Basic astronomy for historians to get a chronology

Abstract: "Chronology is the backbone of history" is usually taught in schools but in the same time the first fall of Babylon is currently fixed either in 1595 BCE or in 1651, 1531, 1499 depending on historians! Such a difference in timeline prevents one from reaching the historical truth. It is for this reason that from Herodotus, the "father of history" (in fact the father of scientific and chronological inquiry), Greek historians gradually established a system of scientific dating in order to write a universal history. Many astronomical phenomena (observed and described by Babylonian astrologers), which are well identified such as eclipses, enable anyone today (with at least an undergraduate level) to synchronize these ancient dating systems and anchor them on absolute dates. As incredible as it may seem this is still not done (among the hundreds of thousands of theses in history there is none which focuses on chronology, except the one of Isaac Newton in 1728 entitled: Chronology of Ancient Kingdoms Amended). The purpose of the present item is to understand the origin of this anomaly and above all to give the tools for easily verifying important dates in history thanks to numerous practical examples like Jesus' birth on Monday 29 September 2 BCE, Herod's death on Monday 26 January 1 BCE, the destruction of Jerusalem's Temple on Sunday 27 August 587 BCE, the first fall of Babylon soon after April 1499 BCE, etc.

Anyone interested in history has been able to see that every Egyptologist has their own chronology (and consequently their own truth about history) and all the history books just mention in their introduction that some dates are controversial and in order to solve this crucial problem they argue that most academic historians have used the "Middle Chronology" as reference (it's magic), because the truth always belongs to the majority in a democracy. How can one explain this anomaly? Academic historians claim that chronology is a complex science and historical documents are difficult to interpret. These two lame excuses are false. In fact the primary purpose of academic historians is to validate and to spread an official history aimed at magnify the national novel of their country (it's a part of the process called "manufacturing consent"). The official history is that of the winner (for every country) and the vanquished are always pictured as barbarians, unworthy of owning their own country such as the American Indians, the Palestinians in the West Bank, the Armenians in Turkey, etc. The only history that most academic historians are really seeking to promote is their own history (their *cursus honorum*), not the truth[1]. The criticizing of ones colleagues is not very polite and it gets you immediately blacklisted, as was already the case for Herodotus (until today among Egyptologists!), but that's life (Luke 6:26).

Chronology is at the heart of our lives, the day we die the only information that will be listed next to our name is our date of birth and date of death. Truth is very often mundane, but quite different from fairy tales "once upon a time in a far away country". These two dates are not kept by chance but because they are a link to the great mystery of humankind: the question of origin and end. That's why calendars are religious, *Anno Domini* "Year of the Lord" for Christians (Gregorian calendar), *Annus Mundi* for Jews (*Seder Olam*), *Anno Hegirae* for Muslims, Chinese Zodiac for some Asiatics, etc. The main difficulty is to convert the dates from a calendar to another one. Given that most calendars have changed in time because of some readjustments, scientists use today as reference the Julian astronomical calendar (quite similar to the ancient Julian calendar). All calendars are based on the sun and the moon: year is related to an Earth rotation around the sun (365.25 days), month to a moon rotation around Earth (29.5 days) and day to an Earth rotation around itself. The synchronization between the solar year of 365 days and the 12 lunar months of 354 days has always been a problem of great complexity. The first exercise is therefore to know the functioning of the Julian calendar (Gregorian after 1582 AD).

[1] All those who deeply know the academic world will be able to check my disillusioned opinion.

The calendar was a reform in 1582 CE (Christian Era) of the Julian calendar. It was introduced by Pope Gregory XIII, after whom the calendar was named. The motivation for the adjustment was to bring the date for the celebration of Easter to the time of the year in which the First Council of Nicaea had agreed upon in 325 CE. Although a canon of the council specified that all Christians should celebrate Easter on the same day, it took almost five centuries before virtually all Christians achieved that objective by adopting the rules of the Church of Alexandria. The reform adopted was a modification of a proposal made by the Calabrian doctor Aloysius Lilius. Lilius's proposals had two components. Firstly, he proposed a correction of the length of the year. The mean tropical year is 365.24219 days long, while the mean vernal equinox year is 365.2424 days. As the average length of a Julian year is 365.25 days, the Julian year is almost 11 minutes longer than the mean year. The discrepancy results in a drift of about 3 days every 400 years. Lilius's proposal resulted in an average year of 365.2425 days. At the time of Gregory's reform there had already been a drift of 10 days since the Council of Nicaea, resulting in the (astronomical) vernal equinox falling on 11 March instead of the ecclesiastically fixed date of 21 March, and if unreformed it would drift further. Accordingly, when the new calendar was put in use, the error accumulated in the 13 centuries since the Council of Nicaea was corrected by a deletion of 10 days. The Julian calendar day Thursday, 4 October 1582 CE was followed by the first day of the Gregorian calendar, Friday, 15 October 1582 CE.

Dionysius Exiguus (470-544) was the inventor of the *Anno Domini* era, which is used to number the years of both the Gregorian and Julian calendar. He used it to identify the several Easters in his Easter table, but did not use it to date any historical event. When he devised his table, Julian calendar years were identified by naming the consuls who held office that year —he himself stated that the "present year" was "the consulship of Probus Junior", which he also stated was 525 years: *since the incarnation of our Lord Jesus Christ*. He invented a new system of numbering years to replace the Diocletian years that had been used in an old Easter table because he did not wish to continue the memory of a tyrant who persecuted Christians. There exists evidence that Dionysius' desire to replace Diocletian years with a calendar based on the incarnation of Christ was to prevent people from believing in the imminent end of the world. At the time it was believed that the Resurrection and the end of the world would occur 500 years after the birth of Jesus. The current *Anno Mundi* calendar commenced with the creation of the world based on information in the Septuagint. It was believed that based on the *Anno Mundi* calendar Jesus was born in the year 5500 (or 5500 years after the world was created) with the year 6000 of the *Anno Mundi* calendar marking the end of the world. *Anno Mundi* 6000 (c. 500 CE) was thus equated with the resurrection of Christ and the end of the world. Because Dionysius did not place the Incarnation in an explicit year, competent scholars have deduced both 1 CE and 1 BCE. Most have selected 1 BCE (historians do not use a year zero). Because the anniversary of the Incarnation was 25 March, which was near Easter, a year that was year 525 "since the Incarnation" implied that 525 whole years were completed near that Easter. Consequently 1 year after the Incarnation would have meant 25 March 1 CE, meaning that Dionysius placed the Incarnation on 25 March 1 BCE. How did he manage to get such a result? Dionysius knew that Epiphanius dated Jesus birth in the year when *Augustus XIII and Silvanus were consuls* (Panarion LI:22:3) and Paul Orosius in the *year 752 of the founding of Rome* (Histories against the pagans VI:22.1). As he stated that the "present year" was "the consulship of Probus Junior", he was able to reckon 525 consular years[2] between the *consulship of Probus Junior* and the one of *Augustus XIII and Silvanus* according to the list of

[2] http://fr.wikipedia.org/wiki/Consuls_romains_du_Bas-Empire
http://fr.wikipedia.org/wiki/Consuls_romains_du_Haut-Empire

Roman consuls. Consequently he defined a new era beginning at Jesus birth with the equation: *consulship of Probus Junior* = 525 *Anno Domini*. As one can see he made a little mistake because the consulship of Probus Junior[3] was the 526th after 525 consulships, what postponed Jesus birth to 1 BCE instead of 2 BCE. For this period of history we have several synchronistic lists, which give correspondences between different dating systems[4]:

Year	Consulship rank after Jesus birth	Roman consuls	Olympiad	Year of Rome	Year of Seleucid era
4 BCE		Gaius Calvisius Sabinus Lucius Passienus Rufus	**194:1**	750	309
3 BCE		Lucius Cornelius Lentulus Marcus Valerius Messalla Messallinus	194:2	751	310
2 BCE	0	Imperator Caesar Augustus XIII Marcus Plautius Silvanus	194:3	**752**	311
1 BCE	1	Cossus Cornelius Lentulus Lucius Calpurnius Piso	194:4	753	312
1 CE	2	Caius Iulius Caesar Lucius Aemilius Paullus	**195:1**	754	313

This first example shows that one must always check the calculations even those from competent scholars because they can make mistakes (nobody's perfect). Calculations to determine Jesus birth are easy to carry out because they are all consistent. For example Clement of Alexandria (Stromata I:21:145) put it 194 years before Commodus death on December 31, 192 CE and Tertullian (Against the Jews VIII:11:75) in the 41st year of Augustus' reign[5], 28 years after Cleopatra's death on August 29, 30 BCE. By combining these data, Jesus birth has to be fixed in 2 BCE between September 1 and October 30.

A chronological detail from the book of Luke allows the fixing of the exact date of Jesus' birth. Indeed, John the Baptist was born 6 months before Jesus (Lk 1:26) and his conception was announced at the Temple 9 months earlier. This announcement may be dated toward June, because this was the class of Abijah, to which belonged Zechariah father of John the Baptist, who officiated at this time of the year (Lk 1:5-13). The name and the order of classes of priests were very old (1Ch 24:7-18). According to Josephus (Jewish Antiquities VII:365-366), each class officiated for a week from the Sabbath to the next Sabbath (1Ch 9:25; 2Ch 23:8), and the Mishna (*Sukka* 4:7) states that during the great annual festivals the 24 classes served together synchronizing both cycles of 24 weeks, the 1st beginning in Nisan and the 2nd in Tishri. Manuscripts found at Qumran (4Q321) confirm the seasonal order of such a calendar[6]. The turnover of classes of priests was cyclic on the year, this system worked until the destruction of the Temple in September 70 CE (*Tosephta Taanit* 2:10 b)[7]. The cycle of 24 classes, which lasted 24 weeks, coincided with lunar year, as the 1st cycle began after the Passover (14 to 21 Nisan) and lasted 24 weeks and the 2nd cycle began after the Feast of Tabernacles (10 to 21 Tishri). A period of 6 lunar months lasts exactly 177 days (= 6x29,5), or approximately 25 weeks (25x7 = 175 days). The religious year began on 1 Nisan. As the weeks went from Saturday to Saturday, the 8 days of Passover overlapped 1 or 2 weeks (depending on the year). Similarly, the calendar year

[3] http://www.roman-empire.net/articles/article-024.html

[4] E.J. BICKERMAN - Chronology of the Ancient World
London 1980 Ed. Thames and Hudson pp. 115-166.

[5] Augustus' reign began from the second triumvirate of October 43 BCE, made official a few weeks later, according to Appian (Civil Wars IV:5-7), by the law *lex Titia* on November 27, 43 BCE. Ancient writers reckoned the reign of Augustus not from January 27 BCE, but from October 43 BCE when Octavian, later Augustus, formed the second triumvirate. The 42nd year of Augustus began (at the end of his 41st year), so in October 2 BCE.

[6] M. WISE, M. ABEGG, E. COOK – Les manuscrits de la mer Morte
Paris 2001 Éd. Plon pp. 388-398.

[7] J. BONSIRVEN – Textes rabbiniques des deux premiers siècles
Roma 1955 Ed. Pontificio Istituto Biblico p. 264.

started on 1 Tishri, thus the Feast of Tabernacles (Tishri 10 to 21) covered 2 or 3 weeks. Therefore, the 24 classes of priests officiated all together on average 2 weeks during the two major festivals (the Feast of Tabernacles starting with Yom Kippur from 10 to 21 Tishri), since the solar year of 365 days is 52 weeks long (= 24x2 + 2x2). The conception of John the Baptist occurred after the announcement during the office of Abijah class and therefore at the beginning of the next class, that of Jeshua. The conception of Jesus is placed 3 months before the end of the gestation of John the Baptist (Lk 1:56). The birth of John the Baptist therefore precedes exactly by 6 months that of Jesus. This previous calendrical information has to be combined with the following constraints (which imposes a chronological framework): Sabbaths coincide with Saturdays; Tishri 1 (Jewish calendar)[8] coincides with the 1st visible crescent just after the autumn equinox (September 25 at that time)[9]; the duration of human gestation is on average 273 days[10] (one can assume that the pregnancies of John the Baptist and Jesus took place normally), consequently:

- Spring equinox was on 23 March in 3 BCE.
- 1st lunar crescent[11] after the spring equinox (= 1st Nisan): Tuesday 16 April 3 BCE.
- Passover on 14 Nisan: Monday 29 April, 3 BCE.
- Start of the first cycle of 24 classes on 26 Nisan: Saturday 11 May 3 BCE.
- Class of Abijah (8th week), beginning on 16 Siwan: Saturday 29 June 3 BCE.
- Class of Jeshua (9th week), beginning on 23 Siwan: Saturday 5 July 3 BCE. Beginning of the gestation of John the Baptist (born 273 days later).
- Yom Kippur on 10 Tishri: Saturday 19 October (3 BCE).
- Start of the second cycle of 24 classes on 24 Tishri: Saturday 2 November 3 BCE.
- Angel Gabriel announced the birth of Jesus 6 months after that of John the Baptist on 23 Kislev: Monday 30 December 3 BCE (2 days before the Festival of Dedication). Beginning of the gestation of Jesus (born 273 days later).
- Birth of John the Baptist on 1 Nisan: Saturday 5 April 2 BCE.
- Birth of Jesus on 1 Tishri: Monday 29 September 2 BCE (after 273 days of gestation).

As can be seen calculations to determine the date of Jesus' birth are quite attainable and give on Monday 29 September 2 BCE (not 25 December 1 BCE). Using his mathematical equations, Kepler believed he could predict the appearance of the night sky for any day in history, as seen from any place on earth. In December 1603 CE he witnessed a Jupiter-Saturn-conjunction followed by a conjunction of Jupiter-Mars. He then made a rapprochement with the star of the Magi thanks to a Hebrew text of Rabbi Abravanel: *For Jewish astrologers, the Messiah would come from a conjunction of Saturn and Jupiter in the constellation of Pisces*. Kepler calculated that the same conjunction occurred three times in the same year of 7 BCE: 29 May, 3 October and 4 December. The repetition of this alignment is extremely rare, he concluded that careful observers of the sky such as the Magi would have been able to notice it, he likened this event with the Star of Bethlehem and thus placed the Nativity in the year 7 BC in his book *De Stella Nova in Pede Serpentarti* (first published in 1605). Based on the coincidence of the lunar eclipse of 13 March 4 BC, just after the Fast of Esther of 12 March, Academician Wallon[12] concluded that the 37-year reign of Herod, having started in 40 BC was completed in 4 BC and therefore the birth of Jesus should be set at 25 December 7 BC. This dating without scientific rigor is still the choice of the "prestigious"

[8] http://www.livius.org/caa-can/calendar/calendar_babylonian.html
[9] http://www.imcce.fr/fr/grandpublic/temps/saisons.php
[10] C. NAUDIN, N. GRUMBACH – Larousse médical
Paris1995 Éd. Larousse p. 449.
[11] http://www.fourmilab.ch/earthview/pacalc.html http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php
[12] H. WALLON – Mémoire sur les années de Jésus-Christ
Paris 1858 Ed. Comptes Rendus Académie des Inscriptions et Belles-Lettres.

French Academy[13], but is easy to check that the link made with the conjunction of Saturn and Jupiter in 7 BCE and the Star of Bethlehem is absolutely baseless.

According to the text of the Gospels (New International Version): *After Jesus was born in Bethlehem in Judea, during the time of King Herod, Magi from the east came to Jerusalem and asked, 'Where is the one who has been born king of the Jews? We saw his star when it rose and have come to worship him (...) Then Herod called the Magi secretly and found out from them the exact time the star had appeared. He sent them to Bethlehem and said, 'Go and search carefully for the child. As soon as you find him, report to me, so that I too may go and worship him.' After they had heard the king, they went on their way, and the star they had seen when it rose went ahead of them until it stopped over the place where the child was. When they saw the star, they were overjoyed. On coming to the house, they saw the child with his mother Mary, and they bowed down and worshipped him. Then they opened their treasures and presented him with gifts of gold, frankincense and myrrh. And having been warned in a dream not to go back to Herod, they returned to their country by another route. When they had gone, an angel of the Lord appeared to Joseph in a dream. 'Get up,' he said, 'take the child and his mother and escape to Egypt. Stay there until I tell you, for Herod is going to search for the child to kill him.' So he got up, took the child and his mother during the night and left for Egypt, where he stayed until the death of Herod (...) When Herod realised that he had been outwitted by the Magi, he was furious, and he gave orders to kill all the boys in Bethlehem and its vicinity who were 2 years old and under, in accordance with the time he had learned from the Magi* (Mt 2:1-16). The word Magi comes from the Greek *magos*, which also appears in the text of Daniel 2:2,10 (LXX). It was a term originally applied to Persian priests[14], a tribe of the Mede according to Herodotus (The Histories I:101), thus Magi means "astrologers". It is noteworthy that many Bible translations prefer to use the term "wise men" instead of "astrologers" because astrology is severely condemned in the Bible (Dt 18:10-12). As the text of Matthew clearly states: *the star they had seen when it rose went ahead of them until it stopped over the place where the child was*, it was a miraculous "star", not an astronomical event (even a comet can't go ahead and stop over a house!).

In his thesis (1605) the Polish historian Laurentius Suslyga was the first to suggest that Christ was born around 4 BCE instead of 2 BCE, based on the coincidence of the lunar eclipse of 13 March 4 BCE just after the Fast of Esther dated 12 March, deriving this date from the chronology of Herod the Great found in Josephus' works. Once again these "scientific" claims are completely preposterous for 3 reasons: 1) the fast of Esther in the 1st century did not exist because it did not appear until the 12th century[15], in addition on 13 Adar was the Feast of Nicanor (Jewish Antiquities XII:412); 2) according to current astronomical calculations, the eclipse of 13 March 4 BCE had a magnitude of 36% only and would have drawn attention to very few people in the early morning when it happened[16]; 3) if Herod died on March 4 BCE, it is impossible to make a reconstitution respecting all the

[13] G. PICARD – La date de naissance de Jésus du point de vue romain
in: *Comptes-rendus des séances de l'Académie des Inscriptions et Belles-Lettres*, 139e année, N. 3, 1995. pp. 799-807.

[14] W.E. VINE – An Expository Dictionary of New Testament Words
New York 1985 Ed. Thomas Nelson Publishers, p. 587.

[15] The She'iltot of R. Aḥa of Shabḥa (8th century) has the earliest record of the custom of fasting on the 13th of Adar. It quotes the declaration of R. Samuel b. Isaac (Megillah 2a): *The 13th day of Adar is the time for public gathering*, Maimonides accepts the custom of public fasting on this day finding his scriptural authority in the words: *Regarding the fasting and the crying* (Est 9:31). Comparing it with other public fasts he declares: *Whereas the other fasts are postponed to the following day if they would otherwise fall on the Sabbath the Fast of Esther is anticipated to the Thursday, since fasting here must precede the celebration* (Yad, Ta'anit 5:5). An earlier tradition of fasting (c. 750 CE) in connection with Purim is preserved in the Talmud (Soferim 14:4), which specifically excludes fasting on the 13th of Adar: *because of Nicanor and his men*. This is in accordance with the prohibition of Megillat Ta'anit against fasting on those days on which the Maccabean victories over Nicanor and their other enemies were celebrated. Elsewhere tractate Soferim asserts: *Our Rabbis in the West [i.e., Ereẓ Israel] are accustomed to fast at intervals after Purim [i.e., on the 3 subsequent days: Monday, Thursday, and Monday] in commemoration of the 3 days fasted by Esther and Mordecai and those who joined them* (Soferim 21:1). Maimonides stated that the commemoration of fasting should precede the festival (Hilkhot Ta'aniyot 1:14), which instituted the Fast of Esther on 13 Adar, before the feast of Purim on 14 and 15 Adar.

[16] 4 BCE = -3* http://eclipse.gsfc.nasa.gov/LEcat5/LE-0099-0000.html

synchronisms (16 in all) mentioned by Josephus which are all consistent with a date of death around 1 BCE/1 CE[17]. According to the texts of Josephus: *Herod died after a day that the Jews observe as a fast which happened just before an eclipse of the moon (...); after he had reigned for 34 years from the time when he had put Antigonus to death, and for 37 years from the time when he had been appointed king by the Romans (...); before the Passover* (Jewish Antiquities XVII:166-167, 191, 213). The first years of Herod's reign are described by Josephus in great chronological detail, which explains the discrepancy between his legal kingship received from the Roman Senate in 40 BCE and the beginning of his effective reign in 36 BCE, dated year 3 on his first minting. According to Josephus, Herod came to Rome in winter (Jewish War I:279) at the end of the year 40 BCE (Jewish Antiquities XIV:487), since he conquered Jerusalem in July 37 BCE, just 3 years after his enthronement by the Romans in December 40 BCE (Jewish War I:343; Jewish Antiquities XIV:389). The Roman Senate named him king and celebrated his first day of reign (Jewish War I:285) on 1st January, 39 BCE, because the posts of governors were awarded on that date[18]. After the capture of Jerusalem in July 37 BCE, Sossius, the governor of Syria, handed over King Antigonus to Marc Antony. Herod, fearing a possible restoration of Antigonus by the Roman Senate, greased Mark Antony's palm to kill his rival (Jewish Antiquities XIV:473, 487-491). Mark Antony who left Italy for Greece in the autumn of 37 BCE, then went to Antioch which he reached in winter. Antigonus was executed just before Herod took power[19] (March 36 BCE). Cassius Dio confirms the chronological data of Josephus, he writes: *These people Antony entrusted to a certain Herod to govern; but Antigonus he bound to a cross and flogged, — a punishment no other king had suffered at the hands of the Romans, — and afterwards slew him (...) Antony spent the entire year [37 BCE] in reaching Italy and returning again to the province* (Roman History XLIX:22-23). All these synchronisms involve Herod having died between April 2 BCE and March 1 BCE[20]. Although Josephus dates Herod's victory in July 37 BCE, he fixes the beginning of his effective reign in 36 BCE, as he states that Herod ended a Hasmonean era which had started 126 years earlier (Jewish Antiquities XIV:490) and as he dates the beginning of the period in 162 BCE the reign of Herod started therefore in 36 BCE (= -162 + 126). This figure is confirmed by two other indications of Josephus: the beginning of his reign is fixed 27 years after the victory of Pompey (Jewish Antiquities XIV:487) dated July 63 BCE, that is 36 BCE (= -63 + 27) and 107 years before the destruction of the Temple (Jewish Antiquities XX:250) dated August 70 CE, that is 36 BCE (= 70 -107 + 1, no year 0). The first coins minted by Herod after his victory over Jerusalem (in July 37 BCE) are dated year 3[21] (wrote ΛΓ in Greek). Since Jewish reigns begin on 1st Nisan (new moon +1)[22], this coin therefore appeared in April of 36 BCE. This method of reckoning reign, from 1st Nisan after an accession, was usual for kings of Judea (Talmud *Rosh Hashanah* 1:1). If Herod died in 4 BCE, year 3 of his reign would have been in 38 BCE, 2 years before his victory, that is unlikely, moreover, at that date Antigonus still ruled Judea. The Jews fasted 4 times a year (Zc 8:19): on 17 Tammuz, 9 Ab, 3 Tishri and 10 Tebeth. The Mishnah (Taanit 4:6) only describes the fasts of 17 Tammuz and 9 Ab. It is noteworthy that 13 Adar was not a fast at

[17] B. MAHIEU – Between Rome and Jerusalem. Herod the Great and his Sons in their Struggle for Recognition in: *Orientalia Lovaniensia Analecta* 208 (Brill 2012) pp. 235-243.
[18] C. SAULNIER - Histoire d'Israël Paris 1985 Éd. Cerf p. 207.
[19] R. MARCUS – Josephus. Jewish Antiquities, Books XIV-XV Cambridge 2004 Ed. Harvard University Press page 255 note e, page 479 note b.
[20] J. FINEGAN - Handbook of Biblical Chronology Massachussetts 1999 Ed. Hendrickson pp. 299-301.
[21] J. MALTIEL-GERSTENFELD - 260 Years of Ancient Jewish Coins 1982 Tel Aviv Ed. Kol Printing Service Ltd pp. 125-131.
[22] http://www.fourmilab.ch/earthview/pacalc.html http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php

the time because it was the Feast of Nicanor (Jewish Antiquities XII:412). This feast of Nicanor on 13 Adar was formerly known as the feast of Mordecai (2M 15:36). The Mishna (*Taanit* 2:10, *Rosh Hashanah* 1:3) also stipulates that there was no fasting at Purim in the month of Adar. The fast of the 7th month (Tishri) commemorated the murder of Governor Gedaliah and the one of the 10th month (Tebeth) commemorated the beginning of the siege of Jerusalem by Nebuchadnezzar (2Ki 25:1, Ezk 24:1-2) as recalled by Josephus (Jewish Antiquities X:116). The fast of 10 Tebeth (January 5 in 1 BCE), observed only in Judea (Jerusalem Talmud, Taanit 4:6), actually preceded by a few days (5) the total lunar eclipse on 14/15 Tebeth[23] (9/10 January in 1 BCE)[24].

The ancient *Roll of fasts*[25] (*Megillat Taanit* 23a) says: *On Shebat 2 a feast-day, no mourning.* The date 2 Shebat was 26 January in 1 BCE[26]. The Scholion of *Megillat Taanit* speaks of the death of Herod in three copies: at 7 Kislev (Oxford, hybrid text) or at 2 Shebat (Parma) which agrees with the date of the *Roll of fasts* (7 Kislev is linked with King Alexander Jannaeus's death). Astronomy enables us to date the events mentioned by Josephus: (1) a memorial fasting followed by (2) an eclipse of the moon and then (3) Herod's death, three events which succeeded in a short time before (4) Passover (-1 = 0 BCE):

month	date (1) fast	(2) eclipse	(3) death	**in 1 BCE**	#	**in 4 BCE**	#
VII	3 Tishri			1st Oct. 2 BCE		4 Oct. 5 BCE	
VIII	Heshvan						
IX	Kislev		7 Kislev ?	3 Dec. 2 BCE		6 Dec. 5 BCE	NO#
X	10 Tebeth			5 Jan. 1 BCE	YES	8 Jan. 4 BCE	
		15 Tebeth		10 Jan. 1 BCE	Total	13 Jan. 4 BCE	
XI	Shebat		2 Shebat	**26 Jan.** 1 BCE	YES	29 Jan. 4 BCE	NO#
XII	[13] Adar			[9 Mar. 1 BCE]		[12 Ma. 4 BCE]	NO#
		14 Adar				13 Mar. 4 BCE	Partial
I	[1st] Nisan			[25 Mar. 1 BCE]		**1 Apr.** 4 BCE**?**	NO#
	[14] Nisan		(4) Passover	[7 Apr. 1 BCE]		[10 Apr. 4 BCE]	
II	Iyar						
III	Siwan						
IV	17 Tammuz			7 Jul. 1 BCE		10 Jul. 4 BCE	
V	9 Ab			29 Jul. 1 BCE		1st Aug. 4 BCE	
VI	Elul						
VII	Tishri						
VIII	Heshvan						
IX	Kislev		7 Kislev ?	21 Nov. 1 BCE		25 Nov. 4 BCE	

On the death of Herod, his sons sought the endorsement of Caesar Augustus to legitimize their royalty, as had done Herod himself. Josephus explains that in the past: *Caesar received the boys [in 20 BCE] with the greatest consideration. He also gave Herod the right to secure in the possession of his kingdom whichever of his offspring he wished* (Jewish Antiquities XV:343). Herod having died on 2 Shebat (Monday 26 January 1 BCE), the first year of effective reign of his sons could start at 1st Nisan (24 March 1 BCE). Herod Philip did as his father. The coins minted[27] from his first year of reign in 1 BCE are dated year 3, wrote LΓ in Greek, which referred to Herod's testament made at the end of the legation of Varus in 4

[23] Astronomy requires matching the eclipses of the moon with the full moon days.
[24] http://eclipse.gsfc.nasa.gov/LEcat5/LE-0099-0000.html
[25] W.E. FILMER - The Chronology of the Reign of Herod the Great
in: *The Journal of Theological Studies* Vol. XVII. Oxford 1966 p. 284.
H. LICHTENSTEIN - Die fastenrolle eine untersuchung zur jüdisch-hellenistishen geschichte
in: *Hebrew Union College Annual* Cincinnati 1931-32 pp. 271-280.
[26] A.E. STEINMANN – When Did Herod the Great Reign?
in: *Novum Testamentum* Vol. 51 (2009) pp. 1-29.
[27] J. MALTIEL-GERSTENFELD - 260 Years of Ancient Jewish Coins
1982 Tel Aviv Ed. Kol Printing Service Ltd p. 144.

BCE, a year being considered as an accession year (without having been co-regency). This point is crucial to understanding the chronology of Herodian reigns. Indeed, fictional accessions, legally back-calculated, were not uncommon at that time[28]. All of the Herods acknowledged receiving their kingdom from Augustus (Jewish Antiquities XVII:244-246). A testament establishing the kingdom of Herod's sons was written in front of Augustus at the end of the legation of Varus (Jewish Antiquities XVII:202-210). This document served as a reference after the death of Herod to confirm the kingdom of his sons[29]. For that reason, just after the death of Herod, Archelaus rushed to Rome to validate by Augustus the testament of his father who made him king (Jewish War II:1-2). Similarly, Antipas disputed succession to the throne because he was referring to the first testament of Herod, who designated him as king, in his view that testament annulling its codicil (Jewish War II:20). Therefore, that testament, not Herod's codicils, had to be used to set the beginning of their statutory royalty because only the decision of Augustus, which validated it, was considered as a last resort (Jewish War II:20-21,28). Herod's sons had to have been legally established kings (in Rome) before taking office (in Jerusalem). Josephus relates Antipater's dialogue with his father: *And indeed what was there that could possibly provoke me against thee? Could the hope of being king do it? I was a king already* (Jewish War I:625-631). If it was only about the certitude of reigning, this explanation would have accused Antipater, because he would have been able to accelerate his accession to the throne by committing parricide, while in recalling that he was King already, Herod's death did not change anything for him; this argument had already been used in the past to prove his innocence (Jewish War I:503). According to Josephus, Herod Archelaus reigned 10 years. The 9th year of his reign (Jewish War II:111), at the end of which he was dismissed, is dated 6 CE according Dio (Roman History LV:25:1, 27:5) and the beginning of his 10th year (Jewish Antiquities XVII:342), marked by the census of Quirinius, is dated 7 CE[30] (Jewish Antiquities XVIII:26).

