Eclipses and supernova 1054 in the Dresden Codex
A new astronomical approach
(extended since previous releases)

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For over a century the pages 51 to 58 of Codex Dresdensis (CxD) have generated extensive attention.
Almost all authors have related the 69 intervals and the 10 inserted pictures on these pages to Solar or Lunar eclipses.
Some investigators consider the series of dates and intervals to be an eclipse ephemeris table while others think it contains reports of observed Solar or Lunar eclipses.
Some of these alleged foreseen or observed eclipses have served as a basis for correlations between the Maya and our Western calendars.

In the next pages, we will show how we arrived at a possible new correlation and how this correlation explains in a fairly surprising way some other intriguing dates, such as 9.9.16.0.0 4 Ahau 8 Cumku.

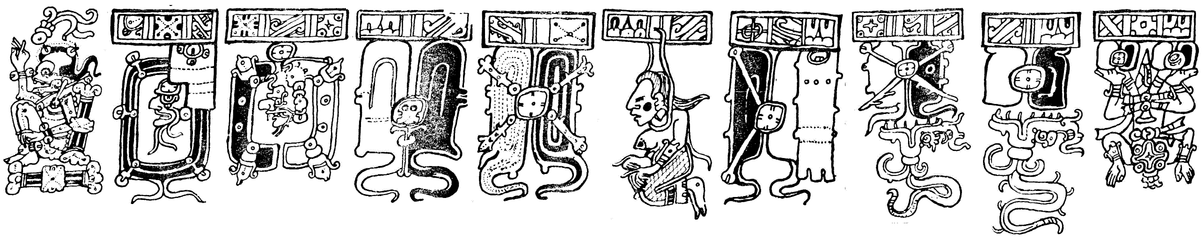
We are aware of the fact that the proposed correlation number is not in line with the generally accepted G.M.T. correlation and with certain archaeological findings. Therefor we are most willing to reject our own newly proposed correlation number if all the facts mentioned in the present paper are more elegantly explained by an other theory.
We think however that it would be non-scientific not to communicate our findings to the scientific community.

The intervals

The 69 time intervals separating the day glyphs series on the pages 51 to 58 of the Codex are the following:

(177), 177, 148, (picture 53a)
177, 177, 177, 178, 177, 177, 177, 177, 177, 148, (picture 55a)
178, 177, 177, 177, 177, 148 (picture 56a)
177, 177, 177, 178, 177, 177, 148, (picture 57a)
177, 177, 178, 177, 177, 177, 177, 177, 177, 148, (picture 52b)
178, 177, 177, 177, 177, 148 (picture 53b)
177, 177, 177, 177, 177, 177, 148 (picture 54b)
177, 177, 178, 177, 177, 177, 177, 177, 148, (picture 56b)
177, 178, 177, 177, 177, 177, 148, (picture 57b)
177, 177, 177, 177, (picture 58b)

Pictures



53a 55a 56a 57a 52b 53b 54b 56b 57b 58b

Since 1 *mean* synodical lunation equals 29.530589 days [1], the intervals of 148, 177, and 178 days correspond obviously to 5 and 6 lunations, giving or taking 1 day:

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[1] Present value according to "Jaarboek van de Koninklijke Sterrenwacht van België" – Jaargang 2000.
During the last millennia this value remained practically unchanged.

5 mean lunations = 147.6529 days
6 mean lunations = 177.1835 days.

Adding up the individual intervals, we find that the intervals between the pictures are as follows:
(502), 1742, 1034, 1211, 1742, 1034, 1210, 1565, 1211 and 708 days.

These are all of the form
n.(6 lunations) + m.(5 lunations),
where n = 2 to 9 and m = 0 to 1.

Investigation of the intervals

As the basis of our study, we computed for the period AD 1 to AD 1600, the following lists of eclipses:

- all solar eclipses on Earth;
- all solar eclipses visible at the following 7 important locations of the Maya area: *Copan, Chichen Itza, Palenque, Piedras Negras, Quirigua, Tikal, Yaxchilan*;
- all lunar eclipses on Earth;
- all lunar eclipses visible at *Tikal*.

The circumstances of the eclipses were calculated in Universal Time, with delta T according to Stephenson & Houlden (1986)[2].

On the basis of these lists, correlations between the calculated dates and those represented in the “eclipse tables” of the pages 51 to 58 of CxD were searched for.

In particular, a search was carried out in view to find correlations between the calculated eclipse dates and
1) the 69 intervals;
2) the time-intervals separating the pictures interrupting the 69 intervals and dividing them into longer periods. The initial period of 502 days was not taken into account since it did not start with a picture.

For both these two cases, correlations were searched for between the intervals in CxD and

- all solar eclipses on Earth;
- all solar eclipses in the Maya region (at the 7 investigated locations);
- all lunar eclipses on Earth;
- all umbral and/or total lunar eclipses on Earth, thus leaving out penumbral lunar eclipses;
- all lunar eclipses visible at Tikal;
- all umbral and/or total lunar eclipses visible at Tikal, with the additional condition that at least part of the umbral and/or total phase had to be visible at Tikal.

The lists of solar and lunar eclipses were examined in a way we considered as realistic as possible: it was accepted that the ancient astronomers might have missed some eclipses that actually occurred. For this, there could have been numerous reasons: very small eclipses were probable not seen, certain partial eclipses might have been clouded out, some eclipses were not noted, or any other reason.
We considered however that a noted eclipse did indeed take place and thus had to correspond to a real eclipse, either somewhere on Earth or in the Mayan region and therefor had to appear in our calculated lists.

Although the search tolerated a discrepancy of 3 days between the calculated dates and those found in the Codex pages, not in a single case where a correlation was found, did the difference between the calculated and the Maya intervals exceed 1 day.

