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Venus and the Hittite sack of Babylon

Arnaud Fournet

Independent researcher, Paris V René Descartes, France
E-mail: fournet.arnaud@wanadoo.fr

Abstract

The paper surveys the ways of building the absolute chronology of the ancient Near-East, with a special focus on Mesopotamia during the second millennium BC. There are two types of astronomical phenomena used for dating 2nd millennium Mesopotamia: eclipse observations and Venus observations. These phenomena are (to a large extent) cyclical and can therefore be calculated backward into the past. They can then be compared with existing "records" of astronomical observations. Depending on the presumed reliability of available documents and the retrospective calculations, a number of absolute datings can be proposed, for Egypt, for Assyria, for Anatolia, etc. Acceptable chronological schemes must accommodate available documents (King Lists, astronomical records, etc.), historical synchronisms and retrospective calculations of phenomena (Venus, eclipses, Sirius, etc.), as harmoniously as possible. There are several competing schemes: Long, High Middle, Low Middle, Short, not to mention Ultra-Short. On the whole, it would appear that the Low Middle chronology with the Fall of Babylon circa 1587 BC would best fit the whole set of available data.

Keywords: Ancient Near-East, absolute chronology, Venus, Assyria, Babylon, Anatolia

Introduction

The paper delves into the absolute chronology of the ancient Near-East, with a special focus on Mesopotamia, during the second millennium BC. It does not claim to solve all pending issues, rather it makes a survey of the available data, of the securest parts of the chronology and of the conflicting approaches to the remaining unsolved issues.

There are two main types of astronomical phenomena used for dating 2nd millennium Mesopotamia: eclipse observations and Venus observations. The complete cycle of upper and lower conjunctions of Venus recurs every 275 years, similar positions of the planet also repeat themselves in two shorter cycles, one of 56 years, the other of 64 years. On the other hand, Egyptian chronology relies on the heliacal rise of Sirius (Sothis), which has a 1460-year cycle.

These phenomena are (to a large extent) cyclical (with some disturbances) and can therefore be calculated backward into the past. They can then be compared with existing "records" of astronomical observations, made centuries and millennia ago. Depending on the presumed reliability of available documents and on the retrospective calculations, a number of absolute datings can be proposed, for Egypt, for Assyria, for Anatolia, for the Aegean sea, etc.

Generally speaking, the most acceptable chronological schemes must accommodate available documents (King Lists, astronomical records, etc.), historical synchronisms and retrospective calculations of phenomena (Venus, eclipses, Sirius, etc.), as harmoniously as possible.

1. The core issue

On the whole, the absolute chronology of the 1st millennium BC raises about no serious issue. But, that of the 2nd is a much thornier topic, especially the first half.

On the one hand, we are lucky to have at our disposal an extensive set of clay tablets, running from the Ur III thru Old Babylonian periods, in the (2070–1750 BC) time bracket, that provides a wealth of detailed information on rulers, society, warfare, trade, literature, religion, science and many other aspects of the history of this world which stretched from Mesopotamia into central Anatolia. On the other hand, this textual record is a floating chronological sequence that is in need of being anchored according to some precise absolute dating.

Another wealth of information is provided by the Assyrian King Lists, which shed light on the four last centuries of the 2nd millennium BC, with a fairly secure absolute chronology, backward to a decade after 1400 BC (with an error margin of ±11 years). See Appendix 1.

The core issue is therefore to find a balance point between the absolute chronology provided by the Assyrian King Lists for the end of the millennium and the floating relative chronology of the beginning of the same millennium. How much time elapsed between the Old Babylonian and the Middle Assyrian periods? The middle of the 2nd millennium BC is the crux.

2. The competing chronologies

There are several competing schemes: Long, High Middle, Low Middle, Short chronology, not to mention Ultra-Short. English-speaking countries generally apply the so-called High Middle chronology, anchored around 1595 BC as the putative dating of the Fall of Babylon and end of the Paleo-Babylonian dynasty. German and Italian Hittitologists generally apply the so-called Short chronology.

To put it rather simply, as a starter, a crucial event is the sack of Babylon by the Hittite king, Muršili I. It provides a clear synchronism between Hittite and Paleo-Babylonian chronologies. If we can date it with some certainty, then most of the first half of the 2nd millennium BC is in place, as regards the Ancient Near-East (Mesopotamia, Anatolia).

There are exactly 52 years between the Fall of Babylon and the first reigning year of Ammi-saduqa[1], who was king for 21 years, followed by Śamśu-ditāna for 31 years, until Hittites put an abrupt end to the dynasty.

On the basis of computations of Venus appearances and of Paleo-Babylonian King Lists, the following competing chronological schemes (see Tab.1) exist:

Table 1. The competing chronological schemes in Orientalism : state of art

Chronology	Ammi-saduqa year 1	Fall of Babylon
Long	1702 BC	1651 BC
(High) Middle	1646 BC	1595 BC
Low Middle	1638 BC	1587 BC
Short	1582 BC	1531 BC
Ultra-Short	1550 BC	1499 BC

Which to choose? That is the question, which has been debated since the 1940s.

[1] Depending on the readings assigned to cuneiform signs, the name is Ammi-zaduga, Ammi-saduqa, Ammi-ṣaduqa

3. The Middle-Assyrian King Lists

The so-called *Assyrian King Lists* are anchored according to the records of a solar eclipse, which occurred on June 15, 763 BC, in Neo-Assyrian times. Another so-called *Synchronistic List* provides similar information, with the addition of the Babylonian contemporaneous kings. Thanks to these data, we can reconstruct a fairly secure absolute chronology, backward to a decade after 1400 BC:

- the Neo-Assyrian dynasty (911–609 BC) is undebated,
- the second part of the Middle-Assyrian dynasty (1179–912 BC) is undebated, though a bit less securely established than the Neo-Assyrian dynasty,
- the first part of the Middle-Assyrian dynasty is a bit uncertain, as King Lists differ in the number of years three kings reigned. King List A assigns four years to *Ashur-nadin-apli* and 13 years to *Ninurta-apal-Ekur,* whereas King Lists B and C only assign three years to both. This creates an uncertainty margin of 11 years (17 vs 6). Besides, *Aššur-dan* I is said to have reigned either 47 or only 36 years. This creates another margin of 11 years.

If the longest reigns are adopted, then the beginning of the Middle-Assyrian dynasty is year 1392 BC. On the contrary, if the shortest reigns are adopted, then it began only in year 1370 BC.

On the whole, the *communis opinio* accepts the general chronological framework provided by the *Assyrian King Lists*. See Appendix 1 for the list of Middle-Assyrian kings. The situation is much less favorable for the so-called Hittite King Lists, which are less reliable (Bryce, 2005, p. 376).

4. Synchronisms

Apart from King Lists and historical records of astronomical phenomena, another source of information useful for establishing chronologies is synchronisms: diplomatic exchanges between kings, battles, wars, marriages of daughters, etc. indicate that two kings must have lived during the same period of time and must have been contemporaneous in a way or another. They can be either strong or weak synchronisms, allowing precise or approximative datings.

Examples of historical synchronisms, for the middle of the 2nd millennium BC:

- The sack of Babylon by the Hittite king Muršili I brought to an end the reign of Śamśu-ditana, the last king of the Paleo-Babylonian dynasty of Hammurabi[2].
- Tutankhamun died in the year the Hittite king Šuppiluliuma I conquered the Mittannian kingdom of Karkemiš, some six years prior to Šuppiluliuma's own death.
- The El-Amarna letters provide a number of synchronisms between events in Šuppiluliuma's reign and the reigns of contemporary Near Eastern rulers: the kings of Mittanni, Babylon, and Assyria, and the rulers of Hittite, Egyptian, and Mittannian vassal states in Syria.
- The battle of Nihriya was fought between the Hittite king Tudhaliya IV and the Assyrian king Tukulti-Ninurta I, possibly rather early in the latter's reign and provides synchronistic data about Hatti, Assyria, and Ugarit in the final decades of the Late Bronze Age (Bryce, 2005, p. 377).
- The well-known battle of Kadeš was fought between the Hittite king Muwattalli II and the pharaoh Ramesses II in the fifth year of the latter's reign.