The above examples illustrate two important points: do not believe by word the "mainstream chronologies", even if they come from prestigious academics, but follow this wise biblical advice: *Make sure of all things* (1Th 5:21); *believe what you have checked and question the rest* (1Jo 4:1) specially regarding chronology (2Th 2:2). In fact, the main difficulty does not come from astronomy or calculations but from wrong readings of historical texts! It is indeed necessary to first ensure that a historical text, used for dating, aptly describes an astronomical phenomenon and not a non-reproducible exceptional event or a symbolic event like the "eclipse" of a king, which was frequently pictured as a real (total) eclipse.

As noted K.A. Kitchen, a prominent Egyptologist, chronological and historical data from the Bible is generally consistent with archaeological findings, at least until Abraham (c. 2000 BCE), however the chronology of the prehistoric period, especially the Deluge, is absolutely insoluble[31] (one might say). For example, the global flood is dated around 2350 BCE, according to the chronology from the Masoretic text, but Sargon of Akkad (c. 2300 BCE) already knew of the Deluge which had occurred before Gilgamesh's time (c. 2700 BCE), four centuries earlier! On the other hand, some geologists estimate that the biblical flood could be a memory of the last ice age, which ended around -10,000. All this data is apparently irreconcilable, but in fact not. First the explanation of the chronologies of the

[28] E.J. BICKERMAN -Notes on Seleucid and Parthian Chronology
in: *Berytus* VIII (1943) pp. 73-83.
[29] W.E. FILMER - The Chronology of the Reign of Herod the Great
in: *The Journal of Theological Studies*, Vol. XVII. Oxford 1966 pp. 283-298.
[30] Consular years used by Cassius Dio were reckoned from January 1 to December 31, 6 CE, but the 37th of Actium was reckoned from September 6 CE to September 7 CE. The 9th year of Archelaus was reckoned from April 6 CE to April 7 CE.
[31] K.A. KITCHEN – On the Reliability of the Old Testament
Cambridge 2003 Ed. Eerdmans Publishing Company pp. 439-447.

Deluge are all based on ideological interpretations, religious or scientific, without any verification with the absolute dating based on astronomy. For example, the Jews date the Deluge in 2104 BCE (= -3761 + 1656) as it is explained in their Seder Olam[32], but there is a wide variety of results[33]. In fact it is clear that there is no evidence of such a statement but only conjectures. Finally, Catholics date the Deluge, equated with the last ice age, around 13,000 BCE in their official Bible[34]. Consequently, it is necessary to use astronomy.

BASIC ASTRONOMY FOR HISTORIANS

Astronomical concepts necessary for historians are actually quite rudimentary. One just has to know the working of solar and lunar cycles, which served to define the years and months. As solar and lunar cycles are actually very complex, they could not be predicted in the past with sufficient accuracy in order to fix calendars (as is the case today with software very easy to use) and consequently they had to be visually observed.

From Earth, the Sun is seen projected against the remote background of the celestial sphere[35]. This apparent path of the Sun around the sky in the course of a year is known as the ecliptic. Since most of the planets revolve around the Sun in more or less a flat plane, viewed from Earth the paths of the other planets across the sky tend to stay fairly close to the ecliptic. Knowing this, ancient people attached great importance to this band of constellations on the ecliptic, known as the zodiac. However, the Earth's axis is not perpendicular to the ecliptic —rather, it is tipped at an angle of 23½ degrees. The ecliptic, therefore, is tipped with respect to the celestial equator by the same angle. Because of this, Northern and Southern Hemispheres experience opposite seasons. In June, the Southern Hemisphere is in winter because it is leaning away from the Sun, while the Northern Hemisphere is experiencing midsummer. The Sun's rays no longer reach the South Pole, and for half the year there the Sun will fail to rise, resulting in continuous night. Six months later, in December, the Earth will have gone half-way round the Sun. The Northern Hemisphere is now in midwinter, while the Southern Hemisphere is in midsummer. In March and September, however, both hemispheres have an equal share of day and night ("equinox" means "[day] equal night"). The length of summer days and the corresponding brevity of winter days increases as you move to higher latitudes. During winter, the Sun is low in the sky, which means that the days are short and the nights long. Also, the Sun's rays must pass through a greater thickness of the atmosphere; some of the heat is absorbed, and the low angle from which the rays come means that they are more spread out. In summer, on the other hand, the Sun passes high across the sky as it rises and sets each day, yielding longer days than in winter. Also, because the Sun is high during this season, the Sun's rays are less spread out and it heats the Earth more directly. Midway between sunrise and sunset the Sun reaches its highest point in the sky around noon. If, over the course of a year, you observed the shadow cast by a stick on a flat piece of ground, you would graphically see how the Sun's height in the sky at noon varies with the passing of the seasons (see

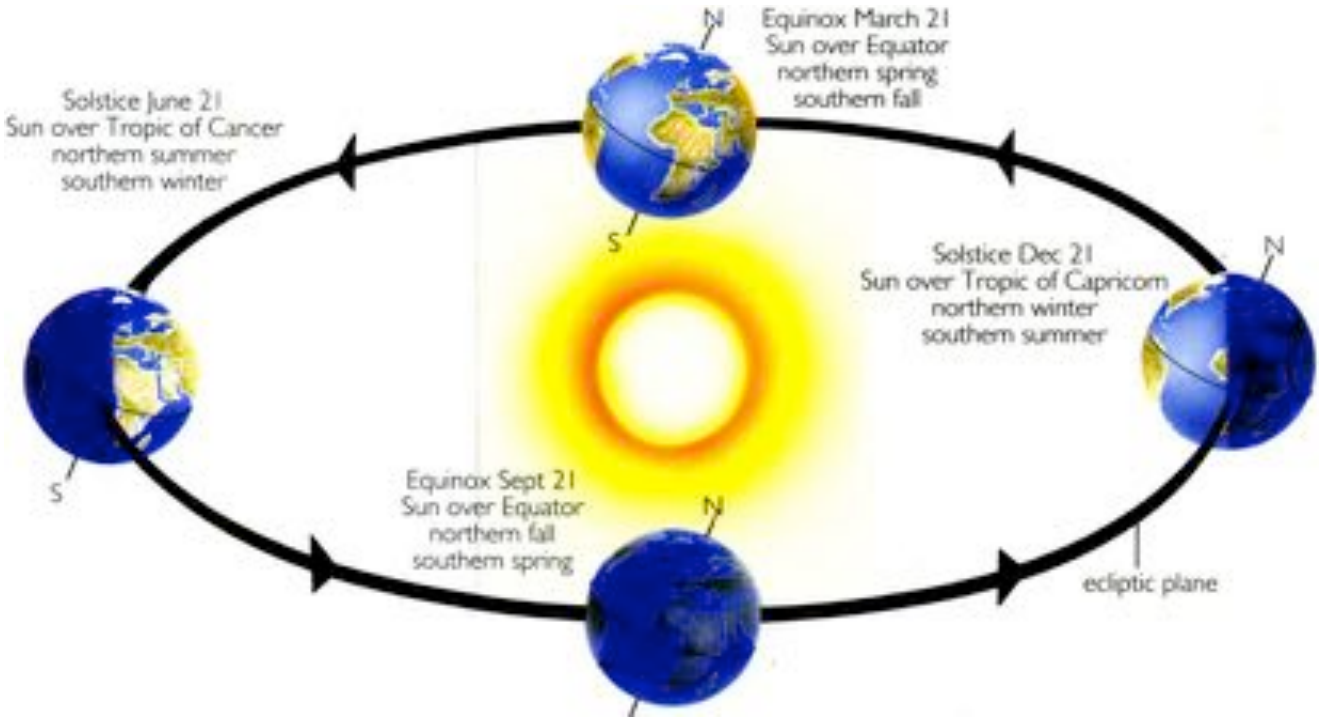
[32] H.W. GUGGENHEIMER – Seder Olam. The Rabbinic View of Biblical Chronology
Lanham 2005 Ed. Roman & Littlefield Publishers, Inc. pp. 3-21.

[33] Many of the earliest Christians who followed the Septuagint calculated creation around **5500 BC**: Clement of Alexandria (5592), Theophilus of Antioch (5529), Julius Africanus (5501), Hippolytus of Rome (5500), Gregory of Tours (5500), Panodorus of Alexandria (5493), Maximus the Confessor (5493), George Syncellus (5492) Sulpicius Severus (5469), Isidore of Seville (5336). Eusebius (5228), Jerome (5199). Proposed calculations using the Masoretic text: Marianus Scotus (4192), Henry Fynes Clinton (4138), Maimonides (4058), Henri Spondanus (4051), Benedict Pereira (4021), Louis Cappel (4005), James Ussher (4004), Augustin Calmet (4002), Isaac Newton (**4000 BC**), Johannes Kepler (3977), Melanchthon (3964), Martin Luther (3961), Cornelius Cornelii a Lapide (3961), John Lightfoot (3960), Joseph Justus Scaliger (3949), Gerardus Mercator (3928), Benito Arias Montano (3849), Andreas Helwig (3836), David Gans (**3761 BC**), Gershom ben Judah (3754), Yom-Tov Lipmann Heller (3616).

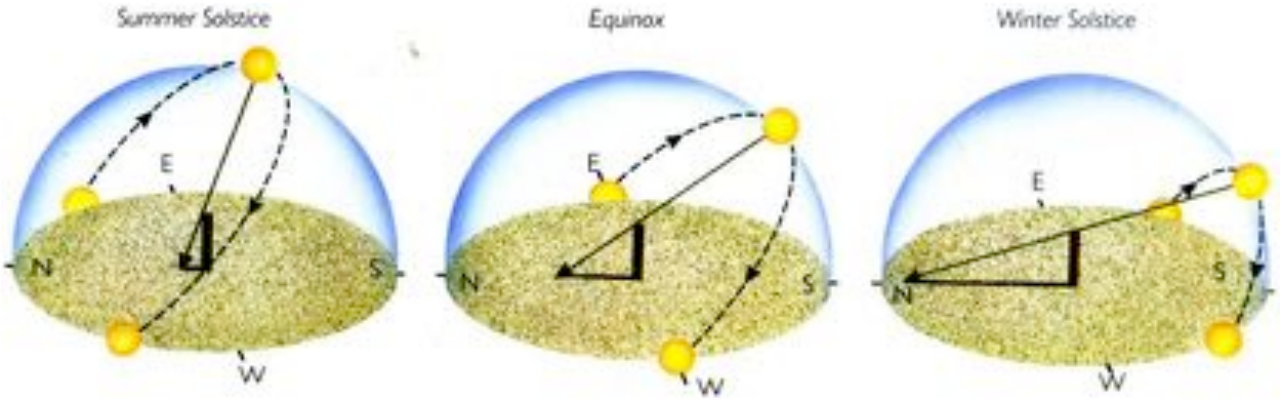
[34] Bible de Jérusalem (Cerf, 1986), p. 1805.

[35] D. LEVY – Skywatching. The ultimate guide to the Universe
1995 London Ed. Harper Collins pp. 84-85.

illustration below). During summer, the shadow is shortest at noon on the solstice, the day with the longest daylight hours. Here, the Sun reaches its highest point in the sky for the year. In winter, the Sun traces its lowest path across the sky on the day of the "winter" solstice. It is during this time that the Sun casts the longest shadows and gives us the day with the fewest daylight hours.



The path of the Sun across the sky at different times of the year (below), as viewed by a Northern Hemisphere observer (a Southern sky-watcher would look north, instead of south, to see the same effect). In the past, there were 2 seasons: summer started with the flax harvest at the spring equinox and winter with the concluding harvest at the autumn equinox with ploughing. At the equinox both day and night have to last exactly 12 hours.



It is now easy to reconstruct a past calendar anchored on the equinoxes like the Jewish religious year, which began on 1st Nisan. This particular day coincides with the 1st visible lunar crescent in Jerusalem after the spring equinox. In 2 BCE, or -1 in astronomy, the spring equinox is dated[36] 25/9/-1 at 19:59 UT (Universal Time). The 1st lunar crescent after 25/9/-1 (25 September 2 BCE) is dated 29/9/-1 (new moon 28/9/-1 at 6:50 UT)[37]. The 1st Tishri is dated 25 September 2BCE,then the 1st Heshvan (next 1st lunar crescent) is dated 29 October and so on. One can see that the 2 Shebat in 1 BCE is dated 26 January and years 4 ad 1 BCE were embolismic with 13 lunar months instead of 12 (because 1st Nisan must be just after the spring equinox, not before):

[36] http://www.imcce.fr/fr/grandpublic/temps/saisons.php
[37] http://www.fourmilab.ch/earthview/pacalc.html http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php

Event	month	Jewish calendar		Julian calendar		Julian calendar
[autumn equinox]			2 BCE	[25 September -1]	5 BCE	[25 September -4]
Jesus birth	VII	1st Tishri	*9*	29 September	*9*	2 October
	VIII	1st Heshvan	*10*	29 October	*10*	31 October
Magi visit	IX	1st Kislev	*11*	27 November	*11*	30 November
Firstborns murder	X	1st Tebeth	*12*	27 December	*12*	29 December
Herod's death	XI	1st Shebat	1 BCE	25 January 0	4 BCE	28 January -3
Return from Egypt	XII	1st Adar	*2*	25 February	*2*	27 February
	[XIIb]	[1st Adar2]		-		-
[spring equinox]			*[3]*	[22 March 0]	*[3]*	[22 March -3]
	I	1st Nisan	*3*	25 March	*3*	28 March
	II	1st Iyar	*4*	23 April	*4*	26 April
	III	1st Siwan	*5*	23 May	*5*	25 May
	IV	1st Tammuz	*6*	21 June	*6*	24 June
	V	1st Ab	*7*	20 July	*7*	24 July
	VI	1st Elul	*8*	19 August	*8*	22 August
	VII	1st Tishri	*9*	17 September	*9*	21 September
[autumn equinox]		(*embolismic year*)	*9*	[25 September 0]	*9*	[25 September -3]
	VIII	1st Heshvan	*10*	17 October	*10*	21 October
	IX	1st Kislev	*11*	15 November	*11*	19 November
	X	1st Tebeth	*12*	15 December	*12*	19 December
	XI	1st Shebat	1 CE	14 January 1	3 BCE	18 January -2
	XII	1st Adar	*2*	13 February	*2*	16 February
Embolismic year	XIIb	1st Adar2	*3*	14 March	*3*	17 March
[spring equinox]			*[3]*	[22 March 1]	*[3]*	[22 March -2]

As many commemorations were related to a lunar calendar in the past, it is possible to calculate precisely the date of these celebrations. For example the earliest source which dates precisely Jesus' death is the Greek historian Phlegon of Tralles who completed in 140 CE his chronology of the most important events dated by Olympiads. He gives a specific date, reported by Eusebius: *In the 4th year, however, of Olympiad 202, an eclipse of the sun happened, greater and more excellent than any that had happened before it; at the 6th hour [12:00], day turned into dark night, so that the stars were seen in the sky, and an earthquake in Bithynia toppled many buildings of the city of Nicaea*[38]. The 4th year of the 202nd Olympiad is from July 32 to June 33 CE. This information was considered reliable at the time because Origen (248 CE) quoted it to refute Celsus (Against Celsus II:14,33,59), a Greek philosopher very critical of Christianity but familiar with history. Eusebius[39] also states in his quotation from Phlegon that Jesus began his ministry in the 15th year of Tiberius and he died 3 years later in the year 18. He gives a more accurate duration of *not quite 4 years* in another of his books (Ecclesiastical History I:10:2). Jerome, who published the chronicle of Eusebius, regarded it as reliable. According to Irenaeus, some heretics propagated (177 CE) a period of only 1 year for the ministry of Jesus (Against Heresies II:22:5). Likewise Matthew mentions both an earthquake and surprising darkness (Mt 27:45-54) during the death of Jesus from noon to 3 p.m., the hour of prayer, according to Acts 3:1. It was not a solar eclipse because it lasted 3 hours, far beyond the duration of a solar eclipse (7 mn 30 s). Several authors report this exceptional darkening for example Thallus a Samaritan historian of the 1st century who says in the third book of his Histories, quoted by Julius Africanus[40] (in 220 CE): *A most terrible darkness fell over all the world, the rocks were torn apart by an earthquake, and many places both in Judea and the rest of the world were thrown down.* Thus Jesus death is dated 33 CE, two elements provided by the

[38] EUSÈBE - Chronicorum
Paris 1857 Patrologiae Graecae t. XIX Ed. Migne p. 535.
[39] R. HELM – Eusebius Werke
Berlin 1956 Ed. Akademie-Verlag Berlin pp. 174,175.
[40] JULIUS AFRICANUS - Chronographiæ
Turnhout 1966 Ed. Brepols (Migne) Patrologiæ Graecae t. X p. 91.

Gospels enable one to fix it on 3 April 33 CE by astronomy. The day of the Passover could coincide with any day of the week, but the next day, corresponding to the 1st day of the feast of unleavened bread was to be a Sabbath (Lv 23:5-7). If this Sabbath (15 Nisan) coincided with the usual Sabbath on Saturday, it was called a "great Sabbath". As Jesus was resurrected on the 1st day of the week, on Sunday in the Jewish calendar (Jn 19:31; 20:1), he must have died on Friday 14 Nisan. It is noteworthy that the only year for which 14 Nisan matches on a Friday[41] during the period from 27 to 35 CE is the year 33 CE. Depuydt proposes Friday 15 April 29 CE assuming an error of one day on the observation of the 1st crescent, but this is unlikely because one would have to admit that the 1st crescent was seen one day too early, but a new moon is not visible. The day corresponding to 14 Nisan over the 26-36 CE period is as follows:

CE	14 Nisan in Julian calendar	Lunar eclipse (in Nisan)	Event
26	**Friday** 22 March	-	
27	Wednesday 9 April	-	
28	Monday 29 March	-	
29	Saturday 16 April	-	Jesus' baptism (Jn 1:28-34)
30	Wednesday 5 April	-	1st Passover (Jn 2:13)
31	Monday 26 March	-	2nd Passover {Jn 5:1}
32	Monday 14 April	(no visible in Jerusalem)	3rd Passover (Jn 6:4)
33	**Friday** 3 April	**OK**	4th Passover (Jn 12:1)
34	Monday 22 March	-	
35	Monday 11 April	-	
36	**Friday** 30 March	-	

A second confirmation of 33 CE comes from the book of Acts describing celestial phenomena that occurred at the death of Jesus: *The sun will be turned into darkness and the moon into blood* (Acts 2:20), text already describing a lunar eclipse just before the destruction of the first Temple[42] (Joel 3:3-5). Generally, during a lunar eclipse it appears blood-red, which is the most natural explanation of the text of Acts. The Roman historian Quintus Curtius suggests, for example, a lunar eclipse, in terms that illuminate how this phenomenon was perceived at the time (c. 50 CE): *Alexander made in this place, a halt of two days, and the next, gave the order to start. But near the eve of the day, the moon was eclipsing, the brightness of its disk began to disappear, and then a kind of veil of blood came sullying its light: worried already about the approaches of a so terrible accident, the Macedonians were imbued with a deep religious feeling, and fear at the same time. This was against the wishes of the gods, they said, that drew them to the ends of the earth, the rivers were already unaffordable and the stars did not pay more than their former clarity and everywhere they met wastelands, deserts everywhere: and why so much blood? to satisfy the vanity of one man! He disdained his homeland, he disowned his father Philip, and in the pride of his thoughts, aspired to heaven! Sedition would burst, when Alexander, still inaccessible to fear, command chiefs and principal officers of his army to assemble in his tent body and at the same time the Egyptian priests, whom he considered very skilful in knowledge of the sky and stars, to express their opinion. Those knew well that, in the course of time, a series marked by revolutions is accomplished, and that the moon is eclipsed when it passes under the earth, or it is hidden by the sun, but what calculation revealed, they careful avoid sharing with vulgar. At hearing them, the sun is the heavenly body of the Greeks, the moon for the Persians: also, whenever it vanishes, it is to the Persians a portent of ruin and desolation, and they cite to examples of ancient kings of this empire, in which the moon by eclipsing, testified that they were fighting with opponent gods. Nothing so powerfully governs the minds of the multitude that superstition carried, cruel, fickle as any other occasion, when vain ideas of*

41 http://www.nr.com/julian.html

42 There was a lunar eclipse in 587 BCE on 4 July (13 Tammuz), which coincided with the legal end of blood sacrifices in the Temple (Dn 9:27). The Talmud relates that the sacrifices in the Temple ceased on 17 Tammuz because of a total lack of sheep (Mishnah 4:6 Taanit 28b) and the Bible dates the beginning of the fall of Jerusalem from 9 Tammuz (2Ki 25:1-4).

religion dominate, it obeys the priests much better than its leaders. Also, the response of the Egyptians, just published in the army, revived the drooping spirits of hope and confidence (Histories of Alexander the Great IV:10). Curtius gives an accurate description of the eclipse dated 13/VI year 5 of Darius III (20 September 331 BCE) by a Babylonian astronomical tablet (BM 36761), but the alleged Egyptian source of his explanations is actually a truncated quotation from Herodotus (Histories VII:37) because it states that the Persians also sacrificed to the sun and the moon (Histories I:131). Quintus Curtius himself recognized the point: *It was a traditional use among the Persians, not turn on after sunrise, when the day was shining in all its brilliance. The starting signal given by the trumpet, left the tent of the king over the tent, loud enough for everyone could see it, shone like the sun embedded in the crystal (...) then came a chariot dedicated to Jupiter, drawn by white horses, and followed by a courier of an extraordinary size, which is called the messenger of the sun: golden wands and white garments distinguished the conductors of these horses* (Histories of Alexander the Great III:3). When Curtius explains that a lunar eclipse with a veil of blood cannot be a harbinger of death he expresses the ideas of his time in cultivated circles but also indicates that these eclipses were seen as prescient in popular circles. In the 1st century Josephus shared this view: *do not you disturb yourselves at the quaking of inanimate creatures, nor do you imagine that this earthquake is a sign of another calamity; for such affections of the elements are according to the course of nature, nor does it import any thing further to men, than what mischief it does immediately of itself* (Jewish War I:377). The evangelist Luke, who was a doctor, must have shared this scientific view about lunar eclipses (sometimes abnormal darkness is caused by thick clouds made of dust or ash). There was actually a partial eclipse of the moon on Friday 3 April 33, which began towards 15:40 (Local Time) and was visible in Jerusalem from 17:50 to 18:30. It was also, according to astronomical calculations[43], the only one falling on Friday[44] between 26 and 36 CE, period of Pilate's legation in Judea:

Tiberius reign	**CE**	14 Nisan: Julian calendar	Lunar eclipse	Event
15/16	**29**	Saturday 16 April	-	*Baptism of Jesus (Lk 3:1-23)*
16/17	**30**	Wednesday 5 April	-	
17/18	**31**	Monday 26 March	-	
18/19	**32**	Monday 14 April	(no visible in Jerusalem)	*death of John the Baptist*
19/**20**	**33**	**Friday** 3 April	**OK**	*death of Jesus*
20/21	**34**	Monday 22 March	-	*death of Herod Philip*
21/22	**35**	Monday 11 April	-	

Dates from the lunar calendars are easy to check because astronomical new moon precedes 1 day the 1st day of each month, which was keyed on the 1st visible crescent. The Hebrew lunar calendar sets the Passover at 14 Nisan, the traditional date of Jesus' death. This date can be back-calculated by astronomy to the period beginning with the ministry of Jesus in the year 15 of Tiberius (29 CE) until the end of the legation of Pontius Pilate (36 CE). In addition, the lunar eclipse requires dating Jesus' death on Friday 3 April 33 CE.

Thus, using chronological data from historical narratives requires knowledge of the functioning of ancient calendars and also their changes over time, particularly with regard to the duration and the exact beginning of the year, month and day. The only way to verify their accuracy is to compare calendar dates with astronomical data calculated in the Julian calendar, an astronomical calendar which serves as a reference. For some highly localized astronomical phenomena such as eclipses (eg a solar eclipse lasts less than 8 minutes) it is necessary to know not only the day but also the hour at which they occurred.

[43] http://eclipse.gsfc.nasa.gov/LEcat5/LE0001-0100.html The maximum eclipse is at 14:47 UT and its beginning is set 86 minutes earlier, dated in Jerusalem at 15:41 (= 14:47 – 86 + 2:20).

[44] J.P. PARISOT, F. SUAGHER - Calendriers et chronologie
Paris 1996 Éd. Masson pp. 164-166.

THE JULIAN (ASTRONOMICAL) CALENDAR

Joseph Scaliger proposed in 1583, one year after the creation of the Gregorian calendar, a new way to calculate dates in astronomy: the Julian days. He chose the adjective Julian in honour of his father, whose name was Jules (Julius as Caesar). Julian day refers to a continuous count of days since the beginning of the Julian Period used primarily by astronomers. The Julian Day Number (JDN) is the integer assigned to a whole solar day in the Julian day count starting from noon Greenwich Mean Time (longitude 0°), with Julian day number 0 assigned to the day starting at noon on 1 January, 4713 BCE proleptic Julian calendar. The Julian Date (JD) of any instant is the Julian day number for the preceding noon plus the fraction of the day since that instant. A Julian date is the continuous addition of days since that reference date of 4713 BCE, with years of 365.25 days. Its greatest advantage is enabling the synchronization of the multitude of ancient calendars (including the old Julian calendar). Let us note that between 1 January of the year 1 BCE, and 1 January of year 1 CE, there were only 365 calendar days, that is one year (not two). Between 4713 BCE and 1770 there were 6482 years (= 4713 + 1770 - 1). Thus, noon on 1 January 1770 of the Julian calendar was the Julian day 2367551 (= 365.25 x 6482), while noon on 1 January 1770 of the Gregorian calendar (i.e. the same day) was the Julian day 2367540, due to the 11 days removed during the introduction of the Gregorian calendar in England and its American colonies in 1752.

Since 1972, the duration of the second in UTC (Coordinated Universal Time) was fixed to the value determined by an average of atomic clocks (TAI: International Atomic Time) around the world and leap seconds have been added to align to about 0.9 second the UTC. This definition allows one to measure the time regardless of the slight slowing of the Earth (about 1 second per year). The mean tropical year, as of 1st January 2000 was 365.2421897 or 365 days, 5 hours, 48 minutes, 45.19 seconds (but it changes slowly)[45]. It is called "tropical year", which is the time measured between two vernal equinoxes.

For practical reasons, the dates are presented in a standard pattern. Thus, 31 December 2001 at 11 o'clock, 59 minutes, 28 seconds and 73 hundredths (on the Greenwich meridian) appears as: 2001-12-31 23:59:28.73 UTC and corresponds to the Julian[46] day 2452275.4996. Dates are expressed in the Gregorian calendar (introduced by Pope Gregory XIII) from Friday, 5 October 1582, and in the Julian calendar for prior dates. Thus we switch in 1582 from Thursday 4 October (Julian) to Friday 15 October (Gregorian) corresponding to Friday 5 October 1582 (Julian). The Gregorian calendar was introduced to correct the progressive advance of the Julian calendar (11 days in 1582) compared to the spring equinox, which is astronomically fixed in the year.

To improve the synchronization of the Gregorian calendar with the tropical year 3 days must be removed every 400 years. A year becomes a leap year.

- if it is divisible by 4. A "29 February" is added and the year has 366 days instead of 365 (since 1996/4 = 499, 1996 is a leap year), except:
- if it is divisible by 100. This Gregorian year is a normal year of 365 days (for example 1900/100 = 19, so 1900 is a normal year), except:
- if it is divisible by 400 (for example 2000/400 = 5, 2000 is a leap year).

These three rules are designed to keep seasons close to fixed dates in the calendar, as the spring equinox keyed on March 21, however this benchmark of spring varies slightly in the Gregorian calendar.

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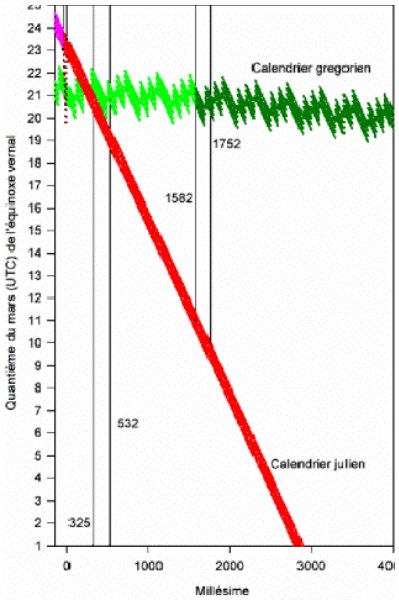
[45] The length in days for the distant past is: $365{,}2421905166 - 61{,}5607\text{x}10^{-6}T - 68{,}4\text{x}10^{-9}T^2 + 263\text{x}10^{-9}T^3 + 3{,}2\text{x}10^{-9}T^4$ where T is in Julian centuries of 365,25 days measured from noon January 1, 2000 TT (in negative numbers for dates in the past).

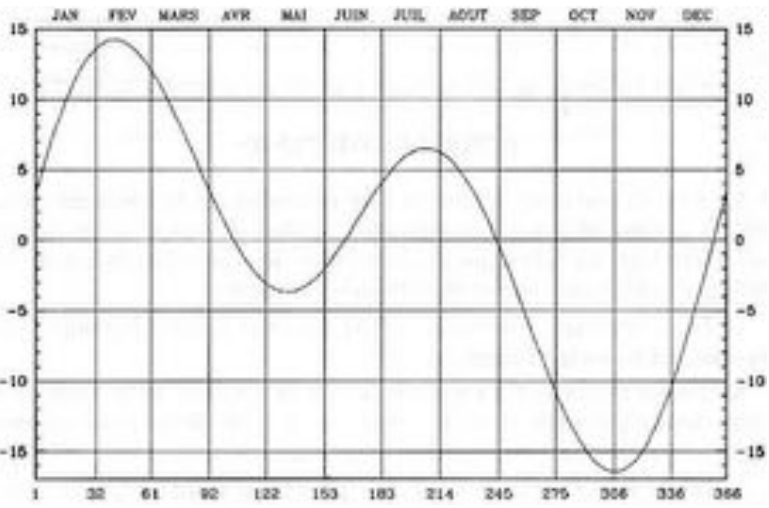
[46] http://www.nr.com/julian.html

For example the equinox of spring varies slightly in the Gregorian calendar (green curve) and more strongly in the Julian calendar (line in red), thus one day more should be added in year 3952 CE.



Calendar	duration in days	shift / tropical year
Lunar	354.36346	-10.88 days every year
Idealized	360	-5 days every year
Egyptian (civil)	365	-1 day every 4 years
Julian	365.25	+1 day every 128 years
Gregorian	365.2425	+1 day every 3,420 years
Tropical (in 1900)	365.24219647	+1 day every 160,256 years

The tropical year (which is observed) is not constant because it decreases 0,539 s each year.