By combining the indicated parameters, we obtained 12 files [3] with series

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[2] “Atlas of historical eclipse maps – East Asia 1500 BC - AD 1900” by F.R. Stephenson and M.A. Houlden – Cambridge University Press, 1986

[3] All files mentioned in this text are available upon request at: felix.verbelen@skynet.be

of eclipses corresponding to the intervals of CxD:

Solar Eclipses

GLO69.txt
Contains **2 series** of solar eclipses having occurred somewhere on Earth, corresponding to all 69 intervals of CxD.

GLO9.txt
Contains **1418 series** of solar eclipses having occurred somewhere on Earth, corresponding to all 9 intervals between the iconograms of CxD.

MAYA69.txt
Contains **0 series**.
The search was for series of solar eclipses visible from at least one of the mentioned Maya locations, corresponding to all 69 intervals of CxD.

MAYA9.txt
Contains **0 series**.
The search was for series of solar eclipses visible from at least one of the mentioned Maya locations, corresponding to all 9 intervals between the iconograms of CxD.

Lunar eclipses

GLO69ALL.txt
Contains **9 series** of lunar eclipses having occurred somewhere on Earth, corresponding to all 69 intervals of CxD.
All lunar eclipses (penumbral + umbral + total) were taken into account.

GLO69UT.txt
Contains **0 series.**
The search was for series of umbral or total lunar eclipses having occurred somewhere on Earth, corresponding to all 69 intervals of CxD.

GLO9ALL.txt
Contains **1456 series** of lunar eclipses having occurred somewhere on Earth, corresponding to all 9 intervals between the iconograms of CxD.
All lunar eclipses (penumbral + umbral + total) were taken into account.

GLO9UT.txt
Contains **203 series** of umbral or total lunar eclipses having occurred somewhere on Earth, corresponding to all 9 intervals between the iconograms of CxD.

TIK69ALL.txt
Contains **0 series**
The search was for series of lunar eclipses observable at Tikal, corresponding to all 69 intervals of CxD.
All lunar eclipses (penumbral + umbral + total) were taken into account.

TIK69UT.txt
Contains **0 series.**
The search was for series of umbral or total lunar eclipses observable at Tikal, corresponding to all 69 intervals of CxD.

TIK9ALL.txt
Contains **92 series** of lunar eclipses observable at Tikal, corresponding to all 9 intervals between the iconograms of CxD.
All lunar eclipses (penumbral + umbral + total) were taken into account.

TIK9UT.txt
Contains **12 series** of umbral or total lunar eclipses observable at Tikal, corresponding to all 9 intervals between the iconograms of CxD.

On the basis of our calculated eclipse lists and the findings with respect to the series of eclipses corresponding to the intervals of CxD, we reached the following provisional conclusions:

A/ **the 69 intervals**

1. The series of intervals do *not* correspond to solar eclipses observed in the Maya area. This is the case for both the full series of 69 intervals and the intervals between the pictures.

2. The series of 69 intervals does *not* correspond to a series of 69 actually observed lunar eclipses in the Maya region.

3. The 69 intervals are *not* the intervals between foreseen eclipses, either solar or lunar. If they were, the table in CxD would be a very poor ephemeris table indeed: only 2 series of solar eclipses and/or 9 series of lunar eclipses *on Earth* correspond fully to the 69 intervals mentioned for the period AD 1 to AD 1600.

   If all *solar eclipses on Earth* are considered during the given period, one finds 3768 eclipses, i.e. 3767 intervals.
   These intervals are as follows:

Interval (days)	**Number of Intervals**
29	216
30	181
146	14
147	295
148	413
149	117
176	483
177	1201
178	804
179	44

Table 1: Intervals between solar eclipses on Earth

So, we find that solar eclipses occur on Earth after 1 lunation (11 %), 5 lunations (22 %) or 6 lunations (67 %). This of cause is not a surprise, since solar (or lunar) eclipses can only occur near one of the two nodes of the intersection of the equatorial plane and the ecliptic.
The intervals in CxD fail to mention the period of 1 lunation and mention the interval of 5 lunations far less often than would be expected if the eclipse table of CxD had to be considered as a reasonable Ephemeris table for solar eclipses.

Considering in the same way the *lunar eclipses on Earth*, we find the following intervals:

All lunar eclipses on Earth	
Interval (days)	**Number of Intervals**
29	242
30	203
146	13
147	324
148	427
149	123
176	463
177	1188
178	793
179	39

Table 2a: Intervals between all lunar eclipses on Earth

Total and umbral Lunar eclipses on Earth	
Intervals (days)	**Number of intervals**
176	389
177	970
178	582
179	24
325	49
326	16
354	20
355	21
501	30
502	197
503	89
678	1
679	12
680	47
857	1

Table 2b: Intervals between all total/umbral lunar eclipses on Earth

So, it is difficult to see how the 69 intervals of CxD could be considered as a valid ephemeris table for lunar eclipses. On the one hand, intervals of 1 lunation are not considered in CxD and the distribution of intervals of 5 and 6 as shown in CxD does not match that of real eclipses on Earth.

Additional considerations are that:

- if it were the Maya’s intention to construct an eclipse ephemeris table, it would have been far easier to simply consider periods of 5.5 lunations +/- 0.5 lunations.
  The insertion of an interval of 5 lunations before each of the pictures is not directly explicable in the case of an eclipse warning table and seems rather to be an indication that the 69 intervals are *not* to be considered as such.

- it is completely unclear how the ancient Maya astronomers could have provided real predictions for expected eclipses, taking into account their limited computational techniques and the relative lack of their own observations (see 1. and 2. above).

A first general conclusion therefor is that the series of 69 intervals are not to be considered as a workable solar or lunar eclipse ephemeris table.

This brings us to the intervals between the pictures.