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[2] Paleo-Babylonian refers to a specific period in the history of Mesopotamia, and by extension of the ancient Near East, after the Third Dynasty of Ur and before the First Dynasty of Babylon, that is to say from 2004 to 1595 BCE according to the High Middle chronology

Another key for establishing dates in the ancient world is the changing shapes and styles of pottery, especially when commercially exchanged from one area to another, for example from Egypt to Mesopotamia. They also provide weak synchronisms. On the basis on Egyptian pottery found in Mari, it has been hypothesized that the debated end of the Paleo-Babylonian dynasty could be roughly dated circa 1600 BC.

5. Records of Venus appearances in tablet *Enuma Anu Enlil* 63 (EAE 63)

Attempts at dating the Fall of Babylon rely on “records" of Venus appearances. Depending on the level of consistency between the “records" and what we can retrospectively compute of the phases of Venus in the past, a number of absolute datings can be proposed. The next issue is then to determine which dating seems to fit the whole picture most adequately.

The “records" are a tablet – actually several partly damaged copies (fig. 1) – called *Enuma Anu Enlil* (EAE 63), which dates back to Neo-Assyrian times but seems to describe Venus appearances during the 21 reigning years of the Paleo-Babylonian king Ammi-ṣaduqa, about a millennium before. Since we know his position in the dynasty, and the length of the reign of each king who belonged to it, we should be able to establish a reliable series of dates for the entire Paleo-Babylonian dynasty. The connection between EAE 63 and Ammi-ṣaduqa is the mention of Year 8 of Ammi-ṣaduqa called ‘year of the golden throne’: <mu $^{\text{giš}}$dúr[=ku]-gar kù-sig$_{17}$[=gi]-ga-kam> in EAE 63 (fig. 2).

The “records" in question are from Aššurbanipal’s (669–27 BC) library at Nineveh and from a file of Sargon at Kiš (7th and 8th centuries BC). They are copies of texts which originated over 1000 years before the time of Aššurbanipal. The extant copies were perhaps made in the 8th or 9th centuries BC. There is no complete version of the text. The text must therefore be reconstructed from at least three different tablets which contain parts of the text (Weir, 1972, p. 24–27), (Reiner, Pingree, 1975)[3].

These texts were first interpreted by Franz Xaver Kugler in 1911, who realized that the Venus observations could be used for chronological purposes. They describe the movements of a heavenly body called ^{d}Nin.si$_4$.anna ‘bright mistress of the sky’ in Sumerian, also known in Akkadian as <be-el-tum mu-nam-me-rat AN-e[=šamê]> ‘mistress, illuminator of the sky’.[4] This name can be compared to Greek ὁ φωσφόρος (ἀστήρ) ‘the light-bringer, a name of the morning-star Venus’. In 1912, Kugler proposed a very high dating of Ammi-ṣaduqa year 1 in 1978 BC.

6. About the (un)reliability of EAE 63

On the whole, it cannot be doubted that EAE 63 is a “record" of Venus appearances during the reign of the Paleo-Babylonian king, Ammi-ṣaduqa. As Weir notes, “there is every reason to believe that the observations [of Venus] were made during his reign" (Weir, 1982, p. 23). Issues begin when it comes to matching the “record" with retrospective calculations. As a first word, it can be noted that year 1 of EAE 63 mentions three days of invibility for Venus in Marsh. This feature is extremely selective and eliminates a considerable number of “solutions".

The excerpt from "The Venus Tablets of Ammizaduga" shows the crucial mention of <mu $^{\text{giš}}$dúr-gar kù-sig$_{17}$[=gi]-ga-kam> (Fig. 2), on which the whole chronological scheme is pegged.

[3] The most recent edition of EAE 63 is based on 15 sources

[4] Cf. Line 8 in the tablet MLC 1890 of the Yale Babylonian collections

Figure 1. Tablet *Enuma Anu Enlil* (EAE 63)[5]: ***a*** – recto, ***b*** – verso.

[5] https://www.britishmuseum.org/collection/object/W_K-160 (accessed 20.02.2020)

CHAPTER II

TRANSCRIPTION AND TRANSLATION

K. 160, *Obverse*

1. [*šumma ina araḫ Abi ûm* 21-*kam* ᵈ·*Nin-sī-an-na ina ṣit šamši*][1] *bal-it*
2. [2 *arḫê ûmī* 11-*kam ina šamê iḫ-ḫa-ram-ma*][1] *ina araḫ Araḫsamna ûm* 2-*kam* ᵈ·*Nin-sī-an-na*
3. [*ina erīb šamši innamir*] *zunnê ina māti ibaššû ár-bu-tu iššakan*

If on the 21st of Ab Venus disappeared in the east, remaining absent in the sky for two months and 11 days, and in the month Araḫsamna on the 2nd day Venus was seen in the west, there will be rains in the land; desolation will be wrought. [7th year]

4. *šumma ina araḫ Du'uzi ûm* 25-*kam* ᵈ·*Nin-sī-an-na ina erib šamši it-bal*
5. *ûmī* 7-*kam ina šamê iḫ-ḫá-ram-ma ina araḫ Ab ûm* 2-*kam* ᵈ·*Nin-sī-an-na*
6. *ina ṣit šamši innamir zunnê ina māti ibaššû ár-bu-tu iššakan*

If on the 25th of Tammuz Venus disappeared in the west, for 7 days remaining absent in the sky, and on the 2nd of Ab Venus was seen in the east, there will be rains in the land; desolation will be wrought. [8th year]

7. *šumma ina araḫ Adar ûm* 25-*kam* ᵈ·*Nin-sī-an-na ina ṣit šamši it-bal.* [8th + 9th years]

If in the month Adar on the 25th day, Venus disappeared in the east,[2] . . . .

8. *mu* ᵍⁱˢ*dúr-gar kug-gi-ga*[3]-*kam*

Year of the golden throne. For restoration, v. K. 2321, R. 24–5.

9. *šumma ina araḫ Sivan*[4] *ûm* 11-*kam* ᵈ·*Nin-sī-an-na ina erīb šamši it-bal* 9 *arḫê ûmī* 4-*kam ina šamê iḫ-ḫa-ram-ma*
10. *ina araḫ Adar ûm* 15-*kam ina ṣit šamši innamir šarru ana šarri šulma išapp-ár*

If on the 11th of Sivan[5] Venus disappeared in the west, remaining absent in the sky for 9 months and 4 days, and on the 15th of Adar she was seen in the east, king shall send greetings[6] to king. [9th year]

11. *šumma ina araḫ Araḫsamna ûm* 10-*kam* ᵈ·*Nin-sī-an-na ina ṣit šamši it-bal* 2-*arḫê ûmī* 6-*kam*[7] *ina šamê iḫḫaram-ma*[8]
12. *ina araḫ Ṭebet ûm* 16-*kam ina erib šamši innamir ebūr māti iššir.*

[1] Restored from K. 2321, Obv. 16.

[2] The period of absence and the date of the western rising were omitted or suppressed to insert the date formula.

[3] The ideogram for 'gold' is usually read *guškin* = *ḫurāṣu*, but in all the variants for this passage the phonetic complement *ga* indicates a Sumerian word ending in *g*. See also PBS. X 20, 12 = AJSL. 39, 180, 12. This is the date formula of the *eighth* year of Ammizaduga; for the more complete forms see Poebel, BE. VI p. 100. In the preceding year, when this event actually occurred, this king placed a golden throne and his statue in Enamtila, which usually refers to the chapel of Enlil in Ekur at Nippur, see Langdon, *Babylonian Liturgies*, p. 134. But there was a chapel of Gula-Bau in Babylon, probably in Esagila, and this date formula undoubtedly refers to that chapel. See also Langdon, *Babylonian Wisdom*, 64, 7.