The Gregorian and Julian calendars are solar calendars based on calculation. They were created to overcome both the difficulties in observation and complexity to synchronize the lunar year with the length of the solar year. The original calendars were for the most part drawn from the observation, the year being based on seasons (equinox or solstice), the month coinciding with the lunar cycle (new or full moon) and the day being related to the daily cycle of the sun (sunrise or sunset or midday etc.). All these astronomical cycles are more or less irregular and their exact durations are very complex to calculate[47]. If the day is measured between two successive culminations of the sun, the average duration is 24 hours, but varies by up to 15 minutes (see graph above), depending on the time of year. The average length[48] of the lunar month is 29.530288 days between two successive new moons (or full moons), but can vary between values ranging from 29.2679 to 29.8376 days. The difficulties of observation led the Romans to replace their lunar calendar (observed) by a calculated lunar calendar of 355 days and finally by a calculated solar calendar. After 150 BCE, the year began at the winter solstice (25 December), Mercedonius, an intercalary month of 22 or 23 days, being inserted every 2 years, the 6th day before the Kalends of March, giving an average of 366.25 days for the year. After 46 BCE, the intercalary month was deleted, the number of days of some months was changed and 1 day is added every 4 years (the 6th day before the calends of March). In addition, the year began on January 1 and the spring equinox fell on 25 March. To resynchronize this calendar the year 708 of Rome (46 BCE) lasted 455 days and was called the "year of confusion" (which means that the Julian dates used by Roman historians can be shifted by 90 days in some cases compared to UTC Julian dates). The pontiffs inserting 1 day every 3 years instead of 4 and there were 12 leap years in 8 BCE instead of 9 planned which led Augustus to remove the next leap years for 12 years. These reforms were discussed by Macrobius

[47] A. DANJON – Astronomie Générale
Paris, 1994, Éd. Librairie scientifique et technique A. Blanchard.

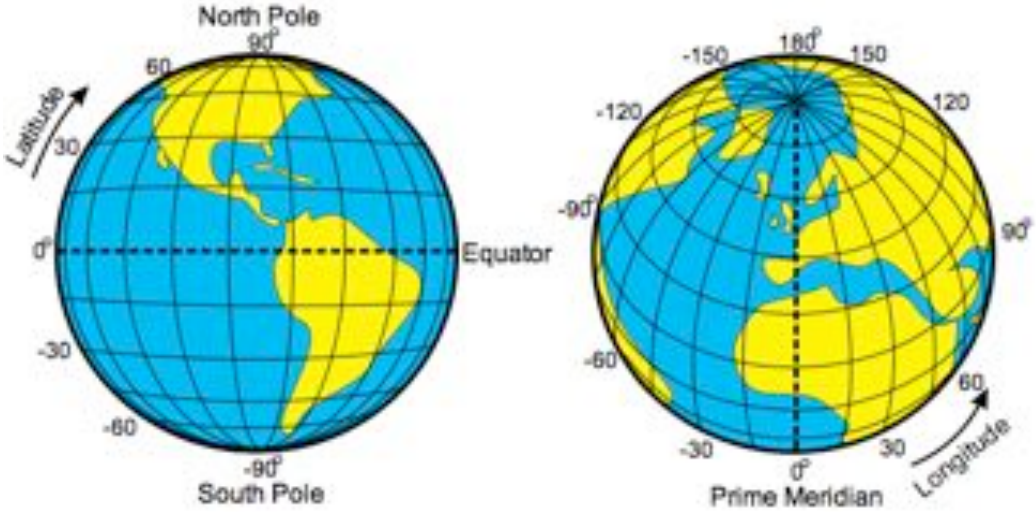
[48] This average varies slightly over time: $D = 29{,}5305888531 + 216{,}21\times10^{-9}T - 0{,}364\times10^{-9}T^2$ with T = (JD - 2451545.0)/36525 and JD = Julian Day, thus D = 29,53058424 days in 1 CE (JD = 4713x365,25 ; T = -20).

(Saturnalia I:14), Censorinus (De Die Natali XX:8), Suetonius (Life of Julius Caesar XL), Solin (De mirabilibus mundi I), Pliny the Elder (Natural History XVIII,LVII) and Dion (Roman History XLIII:26). Chronology of pre-Julian calendars:

	Lunar calendar (calculated)		Solar calendar (calculated)			
	From 150 to 46 BCE	Days	From 46 to 8 BCE	Days	From 8 BCE to 1582	Days
XI	IANVARIVS	29	IANVARIVS	31	IANVARIVS	31
XII	FEBRVARIVS	28	FEBRVARIVS	29(/30)	FEBRVARIVS	28(/29)
	MERCEDONIVS	(22/23)				
I	MARTIVS	31	MARTIVS	31	MARTIVS	31
II	APRILIS	29	APRILIS	30	APRILIS	30
III	MAIVS	31	MAIVS	31	MAIVS	31
IV	IVNIVS	29	IVNIVS	30	IVNIVS	30
V	QVINTILIS	31	IVLIVS	31	IVLIVS	31
VI	SEXTLIS	29	SEXTLIS	30	AVGVSTVS	31
VII	SEPTEMBER	29	SEPTEMBER	31	SEPTEMBER	30
VIII	OCTOBER	31	OCTOBER	30	OCTOBER	31
IX	NOVEMBER	29	NOVEMBER	31	NOVEMBER	30
X	DECEMBER	29	DECEMBER	30	DECEMBER	31

All these variations show that historical dates from a calendar in a given time may be different from the Julian (UTC) calendar. Through astronomy, it is possible to check the accuracy of some of these ancient dates. For example, according to Roman authors, Julius Caesar was assassinated on 15 March of the year 710 of Rome, or 15 March 44 BCE in the old Julian calendar. However, according to astronomy, the vernal equinox fell on 23 March in the Julian (UTC) calendar, implying a shift of 2 days from the official date of 25 March. Consequently Julius Caesar died on 13 March 44 BCE in the Julian (UTC) calendar[49]. This correction, inconsequential, especially enables one to check the consistency of dates.

Given that astronomical data depends on the place of observation, any point on the Earth is defined by its longitude (from West to East) and latitude (from Equator to North Pole). Equator is latitude 0° and Prime Meridian (Greenwich) is longitude 0°.



For example the latitude of Jerusalem is 31°46' (or 31.77°) North and its longitude is 35°14' (or 35.23°) East[50] (1° = 60' =60x60"). As the Earth rotates on its axis once every 24 hours each degree of longitude is traversed in 4 minutes (= 24x60 minutes/360°). A calculated phenomenon 0:00 Universal Time actually occurs in Jerusalem 2:21 Local Time later (LT = UT + 2:21), because 2:21 = 141 minutes = 4 minutes x 35.23°. Eclipses occur only when the earth, moon and sun are perfectly aligned, consequently, solar eclipses occur only during the day (between sunrise and sunset) and lunar eclipses occur only during the

[49] http://www.imcce.fr/page.php?nav=fr/ephemerides/astronomie/saisons/index.php
[50] http://www.astro.com/cgi/aq.cgi?lang=e

night (between sunset and sunrise). For example, the lunar eclipse dated on 3 April 33 CE occurred at 17:37:53 UT (maximum of eclipse) and its *umbra* (shadow) lasted 170 minutes[51]. Using these figures the eclipse began at 16:13 UT (= 17:38 – 1:25; 1:25 = 85 = 170/2) and ended at 19:03 UT (= 17:38 + 1:25), or from 18:34 LT (= 16:13 + 2:21) to 21:24 LT. After clicking on Jerusalem, a software[52] gives: sunrise at 5:25 LT and sunset at 17:59 LT, consequently the lunar eclipse of 3 April 33 CE could have been seen in Jerusalem.

The main challenge for historians is not mastering the complex concepts of astronomy, because at present powerful software easy to use is available on the internet, but decrypting ancient texts to know whether they were describing symbolic or astronomical phenomena. People once believed that the darkness of a celestial body (as was the case with eclipses) was a bad omen for the king or the whole country, but on the other hand an exceptional brightness (like a comet or meteor) was a good omen. Ancient texts describing lunar eclipses speak of "veils of blood", solar eclipses are described by "the sun was swallowed by the sky" or just a "bad omen from the sun". Ancient astronomical texts describing eclipses are more scientific in their description, however when they are connected to official kings list, errors may arise because co-regencies between kings and (official) usurpers were systematically removed, which obviously changes the chronology. Modern historians who naively trust in the Babylonians kings list don't believe that there were co-regencies and likewise they believe that all those kings were legitimate because they say so (the name Sargon means "legitimate king", actually because he was not). Comparing of royal chronologies in different calendars, as well as some dated contracts, enables one to find the genuine dates. The dating of Alexander's death is a good example and will illustrate the difficulty in properly synchronizing multiple calendars in a given place. This famous conqueror died in Babylon and luckily several official reports were written to date that memorable day[53], but it is clear that the multiplicity of dates raises problems. The cycle of lunar months during the Babylonian period 323-319 BCE comes from the astronomical tablets BM 34075 and BM 45962 (theoretical cycle is highlighted in grey):

Date (in 323 BCE)	Calendar	Source	Julian date	Lunar phase
29 Ayyaru	Babylonian	Tablet BM 34075	10/11 June	1st crescent
4 Pharmouthi	Egyptian	Pseudo Callisthenes	13 June	
28 Daisios	Macedonian* (old)	Royal ephemeris	10 June	
30 Daisios	Macedonian (new)	Aristobulus	12 June	New moon

	30	*29*	*30*	*29*	*30*	*29*	*30*	*29*	*30*	*29*	*30*	*29*	*30*
BCE	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIIa
323	[30]	29	30	30	30	30	29	30	29	29			
322			29	30	30	[29]	30	29	30				
321				30	30	[29]	30	29					
320				29	30	[29]	30	29					
319				30									

The most reliable document is the Babylonian tablet dating the event on 29 Ayyaru (from 10 June to June 11 at 18:00). In fact, the date of Alexander's death was immediately known in Babylon as he died in that city. Astronomy confirms the length of the sequence of 9 consecutive months (below) in the Babylonian tablets. The spring equinox is dated on 25 March in 323 BCE (= -322) and the 1st lunar crescent of 12 April (day after the new moon, highlighted in black)[54] is dated on 13 April.

[51] http://eclipse.gsfc.nasa.gov/LEcat5/LE0001-0100.html
[52] http://www.esrl.noaa.gov/gmd/grad/solcalc/
[53] E. GRZYBEK - Du calendrier macédonien au calendrier ptolémaïque
in: *Schweizerische Beiträge zur Altertumswissenschaft* 20 Basel 1990 pp. 29-35.
[54] http://www.fourmilab.ch/earthview/pacalc.html http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php

Spring equinox																		Nisan (I)												
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13
25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
March -322							April																							
Nisan (I)																		Iyyar (II)												
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
					May																									
Iyyar (II)														Siwan (III)																
16	17	18	19	20	21	22	23	24	25	26	27	28	29	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
				June																										
Siwan (III)												Tammuz (IV)																		
19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		July																												
Tammuz (IV)										Ab (V)																				
21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	August																													
Ab (V)								Elul (VI)																						
23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2
September																														
Elul (VI)							Tishri (VII)																							
25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3
October																														
Tishri			Heshvan (VIII)																											
27	28	29	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5
November																														
	Kislev (IX)																													
30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	1	2
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6
December																														
Tebeth (X)																												Shebat (XI)		
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	1	2	29	1	2
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7
January -321																										February				

This remarkable agreement shows two things: the Babylonian months were determined by observation not by a theoretical calculation and the Babylonian priests were good observers. As Aristobulus (Alexander's Secretary) also specifies that the death occurred on the evening of June 10 (after 18:00) it matches the 29 Daisios. The difference with the 30 Daisios received various explanations[55]. Depuydt[56] having noticed that the indication of Alexander's death was recorded in the late 29th Ayyaru observations, the date could only have been June 11 around 17:00. In fact, this conclusion is not logical because extra astronomical comments could be recorded at the end but not during the account of observations because they were known only after a while. In addition, can we talk about evening at 17:00? Plutarch states: *He [Alexander] gave a splendid entertainment to Nearchus, and then, although he had taken his customary bath before going to bed, at the request of Medius he went to hold high revel with him; and here, after drinking all the next day, he began to have a fever. This did not come upon him after he had quaffed a "bowl of Heracles," nor after he had been seized with a sudden pain in the back as though smitten with a spear; these particulars certain writers felt obliged to give, and so, as it were, invented in tragic fashion a moving finale for a great action. But Aristobulus says that he had a raging fever, and that when he got very thirsty he drank wine, whereupon he became delirious, and died on the 30th day of the month Daisios. Moreover, in the court "Journals" there are recorded the following particulars regarding his sickness (...) on the 28th, towards evening, he died* (Life of Alexander 75:4-76:1). According to the pseudo-Callisthenes, Alexander died at sunset (Alexander Romance III:35), thus Alexander died shortly after sunset (c. 18:00). The disagreement between the two dates, 28 and 30 Daisios, can be explained by reference to two Macedonian calendars: the old one

[55] H. HAUBEN - La chronologie macédonienne et ptolémaïque mise à l'épreuve
in: *Chronique d'Égypte* LXVII (1992) fasc. 133 pp. 146,147.
[56] L. DEPUYDT - The Time of Death of Alexander the Great: 11 June 323 BC, ca 4:00-5:00 PM
in: *Die Welt des Orients* 28 (1997) pp. 117-135.

with the 30th, which started at sunset, and the new one with the 28th, which began at sunrise. In addition, in the Greek calendar the last day of the month (29 or 30) was called the 30th. Plutarch relates: *Aristander the seer made a sacrifice, and after taking the omens, declared very confidently to the bystanders that the city would certainly be captured during that month. His words produced laughter and jesting, since it was then the last [29th] day of the month, and the king, seeing that he was perplexed, and being always eager to support his prophecies, gave orders to reckon that day, not as the 30th of the month, but as the 28th* (Life of Alexander 25:1-2). Prolonging the month by 1 day allowed the prediction to come true but did not affect the calendar[57].

	Calendar			death									
	(in 323 BCE)			00---6:00---12:00---18:00---24				00---6:00---12:00---18:00---24				00	
1	Julian (astronomical)	9 June -->		<---------- **10 June** ---------->				<---------- 11 June ---------->					
2	Natural (Day/Night)		Night		Day		**X**		Day		Night		
3	Babylonian		<-------- 28 Ayyaru -------->				<-------- **29 Ayyaru** --------->				<1- Simanu		
4	Macedonian* (old)		<-------- 28 Daisios -------->				<-------**"30" Daisios** ------->				<1- Panemos		
5	Macedonian (new)	27 Daisios ->		<-------- **28 Daisios** --------->				<-------- 29 Daisios -------->					
6	Egyptian (civil)	30 Phamenoth ->		<------- **1 Pharmouthi**------>				<------- 2 Pharmouthi ------->					

The 4 Pharmouthi corresponded to 13 June in 323 BCE[58]! One way to resolve this discrepancy is to assume that the original date was the 1 Pharmouthi and it was damaged (in Greek) according to the following process: *Pharmouthi A* became *Pharmouthi Δ* and then *Pharmouthi tetradi*. This explanation, however, requires a synchronization between the Macedonian and Egyptian calendars, which is unlikely because of the large distance between the cities of Babylon and Alexandria. It is nevertheless quite possible that the news of Alexander's death reached Alexandria 4 days later. Indeed, these two cities are separated by about 1700 km by land routes, it took at least 4 days for the royal steeds, moving at an average speed of 15.3 km/h[59] to deliver this exceptional news. For example, the death of Alexander which was announced on 01/III/**1** in Babylon was known on 05/III/**1** in Idumea, that implies 5 days to cover about 1800 kilometres[60]. Under these conditions, the 4 Pharmouthi could match the 29 Ayyaru 4 days later, because of the delay from travel Even in the best case where two calendars (Egyptian and Macedonian) would have been available at the same place, the synchronization of dates remained difficult. The Rosetta Stone, for example, is an official document, precisely and doubly dated, it reads: *Ptolemy, living forever, beloved of Ptah, in his year 9 (...) the 4 of month Xandikos, corresponding to the Egyptians to the 18th day of Mecheir*[61]. This dating is surprising because the year 9 of Ptolemy (196 BCE) began actually on 1 Thoth (11 October 197 BCE) and ends on next 1 Thoth (11 October 196 BCE), thus 18 Mecheir matches to 27 March. The Macedonian calendar began with the month of Dios keyed on the autumnal equinox which began on 26 September in 197 BCE. The 1st lunar crescent after the equinox (= 1st Dios) is dated 25 October 197 BCE and the 1st visible crescent of the 6th month (Xandikos) is dated 22 March 196 BCE. Consequently the 4 Xandikos corresponds to the 25 March 196 BCE. There are 2 days difference from the 27 March from the Egyptian calendar. A clerical error in an official document is quite unlikely, this difference of 2 days proves that Greek calendars were sketchy. In fact, the Greek lunar months were not set on observation but seem to alternate regularly between months of 29

[57] As the normal sequence 29*-30 became artificially 30*-29.
[58] http://www.chronosynchro.net/wordpress/convertisseur/
[59] A.E. MINETTI - Physiology: efficiency of equine express postal systems
in: *Nature* n° 426 (18 décembre 2003) pp. 785-786.
[60] T. BOIY – Between High and Low. A Chronology of the Early Hellenistic Period
Leuven 2007 Ed. VerlagAntike pp. 130-131.
[61] C. ANDREWS – La Pierre de Rosette
London 1993 Ed. British Museum Press p. 26.

and 30 days, which could induce a shift (sometimes up to 10 days!) with astronomical observations[62]. The Battle of Gaugamela, which Darius III lost against Alexander the Great, dated in Athenian and Babylonian calendars, illustrates the inaccuracy of the Greek calendar. According to an astronomical diary, this famous battle is dated 24/VI in the 5th year of Darius (1 October 331 BCE)[63] just after the lunar eclipse of 13/VI. According to Plutarch: *on the 6th day of the month of Boedromion the Greeks defeated the Persians at Marathon, on the 3rd day at Plataea and Mycale together, and on the 26th day at Arbela [Gaugamela]. Moreover, it was about full moon of the same month that the Athenians won their sea-fight off Naxos* (Life of Camillus 19:3). He states: *It so happened that in the month Boedromion the moon suffered an eclipse, about the beginning of the Mysteries at Athens, and on the 11th night after the eclipse* (Life of Alexander 31:8). These details show that the Babylonian calendar was keyed on the first visible crescent (in 331 BCE), while the Athenian calendar, which was keyed on the new moon was in advance of two days compared to the Babylonian calendar.

331 BCE	Julian	Astronomy	Babylonian	Athenian	
September	6	New moon	29	**1**	
	7	Astronomical crescent	30	2	
	8	1st visible crescent	**1**	3	
	9		2	4	
	10		3	5	
	11		4	6	
	12		5	7	
	13		6	8	
	14		7	9	
	15		8	10	
	16		9	11	
	17		10	12	
	18		11	13	
	19		12	14	
	20	Eclipse of the moon	**13**	**15**	0
	21		14	16	1
	22		15	17	2
	23		16	18	3
	24		17	19	4
	25		18	20	5
	26		19	21	6
	27		20	22	7
	28		21	23	8
	29		22	24	9
	30		23	25	10
October	1		24	**26**	**11**
	2		25	27	

Some historians, knowing the difference between Greek calendars and astronomy, referred sometimes to it for clarification. Thucydides wrote, for example, *new month depending on the moon* (The Peloponnesian War II:28, IV:52). Josephus is also obliged to specify: *in the month Xanthicos, on the 15th day of the lunar month (...) In the month of Xanthicos, which is by us called Nisan, and is the beginning of our year, on the 14th day of the lunar month, when the sun is in Aries* (Jewish Antiquities II:318, III:248), suggesting a difference between the official month and the astronomical lunar month. This simple overview illustrates this: the precise dating of a well referenced event, even in several calendars, brings up complex problems because our understanding of ancient calendars is approximate and the synchronization of a date in multiple calendars, even for a event as important as the death of Alexander, remains difficult and approximate to within plus or minus few days.

[62] E.J. BICKERMAN - Chronology of the Ancient World
London 1980 Ed. Thames and Hudson pp. 28-33.
[63] J.A. BRINKMAN - BM 36761, the Astronomical Diary for 331 B.C.
in: *Nouvelles Assyriologiques Brèves et Utilitaires* (1987) §63.

Large distances between Upper and Lower Egypt made it difficult to synchronize the calendar throughout the whole territory even inside the country[64]. To determine the beginning of the solar year the Egyptians referred to the rising of Sirius, which was appearing at that time on approximately c. 19 July in the Julian calendar. Despite the importance of this day in their calendar, since it coincided with the beginning of the Nile flood, they never mentioned that the Sothic rising was observed a day late by degree of latitude, involving a delay of 7 days between the observatory of Elephantine (24°) and the one of Buto (31°)[65]. The Persian Empire being larger than Egypt, it was impossible to synchronize the lunar calendar over the whole territory since a courrier needed on average one month to reach the ends of the empire. The Persians, though they had a Royal Mail known for its speed[66], needed however at least two weeks to deliver an outstanding new event throughout the whole empire.

The royal road from Susa to Sardis, 2750 km long, could be covered in about 10 days by postal couriers who were moving at an average speed of 15.3 km/h. This duration[67] could even go down to less than one week if the couriers were taking turns day and night, as Xenophon claims (Cyropaedia VIII:6:17-18). Despite this performance, the synchronization of local calendars from a single city remained an impossible feat to achieve, even for two cities as close as Susa and Babylon about 400 km apart, because the new moon was determined each month through an observation and not through a theoretical computation as the Metonic cycle that would have predicted dates in advance[68]. If a scribe of Susa, the day after the 29 Ayyaru, had to wait for the response of Babylonian priests to determine whether the day was 30 Ayyaru or 1st Simanu he could not date his writings for 2 days. This delay amounted to 4 days for the cities of Susa and Persepolis about 800 km apart. Actually for practical reasons, each satrapy had to deal with the management of its own lunar calendar (through the temples). The synchronization was actually obtained by observation. These examples show that the calendars of the past depended on local observation. Concerning the Greek calendar it was reformed about 520 BCE and according to Censorinus, Cleostrate of Tenedos introduced at that time an intercalation cycle of 8-year. Several astronomers then proposed other systems of intercalation: 19-year cycle of Meton in 433 BCE, 76-year cycle of Calippe in 330 BCE and 304-year cycle of Hipparchus in 125 BCE. These reforms, which were in fact only theoretical, confirm that throughout the Classical period (500-323) the Greek calendar was in practice not very accurate (+/- 5 days), as Aristoxenus of Tarentum (355-300?) confirms: *Moreover, the data from physicists about tones is perfectly analogous to the marching of days. For example, when the Corinthians count the 10th day [of month], the Athenians count the 5th and some other peoples the 8th* (Harmonic Elements II:22). Likewise Plutarch (46-125) adds: *This battle [of Marathon] was fought on the 4th of the month Boëdromion, as the Athenians reckon time; but according to the Boeotian calendar, on the 27th of the month Panemus, the day when, down to the present time, the Hellenic council assembles in Plataea, and the Plataeans sacrifice to Zeus the Deliverer for the victory. We must not wonder at the apparent discrepancy between these dates, since, even now that astronomy is a more exact science, different peoples have different beginnings and endings for their months.* (Life of Aristides XIX:7). According to R.F. Avienus

64 W.A. WARD - The Present Status of Egyptian Chronology
in: *Bulletin of the American Schools of Oriental Research* 288 (1991) pp. 53-66.
65 A.S. VON BOMHARD - Le calendrier Égyptien. Une œuvre d'éternité
London 1999 Ed. Periplus pp. 46,47.
66 P. BRIANT - Histoire de l'empire perse. De Cyrus à Alexandre
Paris 1996 Éd. Fayard pp. 382,383.
67 B. LAFONT - Messagers
in: Dictionnaire de la civilisation mésopotamienne (Laffont, 2001) p. 526-528.
68 In the Metonic cycle each 64th day was taken away to the months of 30 days, which was disrupting the regular alternation 30/29 by a couple 30/30 every 15 months.

(The prognostics of Aratus), the only reform of the Greek calendar was the synchronizing of the archontic year (which began at the winter solstice prior 433 BCE) with the Olympic year (starting at the solstice of summer). Diodorus states that it took place in 432 BCE on 13 Scirophorion (= 28 June = summer solstice) of the Athenian calendar (Historical Library XII:36:1-3). This multiplicity of calendars lasted until 100 BCE, prior to which each city had its own way of counting days, starting, naming and intercalating months[69]. The following list of some calendars illustrates[70] the complexity of the situation (the 1st month of each calendar is month 1 and all calendars are aligned on that of Athens).

Athens	Delos	Miletus	Delphi	Epidauros	Cos
1. Ἑκατομβαιών	Ἑκατομβαιών	Πάνημος	1. Ἀπελλαῖος	1. Ἀζόσιος	Πάναμος
Μεταγειτνιών	Μεταγειτνιών	Μεταγειτνιών	Βουκάτιος	Καρνεῖος	Δάλιος
Βοηδρομιών	Βουφονιών	Βοηδρομιών	Βοάθοος	Προράτιος	Ἀλσεῖος
Πυανεψιών	Ἀπατουριών	Πυανοψιών	Ἥραῖος	Ἑρμαῖος	1. Καρνεῖος
Μαιμακτηριών	Ἀρησιών	Ἀπατουριών	Δᾳδοφόριος	Γάμος	Θευδαίσιος
Ποσειδεών[1]	Ποσειδεών	Ποσειδεών	Ποιτρόπιος[1]	Τέλεος	Πεταγείτνιος
Γαμηλιών	1. Ληναιών	Ληναιών	Ἀμάλιος	Ποσιδαῦος	Καφίσιος
Ἀνθεστηριών	Ἱερός	Ἀνθεστηριών	Βύσιος	Ἀρταμίτιος	Βαδρόμιος
Ἐλαφηβολιών	Γαλαξιών	1. Ἀρτεμισιών	Θεοξένιος	Ἀγριάνιος	Γεράστιος
Μουνυχιών	Ἀρτεμισιών	Ταυρεών	Ἐνδυσποιτρόπιος	Πάναμος	Ἀρταμίτιος
Θαργηλιών	Θαργηλιών	Θαργηλιών	Ἡρακλεῖος	Κύκλιος	Ἀγριάνιος
Σκιροφοριών	Πάναμος[1]	Καλαμαιών	Ἰλαῖος	Ἀπελλαῖος	Ὑακίνθιος

Aetolia	Thessaly	Boeotia	Rhodes	Macedonia	Babylonia (Jews)[2]
Λαφραῖος	Φυλλικός	Ἱπποδρόμιος	Πάναμος	Λώιος	Duzu (Tammuz)
Πάναμος	1. Ἰτώνιος	Πάναμος	Καρνεῖος	Γορπαῖος	Abu (Ab)
1. Προκόκλιος	Πάνημος	Παμβοιώτιος	Δάλιος	Ὑπερβερεταῖος	Ululu (Elul)[1]
Ἀθαναῖος	Θεμίστιος	Δαμάτριος	1. Θεσμοφόριος	1. Δῖος	Tashritu (Tishri)
Βουκάτιος	Ἀγαγύλιος	Ἀλαλκομένιος[1]	Διόσθυος	Ἀπελλαῖος	Arahsamnu (Marheshvan)
Δῖος[1]	Ἑρμαῖος	1. Βουκάτιος	Θευδαίσιος	Αὐδναῖος	Kislimu (Kislev)
Εὐσαῖος	Ἀπολλώνιος[1]	Ἑρμαῖος	Πεδαγείτνιος	Περίτιος	Tebetu (Tebeth)
Ὁμολώιος	Λεσχανόριος	Προστατήριος	Βαδρόμιος	Δύστρος	Shabatu (Shebat)
Ἑρμαῖος	Ἄφριος	Ἀγρώνιος	Σμίνθιος	Ξανδικός	Addaru (Adar)[1]
Διονύσιος	Θυῖος	Θιούιος	Ἀρταμίτιος	Ἀρτεμίσιος	1. Nisanu (Nisan)
Ἀγύιος	Ὁμολιός	Ὁμολώιος	Ἀγριάνιος	Δαίσιος	Aiaru (Iyyar)
Ἱπποδρόμιος	Ἱπποδρόμιος	Θειλούθιος	Ὑακίνθιος	Πάνεμος	Simanu (Sivan)

The Greek calendar started (from 520 BCE) at the first new moon after the summer solstice (28 June) in Athens, Delphi and Epidaurus, after the autumnal equinox (28 September) in Rhodes, Cos and Macedonia, at the winter solstice (28 December) in Delos, and after the spring equinox (26 March) in Babylonia and Miletus. In addition, these calendars used the same month names, but placed at different times of the year. The month Panemos, for example, was the 1st month of the year in Cos, the 2nd in Thessaly, the 5th in Miletus, the 6th in Delos, the 9th in Macedonia and in Boeotia, the 10th in Rhodes and the 12th in Aetolia. The Greek astronomer Geminos of Rhodes (80-10?) also states that some Greeks were content to alternate months of 29 and 30 days, and thus the first crescent could fall between 1 and 3 of the month (Introduction to phenomena VIII:34, IX:14). This multiplicity of calendars is surprising because many Greek cities were closely related to the satrapy of Sardis (directly connected to the Persian capital Susa which used a Babylonian calendar well synchronized on the 1st lunar crescent). Several difficulties complicate the dating: the year beginning was different depending on the system of dating, the year duration was different depending on eras. In addition these systems evolved over time (that partially put them out of sync). The year of Rome, for example, which should have started on 21 April began in fact, for practical reasons, on 1st January. The Olympic year began from the 1st full moon after the summer solstice (28 June), the Seleucid era began on 1st

[69] W. KENDRICK PRITCHETT – Athenian Calendars and Ekklesias
Amsterdam Ed. J.C. Gieben Publisher pp. 6-11.
[70] E.J. BICKERMAN - Chronology of the Ancient World
London 1980 Ed. Thames and Hudson pp. 27-40.

Tishri in Macedonia (7 October 312 BCE), but on 1st Nisan in Babylonia (3 April 311 BCE). In addition, the duration and beginning of the year varied over time. The Roman year, for example, gradually moved from an observed lunisolar year (beginning at the winter solstice) into a computed solar year which began on 1st January. The Greeks remained faithful to a lunisolar year first observed, then computed, but the intercalary month was added in a lax manner and variably. We understand better why Thucydides (460-398), despite his desire of accuracy, could not use a Greek reference calendar as well as the remark of Herodotus (484-425) who lamented about the functioning of the Greek calendar. Thucydides is obliged to specify: *new month according to the Moon* (The Peloponnesian War II:28) to mark the difference between the 1st day of the month and the 1st visible crescent (or new moon). Greek months usually beginning at the new moon, the Greek word *neomenie* "new month" was understood as "new moon" and it is in this sense that Thucydides used it (The Peloponnesian War IV:52). Herodotus and Thucydides knew Persian and Babylonian calendars since they mention them but these systems were not employed in Greece, despite the superiority of their functioning because the concept of a universal calendar did not exist at that time, only a calendar related to a king or city made sense. The unreliability of the Greek calendar in its counting of days and months handicapped the Greek historians, then Roman, at least until the beginning of our era. Diodorus of Sicily (90-21 BCE), for example, managed to synchronize the Greek archontic years with the Roman consular year only about 8 years. Herodotus, the father of History, was the first who understood the crucial role of chronology to authenticate historical narratives. However, he had to face a technical problem for dating events: the lack of a universal calendar, which forced him to invent a dating system based on Olympiads, eponymous archons, periods from well-known events such as: battles, King's deaths, religious festivals, eclipses, etc[71].