B/ **the intervals between the pictures**

1. When compared to our catalogues of both solar and lunar eclipses *somewhere on Earth*, a considerable number of series of eclipses separated by the picture intervals are found.
   However, at the same time a great number of intermediate eclipses are not accounted for in CxD. Many of these missing eclipses are very important, including numerous total or annular solar or total lunar eclipses.
   The fact that such an important number of eclipses are not accounted for is by no means a surprise, taking into account the intervals between actual eclipses on Earth, as shown in tables 1, 2a and 2b above and the intervals between the pictures. At the same time it demonstrates that the intervals between the pictures are *not* to be considered as a valid warning table for either solar or lunar eclipses on Earth.

   On the basis of our calculated eclipses lists we found the following intervals between *solar* eclipses observable at 4 important Maya centres:

Interval between solar eclipses (days)	Maya location			
	Chichen Itza	***Copan***	***Palenque***	***Tikal***
148	1	1	1	1
176	2	3	4	3
177	29	38	39	36
178	34	31	34	36
354	54	46	50	52
355	24	23	23	23
501	8	4	5	5
502	25	16	20	22
503	10	8	9	9
531	32	25	28	29
532	20	13	16	13
679	3	4	4	5
680	11	14	12	10
709	4	3	5	5
856	32	21	26	25
857	5	8	5	7
885	8	6	6	6
886	4	4	3	3
1033	45	48	43	41
1034	30	33	32	34
1211	48	60	54	55
1387	19	23	25	24
1388	17	16	18	14
1389	12	8	11	9
1565	29	38	31	30
1566	0	1	0	0
1742	7	5	6	7
1743	4	3	4	3
1890	3	0	2	2
1891	2	1	2	1
1919	5	2	2	3
1920	2	1	2	2
2067	0	1	0	1
2244	5	6	5	5
2245	14	11	14	13
2273	1	0	0	0
2421	2	4	4	3
2422	3	3	3	3
2598	6	6	7	7
2599	7	5	7	7
2775	1	0	1	0
2776	3	2	1	3
2777	1	0	1	1
2953	7	9	7	8
3130	0	1	0	1
3278	1	1	1	1
3456	1	1	1	1
3632	1	1	1	0
3809	0	1	0	1
3986	1	0	1	1
4163	0	1	1	1
4164	1	2	1	2
5198	0	1	0	0
6939	1	1	1	1

Table 3: Intervals between solar eclipses at 4 locations of the Mayan area

As one can see, intervals of 1033/1034, 1211, 1387/1388/1389 and 1565 days between solar eclipses in the Mayan region are quite common. And precisely these intervals are found in CxD.
On the other hand, the interval of 1742 that appears twice in the Codex is in practice far less common.
It looks like we are finding here an indication of the fact that the

intervals between the pictures refer to observed, rather than to predicted eclipses.
Unfortunately, if the full series of intervals between the pictures of CxD are compared to those calculated, we find that not a single series of solar eclipses in the Mayan region matches the series of the Codex intervals.
So, we have to conclude that also the hypothesis that the intervals between the pictures stand for an observed series of solar eclipses by the Maya has to be abandoned.

2. This brings us to the possibility that the intervals between the pictures are related to lunar eclipses observed by the Maya.

   On the basis of our eclipse lists for Tikal, we found the following intervals between observable lunar eclipses in the Maya region:

All lunar eclipses At Tikal	
Interval (days)	**Number of Intervals**
29	61
30	43
146	3
147	136
148	184
149	48
176	250
177	678
178	468
179	25
205	1
206	16
207	14
324	24
325	100
326	13
353	1
354	257
355	119
501	4
502	36
503	12
530	11
531	48
532	9
533	2
678	1
679	1
680	13
681	1
709	16
710	2
885	1
1034	1
1064	1

Table 4a: Intervals between all lunar eclipses observable at Tikal

Total and umbral Lunar eclipses At Tikal	
Intervals (days)	**Number of intervals**
176	142
177	367
178	232
179	9
325	16
326	1
354	172
355	76
501	9
502	87
503	32
530	8
531	48
532	8
678	5
679	70
680	77
708	2
709	19
710	2
856	52
857	33
1032	1
1033	13
1034	24
1035	4
1210	1
1211	12
1387	1
1388	1
1565	1
1566	2

Table 4b: Intervals between total/umbral lunar eclipses observable at Tikal

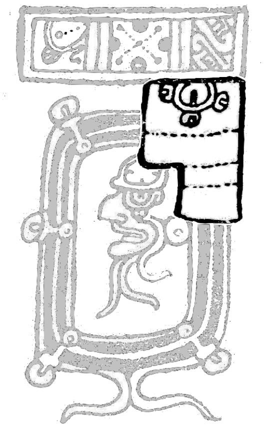
At first glance there does not seem to exist a striking relation between these intervals and those between the pictures of the Codex.
Nevertheless, there *do exist* an important number of series of lunar eclipses visible in the Maya area that match the intervals between the pictures of CxD, if it is accepted that in each case a number of intermediate lunar eclipses are not accounted for in the Codex. But, as we said before, these intermediate eclipses could have been easily missed by the ancient observers: small partial penumbral eclipses, eclipses of which only the end or the start was eventually observable near the horizon at rising or setting moon, and the like. More important eclipses could have been missed due i.e. because of poor weather conditions.

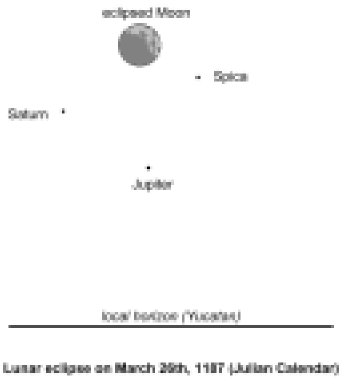
In any case, these findings do not exclude the possibility that the intervals of the Codex are an account of lunar eclipses that were actually observed by the Maya.
Yet, the number of 92 possible solutions if all lunar eclipses, thus including penumbral eclipses, are taken into account or at least 12 possible solutions if only total and umbral lunar eclipses are considered, does not directly allow a strict identification of the actual eclipses recorded by the ancient astronomers.