[4] So the text clearly on K. 2321, Obv. 22.

[5] *Sivan*, the 3rd month, must be changed to *Adar*, the 12th month, and the 9 months which follow are to be struck out. In other words, the scribe was operating with *figures*, not names of months, and 9 months were inserted in the wrong place. See note on K. 2321, Rev. 25, and Obv. 22.

[6] Var. K. 2321, Obv. 23 has *ṣalta išapp-ar*, shall send declaration of war.

[7] K. 2321, R. 16 as 8 here.

[8] Written *NI-ma*, but Var. K. 2321, Obv. 24, *iḫ-ḫa-ram-ma*.

Figure 2. Reconstruction of EAE 63 (Langdon, Fotheringham, Schoch, 1928, p. 7).

Some people like Gurzadyan[6] have a hyper-critical stance and consider hardly anything certain can be extracted from EAE 63 (Gurzadyan, 2000; Gurzadyan 2003). Others, like Huber[7] or De Jong[8], try to accept the data in the "record" as much as is possible, even at the cost of some reservations.

Apart from scribal errors, mismatches may originate in bad weather conditions, refraction in the atmosphere, increased opacity caused by volcanic ashes or an insatisfactory understanding of

[6] Armenian mathematical physicist and cosmologist.

[7] Swiss mathematician and statistician.

[8] Dutch Professor Emeritus of Astronomy.

Venus movements or of the Paleo-Babylonian calendar. For example, Weir has suggested that the orbiter of Venus was more elongated at the time of the records in EAE 63 than what is described in the current mathematical models (Weir, 1982, p. 24).

Another issue is the place where the observations were made and the nature of the skyline, which would affect the visibility of the planet slightly above the horizon. These factors may explain why the calculated periods when Venus should theoretically be visible are not adequately recorded in EAE 63.

According to De Jong and Foertmeyer, events 17, 27, 28, 29, 32 and 33 of EAE 63 cannot be easily reconciled with any chronological scheme (De Jong, Foertmeyer, 2010, p. 152). Unless we find an explanation, they should logically be discarded. They also reject event 10, but it is not clear why. See §8 in the present paper for more detail.

As a general preliminary word, all schemes share about the same pattern of matches, mismatches and aberrant observations, as noted above (De Jong, Foertmeyer, 2010, p. 151), so that EAE 63 does not provide any clear direct indication which scheme is best. De Jong and Foertmeyer conclude: “The results are overall very similar. The main differences are summarized in Table 5" (De Jong, Foertmeyer, 2010, p. 151). See Table 24 in the present paper for a general overview. Weir discusses which scheme should be preferred, but the reasoning is neither clear nor convincing (Weir, 1982). As noted by Huber, the only chronology that is completely and massively unreconcilable with EAE 63 is the Ultra-Short with the Fall of Babylon in 1499 BC (Huber, 2000). This scheme can be firmly considered to be impossible.

As an example, we can have a closer look at Table 3 in De Jong, which is calculated according to the Low Middle scheme and provides the following matches (De Jong, Foertmeyer, 2010, p. 147, tab. 3):

Evening Last appearance of Venus (EL) in the year:

- 40 days earlier than expected (#33) (aberrant, needs an explanation)[9]
- no gap between observation and expected date (#5)
- Logically, Venus should not be observable beyond the expected date. The following data are odd: 1 day beyond expected (#1), 2 days beyond expected (#21, #37), 4 days beyond expected (#13), 5 days beyond expected (#9), 7 days beyond expected (#25).
- Especially aberrant are: 13 days beyond expected (#29), 18 days beyond expected (#17).

Evening First appearance of Venus (EF) in the year:

- Logically, Venus should not be observable before the expected date. The following data are odd: 7 days earlier than expected (#8), 4 days earlier than expected (#16), 2 days earlier than expected (#12).
- Especially aberrant is: 34 days earlier than expected (#32)[10]
- 1 day later than expected (#4)
- 2 days later than expected (#24)
- 3 days later than expected (#36)
- 48 days later than expected (#28) (aberrant, needs an explanation)[13]

Morning First appearance of Venus (MF) in the year:

- 2 days earlier than expected (#26) (odd)
- no gap (#6, #38)

[9] Lines 27, 28 and 33 suggest that sky conditions were seriously disturbed at that time. A possible cause is a volcanic eruption. See section 11 in the present paper.

[10] One is left to wonder if the observation is not recorded in the wrong month.

- 1 day later than expected (#2, #14)
- 2 days later than expected (#22, #34)
- 7 days later than expected (#30)
- 8 days later than expected (#18)
- 9 days later than expected (#10)

Morning Last appearance of Venus (ML) in the year:

- 41 days earlier than expected (#27) (aberrant, needs an explanation)[13]
- 3 days earlier than expected (#3, #39)
- no gap (#6, #38)
- Logically, Venus should not be observable beyond the expected date. The following data are odd: 1 day beyond expected (#15, #23), 4 days beyond expected (#11, #19, #31, #35), 6 days beyond expected (#7).

On the whole, all the schemes (except the Ultra-Short) have about the same pattern. This is to a large extent the result of the cyclical pattern of the appearances and disappearances of Venus.

7. The cycle of Planet Venus's visibility

Venus is visible according to the following cycle of events: beginning of morning visibility in the East, called Γ "Morning First" (MF), end of morning visibility, called Σ "Morning Last" (ML), beginning of evening visibility in the West, called Ξ "Evening First" (EF), end of evening visibility in the West, called Ω "Evening Last" (EL), then a new cycle starts (fig. 3).

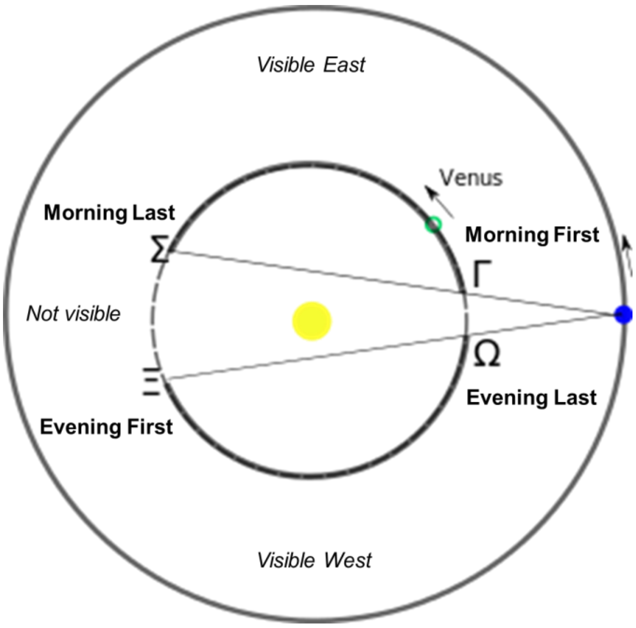

Figure 3. Movements and visibilities of Venus.

8. Going back to *Enuma Anu Enlil* (EAE 63)

In this paragraph, we shall go back to what EAE 63 actually states, including when it has variants, and try to assess how consistently the "records" in EAE 63 match the calculations of dates made by the different authors: Weir, Hubert, De Jong and Foertmeyer.

In what follows, the years are given in the (old) Babylonian calendar, where the spring equinox occurs during Month XII (Month 12 = ITI.ŠE ≈ approximately 06/03–05/04).

Translations of EAE 63 below are mine, though based on previous works (Langdon, Fotheringham, Schoch, 1928; Reiner, Pingree, 1975, p. 17–20), and have been checked with the cuneiform autographs, as much as was possible.

In the following tables 2 - 22 can be found the differences between the calculated dates of Venus's cycle and the actual records in EAE 63.