The Greeks knew various calendars but Herodotus explains why he did not used them: these calendars gave dates only on months and days, but not on years or eras and the same dating of an event varied according to Greek cities (The Histories I:32, II:4). Thucydides too, despite his strong desire for accuracy, didn't use any of them. At the beginning of his account, he explained his way of proceeding: *Here is the account of operations, written in chronological order, by winter [from autumn equinox] and by summer [from spring equinox]. The peace, which after the winning of Eubœa, was concluded for 30 years, lasted 14 years. But in the 15th year, being the 48th of the priesthood of Chrysis in Argos: Ænesias being then ephor at Sparta, and Pythodorus being, 4 months yet archon of Athens, in the 6th month after the battle at Potidæa and in the beginning of the spring (...) The same summer, at the beginning of a new lunar month, the only time by the way at which it appears possible, the sun was eclipsed after noon. After it had assumed the form of a crescent and some of the stars had come out, it returned to its natural shape* (The Peloponnesian War II:1-2; 28). All this detailed information enable us to reconstruct an absolute chronology. According to the list of Athenian archons[72], Pythodorus was archon in 432-431 BC and the solar eclipse observed near Athens, among all the solar eclipses between 440 and 420 BCE visible near Athens which took place in the afternoon[73], is dated 3 August 431 BCE. This eclipse fits well with the description given by Thucydides[74], its magnitude was 0.88 in Athens at 17:30 LT[75] (0.96 in Babylon at 19:00 LT).

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[71] *Olympiads* (Enquête II:160, V:22, VI:127, VII:206, VIII:72, IX:33); *eponymous archons* (Enquête VIII:51; 131); *periods* (Enquête I:209, II:142, III:14,67); *batlles* (Enquête VI:117); *King's death* (Enquête VII:1-7); *religious festivals* (Enquête VII:206, VIII:72); *solar eclipses* (Enquête I:74, VII:37?, IX:10?).

[72] http://en.wikipedia.org/wiki/Archon_of_Athens

[73] http://eclipse.gsfc.nasa.gov/SEatlas/SEatlas-1/SEatlas-0439.GIF

[74] F.R. STEPHENSON - Historical Eclipses and Earth's Rotation
Cambridge 1997 Ed. Cambridge University Press pp. 346-348.

[75] http://eclipse.gsfc.nasa.gov/SEsearch/SEsearchmap.php?Ecl=-04300803

Thucydides also says that a treaty with Darius II (424-405), in his 13th year of reign, was concluded during the spring of the 20th year and the last year of the war when Alexippidas was ephor (The Peloponnesian War VIII:58-60), in the spring 411 BCE because Alexippidas was ephor from September 412 to September 411 BCE and Darius II began his 13th year of reign on 1st Nisan (29 March 411 BCE). A difficulty arises because Thucydides says that the treaty was concluded in late winter (spring equinox) and therefore before 26 March 411 BCE, slightly before the beginning of the 13th year of Darius II. Some have speculated that this was the 13th year reckoned from the date of accession to the throne[76], but this is without parallel. Actually, the 13th year of Darius began either on 1st Nisan (Babylonian New Year) or on 1st Thoth (4 December 412 BCE)[77] in Egypt[78]. The spring equinox was used to separate winter from summer in Greece. Thucydides begins, for example, the 8th year by linking it with a solar eclipse: *Thus the winter ended, and with it ended the 7th year of this war of which Thucydides is the historian. In first days of the next summer there was an eclipse of the sun at the time of new moon, and in the early part of the same month an earthquake* (The Peloponnesian War IV:51-52). There was indeed a partial solar eclipse on 21 March 424 BCE in Athens (0.71 magnitude)[79]. Thus the first days of summer ranging from 21 to 26 March. However, as the 13th year of Darius II had a 2nd Adar (month 12b), 1st Nisan was therefore shifted one month and started on February 27 and not on 29 March (411 BCE). The contract dated 24/12b/**14** of Darius II should be read 24/12b/**13**! as the previous intercalary year was in year 10[80]. Thus, the treaty was concluded in 411 BCE between 27 February and 26 March. Given its reliability why did Thucydides not use archon years more often? It is because the archons took their office in January until 433 BCE, but to synchronize archontic years with Olympic years, the Greeks decided, from Apseudes, that archons would take their office along with the Olympiads (in July):

Year BCE	Athenian archon	Roman consuls	Olympiad	Year of Rome	Year of Seleucid era
435	Antiochides	Caius Iulius Iullus II Lucius Verginius Tricostus I	**86:1**	319	-122
			86:2		
434	Chares	Caius Iulius Iullus III Lucius Verginius Tricostus II		320	-121
			86:3		
433	Apseudes	Military tribune with consular power		321	-120
			86:4		
432		Military tribune with consular power		322	-119
	Pythodorus		**87:1**		
431		Titus Quinctius Poenus Cincinnatus Cnaeus Iulius Mento		323	-118
	Euthydemus		87:2		
430		Lucius Papirius Crassus II Lucius Iulius Iullus		324	-117
	Apollodorus		87:3		

The remark of Thucydides: *Pythodorus being 4 months yet archon of Athens*, involves dating the beginning of the 1st year of the Peloponnesian War about March 431 BCE, which actually corresponds to the beginning of the summer (spring equinox). The recent change in reckoning of archontic years also explains why Thucydides did not consider appropriate to use a system which was still evolving at his time.

[76] L. DEPUYDT - Evidence for Accession Dating under the Achaemenids
in: *Journal of the American Oriental Society* 115/2 (1995) pp. 193-204.
[77] http://www.chronosynchro.net/wordpress/convertisseur
[78] L. DEPUYDT - Regnal Years and Civil Calendar in Achaemenid Egypt
in: *The Journal of Egyptian Archaeology* 81 (1995) pp. 151-173.
[79] http://eclipse.gsfc.nasa.gov/SEsearch/SEsearchmap.php?Ecl=-04230321
[80] V. SCHEIL – Notules
in: *Revue d'Assyriologie et d'Archéologie Oriental* 16, 1919, pp. 111-112.

BCE	month		[A]	[B]	[C]	[D]	[E]	
432	1	X			322	-119	**1**	[**A**] Archon Apseudes
	2	XI						
	3	XII						
	4	I					**2**	[**E**] Darius B (*Babylonian year*)
	5	II						
	6	III						
	7	IV						[**A**] Archon **Pythodorus**
	8	V						
	9	VI						
	10	VII				-118		[**D**] Year of Seleucid era
	11	VIII						
	12	IX						
431	1	X			323			[**C**] Year of Rome
	2	XI						
	3	XII	*1*	**1**				[**B**] 1st year of the Peloponnesian war
	4	I	*2*				**3**	
	5	II	*3*					
	6	III	*4*					
	7	IV						[**A**] Archon Euthydemus *Solar eclipse dated 3 August 431 BCE*
	8	V		***				
	9	VI						
	10	VII				-117		
	11	VIII						
	12	IX						

Thus the chronology reconstituted by Greek historians is accurate and reliable[81]. However, when they began (mainly from 330 BCE) to harmonize their chronology with that from the Babylonian king lists, a major disagreement arose (highlighted in orange):

King (according to Greek historians)	Reign	**King** (according to Babylonian King Lists)	Reign
Cyrus II	539-530	Cyrus II	539-530
Cambyses II	530-522	Cambyses II	530-522
Bardiya (usurper during 7 months)	522-521	Darius I	522 -
Darius I	522-486		-486
Xerxes I (coregency with Darius)	496-475	Xerxes I	486 -
Artabanus (usurper)	475-474	-	-465
Artaxerxes I	475-434	Artaxerxes I	465 -
Darius B (coregency with Artaxerxes)	434-426	-	
Artaxerxes I	426-425	-	
Xerxes II (45 days reign not reckoned)	425-424	-	
Sogdianus (usurper during 6.5 months)	424-424	-	-424
Darius II	424-405	Darius II	424-405

The Babylonian chronology from King Lists, used in Ptolemy's Canon, is wrong because there are no coregents and usurpers[82]. One has to know that very early, historians modified the Greek chronology in order[83] to fit it on Babylonian chronology, creating a great confusion over the period 475-455 BCE. For example, the battle of the Eurymedon between the Delian League of Athens and its Allies, and the Persian Empire of Xerxes I — essential step of Greco-Persian relations— is fixed, according to modern authors, at extreme dates from 476 BCE to 462 BCE[84]. According to Diodorus of Sicily, the battle of the Eurymedon took place under the archonship of Demotion, in 470 BCE, but also under the consulship of Publius Valerius Publicola and Gaius Nautius Rufus, in 475 BCE

[81] M.S. KOUTORGA - Recherches critiques sur l'histoire de la Grèce, pendant la période des guerres médiques in: *Mémoires présentés par divers savants à l'Académie royale des Inscriptions et Belles-Lettres de l'Institut de France*, 1re série. t. VII, Paris 1861.
[82] T. BOIY – Between High and Low. A Chronology of the Early Hellenistic Period 2007 Leuven Ed. Verlag Antike pp. 95-131.
[83] E.J. BICKERMAN - Chronology of the Ancient World London 1980 Ed. Thames and Hudson pp. 165-171.
[84] P. BRIANT, P. LEVEQUE, P. BRULE, R. DESCAT, M.M. MACTOUX - Le monde grec Tome 1 Paris 1995 Éd. Presses Universitaires de France pp. 37-40.

(Historical Library XI:60-61). In fact the Roman chronology of Diodorus was shifted from 5 to 8 years over this period around 465 BCE[85]. Diodorus (Historical Library I:68:6) dated the beginning of the Persian domination in Egypt in the 3rd year of the 63rd Olympiad [in 526 BCE] and the end in the archonship of Euclid [in 403 BCE], or in the year 2 of Artaxerxes II, when Amyrtaeus had become the new pharaoh of the XXVIII dynasty (Historical Library XIV:11:1-12:1, I:44:3). This data taken from his Greek chronology is accurate, however, Diodorus wrote in summary: *The Persians were the masters, after King Cambyses had subjected the nation by force of arms, for 135 years*, contradicting his own chronological calculations (length of 123 years between 526 and 403 BCE). In fact, the total period of 123 years corresponds to an amount calculated with a 40-year reign for Artaxerxes I, while that of 135 years corresponds to an actual reign of 51 years. Diodorus compiled numerous data, probably thanks to an Egyptian informer (Historical Library III:11), without trying to harmonize it.

Length according to:	dated event:	official reign	actual reign	Reign
Cambyses II (in Egypt)*	526 -	6* years	6* years	[526-521]*
Darius I		36 years	36 years	522-486
Xerxes I		20 years	21 years	496-475
Artaxerxes I		40 years	51 years	475-424
Darius II		19 years	19 years	424-405
Artaxerxes II (in Egypt)	-403	2 years	2 years	405-[403]
Total:	123 years	**123 years**	**135 years**	**526-403**

The previous example highlights several points: the using of chronological data from historical narratives requires a good understanding of how usurpers, co-regencies and parallel dynasties (instead of consecutive) have biased official chronologies, in addition, former historians have compiled many documents of different origin (Greek, Babylonian, Egyptian, Persian) without knowing how ancient reigns had been reckoned, as accession years (with or without), beginning of regnal years (on 1st Nisan, 1st Tishri, 1st Thot), etc.

The only way to get an absolute chronology is the dating of some historical synchronisms by astronomy. For example, the partial eclipse in year 7 of Cambyses II (tablet BM 33066) may be dated 523 BCE July 16/17 [mag. 0.54] and the total eclipse 522 BCE January 9/10. Claudius Ptolemy had to have known the original tablet because he gave the right magnitude of 0.50 for the partial eclipse (Almagest V:14). Another astronomical tablet (BM 36879) describes the eclipses in years 1-4 of Cambyses II, dated by astronomy in 529-526 BCE[86]. An astronomical journal (BM 38462) list some lunar eclipses in the years 1 to 27 of Nebuchadnezzar which are dated from 604 to 578 BCE[87]. Other dated lunar eclipses[88] are these of year 1 and 2 of Merodachbaladan (19/20 March 721 BCE, 8/9 March and 1/2 September 720 BCE); year 5 of Nabopolassar (21/22 April 621 BCE); year 2 of Šamaš-šuma-ukîn (10/11 April 666 BCE) and year 42 of Nebuchadnezzar (2/3 March 562 BCE). A diary (VAT 4956)[89] contains numerous astronomical conjunctions in years 37 and 38 of Nebuchadnezzar dated from astronomy in 568 and 567 BCE. Babylonian and Greek chronologies give the same results, except for the death of Xerxes: 465 or 475 BCE?

[85] J. HAILLET - Diodore de Sicile Bibliothèque historique livre XI.
Paris 2001 Éd. Les Belles Lettres pp. XV-XX; XXVII-XXXII.
[86] P.J. HUBER, S. DE MEIS – Babylonian Eclipse Observations from 750 BC to 1 BC
Milano 2004 Ed. Mimesis pp. 94-96.
[87] H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol. V n° 6
Wien 2001 Ed. Akademie der Wissenschaften pp. 27-30,396.
[88] F.R. STEPHENSON - Historical Eclipses and Earth's Rotation
Cambridge 1997 Ed. Cambridge University Press pp. 99-100, 151-152, 166-167, 206.
[89] A.J. SACHS, H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol. I
Wien 1988 Ed. Akademie der Wissenschaften (n° -567).

XERXES, DID HE DIE IN 465 BCE (KING LISTS) OR 475 BCE (THUCYDIDES)?

For example, Herodotus says that Xerxes prepared his campaign against Greece one year after Darius' death (486 BCE) and the crushing of an Egyptian revolt (The Histories VII:7). He explained that after the Egyptian revolt (in 485 BCE), Xerxes began his campaign (Battle of Salamis) at the end of the 5th year (480 BCE) in the archonship of Calliades (The Histories VII:20; VIII:51) and during (the 73rd) Olympic games (The Histories VII:206). The following year there was the battle of Plataea (479 BCE) when Xanthippus was archon (The Histories VIII:131). One can see that all historical data provided by Herodotus is coherent. In the same way it is possible to check data coming from various historians.

Year BCE	Athenian archon	Roman consuls	Olympiad	Year of Rome	Year of Seleucid era
481	Hypsichides	Kaeso Fabius Vibulanus II Spurius Furius Fusus	72:4	273	-168
480	Calliades	Marcus Fabius Vibulanus II Cnaeus Manlius Cincinnatus	**73:1**	274	-167
479	Xanthippus	Kaeso Fabius Vibulanus III Titus Verginius Tricostus Rutilus	73:2	275	-166
478	Timosthenes	Lucius Aemilius Mamercinus II Caius Servilius Structus Ahala*	73:3	276	-165
477	Adimantus	Caius Horatius Pulvillus I Titus Menenius Agrippae Lanatus	73:4	277	-164
476	Phaedon	Aulus Verginius Tricostus Rutilus Spurius Servilius Priscus Structus	**74:1**	278	-163
475	Dromoclides	Publius Valerius Publicola I Caius Nautius Rutilus I	74:2	279	-162
474	Acestorides	Aulus Manlius Vulso Lucius Furius Medullinus	74:3	280	-161
473	Menon	Lucius Aemilius Mamercinus III Vopiscus Iulius Iullus	74:4	281	-160
472	Chares	Lucius Pinarius Mamercinus Rufus Publius Furius Medullinus Fusus	**75:1**	282	-159
471	Praxiergus	Titus Quinctius Capitolinus Barbatus I Appius Claudius Crassinus Regillensis Sabinus	75:2	283	-158

According to Thucydides: *Themistocles manifested a desire to visit the king of Persia (...) The storm caused the vessel to drift towards the camp of the Athenians who then besieged Naxos (...) Accompanied by a Persian coast, then he penetrated into the interior of the country and sent to Artaxerxes, who had succeeded Xerxes, his father a letter* (The Peloponnesian War I:98;137). Therefore, he reports the fall of Naxos after the one of Skyros dated at the beginning of the archonship of Phaedon (476 BCE), according to Plutarch (Life of Theseus §§35,36). Thus, the meeting with Themistocles would have occurred soon after 475/474 BCE. Furthermore, Themistocles died under the archonship of Praxiergus (471 BCE), according to Diodorus Siculus (Historical Library XI:54-60), and Herodotus situated the transfer of power from Darius to Xerxes at the time of the revolt of Egypt (The Histories VII:1-4), 4 years after Marathon (in 490 BCE) and the change Xerxes/ Artaxerxes shortly after the storming of Eion [in 476 BCE], the last event of the reign of Xerxes (The Histories VII:106-107).

If Artaxerxes began his reign in 465 BCE, Themistocles, who died in 471 BCE, could not have met him. Aware of this aberration, many historians today reject the death of Themistocles in 460 or even in 450 BCE. But this choice comes up against a problem: the life of Themistocles is well documented. This paradox is not new, as already evoked by Cornelius Nepos: *I know most historians have related that Themistocles went over into Asia in the reign of Xerxes, but I give credence to Thucydides in preference to others, because he, of all who have left records of*

that period, was nearest in point of time to Themistocles, and was of the same city (Life of Themistocles IX). Plutarch says: *Thucydides and Charon of Lampsacus say that Xerxes was dead, and that Themistocles had an interview with his son; but Ephorus, Dinon, Clitarchus, Heraclides, and many others, write that he came to Xerxes. The chronological tables better agree with the account of Thucydides, and yet neither can their statements be said to be quite set at rest* (Life of Themistocles XXVII). Cicero relates: *Who was more eminent in Greece than Themistocles, who more powerful? But he, after having saved Greece from slavery by his leadership in the war with Persia, and after having been banished because of his unpopularity, would not submit to the injustice of an ungrateful country, as he was in duty bound to do: he did the same thing that Coriolanus had done among our people 20 years before. Not one single supporter could be found to aid these men against their country; therefore, each took his own life* (Laelius on Friendship XII§42). Livy (Roman History II:34-39) dates precisely the life of Coriolanus, indicating that he betrayed in the consulship of Marcus Minucius and Aulus Sempronius (491 BCE) and died 3 years later when Spurius Nautius and Sextus Furius were consuls (488 BCE). The parallel between these two famous men who had a similar purpose would involve the death of Themistocles around 468 BCE. Plutarch also says that Themistocles *ended his days in the city of Magnesia, having lived 65 years* (Life of Themistocles III; XXXI). According to Cornelius Nepos, Themistocles and Aristides were about the same age (Aristides I:1). Elien says: *Themistocles, and Aristides Son of Lysimachus, had the same Governours, they were also brought up together, and taught by one Master, but whilest yet Boyes, they were alwaies at variance ; and this emulation continued from their childhood, to extreme old age* (Various History XIII:44). Plutarch wrote: *Aristides being the friend and supporter of that Clisthenes (...) had Themistocles, son to Neocles, his adversary on the side of the populace. Some say that, being boys and bred up together from their infancy, they were always at variance with each other in all their words and actions* (Aristides II:1). Now, to be part of the Boule (Senat), you had to be at least 30 years old[90]. So Aristide had to have been born a little before 538 BCE, for the constitution of Cleisthenes was in 508 BCE. With an estimated birth around 538 BCE, the death of Themistocles 65 years later would have been c. 473 BCE. Ælian wrote: *On a time Themistocles, yet a boy, returning from School, his Master bade him, meeting Pisistratus the Tyrant, to go a little out of the way. Whereto he generously answered, "Is not here way enough for him?" So much did something ingenious and generous appear in Themistocles at those years* (Various History III:21). As Pisistratus died in the archonship of Philoneos (in 527 BCE), according to Aristotle (Constitution of Athens XVII:1-2), Themistocles had to have risen about 537/536, as being a *παῖς* "boy" at this meeting he was around 10 years old[91]. If Themistocles, who died at the age of 65, was born in 536 BCE, his death was therefore in 471 BCE and he met Artaxerxes I in 474 BCE.

Xerxes' death is actually dated in 465 BCE because it comes from the official Babylonian chronology based on the tablet BM 34576 (King List copy dated 99 BCE)[92], however, the testimony of Thucydides as well as some Egyptian records from Elephantine rather support the dating 475 BCE. In addition the official Babylonian chronology is partly false[93] because it deliberately ignores all coregents and usurpers. Despite the reputation of chronological accuracy granted to Thucydides, historians prefer Babylonian chronology.

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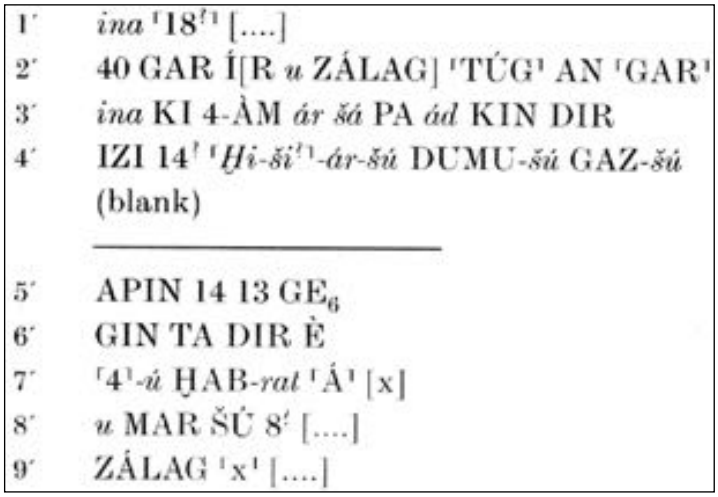
90 C. ORRIEUX, P. SCHMITT PANTEL - Histoire grecque.
Paris 1995 Ed. Presses Universitaires de France pp. 165,197.

91 According to Hippocrates (On the Creation §105) there are 7 "ages of man" of 7 years each in the life cycle of a male person: 1) παιδίον "little boy": 0-7 years, 2) παῖς "boy": 7-14 years, 3) μειράκιον "lad": 14-21 years, 4) νεαίσκος "young man": 21-28 years, 5) ἀνήρ "man": 28-49 years, 6) πρεσβύτης "elderly man": 49-56 years, 7) γέρων "old man": 56-<.

92 T. BOIY - Dating Problems in Cuneiform Tablets
in: *Journal of the American Oriental Society* 121 (2001) pp. 645-649.

93 T. BOIY - Dating Method During the Early Hellenistic Period
in: *Jounal of Cuneiform Studies* 52 (2000) pp. 115-121.
S. ZAWADZKI - The Fall of Assyria (...) in Light of the Nabopolassar Chronicle
Poznan 1988 Ed. A. Mickiewick University Press.

Fortunately the death of Xerxes dated 14/V is mentioned between two lunar eclipses dated [14/III] and 14/VIII in an astronomical tablet[94] (BM 32234) and although its beginning is damaged it contains enough information for dating:


1′ *ina* ˹18ᵗʰ˺ [....]
2′ 40 GAR Í[R *u* ZÁLAG] ˹TÚG˺ AN ˹GAR˺
3′ *ina* KI 4-ÀM *ár šá* PA *ád* KIN DIR
4′ IZI 14ᵗʰ ˹*Ḫi-šiʾ*˺-*ár-šú* DUMU-*šú* GAZ-*šú*
(blank)
5′ APIN 14 13 GE_6
6′ GIN TA DIR È
7′ ˹4˺-*ú* ḪAB-*rat* ˹Á˺ [x]
8′ *u* MAR ŠÚ 8ᵗʰ [....]
9′ ZÁLAG ˹x˺ [....]

1' at ⌜18°ʔ⌝ [...]
2' 40° onset, ma[ximal phase, and clearing]. The "garment of the sky [rain-clouds]" was there.
3' In the area of the 4 rear stars of Sagittarius it was eclipsed. Month VI was intercalary
4' Month V, the 14ʔ, ⌜Xer⌝xes —his son killed him.

5' Month VIII, the 14th, 13° after
6' sunset, [the moon] came out of a cloud,
7' ⌜1/4⌝ of the disk on the [...]
8' and west side was covered. 8°ʔ [onsetʔ and]
9' clearing [...]

Given that the second lunar eclipse is dated 14/VIII (November/ December) it is easy to check in which year it occurred[95] and also that the first dated event 14/V had no connection with an eclipse (475 BCE = -474*, P = Partial; T = Total; N = Penumbral):

year	**[14 III]**	eclipse	**14 V**	eclipse	**14 VIII**	eclipse
BCE	(Sivan)		(Ab)		(Heshvan)	
476	6-Jul.	P	3-Sept.	_	1-Dec.	_
475	26-Jun	T	24-Aug.	_	20-Dec.	P
474	15-Jul.	_	12-Sept.	_	9-Dec.	N
473	3-Jul.	_	31-Aug.	_	28-Nov.	_
472	23-Jul.	_	20-Sept.	_	17-Dec.	_
471	12-Jul.	_	9-Sept.	_	6-Dec.	_
470	1-Jul.	_	29-Aug.	_	25-Nov.	_
469	19-Jun	_	17-Aug.	P	14-Nov.	_
468	9-Jul.	_	6-Sept.	_	3-Dec.	_
467	28-Jun	_	26-Aug.	_	22-Nov.	_
466	16-Jul.	N	13-Sept.	_	11-Dec.	_
465	5-Jun	P	4-Aug.	_	29-Nov.	T
464	25-Jul.	_	22-Sept.	_	19-Dec.	_

This preliminary analysis shows that only two years may agree: 475 or 465 BCE. A complete analysis of these eclipses (when they began and ended and how much area of the moon was darkened) enables one to keep only the year 475. Contrary to the mainstream academic interpretation of astronomical data (which support the "Standard Chronology"),

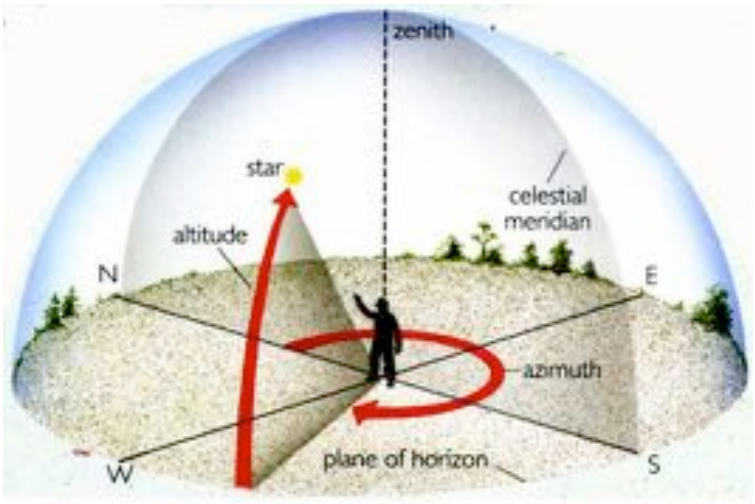
[94] H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol V Wien 2001 Ed. Akademie der Wissenschaften pp. 20-21, 396.
[95] http://eclipse.gsfc.nasa.gov/LEcat5/LE-0499--0400.html

which supports the date 465[96], the analysis of this tablet is easy and gives 475 BCE. First of all, Babylonian astronomical tablets are extremely accurate as regards their describing of astronomical events. For example, the astronomical tablet BM 71537 fixes the death of Artaxerxes III[97] after the solar eclipse of 29/IV (dated 11 March 358 BCE)[98]:

> [year] 21, month IV, (after) 5 month, the 29 [...] not observed
> month VI, Umakuš [Artaxerxes III] went to his fate.
> Aršu, his son sat on the throne.

King	Name according to astronomical tablets	Greek name
Xerxes I	Ḫišiaršu	Xerxes
Artaxerxes I	Artakšatsu	Artoxerxes
Darius II	Umakuš, whom name is Darawušu	Ochos
Artaxerxes II	Aršu, whom name is Artakšatsu	Arsakes
Artaxerxes III	Umakuš, whom name is Artakšatsu	Ochos
Artaxerxes IV	Aršu, son of Umasu, whom name is Artakšatsu	Arses
Darius III	Artakšatsu, whom name is Dariyawuš	Darios

Babylonian astronomers used a reference system based of course on a local observer. Stars position in the sky were measured according to their altitude, or elevation, in degrees between horizon (0°) and zenith (90°) and their azimuth in degrees from north (0°), east (90°), south (180°) or west (270°). Altitude is the angle above the observer's horizon and azimuth is the angle measured clockwise from north along the horizon to the point on the horizon that lies beneath the star. Meridian is an imaginary great circle that passes through the zenith from north to south, dividing the sky in two: the eastern and the western halves. It is important to be aware of this line because when an object crosses it, it's as high in the sky as it's going to get. The Sun crosses the line of the meridian around noon every day. We say that the Sun, or any star, culminates when it crosses the meridian. Meridian covers a total angle of 180° (-90° to 90°) and horizon a total angle of 360°.