A unique series of observed lunar eclipses

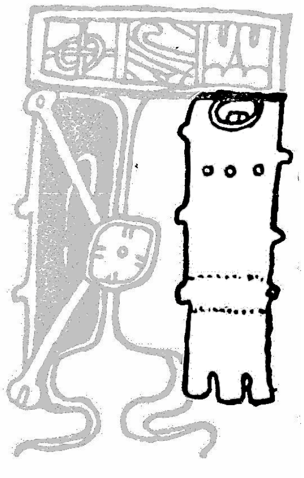
So, at this point we decided to examine the precise celestial circumstances at the time of each of the possibly observed lunar eclipses for each of the 92 series that match the intervals between the pictures.
To do so, we first used the planetarium program “Dance of the Planets” and later different releases of Project Pluto’s “Guide”.

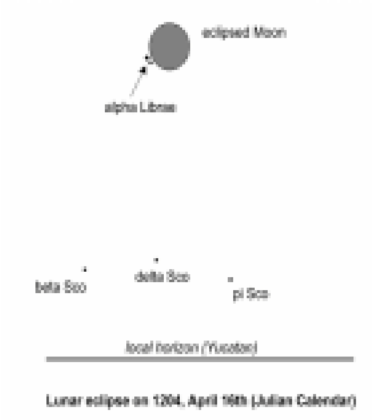
This led quickly to a surprising finding [4].
During the lunar partial umbral eclipse of March 26th, 1187 AD, three most striking celestial bodies surrounded the eclipsed moon: Jupiter, Saturn and 1st magnitude star Spica. Most intriguing of all was that the mutual positions of the eclipsed Moon, Jupiter, Saturn and Spica, together with the local horizon, corresponded fairly well with a graphical element of picture 55a that, as far as we know, had never been fully explained before.
Thompson [5] considers this graphical element to be a “triple death eye design”.





Probably he would be right if there were not a similar element in picture 54b. Thompson [6] describes it as a “long pouchlike object”.
Picture 54b includes a main (double) circle and two tiny circles.
These two small circles are touching and are located at the edge of the main circle.
Evidently, if picture 55a represents the eclipsed moon surrounded by the three luminous celestial bodies, the similar graphics of picture 54b must also represent some striking conjunction at the time of the corresponding lunar eclipse.
And indeed, the conjunction was found right away.





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[4] published in “Heelal”, (periodical of the *Vereniging voor Sterrenkunde*, August 1993)
[5] “A Commentary on the Dresden Codex” by J. Eric Thompson (1972)- p.75
[6] “A Commentary on the Dresden Codex” by J. Eric Thompson (1972)- p.76

On April 16th, 1204 AD, the eclipsed moon passed very nearby the visual double star alpha Librae. During the eclipse, the double star swept along the moon edge at an angular distance of less than 10′ as viewed from Yucatan. In South America (Peru), alpha Librae was even occulted by the eclipsed moon [7].

The graphics of picture 54b give a very good representation of the observation from the Maya area. The difference in magnitude between the two components of alpha Librae are well shown: the double star is composed of a star of magnitude 2.3 and a second fainter star of magnitude 5.6, the two being separated by an angular distance of 3.9′.

The rarity of this celestial configuration at precisely the moment of an umbral lunar eclipse in the Maya region is perhaps better understood if one realises that alpha Librae is the only fairly bright visual double star located near the Moon’s path and that less than 10 visual double stars in total are visible to the naked eye.

So, we had found a unique series of observed lunar eclipses, matching the intervals between the 9 pictures of the Codex, with two exceptional conjunctions at the very time of two of these eclipses which are depicted in the Codex.

The series of pictures could therefor readily be identified with the following lunar eclipse dates:

Picture	Lunar eclipse in Yucatan (Julian Calendar)	Julian Day Number	Delta	Type of lunar eclipse
53a	18 June 1182	2152951	-	Total
55a	***26 March 1187***	2154693	1742	Partial
56a	23 January 1190	2155727	1034	Total
57a	18 May 1193	2156938	1211	Total
52b	23 February 1198	2158680	1742	Partial
53b	22 December 1200	2159713	1033	Total
54b	***16 April 1204***	2160924	1211	Total
56b	29 July 1208	2162489	1565	Total
57b	22 November 1211	2163700	1211	Total
58b	31 October 1213	2164409	709	Penumbral

In the course of our further research on this series of lunar eclipses a number of other interesting elements were found.
For the time being we just mention the following:

- Two of the pictures (55a and 52b) include spiral-like elements or concentric circles.
  These pictures correspond to the *partial* eclipses on 26 March 1187 and 23 February 1198. All the other eclipses (with the exception of the last picture, 58b, which is penumbral) are *total* eclipses.

- Pictures 56b and 57b both include a representation of *the “feathered snake*”. It is interesting to note that on both the dates corresponding to these pictures Venus was visible as a brilliant morning star. In all the other cases Venus was either visible as evening star or too close to the Sun to be observable.

At this point we were anxious to correlate our series of lunar eclipses with the Maya Longcount.

A provisional correlation-number

Apparently picture 53a, i.e. 18 June 1182 is preceded by a period of (177 + 177 + 148) = 502 days, which brings us to a starting date 31 January 1181 (Julian Calendar):

18 June 1182 = JDN 21452951
- 502 = JDN 2152449 = 31 January 1181.

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[7] Jean Meeus, 1993, private communication

This date corresponds to a Full Moon [8] as well as to a heliacal[9] rising of Venus as morning star in the Maya region.

Most scholars agree on the fact that the starting date of the eclipse tables coincides with the Longcount-date 9.16.4.10.8 12 Lamat (1 Muan), which appears on page 52a of CxD.

If this approach is correct, a correlation-number between the JDN and the Longcount is readily obtained:

31 January 1181 = JDN 2152449
9.16.4.10.8 = 1412848
Difference = **739601 = correlation number**

The date 9.16.4.10.8 12 Lamat, which in our hypotheses corresponds to a Full Moon, is written in black by the Maya.
The red date, 9.16.4.11.3 1 Akbal, which is written between the digits of the black date could correspond to the next New Moon on 15 February 1181, but as we will show further, other explanations are possible.