Calculations are mostly those by De Jong and Foertmeyer (De Jong, Foertmeyer, 2010) and mismatches between the calculated dates and the records in EAE 63 are to be interpreted as follows: negative numbers mean that the record in EAE 63 occurs earlier than calculated, positive numbers mean that the record in EAE 63 occurs later than calculated.

Year 1 Venus vanishes West [ITI.ZÍZ] Šabāṭu 15 [Ω Evening Last XI 14], after 3 days, reappears East [ITI.ZÍZ] Šabāṭu 18 [Γ Morning First XI 18]
(this record is relatively consistent with the calculations)

Table 2. Mismatches for Year 1

	Long	High Middle	Low Middle	Short
EL XI 14	0	-2	1	-2
MF XI 18	-1	-3	1	-1

Year 2 [After 8 months 23 days] Venus vanishes East [ITI.APIN] Arahšamnu 11 [Σ Morning Last VIII 10], after 2 months 8/7[11] days, reappears West [ITI.AB] Ṭebētu 19 [Ξ Evening First X 19]
(this record is relatively consistent with the calculations)

Table 3. Mismatches for Year 2

	Long	High Middle	Low Middle	Short
ML VIII 10	-4	-6	-3	-4
EF X 19	2	-4	1	-2

Year 3 [After 8 months 4 days] Venus vanishes West [ITI.APIN] Arahsamnu 23 [Ω Evening Last VI 22], after 20 days, reappears East [ITI.DU$_6$] Tašrītu 13 [Γ Morning First VII 13]
(this record is relatively consistent with the calculations)

Table 4. Mismatches for Year 3

	Long	High Middle	Low Middle	Short
EL VI 22	-6	-4	0	0
MF VII 13	-2	-4	0	-1

Year 4 [After 8 months 19 days] Venus vanishes East [ITI.ŠU] Dumuzi 2 [Σ Morning Last IV 1], after 2 months 1 day, reappears West [ITI.KIN] Ulūlu 3 [Ξ Evening First VI 3]

(this record is relatively consistent with the calculations)

Table 5. Mismatches for Year 4

	Long	High Middle	Low Middle	Short
EL IV 1	-4	2	6	8
EF VI 3	-11	-14	-7	-5

[11] Copies differ as to the number of days.

Year 5 [After 8 months 29 days] Venus vanishes West [ITI.GU$_4$] Ayyaru 2 [Ω Evening Last II 1], after 15/18 days, reappears East [ITI.GU$_4$] Ayyaru 18/28 [Γ Morning First II 18/28] (the calculations suggest that the correct record is Ayyaru 11[12] and 28)

Table 6. Mismatches for Year 5 with Ayyaru 1 and 18

	Long	High Middle	Low Middle	Short
EL II 1	4	1	5	2
MF II 18	7	4	9	8

Table 7. Emended Mismatches for Year 5 with Ayyaru 11 and 28 (18 days)

	Long	High Middle	Low Middle	Short
EL II 11	-6	-9	-5	-8
MF II 28	-3	-6	-1	-2

[After 8 months 7 days][13] Venus vanishes East [ITI.GAN] Kislimu 25/12$^?$ [Σ Morning Last IX 24/11$^?$], after 2 months 4 days, reappears West [ITI.ZÍZ] Šabāṭu 29/16$^?$ [Ξ Evening First XI 29/16$^?$]
(the calculations suggest that the correct record is Kislimu 25 and Šabāṭu 29 and that the variant with Kislimu 12 and Šabāṭu 16, with a shift of 13 days, cannot be correct)

Table 8. Mismatches for Year 5 with Kislimu 25 and Šabāṭu 29

	Long	High Middle	Low Middle	Short
ML IX 24	5	2	4	-1
EF XI 29	0	-7	-2	-3

Year 6 [After 8 months 29 days] Venus vanishes West [ITI.APIN] Arahšamnu 28 [Ω Evening Last VIII 27], after 3 days, reappears East [ITI.GAN] Kislimu 1 [Γ Morning First IX 1] (this record is relatively consistent with the calculations)

Table 9. Mismatches for Year 6

	Long	High Middle	Low Middle	Short
EL VIII 27	0	0	4	3
MF IX 1	0	-2	1	-1

[K 160 Obverse + K 2321 Obverse]

Year 7 [After 8 months 20 days] Venus vanishes East [ITI.IZI] Abu 21 [Σ Morning Last V 20], after 2 months 11 days, reappears West [ITI.APIN] Arahsamnu 2 [Ξ Evening First VIII 2] (this record is relatively consistent with the calculations)

Table 10. Mismatches for Year 7

	Long	High Middle	Low Middle	Short
ML V 20	-2	-3	1	-2
EF VIII 2	-3	-7	-4	-7

Year 8 [After 8 months 23 days] Venus vanishes West [ITI.ŠU] Dumuzi 25 [Ω Evening Last IV 24], after 7 days, reappears East [ITI.IZI] Abu 2 [Γ Morning First V 2]

[12] It is thinkable that the numerals 10+1 have been mistaken and changed into 1+1.
[13] This duration does not work with the record Ayyaru 11 and 28 (18 days of absence).

(this record is quite at odds with the calculations, especially Dumuzi 25 which suggests that Venus remained visible for two more weeks than expected. Dumuzi 5 would make more sense in light of the calculations)

Table 11. Mismatches for Year 8

	Long	High Middle	Low Middle	Short
EL IV 24	18	15	18	14
MF V 2	8	4	8	5

[After 7 months 23 days] Venus vanishes East [ITI.ŠA] Addaru 25 [Σ Morning Last XII 24]

[here mention of Year of the golden throne]
(this record is relatively consistent with the calculations)

Table 12. Mismatches for Year 8 (2^{nd} record)

	Long	High Middle	Low Middle	Short
ML XII 24	0	2	4	-2
? EF III 11	uncalculated			

Year $8^?$ [After an unknown period] Venus (should be: reappears$^?$ West$^?$) on [ITI.SIG$_4$] Simānu 11 [$\Xi^?$ Evening First III 11]
(Apparently, the tablet is disturbed here. One is left to wonder if the record is not about [$\Xi^?$ Evening First III 11] This piece of information is not taken into account in the calculations by De Jong, Foertmeyer (De Jong, Foertmeyer, 2010).

Year 9 [After 9 months 4/5 days] Venus vanishes West [ITI.ŠE] Addāru ?? [Ω Evening Last XII ??], after ?? [xx] days, reappears East [ITI.ŠE] Addāru 15/16 [Γ Morning First XII 15/16]
De Jong, Foertmeyer have retained an unattested *EL XII 10 and opted for MF XII 15. On the whole, this record is relatively consistent with the calculations)

Table 13. Mismatches for Year 9

	Long	High Middle	Low Middle	Short
? EL XII 10	-1	2	2	3
MF XII 15	-1	-3	2	1
*MF XII 16	0	-2	3	2

Year 10 [After 8 months 25 days] Venus vanishes East [ITI.APIN] Arahsamnu 10 [Σ Morning Last VIII 9], after 2 months 6/16/8$^?$ days, reappears West [ITI.AB] Ṭebētu 16 [Ξ Evening First X 16]
(The period of absence is not the same on all tablets. The pair ML VIII 9 and EF X 16 is consistent with the calculations)

Table 14. Mismatches for Year 10

	Long	High Middle	Low Middle	Short
ML VIII 9	-2	-3	1	-2
EF X 16	3	-3	2	-2

Year 11 [After 8 months 10 days] Venus vanishes West [ITI.KIN] Ulūlu 26 [Ω Evening Last VI 25], after 11/12 days, reappears East [ITI.KIN II] $Ul\bar{u}lu_2$ 7/8 [Γ Morning First VI_2 7/8] (this record is relatively consistent with the calculations)