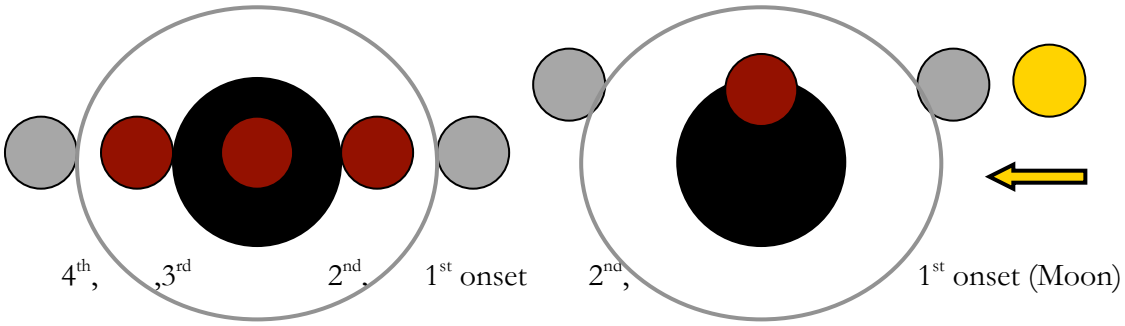


Babylonian astronomers measured the sky with their hands (extended arms) knowing that the little finger has an apparent width of 1° and a span (distance between the ends of the thumb and little finger) has an apparent width of 15°. Thus the moon has an apparent

96 M.W. STOLPER - The Evidence of Cuneiform Texts for the date of Xerxes' Death
in: *The Journal of Hellenic Studies* vol CVIII (1988) pp. 196-198.
M.W. STOLPER - Late Achaemenid Babylonian Chronology
in: *Nouvelles Assyriologiques Brèves et Utilitaires* (1999) N°6 pp. 9-12.
97 F. JOANNÈS - La Mésopotamie au 1er millénaire avant J.C.
2000 Paris Ed. Armand Colin p. 145.
98 H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol V
Wien 2001 Ed. Akademie der Wissenschaften p. 45.

width of 0.5° (30') as does the Sun (half of a little finger). Each zodiac constellation has an apparent diameter of around 15° ("a span"), so there are 12 constellations in the celestial vault. The darkness of the sky appears when the sun is 6° below the horizon. Given that the full celestial sphere (360°) is covered in a 24-hour day (24x60 = 1440 minutes), each celestial degree corresponds to a duration of 4 minutes (= 1440/360). For example the technical indication: 14° after sunset, means *[the eclipse began] 56 minutes (= 14x4) after sunset*, likewise: 14° before sunrise, means *[the eclipse began] 56 minutes before sunrise*. Paradoxically a lunar eclipse in the Babylonian astronomical records may start slightly before sunset or end slightly after sunrise, which normally is not possible (not observable), but as the beginning and end of eclipses are symmetrical, Babylonian astronomers used to add some appropriate calculations to their observations.

There are two types of eclipse, total and partial. For a total eclipse (left below) the "1st onset" points out the beginning of the penumbra (highlighted in grey) on the moon (in yellow), the "2nd onset" the beginning of the full eclipse (in dark red), the "3rd onset" the end of total eclipse and the "4th onset" the end of the penumbra. The full length of the eclipse is given by the time between the 1st and the 4th onset (maximum of 52° or 3.5 hours). For a partial eclipse (right below) the 1st onset point out the beginning of the penumbra and the 2nd onset the end of it. In this case the surface covered by the shadow is given by means of a fraction of the lunar disk (around 2/3 for the example).



Total lunar eclipse **Partial lunar eclipse**

Total eclipse dated 13 December 317 BCE (-316*)

5′	GAN 15 Á ULÙ *u* KUR
6′	*ki* TAB *ina* 19^{1} *gab* ŠÚ 5 ÍR
7′	*ina* 16 *ana bi* SI *u* KUR ZÁLAG
8′	40 GAR ÍR *u* ZÁLAG *ina* GAR ÍR
9′	*né-ḫi ina* ZÁLAG *ḫa-muṭ*
10′	AN-KU$_{10}$-*šú* SA$_5$ 1 ½ KÙŠ
11′	*ina* IGI MAŠ-MAŠ *ár ád ina* 44 ^{1}GE$_6$ GIN^{1}

5' Month IX, the 15th. When it began on the south and east side,
6' in 19° all was covered. 5° maximal phase.
7' In 16° it cleared to between north and east.
8' 40° onset, maximal phase and clearing. During onset (and) maximal phase
9' it was slow, during clearing fast.
10' Its eclipse was red. 1 1/2 cubits
11' in front of β Geminorum it was eclipsed. At 44° after sunset.

According to astronomy, the total eclipse dated 13 December 317 BCE (-316*) lasted 220 minutes and was total during 83 minutes[99]. It began at 20:36 (local time) or 3:34 after sunset, which was at 17:02 in Babylon[100]. This length of 3:34 corresponds to 54°.

Description of the eclipse (total)	according to the tablet	according to astronomy	difference
1st onset [beginning]	44° after sunset	54° after sunset	10° (40 min.)
1st onset – 2nd onset [penumbra]	19°	17°	2° (8 min.)
2nd onset – 3rd onset [maximal]	5° (20 min.)	21° (83 min.)	16° (64 min.)
3rd onset – 4th onset [clearing]	16°	17° (64 min.)	1° (4 min.)
1st onset – 4th onset [length]	40° (160 min.)	55° (220 min.)	15° (60 min.)

Partial eclipse dated 5 April 397 BCE

2′	DIR-ŠE 14	2'	Month XII_2, the 14th
3′	Á ULÙ TAB	3'	it began on the south side,
4′	4-*ú* ḪAB ŠÚ	4'	1/4 of the disk was covered.
5′	*ana* MAR ZÁLAG 27	5'	It cleared to the west. 27°
6′	GAR ÍR *u* ZÁLAG	6'	onset, maximal phase, and clearing.
7′	TÚG AN GAR ULÙ GIN	7'	The "garment of the sky" was there, the south wind blew.
8′	*ina* 48 GE_6 GIN	8'	At 48° after sunset.

According to astronomy, this partial eclipse dated 5 April 397 BCE (-396*) lasted 63 minutes and its magnitude (covered surface of the lunar disk) was 0.08[101]. It began at 21:34 (local time) or 3:09 (189 minutes) after sunset[102], which was at 18:25 in Babylon. This length of 189 minutes corresponds to 47°. As the "garment of the sky" means "rain-clouds[103]", the observation must have been difficult (in that case missing observations were usually replaced with some assessments).

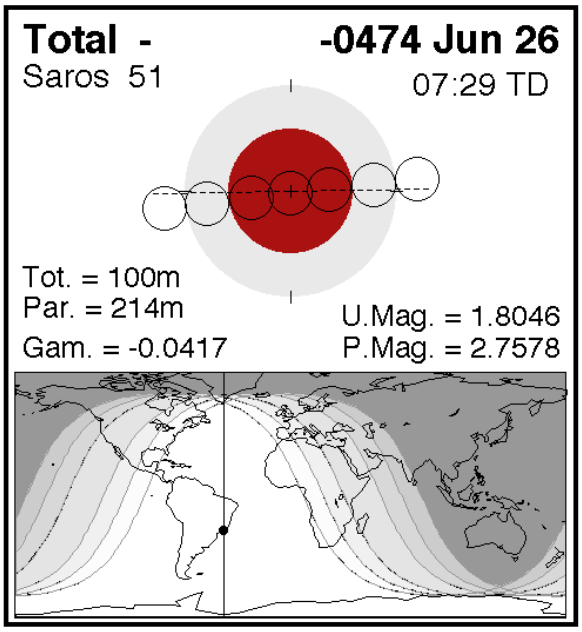
Description of the eclipse (partial)	according to the tablet	according to astronomy	difference
1st onset [beginning]	48° after sunset	47° after sunset	1° (4 min.)
Covered surface of the disk	0.25	0.08	3X
1st onset – 2nd onset [length]	27° (108 min.)	16° (63 min.)	11° (44 min.)

Huber[104] compared the dates given by the astronomical tablets with those obtained by astronomy today. According to his analysis, indications concerning the beginning and end of the eclipse with respect to sunrise and sunset can reach a maximum deviation of +/- 20° (+/- 1 hour 20 minutes) and indications of duration of the eclipse can reach a maximum deviation of +/- 10° (+/- 40 minutes). Huber explains the origin of these differences by some difficulties of observing (when there were clouds for example), copying errors in the tablets, misinterpretation of a poorly preserved text, false identifications of eclipses especially when an eclipse was predicted because it was replaced by an assessment when it was not observed. Finally the Babylonian concept of 1st, 2nd, 3rd and 4th contact (onset) may be slightly different from the present astronomical concept.

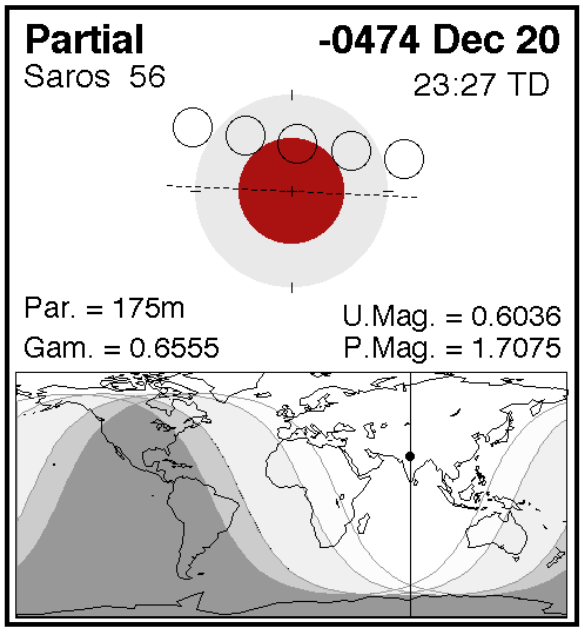
[99] http://eclipse.gsfc.nasa.gov/5MCLEmap/-0399--0300/LE-0316-12-13T.gif
[100] H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol V Wien 2001 Ed. Akademie der Wissenschaften pp. 6-7, 395.
F.R. STEPHENSON - Historical Eclipses and Earth's Rotation Cambridge 1997 Ed. Cambridge University Press pp. 176-177.
[101] http://eclipse.gsfc.nasa.gov/5MCLEmap/-0399--0300/LE-0396-04-05P.gif
[102] H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol V pp. 12-13, 395.
F.R. STEPHENSON - Historical Eclipses and Earth's Rotation pp. 169-170.
[103] A. PARPOLA -The Sky-Garment. A Study of the Harappan Religion and Its Relation to the Mesopotamian and Later Indian Religions in: *Studia Orientalia* vol. 57 (1985).
[104] P.J. HUBER, S. DE MEIS – Babylonian Eclipse Observations from 750 BC to 1 BC Milano 2004 Ed. Mimesis pp. 3,22,28-31.

Astronomical analysis showed two important points: the Babylonian measures were excellent but their lack of precision could reach 1 hour, that is to say around "a span" (15°), and the way of describing eclipses depended on their nature, either partial or total. It is easy to verify that the two lunar eclipses which occurred in 475 BCE, first total then partial, were in reverse in 465 BCE, first partial then total.

Lunar eclipses in 475 BCE[105]

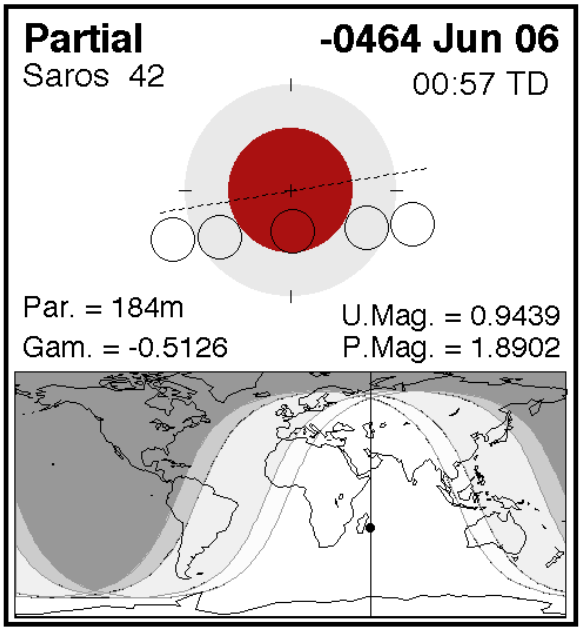


Five Millennium Canon of Lunar Eclipses (Espenak & Meeus)
NASA TP-2009-214172



Five Millennium Canon of Lunar Eclipses (Espenak & Meeus)
NASA TP-2009-214172

Lunar eclipses in 465 BCE[106]



Five Millennium Canon of Lunar Eclipses (Espenak & Meeus)
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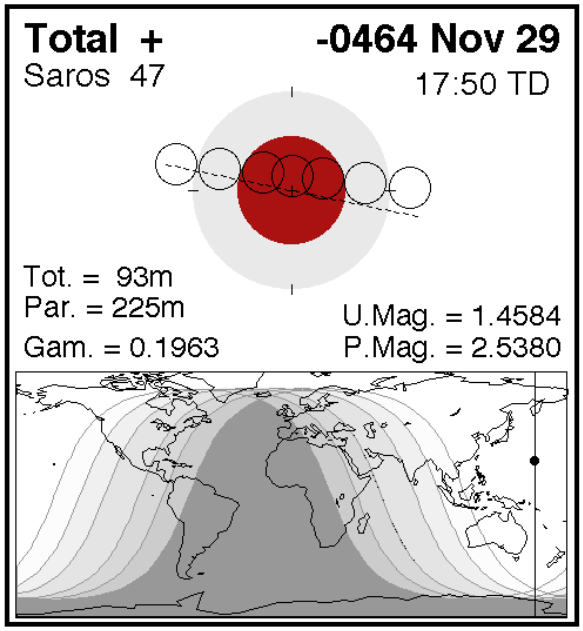


Five Millennium Canon of Lunar Eclipses (Espenak & Meeus)
NASA TP-2009-214172

Stolper[107] dated on 4 August 465 BCE the death of Xerxes (14/V/**21**) as there were actually two eclipses in that year. However, the astronomical description of these two eclipses does not match that indicated on the tablet (BM 32234) because the 1st eclipse was

[105] http://eclipse.gsfc.nasa.gov/5MCLEmap/-0499--0400/LE-0474-06-26T.gif
http://eclipse.gsfc.nasa.gov/5MCLEmap/-0499--0400/LE-0474-12-20P.gif
[106] http://eclipse.gsfc.nasa.gov/5MCLEmap/-0499--0400/LE-0464-06-06P.gif
http://eclipse.gsfc.nasa.gov/5MCLEmap/-0499--0400/LE-0464-11-29T.gif
[107] M.W. STOLPER - The Evidence of Cuneiform Texts for the date of Xerxes' Death in: *The Journal of Hellenic Studies* vol CVIII (1988) pp. 196-198.

total and the 2nd eclipse was partial. A comparison of all the data from the tablet with that of astronomy gives the following results (local time in Babylon; LT = UT +2:58):

Year	Date of eclipse	according to the tablet	Type of eclipse	mag.	according to the tablet	agreement
475 BCE	26 June	[14 III]	Total	1.80	total	OK
	20 December	14 VIII	Partial	0.60	0.25 (1/4)	OK
465 BCE	5 June	[14 III]	Partial	0.94	total	NO
	29 November	14 VIII	Total	1.46	0.25 (1/4)	NO

First eclipse	start 1st	2nd	3rd	end 4th	mag.	sunrise	sunset
26 June 475 BCE	**4:05**	**5:02**	**6:42**	**7:39**	1.82	5:02	19:06
5 June 465 BCE	**21:51**			**0:55**	0.94	5:00	18:59

Second eclipse	start 1st	2nd	3rd	end 4th	mag.	sunrise	sunset
20 December 475 BCE	**20:24**			**23:20**	0.61	7:02	17:00
29 November 465 BCE	**14:25**	**15:31**	**17:05**	**18:11**	1.46	6:47	16:55

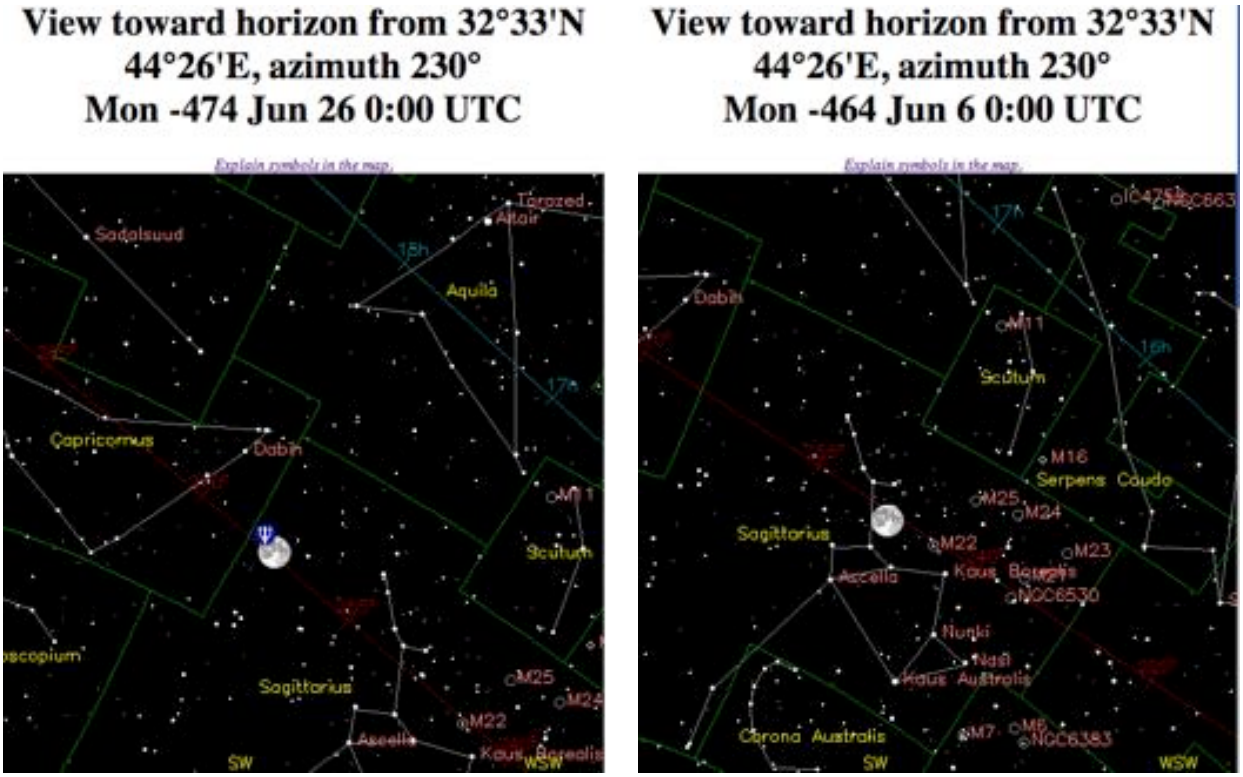
Partial eclipse	eclipse not observed at Babylon	total eclipse

	According to	**475 BCE**	gap	**465 BCE**	gap
First eclipse	tablet BM 32234	26 June		5 June	
1st onset	[-]	13° before sunrise	[-]	43° after sunset	[-]
1st – 2nd onset	[-]	14°	[-]		[-]
2nd – 3rd onset	[-]	25°	[-]		[-]
3rd – 4th onset	18°	14°	4°		NO
1st – 4th onset	40°	54°	14°	46°	6°
Second eclipse		20 December		29 November	
1st onset	13° after sunset	51° after sunset	38°	38° before sunset	NO
			-	17°	NO
			-	24° ##	NO
			-	17°	NO
1st – 2nd onset	[8°]	44°	36°	57°	49°

According to astronomy, only the beginning of the first eclipse (26 June 475 BCE) could be observed, in addition, the weather was rainy ("The garment of the sky was there"). Observations were therefore difficult, thus the two durations of eclipse, 40° and [8°], were due to a guess. In 30% of cases (on average), the Babylonians completed their observations with values calculated[108] according to some theories poorly understood[109]. Despite some difficulties of observation the results obtained by the ancient Babylonian astronomers for the two lunar eclipses of 475 BCE are remarkably good (there are 5 major disagreements in 465 BCE). A second way of checking the data in the astronomical tablet is the wording: *In the area of the 4 rear stars of Sagittarius it [the moon] was eclipsed [1st eclipse].*

The observations were performed in Babylon whose latitude is 32°33' (or 32.55°) North and its longitude is 44°26' (or 44.43°) East[110]. With astronomy software it is possible to see the sky at any one point and a given time[111] (in 475 BCE Universal Time: -474-06-26 0:00; Azimuth: 230°; Field of view: 45°; in 465 BCE Universal Time: -464-06-06 0:00).

[108] P.J. HUBER, S. DE MEIS – Babylonian Eclipse Observations from 750 BC to 1 BC Milano 2004 Ed. Mimesis p. 7.
[109] N.M. SWERDLOW - The Babylonian Theory of the Planets 1998 New Jersey Ed. Princeton University Press pp. 44,45.
[110] http://www.astro.com/cgi/aq.cgi?lang=e
[111] http://www.fourmilab.ch/cgi-bin/Yourhorizon



One can see that in 475 BCE the moon was 20° behind Sagittarius (above left) and in 465 BCE it was inside (above right). According to the astronomical tablet the first lunar eclipse [total] was: *in the area of the 4 rear stars of Sagittarius* [in 475 BCE]. Consequently, according to astronomy, Xerxes died (14/V/**21**) on Wednesday 23 August 475 BCE (see *Dating the reigns of Xerxes and Artaxerxes*).

Contrary to what history books pretend astronomical dating is neither complex nor controversial. In fact, controversies about the dating almost always come from a misunderstanding of historical data. For example, the destruction of Jerusalem in 587 BCE is also dated in 586 BCE by a few scholars (or even in 607 BCE by some). What does astronomy actually say?

WHEN WAS ANCIENT JERUSALEM DESTROYED: 587 OR 586?

According to the biblical text of Jeremiah: *King Nebuchadnezzar of Babylon came with all his army against Jerusalem. They camped against it and built a siege wall all around it. And the city was under siege until the 11th year of King Zedekiah (...) In the 5th month, on the 10th day of the month, that is, in the 19th year of King Nebuchadnezzar the king of Babylon, Nebuzaradan the chief of the guard, who was an attendant of the king of Babylon, came into Jerusalem. He burned down the house of Jehovah, the king's house, and all the houses of Jerusalem; he also burned down every large house. And the walls surrounding Jerusalem were pulled down by the entire Chaldean army that was with the chief of the guard* (Jeremiah 52:4-14). Thus the destruction of Jerusalem is dated either 10/V/**11** of Zedekiah or 10/V/**19** of Nebuchadnezzar II and 9/V (9 Ab) in the Mishna (Taanit 4:7-8).

The reign of Nebuchadnezzar is extremely easy to fix by astronomy because it has many synchronisms with Assyrian and Egyptian chronologies, which are themselves anchored to astronomical dates. In addition, Nebuchadnezzar's reign is very well-known (day by day)[112] and numerous astronomical events are described in the astronomical tablet VAT 4956 dated in his 37th and 38th year. For example, the first 19 years of the reign of Nebuchadnezzar II (605-586) are as follows[113]:

[112] http://web.archive.org/web/20030814000518/http://www.nexus.hu/enkidu/lists/CHRON.CHN
[113] J. FINEGAN - Handbook of Biblical Chronology
Massachusetts 1999 Ed. Hendrickson Publishers pp. 27-28.

year		cycle	April										January			
0	605		I	II	III	IV	V	VI	VI_2	VII	VIII	IX	X	XI	XII	XII_2
1	604	11	29	29	30	29	30	30	-	29	30	30	30	29	29	-
2	603	12U	30	29	29	29	30	30	30	29	30	30	29	30	29	-
3	602	13	30	29	29	30	29	30	-	30	29	30	29	30	30	-
4	601	14	29	30	29	29	30	29	-	30	30	29	30	29	30	-
5	600	15U	29	30	29	30	29	30	28	30	30	30	29	29	30	-
6	599	16	30	30	29	30	30	29	-	30	29	29	30	29	30	-
7	598	17U	29	30	29	30	30	30	29	30	29	29	30	29	29	-
8	597	18	30	29	30	30	30	30	-	29	29	30	29	30	29	-
9	596	19U	29	30	29	30	30	30	30	29	29	30	29	30	29	-
10	595	1	29	30	29	30	30	29	-	30	30	29	30	29	30	-
11	594	2A	29	29	30	29	30	30	-	29	30	29	30	30	29	30
12	593	3	29	29	30	29	30	29	-	30	29	30	30	30	29	-
13	592	4	30	29	30	29	29	30	-	29	29	30	30	30	29	-
14	591	5A	30	30	29	30	29	29	-	30	29	29	30	30	29	30
15	590	6	30	29	30	29	30	29	-	30	29	30	29	29	30	-
16	589	7	30	29	30	29	30	30	-	29	30	29	30	29	29	-
17	588	8A	30	29	30	29	30	30	-	30	29	30	29	30	29	29
18	587	9	30	29	30	29	30	30	-	30	29	30	29	30	29	-
19	586	10	29	30	29	29	30	30	-	30	30	29	30	29	30	-

This cycle of 19 years was based on observation and not on calculations[114] (the computed data in diaries appear roughly in 350 BCE)[115]. It was not a theoretical cycle like the cycle of Meton but a coincidence which came from the following equivalences:

19 solar years = 6539.6 days (= 365.24219 x 365)

19 lunar years + 7 intercalary months = 6539.6 days (= [19 x 12+7] x 29.530288).

The presence of four months Elul2 (VI_2) in the period 603-596, instead of only one, proves that the Babylonian system of intercalary months was empirical. These months (VI_2) were mainly used to calibrate the 1st Tishri (VII) just after the autumn equinox. Historians of Babylonian astronomy have in recent decades come to the conclusion that the cycle was known to the Babylonians by about 500 BCE, but it must be admitted, however, that there are still problems with the list of intercalary months during the latter years of the Achaemenid empire. For instance, in the 16th year of Darius II (408/407), three sources suggest an intercalary Ulul2 but one an intercalary Adar2 (XII_2); in the 16th year of Artaxerxes II, two sources suggest an intercalary Ulul2 but one an intercalary Adar2; and two sources (including a contemporary astronomical Diary) suggest an intercalary Adar2 in the 20th year of Artaxerxes II (385/384) whereas two other sources (including the Saros canon) attribute the intercalary month to his 21st year[116]. A table of intercalary months gives the impression that the 19 years cycle was standardized from 500 or 483 BCE, depending on the way to group periods[117], with some exceptions. However, Parker and Dubberstein assumed[118], because of these anomalies, the Babylonian calendar had really been standardized as from 367 BCE instead of 500 BCE. During the period from 600 BCE to 530 BCE, spring equinox = 27 March and autumn equinox = 29 September[119]. The 1st Nisan corresponds to the 1st lunar crescent (that is New moon day + 1) after the spring

[114] J.M. STEELE – Calendars and Years. Astronomy and Time in the Ancient Near East
Oxford 2007 Ed. Oxbow Books pp. 120-123.
[115] F. ROCHBERG-HALTON – Between Observation and Theory in Babylonian Astronomical Texts
in: *Journal of Near Eastern Studies* 50:2 (1991) pp. 107-120.
[116] C. WALKER - Achaemenid Chronology and the Babylonian Sources
in: Mesopotamia and Iran in the Persian Period Ed. British Museum Press (1997) pp. 23-24.
[117] J.P. BRITTON – Treatments of Annual Phenomena in Cuneiform Sources
in: Under One Sky (Münster 2002) Ed. Ugarit-Verlag pp. 25-35.
[118] R.A. PARKER, W.H. DUBBERSTEIN - Babylonian Chronology 626 B.C.-A.D. 75
Rhode Island 1956 Ed. Brown University Press pp. 1-6.
[119] http://www.imcce.fr/fr/grandpublic/temps/saisons.php

equinox. For example in 580 BCE (= -579) new moon day = 4 April[120]. In 580 BCE (year 25): 1st Nisan = 5 April and 1st Adar = 24 February. The intercalary month (Adar2) is missing because 1st Nisan of year 26 is on 25 March, which is before the spring equinox. The intercalary month was added the following year (year 26). If the intercalary month is missing, 1st Nisan is before 27 March**, not after. In 588 BCE: 1st Nisan = 3 April. Calculation of 1st Nisan from the years 17 to 40 of Nebuchadnezzar II's reign (the Metonic cycle is the theoretical cycle):

year BCE		Tablets with intercalary month	intercalary month	1st Nisan (astronomy)	Metonic cycle (theoritical)	1st Nisan (astronomy)
588	**17**	YOS 17:23, 156, 202	Adar2	3 April	3A	3 April
587	**18**		-	22 April	4	22 April
586	**19**		-	12 April	5	12 April
585	**20**		-	31 March	6A	31 March
584	**21**	YOS 17:36, 38 Bertin 101	Elul2	21 March	7	19 April
583	**22**		-	9 April	8A	9 April
582	**23**	YOS 17:349 GCCI 1:45	Adar2	29 March	9	29 March
581	**24**		-	15 April	10	15 April
580	**25**		-	5 April	11A	5 April
579	**26**	CT 57:989	Adar2	25 March	12	23 April
578	**27**		-	13 April	13	13 April
577	**28**	CT 55:85 UCP 9/1:I,52	Adar2	2 April	14A	2 April
576	**29**		-	21 April	15	21 April
575	**30**		-	10 April	16	10 April
574	**31**	OECT 12:A91,95 TuM2/3:20	Elul2	30 March	17U	30 March
573	**32**		-	17 April	18	17 April
572	**33**	GCCI 1:117,125 Bertin 1116	Adar2	6 April	19A	6 April
571	**34**		-	25 April	1	25 April
570	**35**		-	14 April	2	14 April
569	**36**	GCCI 1:68,98 Bertin 1127	Adar2	3 April	3A	3 April
568	**37**		-	22 April	4	22 April
567	**38**		-	12 April	5	12 April
566	**39**		[Adar2]	1st April	6A	1st April
565	**40**		-	19 April	7	19 April

BCE	year	month	Babylonian	Julian
568	**36**	X	*1st Tebeth*	25 December
		XI	*1st Shebat*	24 January
		XII	*1st Adar*	22 February
		XIIb	*1st Adar2*	24 March
			Spring equinox	27 March
	37	I	*1st Nisan*	22 April
		II	*1st Iyar*	21 May
		III	*1st Siwan*	20 June
		IV	*1st Tammuz*	19 July
		V	*1st Ab*	17 Augu[st]
		VI	*1st Elul*	16 September
			Autumn equinox	29 September
		VII	*1st Tishri*	16 October
		VIII	*1st Heshvan*	14 November
		IX	*1st Kislev*	14 December
567		X	*1st Tebeth*	13 January
		XI	*1st Shebat*	12 February
		XII	*1st Adar*	13 March
			Spring equinox	27 March
	38	I	*1st Nisan*	12 April
		II	*1st Iyar*	11 May

[120] http://www.fourmilab.ch/earthview/pacalc.html
http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php

The previous table shows two important points: the duration of the lunar months and lunar years depended solely on observation and data from astronomical tablets exactly matches the current astronomical calculations. For example, the series of months for the year 1 of Nebuchadnezzar II (604 BCE) was: 29-29-30-29-30-30-29-30-30-30-29-29. It is obvious that the complete series of around 500 lunar months during Nebuchadnezzar's reign belongs only to the period 604-562 BCE, not 20 years earlier 624-582 BCE. One can see that the year 37 began on 22 April (1st Nisan) in 568 BCE and on 3 April in 588 BCE.

