming torches held by the macaws indicated drought, an interpretation held by the Brickers who refer to Thompson (1959:359; 1972:100, in Bricker and Bricker, 2011:343, 347) and Kelley (1976:171). The reason for this is the translation of the phrase in the text in frame 8 (H) located at the B2 coordinate which reads *k'intunhaab'.* In this instance, Kelley mentions that he agrees with Thompson that the phrase could mean "drought" since "holding torches is a reasonable symbol for 'drought,'" (1976:171). Bricker and Bricker go on to say that Picture 9 continues with the drought theme because the dog in that picture holds a torch, though there is no *k'intunhaab* in the associated text. Kelley, however, is reluctant to agree with the drought associated with the dog and in fact states that with regard to the macaw holding torches that "earlier scholars had usually associated the torches with lightning (cf. Brinton1895, p. 71)" and "Thompson himself has more recently decided that the 'drought' interpretation was an error and that the reference is rather to relatively rainless lightning storms (Thompson 1964, p. 152)" (in Kelley, 1976:171 [author's note: the year 1964 for Thompson may be in error since this year is not listed in Kelley's reference section]). The phrase *k'intunhaab'* undoubtedly comes from *k'intunya'abil* in Barrera (1980:404), which not only carries the meaning "tiempo de gran seca" ("time of great dryness [i.e. drought]" [author's translation]) but also "verano" or "summer" (ibid.). Another problem the author sees with the "drought" interpretation is that the frame with the macaw may possibly simply apply for only the 12 day interval (black number), which certainly would not be a lengthy enough time for a drought. It may be that Thompson's interpretation of "rainless lightning storms" was rather close to the truth if the author's interpretation of the Perseid meteor shower is correct. In summary, the author believes that the torches of the macaw refer to a meteor shower rather than a "scorching" drought.

Summary

The author has provided evidence that the dates associated with the macaw-with-torches frame (8/H) in each of the Dresden D.38b-D.41b and Madrid M.10a-M.13a directly correlate to a Perseid meteor shower or outburst that would have occurred in AD 775 and 933. The text in the Dresden almanac seems to confirm a possible meteor shower. The Perseid solution is unique for the combination of a possible four dates in the Dresden almanac and possible three dates in the Madrid almanac, i.e., taken as a cognate pair, *the 775 solution is the only option for the Dresden and 933 is the only option for the Madrid*. Not only is the Perseid solution applicable for the 584286 correlation between the European and Maya calendar but the author also demonstrates that the solution is valid for a 584283 correlation constant. The Perseid solution for 933 July 25.4 (Universal Time) is likely confirmed by an observation in the historical record by China a few hours later, on July 25.7 (UT). It seems that questions posed by Aveni can be answered as far as why an interval would be adjusted in one almanac in relation to the other and astronomical knowledge in one almanac can be used to date its cognate pair.

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Photograph 1. 2009 Perseid Meteor Shower (Courtesy of NASA/JPL).