9.9.9.16.0 1 Ahau 18 Kayab

At the lower left corner of page 24 of CxD, the start of the so-called Venus pages, two intriguing dates are shown: 9.9.9.16.0 1 Ahau 18 Kayab and 9.9.16.0.0 4 Ahau 8 Cumku.
Applying our provisional correlation-number 739601, to the first of these dates we find that **9.9.9.16.0 1 Ahau 18 Kayab** corresponds to **1 May 1048** (Julian Calendar).
This date is quite important since it corresponds to both a Full Moon and a zenith passage of the Sun at latitude 16°51.5′, i.e. at the latitude of Yaxchilan. At Tikal and Piedras Negras, the zenith passage of the Sun was the next day, 2 May 1048 (Julian Calendar).
It was also a period of heliacal setting of Venus as an evening star. The date when the arcus visionis reached 6° was on 15 May 1048, which also corresponds to a moment of New Moon.

Venus and Supernova 1054

The second date, 9.9.16.0.0 4 Ahau 8 Cumku is even more important.

We'll comment on this in a moment, but before doing so, let's first examine the way an ancient astronomer may have observed Venus.

After the Sun and the Moon, Venus is the most luminous object in the sky, and by far the most luminous starlike object of the heavens.
It is only surpassed from time to time by bright comets, novae or meteors, but these are all short living phenomena.

Since Venus orbits the Sun at a distance, which is smaller than that of the Earth, to a terrestrial observer Venus always appears in the vicinity of the Sun.
After several weeks of invisibility, the planet rises near the western horizon in the vicinity of the setting Sun, more or less like the Moon does shortly after "New Moon".
In the course of the following weeks, the already brilliant planet becomes even more luminous, while at the same time its angular distance to the Sun increases, to reach a maximum of some 48 degrees some 4 months later. At that time, the planet is more than 4 times brighter than Jupiter and sets more than 3 hours after the Sun. But unlike the Moon, which continues its orbit away from the Sun, Venus comes to a standstill and reverses its movement to return towards the Sun. For an observer at latitude 14° North (i.e. near Copan) Venus' total appearance in the evening sky lasts on average 260 days.
After some weeks Venus disappears again in the light of the setting Sun and becomes invisible.

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[8] Full Moon occurred on the morning of 1 February 1181, local time.

[9] We call *heliacal* the risings and settings of a celestial body when it becomes visible for the first time or is seen for the last time, either in the morning or the evening sky.

Just a few days later however, the planet reappears as a brilliant morning start, rising just before the Sun at the eastern horizon.

Again, its angular distance with the Sun increases up to some 48° after a number of weeks.
By that time, not even a casual observer can overlook it.
But again the planet reverses its movement and returns towards the Sun. After having been prominently visible in the morning sky for some 260 days, the same period as when the planet was visible as Evening Star, Venus disappears from the morning sky in the vicinity of the rising Sun and remains invisible for several weeks.
Some 584 days after its first appearance in the evening sky, the planet reappears at the western horizon shortly after sunset and the whole cycle starts all over again.

The rather complicated paths followed by Venus surely must have intrigued ancient observers.
It must have taken a number of years of careful observation before they came to the conclusion that the brilliant Evening Star and the magnificent Morning Star were in fact the same celestial object.
Perhaps they reached this conclusion after it became clear that the evening star was never seen during the same period that the morning star was visible. They also must have noticed that the intervals between two successive heliacal risings as evening star were on average equal to the intervals between two successive heliacal risings as morning star: 584 days in each case.

However, determining the precise day of first appearance after a period of invisibility was not an easy task.
At its reappearance in the evening or the morning sky Venus does not show up each time in exactly the same direction. The ancient observers in a way had to rediscover the planet at each heliacal rising.

It seems likely that ancient observers and Maya astronomers in particular, paid more than average attention to the risings and settings of the Sun, the Moon, Venus and probable also other heavenly bodies.
Phenomena that interfered with the expected patterns undoubtedly must have been intriguing.
Comets are known to have generated surprise and fear among ancient populations. Lunar and solar eclipses are spectacular and even today they are still watched with anxiety by a lot of people.

But what must have been the reaction of Mesoamerican astronomers if suddenly a new Venus appeared in the morning sky?
I guess they must have been confused, to say the least.
You will probably object that the sudden advent of a new Venus in the morning sky is pure imagination or speculation.
Yet, it happened.
And it has been described by the Chinese, the Japanese and eventually, as we will show, by the Aztecs and the Maya.
Only, what appeared was not a new planet, but a supernova: the supernova that generated the bright planetary nebula we call M1 or Crab-nebula.

In their book "The Historical Supernovae" [10], D.H. Clark and F.R. Stephenson quote the 13th century chronicle *Meigetsuki* where Fujiwara Sadaie writes:

> *“ 2nd year of the Tenki reign period, 4th month, after the middle decade. At the hour ch'ou (1-3 a.m.) a guest star appeared in the degrees of Tsui and Sen. It was seen in the east and flared up at T'ien-kuan. It was as large as Jupiter.*

Clark and Stephenson conclude that the date of first sighting of the star as indicated in the *Meigetsuki* corresponds to the days immediately following AD 1054 May 29. However, they consider that this Japanese chronicle clashes with several Chinese observations which are dated more than 4 weeks later and focus on AD 1054, July 4th. According to Clark and Stephenson [11] “it seems inconceivable that the star could be sighted in Japan a full month before its discovery in China".

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[10] “The Historical Supernovae” by David H. Clark and F. Richard Stephenson. Pergamon Press, 1977/1979 – p.143

[11] idem – p.147

Maybe they are right, although it is possible that the Chinese observers suffered difficulties due to bad weather conditions for several weeks, or because of other circumstances.