Table 15. Mismatches for Year 11

	Long	High Middle	Low Middle	Short
EL VI 25	2	3	-2	6
MF VI_2 8	-3	-5	7	-2

Year 12 [After 7 months 2 days] Venus vanishes East [ITI.BÁR] Nisannu 9/8 [Σ Morning Last I 9], after 5 months 16/17/18 days, reappears West [ITI.KIN] Ulūlu 24/25 [Ξ Evening First VI 25]
(this record is extraordinarily at odds with the calculations. The period of visibility of Venus was 3 months shorter than should be. A possible explanation is volcanic ash in the atmosphere. Thera 1628/27 BC is only consistent with the Low Middle scheme)

Table 16. Mismatches for Year 12

	Long	High Middle	Low Middle	Short
ML I 8	-51	-45	-41	-40
EF VI 25	44	42	48	51

Year 13 [After 7 months 10 days] Venus vanishes West [ITI.GU_4] Ayyaru 5 [Ω Evening Last II 4], after 6/7 days, reappears East [ITI.GU_4] Ayyaru 12 [Γ Morning First II 12]
(this record is slightly at odds with the calculations)

Table 17. Mismatches for Year 13

	Long	High Middle	Low Middle	Short
EL II 4	11	12	13	9
MF II 12	5	3	7	6

[After 8 months 9 days] Venus vanishes East [ITI.AB] Ṭebētu 20/21 [Σ Morning Last X 19/20], after 15 (should be 21[!]) days, reappears West [ITI.ZÍZ] Šabāṭu 11 [Ξ Evening First XI 11].
Another version has [Σ Morning Last X 24] (1 month 4 days) [Ξ Evening First XI 28].
(something seems to be wrong with EF XI 28. Is an intercalary month missing here?)

Table 18. Mismatches for Year 13 (2nd record)

	Long	High Middle	Low Middle	Short
ML X 20	5	1	4	-1
*ML X 24	9	5	8	3
EF XI 21[14]	-34	-40	-34	-37
*EF XI 28	-27	-33	-27	-30

Year 14 [After 8 months 29 days] Venus vanishes West [ITI.DU_6] Tašrītu 10/11 [Ω Evening Last VII 9/10], after 1 month 16/17 days, reappears East [ITI.APIN] Arahsamnu 26/27/28 [Γ Morning First VIII 27]
(something seems to be wrong with EL VII 9. Is an intercalary month missing here?)

[14] Several authors (De Jong, Huber) use EF XI 21, which is attested in none of the copies of EAE 63.

Table 19. Mismatches for Year 14

	Long	High Middle	Low Middle	Short
EL VII 9	-43	-42	-40	-38
MF VIII 27	0	-3	2	0

Year 15 [After 8 months 20/21 days] Venus vanishes East [ITI.IZI] Abu 20 [Σ Morning Last V 19], after 2 months 15 days, reappears West [ITI.APIN] Arahsamnu 5 [Ξ Evening First VIII 5]

(this record is relatively consistent with the calculations. An existing variant with ML V 20 and EF IX 5 seems less acceptable)

Table 20. Mismatches for Year 15

	Long	High Middle	Low Middle	Short
ML V 19	0	1	4	1
EF VIII 5	3	-2	3	2

Year 16 [After 9 months] Venus vanishes West [ITI.ŠU] Dumuzi 5 [Ω Evening Last IV 4], after 15 days, reappears East [ITI.ŠU] Dumuzi 20 [Γ Morning First IV 20]

(this record is relatively consistent with the calculations)

Table 21. Mismatches for Year 16

	Long	High Middle	Low Middle	Short
EL IV 4	2	-2	2	-2
MF IV 20	0	-4	0	-3

[After 7 months 25 days] Venus vanishes East [ITI.ŠE] Addāru 15 [Σ Morning Last XII 14], after 3 months 9 days,

Year 17 reappears West [ITI.SIG$_4$] Simānu 25 [Ξ Evening First III 25]

(this record is slightly at odds with the calculations)

Table 22. Mismatches for Year 17

	Long	High Middle	Low Middle	Short
ML XII 14	-6	-5	-3	-8
EF III 25	16	11	15	13

Calculations in "A new look at the Venus observations…" (De Jong, Foertmeyer, 2010) stop here, but more data are available.

[After 8 months 15 days] Venus vanishes East [ITI.ŠA] Addaru 10 [Ω Evening Last XII 9], after 4 days, reappears East [ITI.ŠA] Addaru 14 [Γ Morning First XII 14]

Year 18 [no record]

Year 19 [After ?? months ?? days] Venus vanishes West [ITI.KIN II] Ulūlu$_2$ 1 [Ω Evening Last VI 30], after 15/16 days, reappears East [ITI.KIN II] Ulūlu$_2$ 14/17 [Γ Morning First VI$_2$ 14/17]

(This record is about half a month at odds with calculations by Weir (Weir, 1982, p. 36)

Year 20 [After 9 months 8/11 days] Venus vanishes East [ITI.SIG$_4$] Simānu 25 [Σ Morning Last III 24], after 2 months 6/16 days, reappears West [ITI.KIN] Ulūlu 14/24 [Ξ Evening

First VI 14/24]
(This record seems to be a bit corrupted. According to Weir (Weir, 1982, p. 36), calculations are most consistent with III 24 and VI 1. The record should be Simānu 25 + 2 months 6 days + Ulūlu 1)

Year 21 [After 8 months 3 days] Venus vanishes East [ITI.BÁR] Nisannu 26/27/28 [Ω Evening Last I 25/26/27], after 6/7 days, reappears West [ITI.GU$_4$] Ayyaru 3 [Γ Morning First II 3]
(This record is relatively consistent with the calculations made by Weir (Weir, 1982, p. 36)

[After 8 months 25 days] Venus vanishes East [??] 28 [Σ Morning Last ?? 28], after 2 months, reappears West [ITI.ŠA] Addaru 28 [Ξ Evening First XII 28]
(This record is relatively consistent with the calculations in "The Venus Tablets - a Fresh Approach" (Weir, 1982, p. 36)

As a general conclusion, it appears that EAE 63 is relatively reliable. As a rule, recorded dates and calculations are most of time relatively consistent. Year 12 is possibly disturbed by Thera, Year 13 and Year 14 have a shift equivalent to a full (? intercalary) month. Some textual variants better match the calculations than others, and should possibly be preferred.

9. Summary of the (mis)matches in EAE 63

The periods of visibility of Venus are cyclical. After 8 years, they go back to the same point of the year minus 4 days. EAE 63 respects this principle.

Year 1 – Ω Evening Last XI 14 – reliable
Year 1 – Γ Morning First XI 18 – reliable
Year 2 – Σ Morning Last VIII 10 – reliable
Year 2 – Ξ Evening First X 19 – reliable
Year 3 – Ω Evening Last VI 22 – reliable
Year 3 – Γ Morning First VII 13 – reliable
Year 4 – Σ Morning Last IV 1 – reliable
Year 4 – Ξ Evening First VI 3 – reliable
Year 5 – Ω Evening Last II 1 – better match if be emended to Ω Evening Last II 11
Year 5 – Γ Morning First II 18/28 – best match with Γ Morning First II 28
Year 5 – Σ Morning Last IX 24/11$^?$ – best match with Σ Morning Last IX 24
Year 5 – Ξ Evening First XI 29/16$^?$ – best match with Ξ Evening First XI 29
Year 6 – Ω Evening Last VIII 27 – reliable
Year 6 – Γ Morning First IX 1 – reliable
Year 7 – Σ Morning Last V 20 – reliable
Year 7 – Ξ Evening First VIII 2 – reliable
Year 8 – Ω Evening Last IV 24 – better match if emended to Ω Evening Last IV 4
Year 8 – Γ Morning First V 2 – reliable
Year 8 – Σ Morning Last XII 24 – reliable
The data in EAE 63 are not correctly recorded in this period.
Year 9 – Ξ Evening First III 11 – reliable
Year 9 – Ω Evening Last XII ?? – missing data (XII 10/11 is a possibility)
Year 9 – Γ Morning First XII 15/16 – reliable

Cf. Year 1 – Ω / Γ

Year 10 – Σ Morning Last VIII 9 – reliable

Year 10 – Ξ Evening First X 16 – reliable

Cf. Year 2 – Σ / Ξ

Year 11 – Ω Evening Last VI 25 – reliable

Year 11 – Γ Morning First VI_2 7/8 – reliable

Cf. Year 3 – Ω / Γ

Year 12 – Σ Morning Last I 9 – more than 40 days too early in all schemes

Year 12 – Ξ Evening First VI 25 – more than 40 days too late in all schemes

The period of invisibility in Year 12 is extraordinarily long.