The astronomical tablet VAT 4956 is very well known[121]. It is an astronomical diary that records 13 lunar observations, and 15 planetary observations which details the position of the moon and the planets in regard to certain stars and constellations[122], indicating the days and the months throughout the year 37 of the reign of Nebuchadnezzar II until the beginning of his year 38. Text of the 17 first lines of the tablet (important data in bold type):

1- Year 37 of Nebuchadnezzar, king of Babylon. Month I (the 1st of which was identical with) the 30th (of the preceding month), the moon became visible behind the Bull of Heaven; [sunset to moonset:] .... [...]
2- Saturn was in front of the Swallow. The 2nd, in the morning, a rainbow stretched in the west. Night of the 3rd, the moon was 2 cubits in front of [...]
3- it rained? Night of the 9th (error for 8th), beginning of the night, the moon stood 1 cubit in front of *β* Virginis. The 9th, the sun in the west [was surrounded] by a halo [... The 11th]
4- or 12th, Jupiter's acronychal rising. On the 14th, one god was seen with the other; sunrise to moonset: 4°. The 15th, overcast. The 16th, Venus [...]
5- The 20th, in the morning, the sun was surrounded by a halo. Around noon, ... rain PISAN. A rainbow stretched in the east. [...]
6- From the 8th of month XII_2 to the 28th, the river level rose 3 cubits and 8 fingers, b cubits [were missing] to the high flood [...]
7- were killed on order of the king. That month, a fox entered the city. Coughing and a little *risitu*-disease [.]
8- Month II (the 1st of which was identical with) the 30th (of the preceding month), the moon became visible while the sun stood there, 4 cubits below *β* Geminorum; it was thick; there was earth shine [...]
9- Saturn was in front of the Swallow; Mercury, which had set, was not visible. Night of the 1st, gusty storm from east and south. The 1st, all day [...]
10- stood [... in front] of Venus to the west. The 2nd, the north wind blew. The 3rd, Mars entered Praesepe. The 5th, it went out of it. The 10th, Mercury [rose] in the west behind the [Little Twins ...]
11- The 15th, ZI IR. The 18th, Venus was balanced 1 cubit 4 fingers below α Leonis. The 26th, (moonrise to sunrise) 23°; I did not observe the moon. The 27th, 20+x [...]
12- Month III (the 1st of which was identical with) the 30th (of the preceding month), the moon became visible behind Cancer; it was thick; sunset to moonset: 20°; the north wind blew. At that time, Mars and Mercury were 4 cubits in front of α [Leonis ...]
13- Mercury passed below Mars to the East? ; Jupiter was above α Scorpii; Venus was in the west opposite *ϑ* Leonis [...]
14- 1? cubit. Night of the 5th, beginning of the night, the moon passed towards the east 1 cubit <above/below> the bright star of the end of the Lion's foot. Night of the 6th, beginning of the night, [..]
15- it was low. Night of the 8th, first part of the night, the moon stood 2½ cubits below *β* Librae. Night of the 9th, first part of the night, the moon [stood] 1 cubit in front of [...]
16- passed towards the east. The 9th, solstice. Night of the 10th, first part of the night, the moon was balanced 3½ cubits above α Scorpii. The 12th, Mars was b cubits above [α Leonis ...]
17- [...] The 15th, one god was seen with the other; sunrise to moonset: 7°30'. A lunar eclipse which was omitted [...]
18- [... the moon was be]low the bright star at the end of the [Lion's] foot [...]

Several astronomical phenomena (highlighted in blue) are easy to date:

- Line 1: the 1st lunar crescent after the spring equinox (27 March)[123] is on 22 April in 568

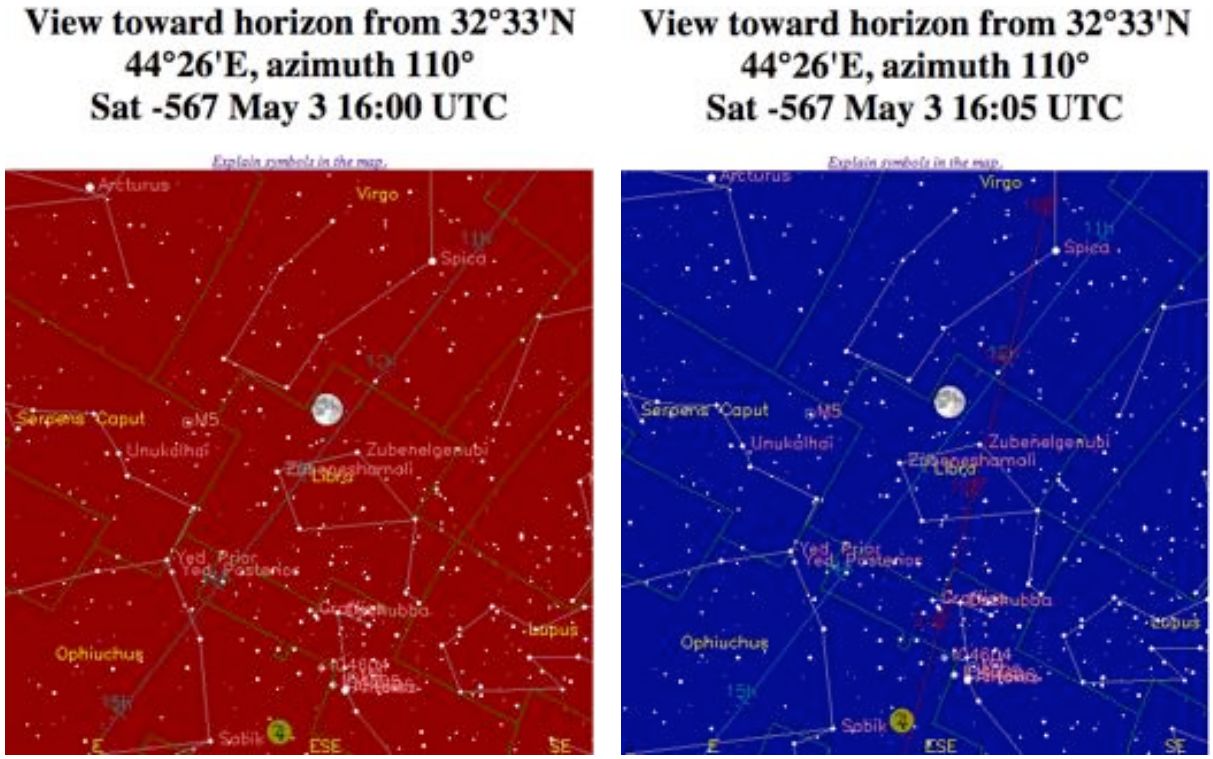
[121] http://www.lavia.org/english/archivo/VAT4956en.htm
http://adamoh.org/TreeOfLife.wan.io/OTCh/VAT4956/VAT4956ATranscriptionOfItsTranslationAndComments.htm
[122] A.J. SACHS, H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol. I
Wien 1988 Ed. Akademie der Wissenschaften (n° -567).
[123] http://www.imcce.fr/fr/grandpublic/temps/saisons.php

BCE (-567) or 3 April in 588 BCE (-587*).

- Line 4: the Jupiter's acronychal rising dated 12/I/**37** on the tablet occurred on 3 May in 568 BCE and 18 December in 588 BCE[124].
- Line 16: the summer solstice dated 9/III/**37** occurred on 29 June[125] in 568 or in 588 BCE (the summer solstice occurs on a fixed date in the year).
- Line 17: the lunar eclipse dated 9/III/**37** occurred on 15 June[126] in 568 BCE.

According to the tablet VAT 4956		According to astronomy in:					
Date	astronomical event	**-567*** (568 BCE)			**-587*** (588 BCE)		
1/I/**37**	(1st lunar crescent)	22 April	22 April		3 April	3 April	
12/I/**37**	Jupiter's acronychal rising	3 May	3 May	**OK**	14 April	18 December	##
1/III/**37**	(1st lunar crescent)	20 June	20 June		1 June	1 June	
9/III/**37**	Solstice	28 June	29 June	**OK**	9 June	29 June	##
15/III/**37**	Lunar eclipse	4 July	4 July	**OK**	15 June	-	##

Two astronomical dated events occurred only in 568 BCE: summer solstice and Jupiter's acronychal rising. The acronychal rising is the last day of the year when the star or the planet (after a period when it was visible at night) rises in the evening after sunset and the Sun is already far enough below the eastern horizon (-6°) to make it visible in the evening twilight. In 568 BCE[127]: Universal Time: -567-05-03 16:00 then 16:05 (LT = UT + 2:58); Azimuth: 110°; Field of view: 60° (Jupiter is at the bottom 3° above the horizon):



Assyrian, Babylonian, Egyptian and Israelite chronologies provide synchronisms that can be dated independently. For example, Assyrian chronology may be rebuilt for the period 911-609 only thanks to eponyms. The list of Assyrian eponyms is anchored on the solar eclipse which occurred on Simanu (month III, day 30) in the eponymy of Bur-Sagale (dated June 15, 763 BCE). The Assyrian period 911-648[128] is dated owing to its canonical

[124] http://www.fourmilab.ch/cgi-bin/Yourhorizon
[125] http://www.imcce.fr/fr/grandpublic/temps/saisons.php
[126] http://eclipse.gsfc.nasa.gov/LEcat5/LE-0599--0500.html
[127] In 588 BCE: Universal Time: -587-12-18 15:25 then 15:30; Azimuth 60°.
[128] S. PARPOLA – Assyrian Chronology 681-648 BC. in: Letters from Assyrian Scholars to the Kings Esarhaddon and Assurbanipal Part II (Winona Lake 2007 Ed. Eisenbrauns), pp. 381-430.

eponyms and the period 648-609 by a prosopography of its eponyms[129]. A few eponyms are non canonical because they died during the year of their eponymy and there are also some gaps of 1 year between eponym dates and regnal years in tablet with double dates because the first Assyrian regnal year (accession) was reckoned in either system: year 0 (Babylonian) or year 1 (Assyrian). Thus, as there are exactly 154 canonical eponyms between Gargamisaiu and Bur-Sagale, which is dated 763, that involves dating the one of Gargamisaiu into 609 (= 763 – 154). The only solar eclipse over Assyria during the period 800-750 is the total eclipse dated June 15, 763 BCE. The partial solar eclipses dated June 4, 800 and June 24, 791 were not able to be viewed over Assyria.

- The fall of the Assyrian empire, which took place in October 609 after the battle of Harran, is characterized by a quadruple synchronism, since the year of Assur-uballit II corresponds to year 17 of Nabopolassar to Josiah's year 31 and year 1 of Necho II.
- According to the biography of Adad-Guppi[130], mother of Nabonidus, Nabopolassar reigned 21 years, then Nebuchadnezzar 43 years, Amel-Marduk 2 years, Neriglissar 4 years just before Nabonidus. According to the Hillah's stele[131] there were 54 years between the destruction of the temple of Sin, in Harran, and the beginning of the reign of Nabonidus. According to a Babylonian chronicle (BM 21901)[132] and Adad-Guppi's stele, the temple of Harran was destroyed in the year 16 of Nabopolassar.
- Dated lunar eclipses[133] are: year 1 and 2 of Merodachbaladan (March 19/20 721, March 8/9 and September 1/2 720); year 5 of Nabopolassar (April 21/22 621); year 2 of Šamaš-šuma-ukîn (April 10/11 666); year 42 of Nebuchadnezzar (March 2/3 562). A diary (VAT 4956)[134] contains numerous astronomical conjunctions in years 37 and 38 of Nebuchadnezzar dated from astronomy in 568 and 567. An astronomical journal (BM 38462)[135] list some lunar eclipses in the years 1 to 27 of Nebuchadnezzar which are dated from 604 to 578.

The chronology of the Saite period (663-525) may be reckoned exactly thanks to "biographies[136] of prominent men or Apis bulls":

1. *Grave stele of Psammetichus son of Genefbahorek*. Date of birth: Year 3 of Necho II, month 10, day 1. Date of death: Year 35 of Amasis, month 2, day 6. Length of life: 71 years, 4 months, 6 days (see column A. 1st Thot matches the beginning of Egyptian year).
2. *Grave stele of the priest Psammetichus son of Iahuben*. Date of birth: Year 1 of Necho II, month 11, day 1. Date of death: Year 27 [of Amasis], month 8, day 28. Length of life: 65 years, 10 months, 2 days (see column B).

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129 S. PARPOLA – The Prosopography of the Neo-Assyrian Empire
Helsinki 1998 University of Helsinki pp. XVIII-XX.
130 J.B. PRITCHARD - Ancient Near Eastern Texts
Princeton 1969 Ed. Princeton University Press p. 560-561.
131 P.A. BEAULIEU – The Reign of Nabonidus, King of Babylon 556-539 B.C.
in: *Yale Near Eastern Research* 10 (1989) n°2.
132 J.J. GLASSNER – Chroniques mésopotamiennes n°22
Paris 1993 Éd. Belles Lettres pp. 193-197.
133 F.R. STEPHENSON - Historical Eclipses and Earth's Rotation
Cambridge 1997 Ed. Cambridge University Press pp. 99-100, 151-152, 206.
134 A.J. SACHS, H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol. I
Wien 1988 Ed. Akademie der Wissenschaften (n° -567).
135 H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol. V n° 6
Wien 2001 Ed. Akademie der Wissenschaften pp. 27-30,396.
136 H. GAUTHIER – Le livre des rois d'Égypte
Le Caire 1915 Éd. Institut Français d'Archéologie Orientale pp. 74, 87-88, 92-93, 106, 115, 119.
F.K. KIENITZ – Die politische Geschichte Ägyptens vom 7. bis zum 4. Jahrhundert vor der Zeitwende
Berlin 1953 Ed. Akademie-Verlag pp. 154-156.
J.H. BREASTED – Ancient records of Egypt: Historical documents from the earliest times to the Persian conquest. Vol. IV
Chicago 1906 (1962) Ed. The University of Chicago Press pp. 497-498, 501-505, 518-520.

3. *Grave stele of the 4th Apis of the 26th Dynasty*. Date of birth: Year 16 of Necho II, month 2, day 7. Installation: Year 1 of Psammetichus II, month 11, day 9. Date of death: Year 12 of Apries, month 8, day 12. Date of burial: Year 12 of Apries, month 10, day 21. Length of life: 17 years, 6 months, 5 days (see column C).
4. *Grave stele of the 3rd Apis of the 26th Dynasty*. Date of birth: Year 53 of Psammetichus I, month 6, day 19. Installation: Year 54 of Psammetichus I, month 3, day 12. Date of death: Year 16 of Necho II, month 2, day 6. Date of burial: Year 16 of Necho II, month 4, day 16. Length of life: 16 years, 7 months, 17 days (see column D).
5. *Epitaph of Apis bull from Cambyses*[137]. Date of birth: Year 27 [of Amasis]. Date of death: Year 6 of Cambyses II. Length of life unknown, but the average life-span of Apis bulls is from 16 to 19 years during the 26th Dynasty[138] (see column E).
6. Pharaoh Apries was still living according to a stele[139] dated year 3 of Amasis (which was beginning on January 12, 567).

Egyptian King			BCE	1st Thot	A	B	C	D	E
Psammetichus I	1		663	5-Feb					
	2		**662**	5-Feb					
	3		**661**	4-Feb					
	4		**660**	4-Feb					
	5		**659**	4-Feb					
	6		**658**	4-Feb					
	7		**657**	3-Feb					
	8		**656**	3-Feb					
	9		**655**	3-Feb					
	10		**654**	3-Feb					
	11		**653**	2-Feb					
	12		**652**	2-Feb					
	13		**651**	2-Feb					
	14		**650**	2-Feb					
	15		**649**	1-Feb					
	16		**648**	1-Feb					
	17		**647**	1-Feb					
	18		**646**	1-Feb					
	19		**645**	30-Jan					
	20		**644**	31-Jan					
	21		**643**	31-Jan					
	22		**642**	31-Jan					
	23		**641**	30-Jan					
	24		**640**	30-Jan					
	25		**639**	30-Jan					
	26		**638**	30-Jan					
	27		**637**	29-Jan					
	28		**636**	29-Jan					
	29		**635**	29-Jan					
	30		**634**	29-Jan					
	31		**633**	28-Jan					
	32		**632**	28-Jan					
	33		**631**	28-Jan					
	34		**630**	28-Jan					
	35		**629**	27-Jan					
	36		**628**	27-Jan					
	37		**627**	27-Jan					
	38		**626**	27-Jan					
	39		**625**	26-Jan					
	40		**624**	26-Jan					

[137] A. KUHRT – The Persian Empire
London 2010 Ed. Routledge pp. 122-124.
[138] M. MALININE, G. POSENER, J. VERCOUTER – Catalogue des stèles du Sérapéum de Memphis I
Paris 1968 Éd. Imprimerie Nationale p. XIII.
[139] A. SPALINGER - Egypt and Babylonia: A Survey
Hamburg 1977, in: *Studien Zur Altägyptischen Kultur* Band 5 pp. 241-242.

	41		623	26-Jan					
	42		622	26-Jan					
	43		621	25-Jan					
	44		620	25-Jan					
	45		619	25-Jan					
	46		618	25-Jan					
	47		617	24-Jan					
	48		616	24-Jan					
	49		615	24-Jan					
	50		614	24-Jan					
	51		613	23-Jan					
	52		612	23-Jan					
	53		611	23-Jan				0	
	54		610	23-Jan				1	
Necho II	**1**		609	22-Jan		0		2	
	2		608	22-Jan		1		3	
	3		607	22-Jan	0	2		4	
	4		606	22-Jan	1	3		5	
	5		605	21-Jan	2	4		6	
	6		604	21-Jan	3	5		7	
	7		603	21-Jan	4	6		8	
	8		602	21-Jan	5	7		9	
	9		601	20-Jan	6	8		10	
	10		600	20-Jan	7	9		11	
	11		599	20-Jan	8	10		12	
	12		598	20-Jan	9	11		13	
	13		597	19-Jan	10	12		14	
	14		596	19-Jan	11	13		15	
	15		595	19-Jan	12	14		16	
Psammetichus II	**16**	**1**	594	19-Jan	13	15	**0** **0**	**16y 7m**	
		2	593	18-Jan	14	16	1		
		3	592	18-Jan	15	17	2		
		4	591	18-Jan	16	18	3		
		5	590	18-Jan	17	19	4		
		6	589	17-Jan	18	20	5		
Apries	1	7	588	17-Jan	19	21	6		
	2		587	17-Jan	20	22	7		
	3		586	17-Jan	21	23	8		
	4		585	16-Jan	22	24	9		
	5		584	16-Jan	23	25	10		
	6		583	16-Jan	24	26	11		
	7		582	16-Jan	25	27	12		
	8		581	15-Jan	26	28	13		
	9		580	15-Jan	27	29	14		
	10		579	15-Jan	28	30	15		
	11		578	15-Jan	29	31	16		
	12		577	14-Jan	30	32	**17y 6m**		
	13		576	14-Jan	31	33			
	14		575	14-Jan	32	34			
	15		574	14-Jan	33	35			
	16		573	13-Jan	34	36			
	17		572	13-Jan	35	37			
	18		571	13-Jan	36	38			
	19		570	13-Jan	37	39			
Amasis	20	1	569	12-Jan	38	40			
	21	2	568	12-Jan	39	41			
	22	3	567	12-Jan	40	42			
		4	566	12-Jan	41	43			
		5	565	11-Jan	42	44			
		6	564	11-Jan	43	45			
		7	563	11-Jan	44	46			
		8	562	11-Jan	45	47			
		9	561	10-Jan	46	48			
		10	560	10-Jan	47	49			
		11	559	10-Jan	48	50			
		12	558	10-Jan	49	51			

		13	**557**	9-Jan	50	52			
		14	**556**	9-Jan	51	53			
		15	**555**	9-Jan	52	54			
		16	**554**	9-Jan	53	55			
		17	**553**	8-Jan	54	56			
		18	**552**	8-Jan	55	57			
		19	**551**	8-Jan	56	58			
		20	**550**	8-Jan	57	59			
		21	**549**	7-Jan	58	60			
		22	**548**	7-Jan	59	61			
		23	**547**	7-Jan	60	62			
		24	**546**	7-Jan	61	63			
		25	**545**	6-Jan	62	64			
		26	**544**	6-Jan	63	65			
		27	**543**	6-Jan	64	**65y 10m**			0
		28	**542**	6-Jan	65				1
		29	**541**	5-Jan	66				2
		30	**540**	5-Jan	67				3
		31	**539**	5-Jan	68				4
		32	**538**	5-Jan	69				5
		33	**537**	4-Jan	70				6
		34	**536**	4-Jan	71				7
		35	**535**	4-Jan	**71y 4m**				8
		36	**534**	4-Jan					9
		37	**533**	3-Jan					10
		38	**532**	3-Jan					11
		39	**531**	3-Jan					12
		40	**530**	3-Jan					13
		41	**529**	2-Jan					14
		42	**528**	2-Jan					15
		43	**527**	2-Jan					16
Psammetichus III	1	44	**526**	2-Jan					17
Cambyses II	**2**	**5**	**525**	1-Jan					**18**
	3	**6**	**524**	1-Jan					**(19y)**
	4	**7**	**523**	1-Jan					
	5	**8**	**522**	1-Jan					

Several historical synchronisms with the Egyptian chronology are anchored on astronomical data as lunar eclipses:

- The partial eclipse in year 7 of Cambyses II (tablet BM 33066) may be dated 523 July 16/17 [magnitude = 0.54] and the total eclipse 522 January 9/10. Claudius Ptolemy had to have known the original tablet because he gave the right magnitude of 0.50 for the partial eclipse (Almagest V:14). Another astronomical tablet (BM 36879) describes eclipses in years 1-4 of Cambyses II, dated by astronomy 529-526[140]. A diary (VAT 4956)[141] contains numerous astronomical conjunctions in years 37 and 38 of Nebuchadnezzar dated from astronomy in 568 and 567. An astronomical journal (BM 38462)[142] list some lunar eclipses in the years 1 to 27 of Nebuchadnezzar which are dated from 604 to 578. Other dated lunar eclipses[143] are these of: year 1 and 2 of Merodachbaladan (March 19/20, 721, March 8/9 and September 1/2, 720); year 5 of Nabopolassar (April 21/22, 621); year 2 of Šamaš-šuma-ukîn (April 10/11, 666); year 42 of Nebuchadnezzar (March 2/3 562).

[140] P.J. HUBER, S. DE MEIS – Babylonian Eclipse Observations from 750 BC to 1 BC Milano 2004 Ed. Mimesis pp. 94-96.
[141] A.J. SACHS, H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol. I Wien 1988 Ed. Akademie der Wissenschaften (n° -567).
[142] H. HUNGER - Astronomical Diaries and Related Texts from Babylonia vol. V n° 6 Wien 2001 Ed. Akademie der Wissenschaften pp. 27-30,396.
[143] F.R. STEPHENSON - Historical Eclipses and Earth's Rotation Cambridge 1997 Ed. Cambridge University Press pp. 99-100, 151-152, 166-167, 206.

- Cambyses II defeated Egypt in his 5th year, month 2 (May 525 BCE), which is also dated year 2, month 5, of Psammetichus III (May 525 BCE).
- According to the biography of Adad-Guppi[144], mother of Nabonidus, Nabopolassar reigned 21 years, then Nebuchadnezzar 43 years, Amel-Marduk 2 years, Neriglissar 4 years just before Nabonidus. According to the Hillah's stele[145] there were 54 years between the destruction of the temple of Sin, in Harran, and the beginning of the reign of Nabonidus. According to a Babylonian chronicle (BM 21901)[146] and Adad-Guppi's stele, the temple of Harran was destroyed in the year 16 of Nabopolassar.
- After the fall of the Assyrian empire in October 609 BCE, Babylonian domination lasted exactly 70 years (Jr 25:11-12) until its fall in October 539 BCE.
- The Assyrian period 911-648 is dated owing to its eponyms[147] and the period 648-609 by a prosopography of its eponyms[148].
- Year 23 of Nebuchadnezzar II (582 BCE) in Palestine (Jewish Antiquities X:180-182) corresponds to year 7 of Apries[149]. Year 1 of Amel Marduk (561 BCE) corresponds to year 37 of Jehoiachin's exile (2 Ki 25:27). This exile began just after the attack on Jerusalem by Nebuchadnezzar II in the year 7 of his reign (598 BCE).
- The fall of the Assyrian empire, which took place in October 609 BCE after the battle of Harran, is characterized by four synchronisms, since the year 3 of Assur-uballit II corresponds to year 17 of Nabopolassar to Josiah's year 31 and year 1 of Necho II.
- Year 6 of Assurbanipal corresponds to year 1 of Psammetichus I[150].
- After the death of Shabaka, his successor Shabataka immediately summoned an army, which he placed under the command of his brother Taharqa to repel an Assyrian attack which was threatening[151]. Sennacherib's 3rd campaign thus corresponds to the 1st year of Shabataka. The inscription of Sargon II, found at Tang-i Var[152], involves dating this campaign in the 10th year of Sargon II (712 BCE).

Pharaoh	Reign (from Apis)	Length of reign	Highest year	Synchronism with:
Shabataka	[/**712**-01/689]	23 years	3	year **10** of Sargon II
Taharqa	[01/689-01/663]	26 years	26	
Psammetichus I	02/**663**-01/609	54 years	54	year **6** of Assurbanipal
Necho II	02/**609**-10/594	15 years 10 months	16	year **17** of Nabopolassar
Psammetichus II	11/594-01/588	6 years 1 month	7	
Apries	02/588-12/570	19 years	17	
Apries/ Amasis	01/569-12/567	[3 years co-regency]	[3]	
Amasis	01/569-10/526	43 years 10 months	44	
Psammetichus III	11/526-04/**525**	6 months	2	year **5** of Cambyses II

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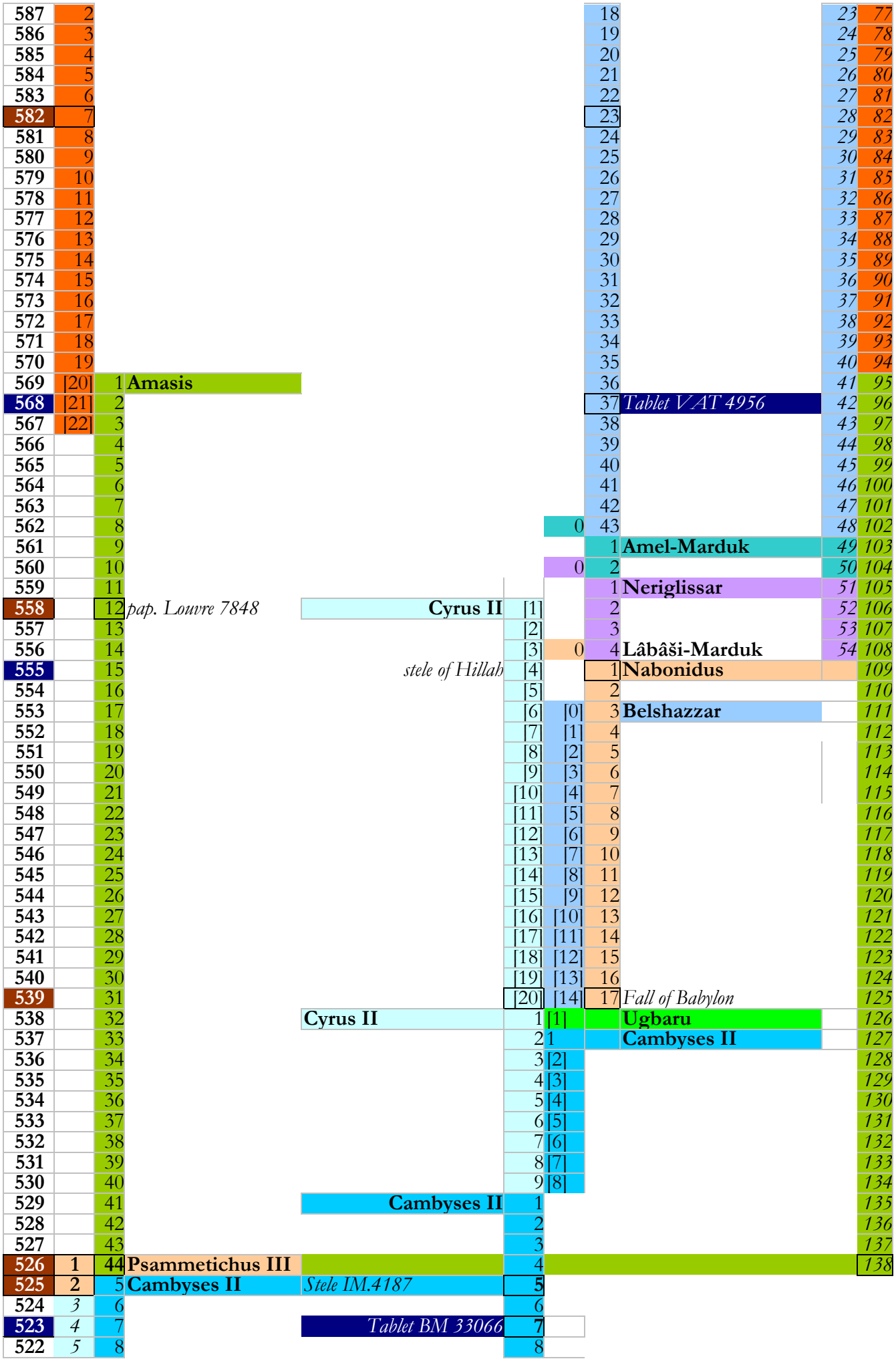
BCE			Assyrian king Egyptian king	*Assyrian eponym*				Babylonian king		
717	14		**Sargon II**	*Tab-šar-Aššur*	5		5	**Merodachbaladan II**		
716	15		**Shabaka**	*Tab-sil-Ešarra*	6		6			
715	16			*Taklak-ana-beli*	7	[0]	7			
714	17			*Ištar-duri*	8	[1]	8			
713	18			*Aššur-babi*	9	[2]	9			
712	[1]	1	**Shabataka/**	*Šarru-êmuranni*	10	[3]	10			
711	[2]	2	**[Taharqa]**	*Ninurta-âlik-pâni*	11	[4]	11			
710	[3]	3		*Šamaš-bêlu-uṣur*	12	[5]	12			
709	[4]	4		*Mannu-kî-Aššur-lê'i*	13	[6]	1	**Sargon II**		
708	[5]	5		*Šamaš-upahhir*	14	[7]	2			
707	[6]	6		*Ša-Aššur-dubbu*	15	[8]	3			
706	[7]	7		*Mutakkil-Aššur*	16	[9]	4			
705	[8]	8		*Nashru-Bêl*	17	[10]	5			
704	[9]	9	**Sennacherib**	*Nabû-deni-epuš*	1		18	**(Sargon II)**		
703	[10]	10		*Nuḫšaya*	2		19	**Marduk-zakir-šumi II**		
702	[11]	11		*Nabû-lê'i*	3		1	**Bêl-ibni**		
701	[12]	12		*Hananu*	4		2			
700	[13]	13		*Metunu*	5		3			
699	[14]	14		*Bêl-šarrani*	6		1	**Aššur-nâdin-šumi II**		
698	[15]	15	Arda-Mulissu	*Sulmu-šarri*	7	[1]	2			
697	[16]	16		*Nabû-dûru-uṣur*	8	[2]	3			
696	[17]	17		*Šulmu-bêli*	9	[3]	4			
695	[18]	18		*Aššur-bêlu-uṣur*	10	[4]	5			
694	[19]	19		*Ilu-issîya*	11	[5]	6			
693	[20]	20		*Iddin-ahhê*	12	[6]	1	**Nergal-ušêzib**		
692	[21]	21		*Zazâya*	13	[7]	1	**Mušêzib-Marduk**		
691	[22]	22		*Bêl-êmuranni*	14	[8]	2			
690	[23]	23		*Nabû-kênu-uṣur*	15	[9]	3			
689	1		**Taharqa**	*Gihilu*	16	[10]	4			
688	2			*Iddin-ahhê*	17	[11]	1	**Sennacherib**		
687	3			*Sin-ahhê-erîba*	18	[12]	2			
686	4			*Bêl-êmuranni*	19	[13]	3			
685	5			*Aššur-da"inanni*	20	[14]	4			
684	6			*Manzernê*	21	[15]	5			
683	7			*Mannu-kî-Adad*	22	[1]	6			
682	8			*Nabû-sharru-uṣur*	23	[2]	7			
681	9			*Nabû-ahhê-êreš*	24	[3]	8			
680	10		**Esarhaddon**	*Danânu*	1		1	**Esarhaddon**		
679	11			*Issi-Adad-anênu*	2		2			
678	12			*Nergal-šarru-uṣur*	3		3			
677	13			*Abî-râmu*	4		4			
676	14			*Banbâ*	5		5			
675	15			*Nabû-ahhê-iddin*	6		6			
674	16			*Šarru-nûrî*	7		7			
673	17			*Atar-ilu*	8		8			
672	18			*Nabû-bêlu-uṣur*	9	[1]	9			
671	19			*Kanûnâyu*	10	[2]	10			
670	20			*Sulmu-bêli-lašme*	11	[3]	11			
669	21			*Šamash-kâšid-ayâbi*	12	[4]	12			
668	22		**Assurbanipal**	*Marlarim*	1		1	**Aššurbanipal**		
667	23			*Gabbaru*	2		1	**Samaš-šuma-ukîn**		
666	24			*Kanûnâyu*	3		2	*Tablet BM 45640*		
665	25			*Mannu-kî-šarri*	4		3			
664	26		*Thebes devastated*	*Šarru-lû-dâri*	5		4			
663	1		**Psammetichus I**	*Bêl-na'id*	6		5			*1*
662	2			*Tab-šar-Sîn*	7		6			*2*
661	3			*Arba'ilâyu*	8		7			*3*
660	4			*Girsapûnu*	9		8			*4*
659	5			*Silim-Aššur*	10		9			*5*
658	6			*Ša-Nabû-šû*	11		10			*6*
657	7			*Lâ-bâši*	12		11			*7*
656	8			*Milkî-râmu*	13		12			*8*
655	9			*Amyânu*	14		13			*9*
654	10			*Assur-nâsir*	15		14			*10*