It is also a fact that *K'i-tan-kuo-chih* [12] says:

> *" ...(23rd year of the Chung-hsi reign period), 8th month, the king died... Previously there had been an eclipse of the Sun at midday, and a guest star appeared at Mao. ..."*

On AD 1054 May 10 there was a total eclipse in central China which was visible as a large partial eclipse in other parts of China.
The way *K'i-tan-kuo-chih* links the solar eclipse and the appearance of the guest star does not conflict with the Japanese chronicle.

Another Chinese observer, *Sung-hui-yao* gives the following description [13]:

> *" 1st year of the Chih-ho reign period, 7th month, 22nd day.... Yang Wei-tê said, 'I humbly observe that a guest star has appeared; above the star in question there is a faint glow, yellow in colour. ...*

> *" During the 3rd month of the 1st year of the Chia-yu reign period the Director of the Astronomical Bureau said, 'The guest star has vanished, which is an omen of the departure of the guest.' Earlier, during the 5th month in the first year of the Chih-ho reign period the guest star appeared in the morning in the east guarding T'ien-kuan. It was visible in the daytime, like Venus. It had pointed rays on all sides and its colour was reddish-white. Altogether it was visible for 23 days. (in daylight)*

Now let's compare these Japanese and Chinese accounts with a description found in the Florentine Codex by Fray Bernadino de Sahagun.

The original Nahuatl text of the *Florentine Codex*, in Book 7, Third Chapter states [14]:

> *" Of the morning star, the great star, it was said that when first it emerged and came forth, four times it vanished and disappeared quickly. And afterwards it burst forth completely, took its place in full light, became brilliant, and shone white. Like the moon's rays, so did it shine.*
> *And when it newly emerged, much fear came over them; all were frightened. Everywhere the outlets and openings [of the houses] were closed up. It was said that perchance [the light] might bring a cause of sickness, something evel, when it came to emerge.*
> *But sometime they regarded it as benevolent."*

This last sentence probably explains why, in the Spanish version [15] Sahagun translates "the morning star, the great star" by "the star Venus":

> *" The star Venus these people named Citlalpol or Uey citlalin, and they said that when it riseth in the East it maketh four assaults. The [first] three times it shineth little and hideth again; and at the fourth it cometh forth with all its brightness and followeth its course. And they say of its light that it is like that of the moon. On its first assault they held it an omen of evil, saying that it brought sickness with it."*

Now it is interesting to look also at a translation by Xi and Bo (1996) of the Japanese chronicle by *Meigetsuki* as quoted by Collins & Al. [16],

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[12] idem – p.142

[13] idem - p.141/142

[14] *Florentine Codex* – General History of the things of New Spain by Fray Bernardino de Sahagun – Book 7 – The Sun, Moon, and Stars, and the Bindings of the Years – Translated from Aztec into English, with notes and illustrations by Arthur J.O. Anderson and Charles E. Dibble – in thirteen parts – Part VIII. Published by The school of American Research and The University of Utah, Santa Fe, New Mexico 1953, reprint 1977. – Page 11.

[15] Id. – Page 62.

[16] "A Re-Interpretation of Historical References to the Supernova of 1054 AD", Georges W.Collins & Al. In PASP, July 1999.

since this translation differs at an essential point from the translation given by Clark and Stephenson:

> “ *After the 2nd of the 4th month, the second year in the Ten Ki period of Japan, at the time of Chhou, a guest star* ***appeared three times*** *at the Hsiu Tsui (Turtle). It was seen in the east, “with Ten Kwan Hsing, as big as Jupiter.”*

It is remarkable that both the Japanese and the Nahuatl texts mention the forthcoming of a brilliant star in the East that vanished and reappeared several times, before it became steady.
In their analysis of possible historical references to the supernova, Collins & Al. mention several possible dates of sightings of the supernova, originating both from the Far East and Europe.
The European accounts tend to place the appearance of the supernova in April 1054 (11th, 19th, 24th and “late” April) but are considered doubtful.
The Eastern Asian texts place it between May 10th and July 27th, with also European references (Italy and Armenia) for appearance dates in May (14th and 20th May).

From an astronomical point of view, one thing is sure: on the 27th of May 1054, the Sun was in conjunction with the supernova or its future position. This means that the supernova could not have been visible during the 2 or 3 days preceding and following May 27th, 1054.
If the supernova was first seen in the eastern sky, just before sunrise, then it must have been after May 27th 1054.
If, on the contrary, it was seen before that date, then it must have been in the western sky, just before sundown.

During that period, Venus was a brilliant evening star, rising heliacally around 17 January 1054 and setting heliacally around 30 September 1054.

The date 9.9.16.0.0 4 Ahau 8 Cumku, Supernova 1054 and Quetzalcoatl

Applying our correlation-number 739601 to **9.9.16.0.0. 4 Ahau 8 Cumku**, we find the date of **10 May 1054** (Julian Calendar).

This date is not directly related to Venus, but, as we have shown, it is very well linked to the appearance of supernova 1054.
In this context it is also most interesting to note that the first historically recorded supernova after 1054 is that of August 1181, and as we have seen, 1181 is the start of the eclipse tables on pages 51-58 of CxD according to our interpretation.
During the whole period 1000 AD to 1500 AD only the following bright new stars (novae or supernovae) were recorded [17]:

Year (AD)	Duration
1006	Several years
1054	22 months
1181	185 days

The appearance of supernova 1054 on the 10th of May is supported by a number of accounts, both from China and from Mesoamerica:

1. A reference in the *Sung-shih-hsin-pien* translated as follows by Ho et al. (1972) [18]:

   > “ *During the first year of the Chih-ho reign-period (1054) there was a solar eclipse at midday and a guest star appeared within the Mao [lunar Mansion]:[the Pleiades].*

   If this account is correct, then the supernova was observed in China on the day of the great eclipse of 10 May 1054, since there was no other solar eclipse in China in 1054.
   In that case the Maya observed it the same day the Chinese did, while the

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[17] “The Historical Supernovae” by David H. Clark and F. Richard Stephenson. Pergamon Press, 1977/1979, p.55

[18] “A Re-Interpretation of Historical References to the Supernova of 1054 AD”, Georges W.Collins & Al. In PASP, July 1999.