Cf. Year 4 – Σ / Ξ

Year 13 – Ω Evening Last II 4 – about 10 days too late in all schemes

Year 13 – Γ Morning First II 12 – reliable

Year 13 – Σ Morning Last X 19/20 – reliable (variant X 24 less satisfactory)

Year 13 – Ξ Evening First XI 11/28 – seems to be off the mark by about a month too early

Cf. Year 5 – Ω / Γ / Σ / Ξ

Year 14 – Ω Evening Last VII 9/10 – seems to be off the mark by about a month too early

Something seems to be wrong with the calendar in Year 13/14.

Year 14 – Γ Morning First VIII 27 – reliable

Cf. Year 6 – Ω / Γ

Year 15 – Σ Morning Last V 19 – reliable

Year 15 – Ξ Evening First VIII 5 – reliable

Cf. Year 7 – Σ / Ξ

Year 16 – Ω Evening Last IV 4 – reliable

Year 16 – Γ Morning First IV 20 – reliable

Year 16 – Σ Morning Last XII 14 – reliable

Cf. Year 8 – Ω / Γ / Σ

Year 17 – Ξ Evening First III 25 – more than 10 days too late in all schemes

Year 17 – Ω Evening Last XII 9 – reliable

Year 17 – Γ Morning First XII 14 – reliable

Cf. Year 1, 9 – Σ / Ξ / Γ

Year 18 – no record

Year 19 – Ω Evening Last VI 30 – more than 15 days too early in all schemes

Year 19 – Γ Morning First VI_2 14/17 – more than 15 days too early in all schemes

Cf. Year 3, 11 – Ω / Γ

Year 20 – Σ Morning Last III 24 – reliable

Year 20 – Ξ Evening First VI 14/24 – more than 10/20 days too late in all schemes

Cf. Year 4, 12 – Σ / Ξ

Year 21 – Ω Evening Last I 25/26/27 – reliable

Year 21 – Γ Morning First II 3 – reliable

Year 21 – Σ Morning Last ?? 28 – consistent with X 28

Year 21 – Ξ Evening First XII 28 – reliable

Cf. Year 5, 13 – Ω / Γ / Σ / Ξ

For the cyclicality of the data in EAE 63 see the table 23. Records with huge gaps are marked with Δ. Data in EAE 63 are cyclical as expected.

Table 23. Records in EAE 63 arranged according to 8-year cycles

		Should be 4 days earlier	
	8-year cycle I	8-year cycle II	8-year cycle III
Ω Evening Last	Year 1 – XI 14	?	Year 17 – XII 9
Γ Morning First	Year 1 – XI 18	Year 9 – XII 15/16	Year 17 – XII 14
Σ Morning Last	Year 2 – VIII 10	Year 10 – VIII 9	?
Ξ Evening First	Year 2 – X 19	Year 10 – X 16	?
Ω Evening Last	Year 3 – VI 22	Year 11 – VI 25	Δ Year 19 – VI 30
Γ Morning First	Year 3 – VII 13	Year 11 – VI_2 7/8	Δ Year 19 – VI_2 14/17
Σ Morning Last	Year 4 – IV 1	ΔΔ Year 12 – I 9	Year 20 – III 24
Ξ Evening First	Year 4 – VI 3	ΔΔ Year 12 – VI 25	Δ Year 20 – VI 14/24
Ω Evening Last	Year 5 – II 1 ($11^?$)	Year 13 – II 4	Year 21 – I 25/26/27
Γ Morning First	Year 5 – II 28	Year 13 – II 12	Year 21 – First II 3
Σ Morning Last	Year 5 – IX 24	Year 13 – X 19/20	Year 21 – *[$X^?$] 28
Ξ Evening First	Year 5 – XI 29	Δ Year 13 – XI 11/28	Year 21 – XII 28
Ω Evening Last	Year 6 – VIII 27	Δ Year 14 – VII 9/10	
Γ Morning First	Year 6 – IX 1	Year 14 – VIII 27	
Σ Morning Last	Year 7 – V 20	Year 15 – V 19	
Ξ Evening First	Year 7 – VIII 2	Year 15 – VIII 5	
Ω Evening Last	Year 8 – IV 24 ($4^?$)	Year 16 – IV 4	
Γ Morning First	Year 8 – V 2	Year 16 – IV 20	
Σ Morning Last	Year 8 – XII 24	Year 16 – XII 14	
Ξ Evening First	?	Δ Year 17 – III 25	

10. Equinox and the 1st day of Nisannu

As noted before, because the appearances and disappearances of Venus are cyclical, EAE 63 does not provide a direct indication which scheme best matches the recorded dates.

De Jong and Foertmeyer nevertheless make an interesting remark in favor of the Middle chronology (De Jong, Foertmeyer, 2010, p. 151–52).

Fundamentally, the Old Babylonian calendar is ruled by agricultural needs. On average the harvest of dates falls in Ulūlu (month VI) and the harvest of barley in Addaru (month XII). Because the solar year is 5¼ days longer than 12 months of 30 days, an intercalary month must be inserted regularly to keep the calendar on line with the seasons and agricultural needs. The insertion of an extra month can happen in the middle ($Ulūlu_2$) or at the end ($Addaru_2$) of the year.

As a rule, the strategy of insertion is based on the principle that the spring equinox should fall on Addaru (XII) 15, thus the beginning of the Old Babylonian year (Nisannu 1), though floating because of the 5¼ days gap between the actual solar year and 12x30 days, falls on average about 15 days after the spring equinox. This principle guarantees that the mobile calendar of 12 months of 30 days remains approximately pegged according to the solar year and seasons.

The table 24 shows the coincidence of the spring equinox in the different chronological schemes, for the 16 first years of the reign of Ammi-ṣaduqa, according to the mentioned above calculations (De Jong, Foertmeyer, 2010, p. 151).

Table 24. Coincidence of XII 15 with the spring equinox

	Spring equinox	Addaru (XII) 15	Nisannu 1
Long	April 5	≠ April 22	May 7
High-Middle	April 5	≈ April 4	April 19
Low-Middle	April 4	≈ April 3	April 18
Short	April 4	≠ May 16	May 31

The comments made by De Jong and Foertmeyer are nevertheless prudent: “These data show that for the Long Chronology the Babylonian calendar is on average more than two weeks late, and for the Short Chronology almost three weeks early, while for the two Middle Chronologies the calendar (averaged over sixteen years) seems to agree nicely with Old Babylonian calendar practice. Although for each of the criteria in table 5 a preference for one or at most two of the chronologies might be expressed, our analysis of the Venus observations does not allow us to choose between the four Venus chronologies" (De Jong, Foertmeyer, 2010, p. 152–53).

11. The Thera (Santorini) explosion

As noted before, a volcanic eruption is a possible explanation for the extraordinarily short period of visibility of Venus recorded for Year 12 in EAE 63.