653	11			*Assur-ilâya*	16			15					11
652	12			*Assur-dûru-uṣur*	17			16					12
651	13			*Sagabbu*	18			17					13
650	14			*Bêl-Ḫarrân-šadûa*	19			18					14
649	15			*Aḫu-ilâya*	20			19					15
648	16			*Belshunu*	21			20					16
647	17			*Nabû-nadin-ahi*	22			1	**Kandalanu**				17
646	18			*Nabû-šar-ahhešu*	23			2					18
645	19			*Šamaš-da"inanni of Babylon*	24			3					19
644	20			*Nabû-sharru-uṣur*	25			4					20
643	21			*Nabû-sharru-uṣur of Marash*	26			5					21
642	22			*Samaš-da"inanni of Que*	27			6					22
641	23			*Aššur-garu'a-nere*	28			7					23
640	24			*Šarru-metu-uballit*	29			8					24
639	25			*Mušallim-Aššur*	30			9					25
638	26			*Aššur-gimilli-tere*	31			10					26
637	27			*Zababa-eriba*	32			11					27
636	28			*Sin-šarru-uṣur*	33			12					28
635	29			*Bel-lu-dari*	34			13					29
634	30			*Bullutu*	35			14					30
633	31			*Upaqa-ana-Arbail*	36			15					31
632	32			*Tab-sil-Sin*	37			16					32
631	33			*Adad-remanni*	38			17					33
630	34			*Salmu-šarri-iqbi*	39			18					34
629	35		**Aššur-etel-ilâni**	*Nabû-šarru-uṣur*	[40]	1		19					35
628	36			*?Nur-salam-sarpi?*	[41]	2		20					36
627	37			*Marduk-šarru-uṣur*	[42]	3		21	**Sin-šum-lišir**				37
626	38		**Sin-šar-iškun**	*Iqbi-ilani / Marduk-remanni*	**0**	4		22)	**Sin-šar-iškun**				38
625	39			*Sin-šarru-uṣur*	1			1	**Nabopolassar**				39
624	40			*Kanunaiu*	2			2					40
623	41			*Aššur-matu-taqqin*	3			3					41
622	42			*Daddî*	4			4					42
621	43			*Bel-iqbi*	5			5					43
620	44			*Sa'ilu*	6			6					44
619	45			*Mannu-ki-ahhe*	7			7					45
618	46			*Nabû-sakip*	8			8					46
617	47			*Assur-remanni*	9			9					47
616	48			*Bel-ahu-uṣur*	10			10					48
615	49			*Sin-alik-pani*	11			11					49
614	50			*Paši*	12			12					50
613	51			*Nabû-tapputi-alik*	13			13					51
612	52			*Shamash-šarru-ibni*	14			14					52
611	53		**Aššur-uballit II**	*Nabû-mar-šarri-uṣur*	1			15					53
610	54			*Nabû-šarru-uṣur*	2			16	*Temple of Harran wrecked*				54
609	1		**Necho II**	*Gargamisaiu*	3		[0]	17	*Stele of Adad-Guppi*		1		55
608	2						[1]	18			2		56
607	3						[2]	19			3		57
606	4						[3]	20			4		58
605	5						[4]	21			5		59
604	6							1	**Nebuchadnezzar II**		6		60
603	7							2			7		61
602	8							3			8		62
601	9							4			9		63
600	10							5			10		64
599	11							6			11		65
598	12							7			12		66
597	13							8			13		67
596	14							9			14		68
595	15							10			15		69
594	16	1	**Psammetichus II**					11			16		70
593		2						12			17		71
592		3						13			18		72
591		4						14			19		73
590		5						15			20		74
589		6						16			21		75
588	1	7	**Apries**					17			22		76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526 1 44 Psammetichus III
525 2 5 Cambyses II
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Stele IM.4157
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Tablet BM 33066 7
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1 Neriglissar
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0 4 Lâbâši-Marduk
1 Nabonidus
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3 Belshazzar
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16
17 Fall of Babylon
Ugbaru
Cambyses II
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24 78
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36 90
37 91
38 92
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Year 44 of Amasis, the last of his reign, should be dated 526. The solution proposed by Parker of a year 45 dated 526 is not possible, as recognized by Depuydt[153] who prefers to date the death of Amasis in 527 in his 44th year, assuming that the 4th year of Cambyses (526) was a period of disorder without pharaoh! But this choice leads to an implausible result, contrary to the accounts of all the ancient historians[154]: the throne of Egypt would have been a vacuum for 1 year after the disappearance of Psammetichus III, from May 526 to May 525, when Cambyses was recognized Pharaoh, but the end of the ancient Egyptian empire was an important milestone that has been recounted by the following historians:

- According to Diodorus Siculus: *After a reign of 55 years*[155] *he [Amasis] ended his days at the time when Cambyses, the king of the Persians, attacked Egypt, in the 3rd year of the 63rd Olympiad* (Historical Library I:68:6). Thus Amasis died between July 526 and July 525.
- According to the Egyptian priest Manetho[156]: *Cambyses, in the 5th year of his reign over the Persians [in -525] became king of Egypt and led it for 3 years [from spring 525 to spring 522].*
- According to Herodotus (c. -450): *On the death of Cyrus, Cambyses his son by Cassandane daughter of Pharnaspes took the kingdom (...) Amasis was the Egyptian king against whom Cambyses, son of Cyrus, made his expedition; and with him went an army composed of the many nations under his rule, among them being included both Ionic and Aeolic Greeks (...) One of the mercenaries of Amasis, a Halicarnassian, Phanes by name, a man of good judgment, and a brave warrior, dissatisfied for some reason or other with his master, deserted the service, and taking ship, fled to Cambyses, wishing to get speech with him (...) Psammenitus, son of Amasis, lay encamped at the mouth of the. Nile, called the Pelusiac, awaiting Cambyses. For Cambyses, when he went up against Egypt, found Amasis no longer in life: he had died after ruling Egypt 44 years, during all which time no great misfortune had befallen him (...) The Egyptians who fought in the battle, no sooner turned their backs upon the enemy, than they fled away in complete disorder to Memphis (...) 10 days after the fort had fallen, Cambyses resolved to try the spirit of Psammenitus, the Egyptian king, whose whole reign had been but 6 months (...) Psammenitus plotted evil, and received his reward accordingly. He was discovered to be stirring up revolt in Egypt, wherefore Cambyses, when his guilt clearly appeared, compelled him to drink bull's blood, which presently caused his death. Such was the end of Psammenitus* (The Histories II:1; III:1,4,10-16).

The Egyptian priest Manetho indicates the same values as Herodotus, 44 years for Amasis and 6 months for Psammetichus III. By combining this information with data from the reign of Persian King Cambyses who became Egyptian in May 525, the death of Amasis can be fixed around October 526. Fixing the date of the conquest of Egypt in 525 is also confirmed since the 5th year of Cambyses began the 1st Nisan (March 29) in the Persian system, and the 1st Thoth (January 2) in the Egyptian system. The account of these historians is confirmed by several archaeological finds:

- The narrative of Udjahorresnet[157], the Egyptian general who led the naval fleet under Amasis, then under Psammetichus III and finally under Cambyses, authenticates the version of Herodotus. This war probably lasted at least six months because, according to the historian Polyaenus: *When Cambyses attacked Pelusium, which guarded the entrance into Egypt, the Egyptians defended it with great resolution. They advanced formidable engines against the besiegers, and hurled missiles, stones, and fire at them from their catapults.* (Stratagems of war VII:9). These

153 L. DEPUYDT - Egyptian Regnal Dating under Cambyses and the Date of the Persian Conquest
1996 in: Studies in Honor of William Kelly Simpson pp. 179-190.
154 Herodotus was close to events, and Manetho, an Egyptian priest, was to know the history of his country.
155 Amasis' reign is counted from the revolt after the attack of Nebuchadnezzar II the 23rd year in 582 BCE (Jewish Antiquities X:180-182): 581-526 (55 years) instead of 570-526 (44 years).
156 W.G. WADDELL - Manetho (Loeb Classical Library 350)
Cambridge 1956 Ed. Harvard University Press pp. 169-177.
157 P. BRIANT - Histoire de l'empire perse. De Cyrus à Alexandre
Paris 1996 Éd. Fayard pp. 63-65.

narratives overlap exactly and give the following chronological scheme: war of Cambyses against Egypt beginning in the year 44, the last year of Amasis, which ends after the brief reign of 6 months of Psammetichus III, his successor or in the 5th year of Cambyses.

- According to the stele IM.4187 in the Louvre, an Apis bull was born at month 5, day 29, year 5 of Cambyses, died on month 9, day 4, year 4 of Darius I and was buried month 11, day 13, of the same year, covering a total period of 7 years 3 months and 5 days (reading 8 years less likely). This computation is consistent (between the month 9, day 4, and the month 11, day 13, there are exactly 70 days for the period of embalming the bull) and gives the following dates in the Julian calendar: May 29, 525, August 31, 518 and November 8, 518. This stele proves that Cambyses reigned in Egypt from May 525 because at the end of this month, an Apis bull is dedicated to him. Thus the conquest of Egypt had to be completed in early May 525 as the last text referring to Psammetichus III (below) is dated I Peret year 2 (May 525). He was the son of Amasis as confirmed by the stele No. 309 of the Serapeum (Louvre). It is indeed Psammetichus III because one of the contracting parties cited in the text was still alive in the year 35 of Darius I[158].

Before his conquest Cambyses was a Persian leader but thereafter he also became an Egyptian pharaoh. This new situation has created a dual system of counting the reign.

- Egyptian documents of the time of Darius I mention the events of years 3 and 4 of Cambyses, apparently before the conquest of Egypt. A papyrus dated 9th year of Darius says: *In his 2nd year, therefore, Cambyses conquered Egypt really, and in 5th year he died.* This demotic text (Papyrus Rylands IX 21), entitled *Peteisis petition* spoke of a conflict in a family of priests of the temple of Amon at Teuzoi (El-Hibeh) between the 4th year of Psammetichus I and the 4th year of Cambyses[159]. It ends with the following dates: *Until the Year 44 of Amasis. In Year 3 of Cambyses, Hor son of Psammet-kmenempe, the prophet of Amon (...) in Year 4 of Cambyses.* A second Egyptian papyrus known as the *Demotic Chronicle*, confirmed the year 44 of Amasis as last year[160]. This source says that Darius (I) in the 3rd year of his reign would have given the satrap of Egypt the order of gathering a committee of wise men from among the Egyptian warriors, priests and scribes in order: *that they put in writing that Egyptian law was in force until the 44th year of the reign of Amasis.*
- Cambyses died in 522, it was therefore his 5th year in Egypt, the 2nd corresponded to 525 and the 1st to 526. This conquest began in 526, since Herodotus (The Histories III:1,10) states that the war began with the death of Amasis. Years 2 to 5 of Cambyses refer to his years of domination in Egypt (not his regnal years). It is not logical to assume that the Egyptians used a counting system reserved for their pharaohs rather than for foreign leaders[161], which Cambyses was before his conquest (though, after 525, Persian leaders would be considered as Pharaohs).

The year 5 of Cambyses (525 BCE) began on Nisan 1st, that is March 28, and Year 44 of Amasis (526 BCE) began on Thot 1st, that is January 2. Thus, as the reign of Psammeticus III was 6 months long, his year 1 (526 BCE) began near November and his year 2 began on Thot 1st, that is January 1st, 525 BCE, and ended around April.

158 H. GAUTHIER – Le livre des rois d'Égypte
Le Caire 1915 Éd. Institut Français d'Archéologie Orientale pp. 131-132).
159 P. BRIANT - Histoire de l'empire perse. De Cyrus à Alexandre
Paris 1996 Éd. Fayard p. 92.
160 A. KUHRT - The Persian Empire
London 2010 Ed. Routeledge pp. 124-125.
161 R.A. PARKER - Persian and Egyptian Chronology
in: *The American Journal of Semitic Languages and Literatures* LVIII/3 (1941) pp. 298-301.

It is interesting to note that the Israelite chronology fits very well the previous chronologies (Egyptian, Assyrian and Babylonian). For example, the text of 2Kings 18:9 in which the fall of Samaria began in the 4th year of King Hezekiah, that is, the 7th year of Hosea, that Shalmaneser the king of Assyria came against Samaria and began to lay siege to it, which lasted 3 years. According to a Babylonian chronicle the fall of Samaria began on the 5th and last year of Shalmaneser V and was completed 3 years later in the 2nd year of Sargon II (Annals of Sargon). According to the Bible, there are many dated synchronisms between kings of Judah (Ahaz, Hezechiah) and kings of Israel (Pekah, Hosea) with Assyrian kings (Tiglath-pileser III, Salmanazar V, Sargon II, Sennacherib) and one Babylonian king (Merodachbaladan II). In addition, there were four dated lunar eclipses during this period: one on year 1 of Nabû-mukîn-zêri (April 9, 731), one in year 1 of Merodachbaladan II (March 19, 721) and two on his year 2 (March 8, September 1st, 720).

	ASSYRIA	BABYLONIA	JUDEA	ISRAEL	EGYPT	*reference*
800	11 **Adad-nêrari III**	? Ninurta-apla-X	**10 Uziah**	23 **Jeroboam**	Shoshenq IV	
799	12	1	**11**	24	1 (22nd Dyn.)	
798	13	2	**12**	25	2	
797	14	3	**13**	26	3	
796	15	4	**14 Azariah**	27	4	*2Ki 14:23*
795	16	5	**15**	28	5	*2Ki 15:1,2*
794	17	6	16	29	6	*2Ch 26:3*
793	18	7	17	30	7	
792	19	8	18	31	8	
791	20	9	19	32	9	
790	21	10? Marduk-bêl-zêri	20	33	10	
789	22	1	21	34	11	
788	23	2	22	35	12	
787	24	3	23	36	1 Pamiu	
786	25	4	24	37	2	
785	26	5	25	38	3	
784	27	6	26	39	4	
783	28 **Shalmaneser** IV	7	27	40	5	
782	1 [0] **Bar Ga'ah**	8	28	41	6	
781	2 [1] (**Pulu**)	9	29	1 **Zekariah**	1 Shoshenq V	*2Ki 14:29*
780	3 [2]	10? Marduk-apla-uṣur	30	[2]	2	
779	4 [3]	1	31	[3]	3	
778	5 [4]	2	32	[4]	4	
777	6 [5]	3	33	[5]	5	
776	7 [6]	4	34	[6]	6	
775	8 [7]	5	35	[7]	7	
774	9 [8]	6	36	[8]	8	
773	10 **Aššur-dân III**	7	37	[9]	9	
772	1 [10]	8	38	[10]	10	*2Ki 15:8*
771	2 [11]	9	39	[11]**Shallum**	11	*2Ki 15:13*
770	3 [12]	10 Erîba-Marduk	40	1**Menahem**	12	*2Ki 15:17*
769	4 [13]	1	41	1	13	
768	5 [14]	2	42	2	14	
767	6 [15]	3	43	3	15	
766	7 [16]	4	44	4	16	(*Isa 10:5-8*)
765	8 [17]	5	45	5 (**Pulu**)	17	*2Ki 15:19-20*
764	9 [18]	6	46	6	18	
763	10 (*total solar eclipse*)	7	47	7	19	*Bur-Sagale*
762	11 [20]	8	48	8	20	
761	12 [21]	9 Nabû-šum-iškun	49	9	21	
760	13 [22]	1	50	10 **Pekayah**	22	*2Ki 15:22-23*
759	14 [23]	2	51	1	23	
758	15 [24]	3	52 **Jotham**	2 **Pekah**	24	*2Ki 15:27-33*
757	16 [25]	4	1	1	25	
756	17 [26]	5	2	2	26	

755	18 **Aššur-nêrari V**	6	3	3	27	
754	1 [28]	7	4	4	28	
753	2 [29]	8	5	5	29	
752	3 [30]	9	6	6	30	
751	4 [31]	10	7	7	31	
750	5 [32]	11	8	8	32	
749	6 [33]	12	9	9	33	
748	7 [34]	13 Nabû-nâsir	10	10	34	
747	8 [35]	1	11	11	35	
746	9 [36]	2	12	12	36	
745	10 [0]	3	13	13	37	
744	1**Tiglath-pileser** III	4	14	14	1 Osorkon IV	
743	2	5	15	15	2 (= **So**)	
742	3	6	16	16	3	
741	4	7	**1 Ahaz** *17*	**17**	4	*2Ki 16:1-10*
740	5 [1] Shalmaneser V	8	2 *18*	18	5	*2Ch 28:16*
739	6 [2]	9	3 *19*	19	6	*2Ki 16:5,6*
738	**7** [3]	10	[4] *20*	**20 Hosea**	7	*2Ki 15:27-30*
737	8 [4]	11	[5]	[1]	8	
736	9 [5]	12	6	[2]	9	
735	10 [6]	13	7	[3]	10	
734	11 [7]	14 Nabû-nâdîn-zêri	8	[4]	11	*2Ki 16:7-9*
733	12 [8]	1	9	[5]	12	
732	13 [9]	2 Nabû-mukîn-zêri	10	[6]	13	
731	14 [10]	**1** (*lunar eclipse April 9*)	11	[7]	14	
730	15 [11]	2	12	[8]	15	
729	16 [12]	3 Pulu	13	[9]	16	*2Ki 17:1*
728	17 [14]	**1**	14	**1** [10]	17	
727	18 [15]	2 Ulûlaiu	15	2 [11]	18	
726	1 **Shalmaneser** V	1 (Shalmaneser V)	16 **Ezechias**	3 [12]	19	*2Ki 18:1*
725	2	2	1	4 [13]	20	
724	3	3	2	5 [14]	21	
723	4	4	3#	6 [15]	22 #(*alliance*)	*2Ki 17:2-5*
722	**5 Sargon** II	5 **Merodachbaladan II**	**4**	**7** [16]	23	*2Ki 18:9*
721	**1**	**1** (*lunar eclipse March 19*)	5	8 [17]	24	
720	**2** *Fall of Samaria*	**2** (*March 8; September 1st*)	**6**	**9** [18]	25	*2Ki 18:10*
719	3	3	7	[19]	26	
718	4	4	8	[20]	27	
717	5	5	9	[21]	28	
716	6	6	10	[22]	29	
715	7 #(*alliance*)	7	11	[23]	30 #(*alliance*)	
714	8 -[1] Sennacherib	8	12	[24]	31	
713	9 -[2]	9	13	[25]	32	
712	**10**-[3] *Ashdod Lakish*	**10** (*failed alliance*)	**14**	[26]	1 **Shabataka**	*Is 36:1; 39:1*
711	**11**-[4] *taken*	11	15	[27]	2 /**Taharqa**	*1*
710	**12**-[5]	12 Sargon II	16	[28]	3 (25th Dyn.)	*2*
709	**13**-[6]	1	17	[29]	4	*3*
708	**14**-[7]	2	18	[30]	5	*4*
707	**15**-[8]	3	19	[31]	6	*5*
706	**16**-[9]	4	20	[32]	7	*6*
705	**17 Sennacherib**	5 **Sennacherib**	21	[33]	8	*7*
704	1	1	22	[34]	9	*8*
703	2	2 Bêl-ibni	23	[35]	10	*9*
702	3	1	24	[36]	11	10
701	4	2	25	[37]	12	*11*
700	5	3 Aššur-nâdin-šumi II	26	[38]	13	*12*
699	6	1	27	[39]	14	*13*
698	7 [1] Arda-Mulissu	2	28	[40]	15	*14*
697	8 [2]	3	**29**	[41]	16	***15***
696	9 [3]	4	**1 Manasseh**	[42]	17	*2Ki 21:1*
695	10 [4]	5	2	[43]	18	
694	11 [5]	6	3	[44]	19	

693	12 [6]	1 Nergal-ušezib	4	[45]	20	
692	13 [7]	1 Mušezib-Marduk	5	[46]	21	
691	14 [8]	2	6	[47]	22	
690	15 [9]	3	7	[48]	23	
689	16 [10]	4	8	[49]	1 **Taharqa**	
688	17 [11]	1 Sennacherib	9	[50]	2	
687	18 [12]	2	10	[51]	3	
686	19 [13]	3	11	[52]	4	
685	20 [14]	4	12	[53]	5	
684	21 [15]	5	13	[54]	6	
683	22 [1] Esarhaddon	6	14	[55]	7	
682	23 [2]	7	15	[56]	8	
681	24 [3]	8	16	[57]	9	
680	**1 Esarhaddon**	1 Esarhaddon	17	[58]	10	
679	2	2	18	[59]	11	
678	3	3	19	[60]	12	
677	4	4	20	[61]	13	
676	5	5	21	[62]	14	
675	6	6	22	[63]	15	
674	7	7	23	[64]	16	
673	**8** (*Manasseh deported*)	8 (*2Chr 33:11*)	24	[65]	17 *Ezr 4:2*	*Is 7:8,9*
672	9 [1] Aššurbanipal	9	25		18 (*Israel deported into Assyria*)	
671	10 [2]	10	26	**1 Necho I**	19	
670	11 [3]	11	27	2 (26th Dyn.)	20	
669	12 [4]	12	28	3	21	
668	**1 Aššurbanipal**	1 Aššurbanipal	29	4	22	
667	2	1 Šamašumaukin	30	5	23	
666	3	2 (*lunar eclipse April 10*)	31	6	24	*BM 45640*
665	4	3	32	7	25	
664	**5** (*Thebes sacked*)	4 (*Nah 3:8*)	**33**	8	26	*Ezr 4:10*
663	6	5	34	**1 Psammetichus I**		
662	7	6	35	2		
661	8	7	36	3		
660	9	8	37	4		
659	10	9	38	5		
658	11	10	39	6		
657	12	11	40	7		
656	13	12	41	8		
655	14	13	42	9		
654	15	14	43	10		
653	16	15	44	11		
652	17	16	45	12		
651	18	17	46	13		
650	19	18	47	14		
649	20	19	48	15		
648	21	20 **Kandalanu**	49	16		
647	22	1	50	17		
646	23	2	51	18		
645	24	3	52	19		
644	25	4	53	20		
643	26	5	54	21		
642	27	6	**55 Amon**	22		*2Ki 21:1*
641	28	7	1	23		*2Ki 21:19*
640	29	8	**2 Josias**	24		*2Ki 22:1*
639	30	9	1	25		
638	31	10	2	26		
637	32	11	3	27		
636	33	12	4	28		
635	34	13	5	29		
634	35	14	6	30		
633	36	15	7	31		
632	37	16	8	32		

631	38	17	9	33	
630	39	18	10	34	
629	1 **Aššur-etel-ilâni**	19	11	35	
628	2 [41]	20	12	36	
627	3 [42]	21	13	37	
626	4 **Sin-šar-iškun**	22 **Nabopolassar**	14	38	
625	1	1	15	39	
624	2	2	16	40	
623	3	3	17	41	
622	4	4	18	42	
621	5	5 *Lunar eclipse (22 April)*	19	43	
620	6	6 (*Almagest V,14*)	20	44	
619	7	7	21	45	
618	8	8	22	46	
617	9	9	23	47	
616	10	10	24	48	
615	11	11	25	49	
614	12	12	26	50	
613	13	13	27	51	
612	14 **Aššur-uballit II**	14 *Nineveh destroyed*	28	52	*Nah 3:15-19*
611	1	15	29	53	
610	2	16	30	54	
609	3 *Battle of Harran*	17 *BM 21901*	**31 Joiaqim**	1 **Necho II**	*2Ki 22:1;*

The only problem to solve is why the destruction of Jerusalem in Jeremiah's text is dated on 10/V/**11** of Zedekiah (587 BCE) and on 10/V/**19** of Nebuchadnezzar (586 BCE). This discrepancy of one year is not an error, but reflects a change which took place at the Battle of Harran (609 BCE), a historical event well documented and dated in four different chronologies. Just before this battle, Josiah in his 31st year of reign was killed in Megiddo by Necho II (2Ki 23:29). According to Flavius Josephus this pharaoh had come to assist the Assyrian king against Babylonians and allied Media (Antiquities of the Jews X:74). Herodotus reports this event (History II:159) and a Babylonian chronicle (BM 21901) teaches us that this event took place in the 17th year of Nabopolassar in the month of Dumuzi (July), and that the Assyrian king Assur-uballit II was defeated in the 3rd year of his reign. Chronology from the Battle of Harran to 400 BCE:

	BABYLONIA			JUDEA				EGYPT		reference
609	3 *Battle of Harran*	**17**	[0]	**Joiaqim**	**31**	*0*		1 **Necho II**		*2Ki 22:1*
608	*End of Assyria*	**18**	[1]		**1**	*1*		2		*23:36*
607		**19**	[2]		**2**	*2*		3		
606		**20**	[3]		**3**	*3*		4		
605	**Nebuchadnezzar**	**21**	1		**4**	4		5	*Battle of Karkemish*	*Jr 25:1;46:2*
604		**1**	2		**5**	*5*		6		
603		**2**	3		**6**	*6*		7		
602		**3**	4		**7**	*7*		8		
601	*Birth of Darius the*	**4**	5		**8**	*8*	**0**	9	*Joiaqim vassal of*	*Dn 5:31*
600	*Mede (Harpagus)*	**5**	6		**9**	*9*	**1**	10	*Nebuchadnezzar*	*2Ki 24:1*
599		**6**	7		**10**	*10*	**2**	11		
598	*BM 21946*	**7**	8	**Zedekiah**	**11**	*11*	**3**	12	*Exile of Joiakîn*	*Jr 52:28*
597		**8**	9		**1**	*12*	*1*	13	*2Chr 36:9,10*	*2Ki 24:12*
596		**9**	10		**2**	*13*	*2*	14		
595		**10**	11		**3**	*14*	*3*	15		
594		**11**	12		**4**	*15*	*4*	16		
593		**12**	13		**5**	*16*	*5*	1	Psammetichus II	
592		**13**	14		**6**	*17*	*6*	2		
591		**14**	15		**7**	*18*	*7*	3		
590		**15**	16		**8**	*19*	*8*	4		
589		**16**	17	*Jer 52:4*	**9**	*20*	*9*	5	*Siege of Jerusalem*	*Ezk 24:1*
588	*Jubilee violated*	**17**	18	*50*	**10**	*21*	*10*	**6/1**	**Apries**	*Jr 32:1*
587		**18**	19	*1 Temple destroyed*	**11**	*22*	*11*	2	*Exile of the people*	*Jr 52:1,12,29*