Aztecs (Sahagun) only recorded it after conjunction with the Sun.

2. In the *Anales de Quauhtitlan* we find another indication that the supernova really occurred in the days before 27 May 1054. The account links the appearance of the supernova directly to the story of Quetzalcoatl: [19]

> *" at the time when the planet (Venus) was visible in the sky [as evening star] Quetzalcoatl died. And when Quetzalcoatl was dead he was not seen for 4 days; they say that then he dwelt in the underworld, and for 4 days more he was bone (that is, he was emaciated, he was weak), not until 8 days had passed did the great star appear, that is, as the morning star. They said that then Quetzalcoatl ascended the throne as god" (Seler, 1904c, pp. 359-365)*

This descriptions fits perfectly a scenario where the supernova appears around 10 May 1054: Venus was a brilliant evening star, the supernova disappeared from the evening sky at the time of conjunction with the Sun which was on 27 May 1054 and reappeared some days later in the morning sky.

3. Brasseur writes [20]:

> *" It is remarkable that the time is being measured from the moment that she (the Morning star) appeared …*

and further [21] :

> *" It was then … that the people (of Mexico) according the difference in time, calculated again the days, nights and hours …*

These statements are most remarkable if one realises that the date 4 Ahau 8 Cumku coincides not only with the longcount date 9.9.16.0.0, but also with longcount date 0.0.0.0.0 .

Other dates in the Dresden Codex

Using our correlation number 739601, we examined the other longcount dates mentioned in the Dresden Codex.

This is a provisional result of our investigation:

Ref	**Long Count date**	**decimal**	**+739601**	**Possible astronomical event**	**Calendar date (Jul.Cal.– UT) yyyymmdd**
CxD p.24	**9.9.9.16.0**	1364360	2103961	Close evening grouping Venus+Mercury Greatest elongation Mercury Full Moon Zenit passage SUN at 16°56'(Tikal)	10480501
	9.9.16.0.0	1366560	2106161	**Supernova 1054 (?)** Zenith passage SUN at 19°06' Moon+Mars+Mercury+Venus (+Jupiter) in evening sky	10540511
	delta	2200			

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[19] "Skywatchers of Ancient Mexico" by Anthony F. Aveni, University of Texas Press, 1980, reprinted 1994, p.187

[20] "Sources de l'Histoire primitive du Mexique" by Brasseur – p. 82

[21] "Histoire des Nations Civilisées du Mexique" by Brasseur – Vol I, p. 311

CxD p.52	**9.16.4.10.8 (12 Lamat)**	1412848	2152449	**Start eclipse table** Zenith transit FULL Moon at 17°13′ (Tikal) Mars in meridian at sunrise Heliacal rising Venus	11810131
CxD p.53a	**+ 502**		2152951	Total Lunar eclipse in Mesoamerica	11820618
CxD 55a	**+1742**		2154693	*Partial* Lunar eclipse in Mesoamerica Striking grouping Eclipsed Moon + Jupiter + Saturn + Spica !	11870326
CxD 56a	**+1034**		2155727	Total Lunar eclipse in Mesoamerica Full Moon transit near zenith (dec=18°20′) (+ Mars at 5°)	11900123
CxD 57a	**+1211**		2156938	Total Lunar eclipse in Mesoamerica Zenith transit Sun at 21°01′	11930518
CxD52b	**+1742**		2158680	*Partial* Lunar eclipse in Mesoamerica	11980223
CxD 53b	**+1033**		2159713	Total Lunar eclipse in Mesoamerica (Moon transit near zenith dec=23°20′) Sun near winter solstice	12001222
CxD 54b	**+1211**		2160924	Total Lunar eclipse in Mesoamerica + appulse alfa Librae with eclipsed Moon	12040416
CxD 56b	**+1565**		2162489	Total Lunar eclipse in Mesoamerica Zenith transit Sun 16°57′	12080729
CxD 57b	**+1211**		2163700	Total Lunar eclipse in Mesoamerica Moon transit near zenith (dec=21°53°) Saturn (dec. 16°) near zenith at sunrise (at 1° to Regulus)	12101122
CxD 58b	**+709**		2164409	*Penumbral* eclipse in Mesoamerica Moon transit near zenith (dec= 15°15′)	12131031
CxD 58	**9.12.11.11.0**	1386580	2126181	Mars in meridian near zenith at sunset (dec.Mars=26°09′)	11090303
	9.18.2.2.0	1426360	2165961	Mars in meridian near zenith at sunset (dec.Mars=22°35′)	12180130
	Delta	39780			

CxD p.62-63	**10.6.10.6.3**	1486923	2226524	Ju + Sa transit in zenith	13831122
	8.11.8.7.0	1234220	1973821	Heliacal rising Jupiter + grouping Ve+Ma / Ve+Ju / greatest elongation Venus	6920111
	11.15	235			
	8.16.3.13.0	1268540	2008141	Greatest elongation Venus	7851228
	0.17	17			
	8.16.14.15.4	1272544	2012145	Mo + Ma + Sa transit near zenith Near winter solstice	7961214
	6.1	121			
	8.16.15.16.1	1272921	2012522	Groupings Ve+Ju / Ma+Me	7971226
	1.4.16	456			
	10.8.3.16.4	1499004	2238605	Near winter solstice	14161219
	10.13.13.3.2	1538342	2277943	?	15240901
	7.2.14.19	51419			
CxD p.70	**8.6.16.12.0**	12011200	1940801	Heliacal rising Venus + close conjunction Ve+Ma	6010816

As is shown in this table, almost every longcount date corresponds to a possible interesting astronomical observation in the Maya area.
At the same time it is also worth noticing that, according to correlation number 739601, good results are obtained for dates until the 14th century of

our era, while for later dates the relation between the longcount dates and the astronomical configurations are less obvious.