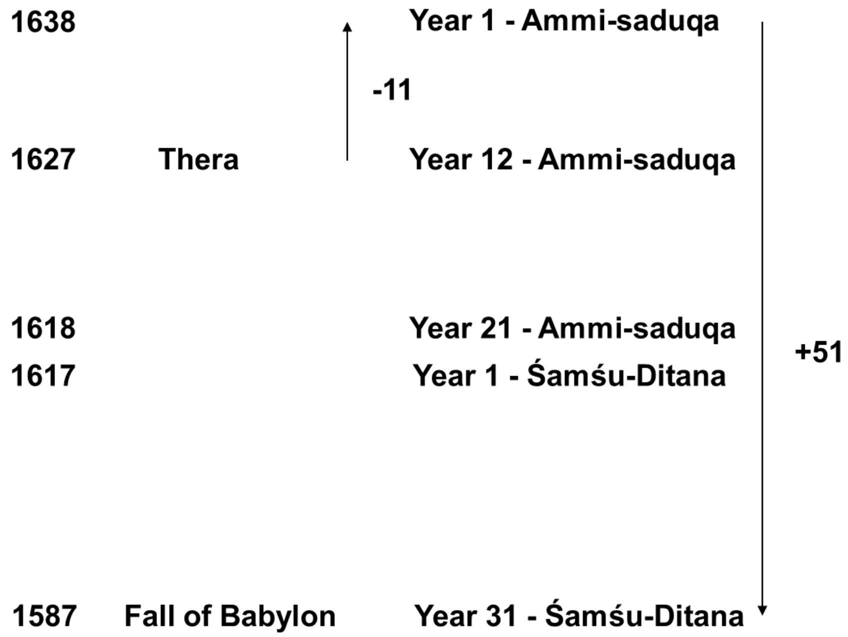

Figure 4. Synchronicity of Thera explosion with the end of the Paleo-Babylonian dynasty

It would have emitted so much ash that Venus was hardly visible for a year or two. According to De Jong and Foertmeyer, this period of “1 to 2 years is about the half-life of aerosols produced by a volcano eruption in the stratosphere" (De Jong, Foertmeyer, 2010, p. 154). It must be emphasized that, if accepted, the link between Year 12 and Thera is compelling (fig. 4).

Of course, the Thera explosion comes to mind if a volcanic eruption is involved in Year 12 anomalous records. Still, a word of prudence is necessary, as we cannot prove such a direct causal link. De Jong and Foertmeyer suggest that Thera can be dated in the time bracket: November 1628 – May 1627 BC (De Jong, Foertmeyer, 2010, p. 154). This would mean that the only acceptable scheme is the Low-Middle chronology.

12. Information from ^{14}C dating

Another direct source of absolute dating, though a bit imprecise, is Carbon-14 dating.

The paper of Manning and Griggs describes extremely interesting findings about ancient wood samples in Kültepe (ancient Kaneš) and Acemhöyük in relationship with the Old Assyrian commercial settlements in Anatolia (Manning, Griggs, Lorentzen *et al*, 2016). This work is an improvement over previous attempts at dating Anatolian wood samples by the same team.

Their conclusion is unambiguous: the tree-ring-sequenced ^{14}C time-series for Kültepe and Acemhöyük is consistent only with the Middle chronology (High-Middle or Low-Middle), and excludes the Long, Short or Ultra-Short chronologies (fig. 5).

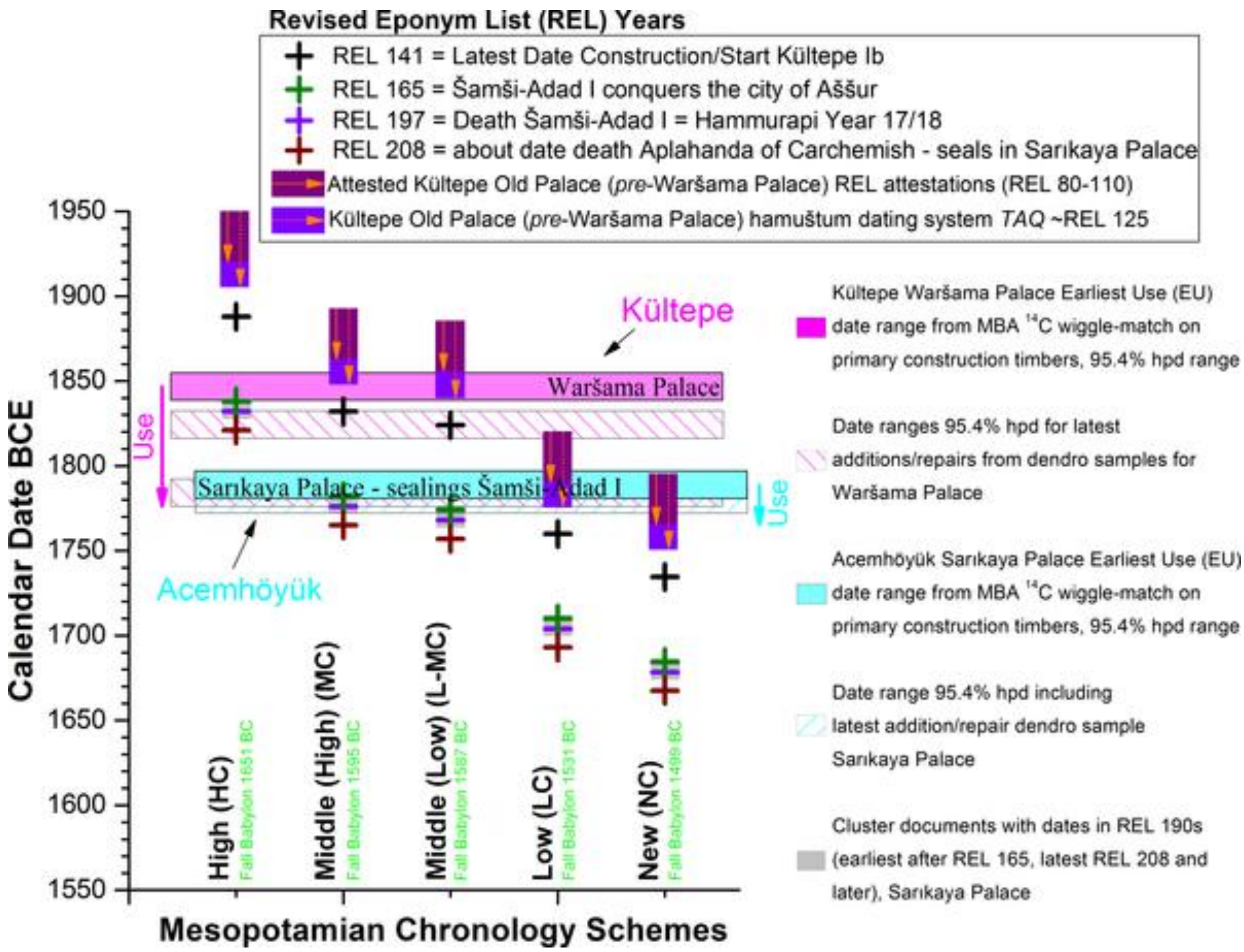

Figure 5. Comparison of the chronological schemes (Manning, Griggs, Lorentzen et al, 2016, fig. 9).

The Long and Short schemes fall out of the possible window. ^{14}C dating is not precise enough to determine which of the High-Middle or Low-Middle is best.

13. Conclusion

The paper tried to assess the points in favor of the different chronologies: Long, High-Middle, Low-Middle, Short or Ultra-Short. We can summarize the *status questionis* as follows:

- EAE 63 describes the appearances and disappearances of a body called ^{d}NIN.SI$_4$.AN.NA, a literary name for Venus.
- EAE 63 provides a record for 20 years and Year 8 bears the mention "year of the golden throne", pointing at Ammi-ṣaduqa, the last-but-one king of the Paleo-Babylonian dynasty.

- The 20 records in EAE 63 have the cyclical 8-year pattern that characterizes Venus.
- There is little doubt that EAE 63 is on the whole authentic and reliable, about 80% of the recorded dates match calculations with an error margin of a few days.
- On the basis of EAE 63, only a limited list of dates for Ammi-ṣaduqa Year 1 is thinkable: 1701 BC, 1645 BC, 1637 BC, 1581 BC or 1549 BC.
- Because of the inherent cyclicity of Venus, EAE 63 provides no clear and direct indication which chronological scheme should be preferred, though it would seem that 1549 BC (Ultra-Short) matches the records considerably less than the other candidates.
- One of the records, Year 12, suggests that Venus was visible on that year during a period of time, that is about three months shorter than expected.
- A possibility for explaining the abnormally short period of visibility during Year 12 is a volcanic eruption, that would have thrown considerable amounts of ash in the atmosphere,
- A candidate for a massive volcanic eruption is Thera, which is dated between November 1628 and May 1627. This would mean that Year 12 of Ammi-ṣaduqa is 1627 BC.
- If accepted, this would mean that the only acceptable chronology is the Low-Middle one: Year 1 of Ammi-ṣaduqa is 1638, Year 12 is 1627 BC, Fall of Babylon is 1587 BC.
- ^{14}C dating of wood associated with the Old Assyrian commerce in Anatolia suggests that only one of the two Middle chronologies can be correct. The Long and Short schemes fall out of the possible window. Carbon-14 dating is not precise enough to determine which of the High-Middle or Low-Middle is best.

As a general conclusion, a convergent body of evidence pleads in favor of the Low-Middle chronology being the most acceptable scheme for the first half of the 2nd millennium BC.

Appendix 1 – Middle Assyrian Dynasty

The list is based on (slightly divergent) King Lists and anchored according to a solar eclipse, which occurred on June 15, 763 BC. Another Synchronistic List provides similar information, with the addition of the Babylonian contemporaneous kings.

Eriba-Adad I (27 years) [15]	≈ ^{A}1392–1366 – ≈ ^{BC}1381–1353 – ≈1370–1342
Aššur-uballiṭ I (35 years) [16]	≈ ^{A}1365–1330 – ≈ ^{BC}1353–1318 – ≈1342–1307
Enlil-nirari (10 years)	≈ ^{A}1330–1320 – ≈ ^{BC}1317–1308 – ≈1306–1297
Arik-den-ili (12 years) [17]	≈ ^{A}1319–1308 – ≈ ^{BC}1307–1296 – ≈1296–1285
Adad-nirari I (31 years) [18]	≈ ^{A}1307–1275 – ≈ ^{BC}1295–1264 – ≈1284–1253
Šalmaneser I (30 years)	≈ ^{A}1274–1245 – ≈ ^{BC}1263–1234 – ≈1252–1223
Tukulti-Ninurta I (36 years)	≈ ^{A}1244–1208 – ≈ ^{BC}1233–1197 – ≈1222–1186
Aššur-nadin-apli (^{A}4 / ^{BC}3 years) [19]	≈ ^{A}1208–1204 – ≈ ^{BC}1197–1194 – ≈1186–1183
Aššur-nirari III (6 years) [20]	≈ ^{A}1203–1198 – ≈ ^{BC}1193–1188 – ≈1182–1177
Enlil-kudurri-usur (5 years) [21]	≈ ^{A}1197–1193 – ≈ ^{BC}1187–1183 – ≈1176–1172
Ninurta-apal-É.kur (^{A}13 / ^{BC}3 years) [22]	≈ ^{A}1192–1180 – ≈ ^{BC}1182–1180 – ≈1171–1169
Aššur-dan I (47[23] years) [24]	≈ 1179–1133 (or ? ≈ 1168–1133)
Ninurta-tukultī-Aššur (less than a year) [25]	1133
Mutakkil-Nusku (less than a year) [26]	1133
Aššur-rēša-iši I (18 years) [27]	1133–1115 BC
Tiglath-Pileser I (40 years) [28]	1115–1076 BC
Ašarid-apal-Ekur (2 years) [29]	1076–1074 BC
Aššur-bel-kala (18 years) [30]	1074–1056 BC
Eriba-Adad II (2 years) [31]	1056–1054 BC
Šamši-Adad IV (4 years) [32]	1054/3–1050 BC
Aššur-nāṣir-apli I (19 years) [33]	1049–1031 BC
Salmānu-ašarēd II (12 years) [34]	1031–1019 BC
Aššur-nērārī IV (6 years) [35]	1019–1013 BC

[15] <^{m}SU-^{d}IM>
[16] <^{md}A-šur-TI-LA>
[17] <^{m}GÍD-DI-DINGIR>
[18] <^{md}IM-ZAB+DAḪ>
[19] <^{m}aš-šur-SUM-DUMU.UŠ>
[20] <^{m}aš-šur-ERIM.GABA>
[21] <^{md}Enlil(be)-ku-dúr-uṣur>
[22] <^{md}MAŠ-A-é-kur>
[23] Another source gives only 36 years. A 47-year-long reign would be exceptionally long.
[24] <^{m}Aš-šur-dān(kal)^{an}>.
[25] <^{md}Ninurta$_{2}$-tukul-ti-Aš-šur>
[26] <^{m}mu-ta/tak-kil-^{d}PA.KU>
[27] <^{m}aš-šur-SAG-i-ši>
[28] <TUKUL.TI.A.É.ŠÁR.RA> Tukultī-Apal-É.śarra. Tiglath-Pileser is the Hebrew equivalent.
[29] <^{m}a-šá-rid-A-É.KUR>, <^{m}SAG.KAL-DUMU.UŠ-É.KUR>
[30] <^{m}aš-šur-EN-ka-la>
[31] <^{m}SU-^{d}IM>
[32] <^{md}šam-ši-^{d}IM>
[33] < ^{m}aš-šur-PAB-A>
[34] <^{md}SILIM-ma-nu-MAŠ/SAG>

Aššur-rabi II (41 years) [36]	1013–972 BC
Aššūr-reš-iši II (5 years) [37]	972 BC–967 BC
Tiglath-Pileser II (32 years)	967–935 BC
Aššur-dān II (22 years)	934 BC–912 BC

Appendix 2 – Paleo-Babylonian (or Amorite) Dynasty

The list is provided according to the High Middle (^{HM}) and Low Middle (^{LM}) chronologies.

Śumu-abum (13 years) [38]	^{HM}1894–1881 – ^{LM}1886–1873 BC
Śumu-la-il (36 years) [39]	^{HM}1881–1845 – ^{LM}1873–1837 BC
Ṣabûm, Sabium (14 years) [40]	^{HM}1845–1831 – ^{LM}1837–1823 BC
Apil-Sin (18 years) [41]	^{HM}1831–1813 – ^{LM}1823–1815 BC
Sin-muballiṭ (21 years) [42]	^{HM}1813–1792 – ^{LM}1805–1784 BC
Hammu-rabi (42 years) [43]	^{HM}1792–1750 – ^{LM}1784–1742 BC
Śamśu-ilūna (38 years) [44]	^{HM}1750–1712 – ^{LM}1742–1704 BC
Abi-ešuh (28 years) [45]	^{HM}1712–1684 – ^{LM}1704–1676 BC
Ammi-Ditana (37 years) [46]	^{HM}1684–1647 – ^{LM}1676–1639 BC
Ammi-Ṣaduqa (21 years) [47]	^{HM}1647–1626 – ^{LM}1638–1618 BC
The Thera (Santorini) explosion may have occurred during his reign.	
Śamśu-Ditana (31 years) [48]	^{HM}1626–1595 – ^{LM}1617–1587 BC
Sack of Babylon, end of the dynasty	

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35 <^{m}aš-šur-ERIM.GABA>
36 <^{m}aš-šur-GAL-bi>
37 <^{m}aš-šur-SAG-i-ši>
38 <su-mu-a-bu-um>
39 <su-mu-la-il[=èl]>
40 <za[=sà]-bu-um>
41 <a-pil-^{d}en.zu>
42 <^{d}en.zu-mu-ba-lí[=ni]-it>
43 <(h)a-am-mu-ra-bi>
44 <sa-am-su-i-lu-na>
45 <a-bi-e-šu-uh>
46 <am-mi-di-ta-na>
47 <am-mi-ṣa[=za]-du-qá[=ga]>
48 <sa-am-su-di-ta-na>

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