We hope to investigate this subject further and come back later with additional comments. For the time being however, we want to make the following remarks.

Landa’s 12 Kan 0 Pop

Landa in his famous “Relacion de las cosas de Yucatan” states that [22]

> *“the first day of the year of these people was always on the sixteenth day of our month of July (and the first of their month of Pop)*

Most authors came to the conclusion that Landa’s (12 Kan) 0 Pop date refers to Sunday 16 July 1553 (Julian Calendar) and there is no direct reason to object this conclusion.
The Julian Day Number of 16 July 1553 is 2288488.
When we apply our correlation-number 739601, we obtain a corresponding Maya date 10.15.2.8.7 6 Manik 15 Chen.
This is not exactly what we expect.

On the basis of correlation-number 739601, a 0 Pop occurred on 22 January 1553 (Julian Calendar), which is JDN 2288313.

The difference in days between 16 July 1553 and 22 January 1553 is 2288488 – 2288313 = 175 days, which equals almost 6 lunations or 6 months, and is therefor almost as big as it could be.
Nevertheless, there are a least three considerations that may account fully for this apparent discrepancy:

1. Ginzel writes [23]:

   > *“ Seler’s investigations show that at the beginning of the 16th century, the Mexican year started on 6th February, Julian.*
   > …
   >
   > And further:
   >
   > *“ As far as the Maya are concerned, it is a well established fact that, in prehistoric times, they celebrated a “little first festival”, the yaxkin (7)[24], so 9 periods [of 20 days] later the Pax (16) festival must have been the great New Year’s festival; in historical times Pop (1) became the official New Year’s festival.*
   > *Probably the Central American have counted with two yearly starting dates, this means counted with half years.*

   On this basis, our correlation-number may very well point to the original New year’s festival, although there still remains a difference of some 15 days between the date we found (22 January) and the date of 6 February mentioned by Seler.

2. This difference may be explained by simple astronomical and geographical considerations.

   Many authors agree on the fact that, at some point, the Maya started their year at a moment of a solar zenith transit.
   But the date of a solar zenith transit depends on the geographical latitude of the observer.
   For example, in 1553 zenith transits occurred as follows (Julian Calendar):

Location	Geographical Latitude	Date of Solar South-North	Date of Solar North-South

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[22] “Landa’s Relacion de las Cosas de Yucatan”, edited with notes by Alfred M. Tozzer, 1941, reprinted by Kraus Reprint Corporation, 1966, p.150

[23] “Handbuch der Mathematischen und Technischen Chronologie” by F.K.Ginzel – Band I, J.C.Hinrichs’sche Buchhandlung (1906), p.445/446

[24] According to our correlation number, 7 Yaxkin coincides in 1553 with May 29th (Julian Calendar)

	(north)	transit	transit
Chichen Itza	20.67°	13/14 May	11 July
Tikal	17.33°	29 April	24 July
Copan	14.83°	20/21 April	3 August

A North-South transit occurred on July 16th, 1553 at latitude 19.57° north.

Now suppose that the ancient Maya didn’t know the Earth to be spherical (seems likely).
Therefor they also didn’t understand why a south-north transit at Tikal occurred some 9 days later than at Copan, and why it happened some 15 days later at Chichen Itza then at Tikal. Neither did they understand why in the direction north-south it was the opposite.
Nevertheless, they could easily find the correct date, for example by just observing the shadow cast by a stela or that of a hanging ball.
Now suppose that a starting point of a calendar, i.e. 4 Ahau 8 Cumku, was based on a zenith transit at Tikal and that, during the following years, the Maya scholars moved to, say, Chichen Itza.
They would certainly have noticed that the number of days in a Haab-year, the synodical period of the Moon and of Venus and the periodicity of many other phenomena remained unchanged, but they would also have noticed the shifts of solar zenith transits.
Would they have been inclined to modify their calendar or would they just have introduced a correction?
It is our feeling that the Maya made corrections to take into account the start of their (Haab)year, but that they left the Tzolkin and Longcount unchanged.

Perhaps the way they wrote double dates, such as the intermixed 12 Lamat and 1 Akbal dates we find on page 52a of CxD (supposed start of the eclipse table), might be an example of the way they took into account the geographical differences between the main areas of their territory.
If this is the case, it might be necessary to use a double (or shifted) correlation-number, to take into account these latitude based differences.
This aspect remains to be examined in detail and we hope to come back on it later.

3. Applying our correlation-number, we find a 12 Kan 12 Pop date on February 3th, 1553 (Julian Calendar).
This is remarkably close to the date of February 6th given by Seler.
So, one may wonder if Landa’s presumed identification of 12 Kan with the start of the New Year was indeed in July 1553.

Looking at the section of the manuscript dealing with this very important evidence, it seems as if the scribe who reproduces Landa’s text shows hesitation on how to handle the 12 Kan date at the moment of 0 Pop

[25].

Conclusion

On the basis of the underlying evidence, the identification of the pictures of the pages 51 to 58 of Codex Dresdensis with a specific series of lunar eclipses in the Maya area seems firmly established.
The derived correlation-number, **739601**, explains the importance of the date 9.9.16.0.0 4 Ahau 8 Cumku and establishes a direct relation between this date and the appearance of supernova 1054, while at the same time a link is made between the observation of the supernova and the Quetzalcoatl legend.

Evidence for these theses not only results from our identification of a series of lunar eclipses, but gets support from Eastern Asian as well as from Mexican chronicles.

As we said right at the beginning of this paper, we are aware of the fact that our correlation number clashes with the correlation number(s) which at present are generally accepted.
Nevertheless, we feel that the evidence that we presented briefly is sufficiently strong to reopen the debate.

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extended 2001, 2004, 2006

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