586	*Ezk 26:1-12*	19	*1*	*2*	*1*	*23*	*12*	3	*1st year of exile*	*Ezk 33:21*
585	*Dan 2:1*	20	*2*	*3*	*2*	*24*	*13*	4		
584	*Dan 4:25-29*	21	*3*	*4*	*3*	*25*	*14*	5		
583	*(7 years of madness)*	22	*4*	*5*	*4*	*26*	*15*	6		
582		23	*5*	6	*5*	*27*	*16*	7	*Last exile*	*Jr 52:30*
581		24		*7*	*6*	*28*	*17*	8		
580		25		*8*	*7*	*29*	*18*	9		
579		26		*9*	*8*	*30*	*19*	10		
578		27		*10*	*9*	*31*	*20*	11		
577		28		*11*	*10*	*32*	*21*	12		
576		29		*12*	*11*	*33*	*22*	13		
575		30		*13*	*12*	*34*	*23*	14		
574	*(Tyre, siege of 13 years)*	31		*14*	*13*	*35*	*24*	15		
573	*Against Apion 1:156*	32		*15*	*14*	*36*	*25*	16		*Ezk 40:1*
572		33		16	*15*	*37*	*26*	17		
571		34		*17*	*16*	*38*	*27*	18	*Ezk*	*29:12-20*
570		35		*18*	*17*	*39*	*28*	19		
569		36		*19*	*18*	*40*	*29*	1	20 **Amasis**	
568	*VT 4956 (eclipse)*	37		*20*	*19*	*41*	*30*	2	21	*Jr 43:10,13*
567	*(Egypt attacked)*	38		*21*	*20*	*42*	*31*	3	22 *Death of Apries*	
566		39		*22*	*21*	*43*	*32*	4	*1 Egypt desolated 40 years*	*Jr 44:30*
565		40		*23*	*22*	*44*	*33*	5	*2*	
564		41		*24*	*23*	*45*	*34*	6	*3*	
563		42		*25*	*24*	*46*	*35*	7	*4*	
562	**Amêl Marduk**	43		*26*	*25*	*47*	*36*	8	*5*	
561		1		*27*	*26*	*48*	*37*	9	*6 Jehoiachin liberated*	*Jr 52:31*
560	**Neriglissar**	2		*28*	*27*	*49*		10	*7*	
559	*(Cyrus II Persian king)*	1		*29*	*28*	*50*		11	*8*	
558		2		*30*	*29*	*51*		12	*9*	
557		3		*31*	*30*	*52*		13	*10*	
556	***Labashi-Marduk***	4		*32*	*31*	*53*		14	*11*	
555	**Nabonidus**	1		*33*	*32*	*54*		15	*12*	
554		2		*34*	*33*	*55*		16	*13*	
553	**Belshazzar**	3	*0*	*35*	*34*	*56*		17	*14*	
552		4	*1*	*36*	*35*	*57*		18	*15*	*Dn 7:1*
551		5	*2*	*37*	*36*	*58*		19	*16*	
550	*Harpagus Median king*	6	*3*	*38*	*37*	*59*		20	*17*	*Dn 8:1,20-21*
549	*vassal of Cyrus II*	7	*4*	*39*	*38*	*60*		21	*18*	
548		8	*5*	*40*	*39*	*61*		22	*19*	
547		9	*6*	*41*	*40*	*62*		23	*20*	
546		10	*7*	*42*	*41*	*63*		24	*21*	
545		11	*8*	*43*	*42*	*64*		25	*22*	
544		12	*9*	*44*	*43*	*65*		26	*23*	
543		13	*10*	*45*	*44*	*66*		27	*24*	
542		14	*11*	*46*	*45*	*67*		28	*25*	
541		15	*12*	*47*	*46*	*68*		29	*26*	
540		16	*13*	*48*	*47*	*69*		30	*27*	
539	*Fall of Babylon*	17	*14*	**Cyrus II**	*48*	*70*		31	*28*	*Jr 25:11,12*
538	*Freedom year 1*	1		*50*	*49*			32	*29*	*Is 43:1,3;*
537		2			*50*			33	*30*	*45:1*
536		3			*51*			34	*31*	*Dn 10:1*
535		4			*52*			35	*32*	
534		5			*53*			36	*33*	
533		6			*54*			37	*34*	
532		7			*55*			38	*35*	
531		8			*56*			39	*36*	
530		9	0	**Cambyses II**	*57*			40	*37*	
529			1		*58*			41	*38*	
528			2		*59*			42	*39*	
527			3		*60*			43	*40* *Ezk*	*29:12-16*
526			4		*61*		1	44	**Psammetichus III**	
525			5		*62*		2			*Fall of Egypt*

524			6		63					
523	*Lunar eclipse 16 July*		7		64					*BM 33066*
522		0	8	**Darius I**	65					
521		1			66					
520		2			67					
519		3			68					
518		4			69	50			*End of Temple's desolation*	*Zc 7:1-5*
517		5			70	1			*New jubilee cycle*	*Dn 9:2*
516		6				2				
515		7				3				
514		8				4				
513		9				5				
512		10				6				
511		11				7				
510		12				8				
509		13				9				
508		14				10				
507		15				11				
506		16				12				
505		17				13				
504		18				14				
503		19				15				
502	*Lunar eclipse 19 Nov.*	20				16				
501	*Almagest IV:9*	21				17				
500		22				18				
499		23				19				
498		24				20				
497		25				21				
496		26	0	**Xerxes I**		22				
495		27	1			23				
494		28	2			24				
493		29	3			25			*Vashti repudiated*	*Est 1:3*
492		30	4			26				
491	*Lunar eclipse 25 Apr.*	31	5			27				
490	*Almagest IV:1*	32	6			28				
489		33	7			29			*Wedding of Xerxes*	*Est 2:16-17*
488		34	8			30				
487		35	9			31				
486		36	10			32				
485	*Babylonian revolt*		11			33				*Ezr 4:6*
484	*Est 2:21-3:7*		12			34				*Est 3:7-10*
483			13			35				
482			14			36				
481			15			37				
480			16			38				
479			17			39				
478			18			40				
477			19			41				
476			20			42				
475	*Lunar eclipse Jun. 26*	0	21	**Artaxerxes I**		43				*BM 32234*
474	*Lunar eclipse Dec. 20*	1				44				
473		2				45				
472		3				46				
471		4				47				
470		5				48				
469		6				49				
468		7				50			*1st jubilee celebrated*	*Ezr 7:1-8,24*
467		8				1				
466		6				2				
465		10				3				
464		11				4				
463		12				5				

462		**13**				*6*				
461		**14**				*7*				
460		**15**				*8*				
459		**16**				*9*				
458		**17**				*10*				
457		**18**				*11*				
456		**19**				*12*				
455		**20**				*13*	*1*		*Beginning of 483 years*	*Dn 9:24-27*
454		**21**				*14*	*2*		*(483 = 69x7)*	*Ne 2:1-9*
453		**22**				*15*	*3*			
452		**23**				*16*	*4*			
451		**24**				*17*	*5*			
450		**25**				*18*	*6*			
449		**26**				*19*	*7*			
448		**27**				*20*	*8*			
447		**28**				*21*	*9*			
446		**29**				*22*	*10*			
445		**30**				*23*	*11*			
444		**31**				*24*	*12*			
443		**32**				*25*	*13*		*Inspection of Nehemiah*	*Ne 5:14*
442		**33**				*26*	*14*			
441		**34**				*27*	*15*			
440		**35**				*28*	*16*			
439		**36**				*29*	*17*			
438		**37**				*20*	*18*			
437		**38**				*31*	*19*			
436		**39**				*32*	*20*			
435		**40**				*33*	*21*			
434		**41**	**0**	**Darius B**		*34*	*22*			
433		**42**	**1**			*35*	*23*			
432		[]	**2**			*36*	*24*			
431		[]	**3**			*37*	*25*			
430		[]	**4**			*38*	*26*			
429		[]	**5**			*39*	*27*			
428		[]	**6**			*40*	*28*			
427		[]	**7**			*41*	*29*			
426		[]	**8**			*42*	*30*			
425		**50**	**0**	**Xerxes II**		*43*	*31*			
424		**0**	51	**Darius II**		*44*	*32*			
423		**1**				*45*	*33*			
422		**2**				*46*	*34*			
421		**3**				*47*	*35*			
420		**4**				*48*	*36*			
419		**5**				*49*	*37*			
418		**6**				*50*	*38*			
417		**7**				*1*	*39*			
416		**8**				*2*	*40*			
415		**9**				*3*	*41*			
414		**10**				*4*	*42*			
413		**11**				*5*	*43*			
412		**12**				*6*	*44*			
411		**13**				*7*	*45*			
410		**14**				*8*	*46*			
409		**15**				*9*	*47*			
408		**16**				*10*	*48*			
407		**17**				*11*	*49*		*(49 = 7x7)*	*(Dn 9:25)*
406		**18**				*12*	*50*		*Jerusalem city achieved*	*Nh 12:22-43*
405		**19**	**0**	**Artaxerxes II**		*13*	*51*		*(inauguration)*	
404			**1**			*14*	*52*			

The Battle of Harran was a turning point in history because it marked the definitive end of the Assyrian Empire and the beginning of the 70-year domination of the Babylonian

empire: *these nations [including Tyre and Judea] will have to serve the king of Babylon for 70 years. But when 70 years have been fulfilled, I will call to account the king of Babylon and that nation for their error, declares Jehovah, and I will make the land of the Chaldeans a desolate wasteland [on October 539 BCE] for all time* (Jr 25:11-12). Nebuchadnezzar's reign is counted in two ways by Jeremiah however far from being a mistake this reckoning proves to be an amazing chronological accuracy. Indeed, the first 8 years of Babylonian domination (609-601) were through the pharaoh Necho, furthermore, Egyptians counted their years of reign from year 1, without accession (year 0) as Babylonians were doing, and the following years from 1st Thoth instead of 1st Nisan for Babylonians. Thus the 1st year of Nebuchadnezzar's reign was reckoned in 605 BCE because Joiaqim was under Babylonian rulership through Necho (Jr 25:1; 46:2). This chronological reckoning is it correct?

Given that the 1st year of Necho's reign began in 609 BCE it had to start after 1st Thoth but as there is no year 55 of Psammetichus I (which would have had to start also on 1st Thoth), Necho began to reign just after 1st Thoth, 23 January in 609 BCE[162]. Mesopotamian chronicles[163] describe the events from day to day, such as the Battle of Harran which involved several great kings simultaneously but without naming them (as for example Necho, king of Egypt, and Cyaxares, king of the Medes), except Aššur-uballit II, king of Assyria. According to Mesopotamian chronicles the Babylonians and the Medes put theirs armies together and marched to Harran against Aššur-uballit in the 16th year of Nabopolassar, month Arahsamna [November 610 BCE], but an army of Egypt came to help him. In the month Addaru [March 609 BCE] Nebuchadnezzar, the crown prince (co-regent), left his troops and their camp, and went home with his father. The 17th year in the month Du'uzu [July 609 BCE] Aššur-uballit with a large army from Egypt crossed the river Euphrates and marched against Harran to conquer it but until the month Ululu [September 609 BCE] they did battle against the city but achieved nothing. Four years later, the 20th year, the army of Egypt marched against the Babylonian king who went home in the month Šabatu [February 605 BCE]. In the 21st year Nabopolassar stayed in his own land [April 605 BCE], Nebuchadnezzar mustered the Babylonian army and marched to Karchemiš and completely defeated the Egyptian army and conquered the whole area of Hamath but on 8 Abu [14 August 605 BCE] Nabopolassar died and Nebuchadnezzar returned to Babylon on 1st Ululu [5 September 605 BCE].

The Babylonian chronicle gives a detailed account but omits one key element: why did Necho who came to help the Assyrian army not intervene in the Battle of Harran? According to Berossus a Babylonian writer, a priest of Bel Marduk and astronomer, in his *History of Babylonia* (c. 280 BCE), Necho was appointed satrap of Palestine and Phoenicia, presumably for his renunciation to support the Assyrian king at the Battle of Harran (which began July 609 BCE), but was then dismissed for having rebelled (February 605 BCE) against Nebuchadnezzar (Against Apion I:134-137). This turnaround explains why Necho's intervention in Syria was a victory according to Herodotus (The Histories II:159) and also why he was able to depose Jehoahaz (September 609 BCE) who he replaced by Jehoiakim, actually a vassal of Nebuchadnezzar (2Ki 24:1). Consequently the destruction of Jerusalem in Jeremiah's text is dated on 10/V/**19** of Nebuchadnezzar II (Jr 52:12), instead of the usual 10/V/**18** (Jr 52:29), because the Babylonian reign began under Egyptian administration. Concerning the day of the destruction of Jerusalem 10/V it is also dated 7/V (2Ki 25:8) and 9/V (9 Ab) in the Talmud (Taanit 28b; Mishna Taanit 4:6-8).

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162 http://www.chronosynchro.net/wordpress/convertisseur/

163 http://www.livius.org/cg-cm/chronicles/chron00.html
http://www.livius.org/cg-cm/chronicles/abc4/late-nabopolassar.html
http://www.livius.org/cg-cm/chronicles/abc5/jerusalem.html#1

The Talmud also reports that the fire began at night just after the conclusion of the Sabbath thus at sunset of the 9th day of the month of Ab the Babylonians set fire to the Temple (Taanit 29a). In other words, that year the day of the 9th of Ab itself took place on a Sunday. As the 1st Nisan is the 1st lunar crescent (= new moon +1)[164] after spring equinox[165] it is possible to find the exact day of the week[166] which matches to 9 Ab:

Year	Spring equinox	1 Nisan	1 Iyyar	1 Siwan	1 Tammuz	1 Ab	9 Ab	
587 BCE	27 March	22 April	21 May	20 June	19 July	18 August	27 August	Sunday
70 CE	22 March	31 March	30 April	29 May	27 June	27 July	4 August	Saturday

Chronological indications of the Talmud are excellent; the temple of Jerusalem was burned by Titus in 70 CE by a remarkable coincidence the same day of the year by Nebuchadnezzar in 587 BCE (Jewish War VI:250-253). The chronological reconstruction of the destruction of the first temple is as follows: Nebuzaradan the chief of the body-guard came to Jerusalem and began to burn the houses of the city on 7 Ab (Friday 25 August), then he had evacuated the city on the Sabbath dated on 8 Ab (Saturday 26 August), afterwards on 9 Ab he set fire to the Temple around sunset (c. 18:00-6:00 Sunday 27 August 587 BCE) and prevented the Jews from extinguishing it during the night, which was the beginning of 10 Ab (Monday 28 August 587 BCE). In 70 CE the temple burned until Sunday 5 August.

The oldest lunar eclipse in astronomical tablets (BM 32238) is after sunrise in Year 1 of king [Nabu]-Mukin-zeri in the first month of the year (9 April 731). Before that date, lunar eclipses are described in a more summary way which allows an absolute dating only if the study period is less than 10 years because lunar phenomena are cyclical and may recur (+/1 day) after the 11th year (1 year = 12 months + [1 intercalary month]):

- 11 solar years = 11 x 365.24519 = 4017.7 days
- 11 lunar years = (11x12 + 4) x 29.530588 = 4016.2 days

The dating of events over a period which the uncertainty is greater than 10 years requires the use of astronomical phenomena whose cycle is greater than 10 years such as solar eclipses or heliacal risings of Sirius (or Venus). Sirius and Venus were observed both by Babylonians and Egyptians because they are the brightest stars of the sky.

For example, Assyrian chronology may be rebuilt over the period 911-609 thanks to eponyms[167]. The list of Assyrian eponyms is anchored on the solar eclipse which occurred on Simanu in the eponymy of Bur-Sagale (15 June 763)[168]. The Assyrian period 911-648 is dated owing to its canonical eponyms[169] and the period 648-609 by a prosopography of its eponyms[170]. A few eponyms are non canonical because they died during the year of their eponymy and there are also some gaps of 1 year between eponym dates and regnal years in tablet with double dates because the first Assyrian regnal year (accession) was reckoned in either system: year 0 (Babylonian) or year 1 (Assyrian). Thus, as there are exactly 154 canonical eponyms between Gargamisaiu and Bur-Sagale, which is dated 763 BCE, that involves dating the one of Gargamisaiu in 609 (= 763 – 154).

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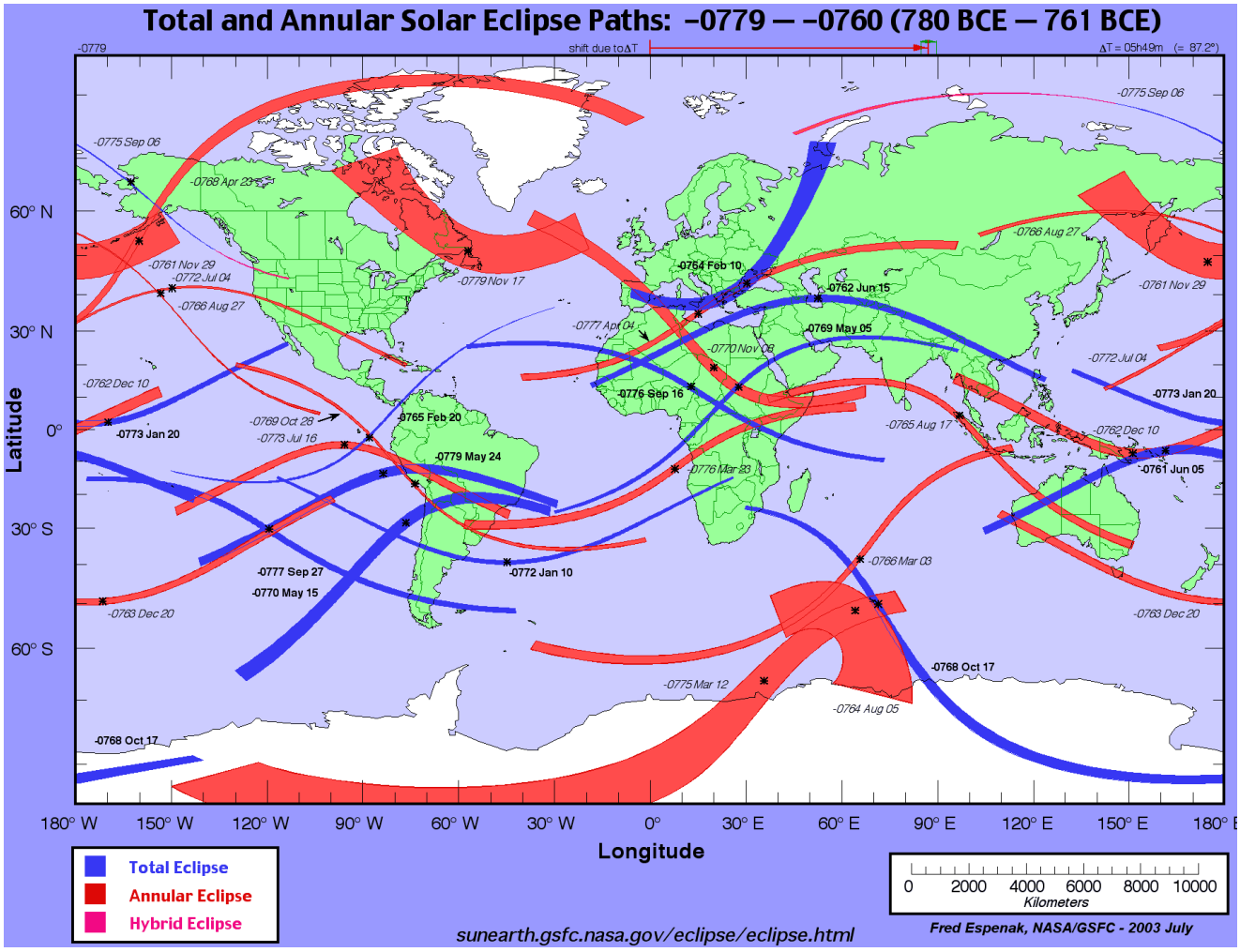
[164] http://www.fourmilab.ch/earthview/pacalc.html
http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php
[165] http://www.imcce.fr/fr/grandpublic/temps/saisons.php
[166] http://www.nr.com/julian.html
[167] http://www.livius.org/li-ln/limmu/limmu_1b.html
[168] http://eclipse.gsfc.nasa.gov/SEatlas/SEatlas-1/SEatlas-0779.GIF
[169] S. PARPOLA – Assyrian Chronology 681-648 BC.
in: Letters from Assyrian Scholars to the Kings Esarhaddon and Assurbanipal Part II Eisenbrauns, 2007) pp. 381-430.
[170] S. PARPOLA – The Prosopography of the Neo-Assyrian Empire
Helsinki 1998 University of Helsinki pp. XVIII-XX.



Year	Spring equinox	1 Nisan	29 Nisan	1 Iyyar	30 Iyyar	1 Siwan	29 Siwan	1 Tammuz
763 BCE	29 March	20 March	17 April	18 April	17 May	18 May	**15 June**	16 June

As solar eclipses occur during new moons (highlighted in black) for reasons of geometry (the sun, moon and earth must be perfectly aligned) the date [29] Siwan is excellent, however it can be noted that the 1st of Nisan is dated a little while (9 days) before the spring equinox. Anyway the only solar eclipse over Assyria during the period 800-750 BCE was the total eclipse dated 15 June 763 BCE (-762). Other solar eclipses have been suggested but it is noteworthy that the partial solar eclipses dated 4 June 800 BCE and 24 June 791 BCE were not able to be viewed over Assyria.

The Mesopotamian chronology of the period 1133-609 is reconstructed using the number of Assyrian eponyms (1 a year) and the length of Babylonian reigns (#) combined with the set of synchronisms among Assyrian and Babylonian kings in Annals:

ASSYRIAN KING	#	Reign	BABYLONIAN KING	#	Reign	JUDEAN RULER	#	Reign
Aššur-rêš-iši I	18	**1133**-1115	Ninurta-nâdin-šumi	6	**1133**-1127	Eli (*Philistines*)	40	1162-1122
Tiglath-pileser I	39	1115 -	Nebuchadnezzar I	22	1127-1105	Samson	20	1122-1102
			Enlil-nâdin-apli	4	1105-1101	Sons of Samuel	5	1102-1097
		-1076	Marduk-nâdin-ahhê	18	1101-1083	Saul	40	1097 -
Ašared-apil-Ekur	2	1076-1074	Marduk-šapik-zêri	13	1083-1070			-1057
Aššur-bêl-kala	18	1074-1056	Adad-apla-iddina	22	1070-1048	David	40	1057 -
Erîba-Adad II	2	1056-1054	Marduk-ahhê-erîba	1	1048-1047			
Šamšî-Adad IV	4	1054-1050	Marduk-zêr-[…]	12	1047-1035			
Aššurnaṣirpal I	19	1050-1031	Nabû-šum-libur	8	1035-1027			-1017
Shalmaneser II	12	1031-1019	Simbar-šipak	18	1027-1009	Solomon	40	1017 -
Aššur-nêrârî IV	6	1019-1013	Ea-mukîn-zêri	1	1009-1008			
Aššur-rabi II	41	1013 -	Kaššu-nâdin-ahi	2	1008-1006			
			Eulmaš-šakin-šumi	17	1006 -989			

			Ninurta-kudurri-uṣur I	3	989-986			
			Širiki-šuqamuna	1	986-985			
		-972	Mâr-bîti-apla-uṣur	5	985-980			-977
Aššur-rêš-iši II	5	972-967	Nabû-mukîn-apli	36	980-944	Roboam	17	977-960
Tiglath-pileser II	32	967-935	Ninurta-kudurri-uṣur II	3	944-943	Abiyam	3	960-957
Aššur-dân II	23	935-912	Mâr-bîti-ahhê-iddin		943- ?	Asa	41	957-916
Adad-nêrârî II	21	**912**-891	Šamaš-mudammiq		? -900	Jehosaphat	25	916-891
Tukultî-Ninurta II	7	891-884	Nabû-šum-ukîn I	12	900-888	Jehoram	8	893-885
Aššurnaṣirpal II	26	884-859	Nabû-apla-iddina	33	888-855	[Athaliah]	6	885-879
Shalmaneser III	35	859-824	Marduk-zâkir-šumi I	36	855-819	Joas	40	879-839
Šamšî-Adad V	13	824 -	Marduk-balâssu-iqbi	6	819-813	Amasiah	29	839 -
		-811	Bâba-ah-iddina		813			-810
Adad-nêrârî III	28	811 -	unknown kings		?	Uziah	52	810 -
		-783	Marduk-bêl-zêri		790?-780?			
Shalmaneser IV	10	783-773	Marduk-apla-uṣur		780?-770			
Aššur-dân III	18	**773**-755	Erîba-Marduk	9	770-761			-758
Aššur-nêrârî V	10	755-745	Nabû-šum-iškun	13	761-748	Jotham	16	758-742
Tiglath-pileser III	18	745 -	Nabû-naṣir	14	748-734	Ahaz	16	742 -
			Nabû-nâdin-zêri	2	734-732			
			Nabû-šum-ukîn II	1	732-731			
			Nabû-mukîn-zêri	2	731-729			
		-727	Tiglath-pileser III Pûlu	2	729-727			-726
Shalmaneser V	5	727-722	Shalmaneser V Ulûlaiu	5	727-722	Ezechias	29	726 -
Sargon II	17	722 -	Merodachbaladan II	12	722-710			
		-705	Sargon II	5	710-705			
Sennacherib	24	705 -	Sennacherib	2	705-703			
			Marduk-zakir-šumi II	0	703			
			Bêl-ibni	3	703-700			-697
			Aššur-nâdin-šumi	6	700-694	Manasseh	55	697 -
			Nergal-ušezib	1	694-693			
			Mušezib-Marduk	4	693-689			
		-681	Sennacherib	8	689-681			
Esarhaddon	12	681-669	Esarhaddon	12	681-669			
Aššurbanipal	42	669-627	Šamaš-šum-ukîn	40	668-648			-642
Aššur-etel-ilâni	4	630 -	Kandalanu	21	648 -	Amon	2	642-640
			Sin-šum-lišir		-627	Josias	31	640 -
		-626	Sin-šar-iškun	1	627-626			
Sin-šar-iškun	14	626-612	Nabopolassar	21	626 -			
Aššur-uballiṭ II	3	612-**609**			**609**			**-609**
					-**605**			

Chronology of Assyrian reigns can therefore be fully reconstructed starting from Aššur-uballiṭ II (612-609) up to Erišu I (N° 33), since all the years of reign between these two kings are known, being aware that Assyrian years are solar up to Aššur-dân I (1179-1133) and lunar prior to this king. The durations of four reigns are missing (N° 65, 66, 37, and 38), but they can be calculated through synchronisms from Assyrian annals that indicate the exact length between the reconstruction of some famous temples[171].

N°	ASSYRIAN KING	Reign	length	#		synchronisms
27	Sulili (Zariqum)	1954-1940	*[14]*			*First lists of eponyms (lost)*
28	Kikkia	1940-1927	*[14]*	*(-1)*		
29	Akia	1927-1913	*[14]*			*Fall of Ur* (in **-1912**)
30	Puzur-Aššur I	**1913**-1900	*[14]*	*(-1)*		*Beginning of the Paleo-Assyrian period*
31	Šalim-ahum	1900-1886	*[14]*			
32	Ilu-šumma	1886-1873	*[14]*	*(-1)*		
33	Êrišu I	1873-**1834**	40	(-1)	40	*First Chronicles*
34	Ikunum	1834-1821	14	(-1)	159	*(eponym starting on 1st Sippu)*
35	Sargon I	1821-1782	40	(-1)		

171 H. GASCHE, J.A. ARMSTRONG, S.W. COLE – Dating the Fall of Babylon in: Mesopotamian History and Environment (1998) Chicago pp. 57-80.

36	Puzur-Aššur II	1782-1774	8			
37	Naram-Sîn	1774-1722	[54]	(-2)		
38	Êrišu II	1722-1712	[10]			
39	Šamšî-Adad I	1712-**1680**	33	(-1)		year 33 of Šamšî-Adad I =
40	Išme-Dagan I	1680-1670	11	(-1)	434	= year 17 of Hammurabi (1697-1680)
41	Aššur-dugul	1670-1664	6			41* Mut-Aškur/ Rimu-x/ Asîsum
42	Aššur-apla-idi	1664	0			
43	Nâṣir-Sîn	1664	0			
44	Sîn-namir	1664	0			
45	Ipqi-Ištar	1664	0			
46	Adad-ṣalûlu	1664	0			
47	Adasi	1664	0			
48	Bêlu-bâni	1664-1654	10			
49	Libbaya	1654-1638	17	(-1)		
50	Šarma-Adad I	1638-1626	12			
51	Puzur-Sîn	1626-1615	12	(-1)		
52	Bazaya	1615-1588	28	(-1)		
53	Lullaya	1588-1582	6			
54	Šû-Ninûa	1582-1568	14			
55	Šarma-Adad II	1568-1565	3			
56	Êrišu III	1565-1553	13	(-1)		
57	Šamšî-Adad II	1553-1547	6			
58	Išme-Dagan II	1547-1531	16			
59	Šamšî-Adad III	1531-1516	16	(-1)		
60	Aššur-nêrârî I	1516-1491	26	(-1)		
61	Puzur-Aššur III	1491-1467	24			
62	Enlil-nâṣir I	1467-1455	13	(-1)		
63	Nûr-ili	1455-1443	12			
64	Aššur-šadûni	1443-1443	0			
65	Aššur-rabi I	1443-1433	[10*]			
66	Aššur-nâdin-aḫḫe I	1433-1424	[10*]	(-1)		
67	Enlil-naṣir II	1424-1418	6			
68	Aššur-nêrârî II	1418-1411	7			
69	Aššur-bêl-nišešu	1411-1403	9	(-1)		
70	Aššur-rê'im-nišešu	1403-1395	8			
71	Aššur-nâdin-aḫḫe II	1395-1385	10			
72	Erîba-Adad I	1385-1358	27	-		
73	Aššur-uballiṭ I	1358-1323	36	(-1)		
74	Enlil-nêrârî	1323-1313	10	-		
75	Arik-dên-ili	1313-1302	12	(-1)		
76	Adad-nêrârî I	1302-1271	32	(-1)		
77	Salmanazar I	1271-**1259**	12			434 *eponyms from Išme-Dagan I*
		1259-1242	18	(-1)	580	452 = 434 + 12
78	Tukultî-Ninurta I	1242-1206	37	(-1)		
79	Aššur-nâdin-apli	1206-1203	4	(-1)		
80	Aššur-nêrârî III	1203-1197	6	-		
81	Enlil-kudurri-uṣur	1197-1192	5	-		
82	Ninurta-apil-Ekur	1192-1179	13	-		
83	Aššur-dân I	1179-**1133**	46	-		*(eponym starting on 1st Nisan:*
84	Ninurta-tukultî-Aššur	1133	0	-		*as Babylonian intercalation)*
85	Mutakkil-Nusku	1133	0	-		
86	Aššur-rêš-iši I	1133-1115	18	-		
87	Tiglath-phalazar I	1115-1076	39	-		*Several double dates (Assyrian/ Babylonian)*
88	Ašared-apil-Ekur	1076-1074	2	-		*(Babylonian calendar used)*
89	Aššur-bêl-kala	1074-1056	18	-		
90	Erîba-Adad II	1056-1054	2	-		
91	Šamšî-Adad IV	1054-1050	4	-		
92	Aššurnaṣirpal I	1050-1031	19	-		
93	Salmanazar II	1031-1019	12	-		
94	Aššur-nêrârî IV	1019-1013	6	-		
95	Aššur-rabi II	1013-972	41	-		
96	Aššur-rêš-iši II	972-967	5	-		

97	Tiglath-phalazar II	967-935	32	-	
98	Aššur-dân II	935-912	23	-	
99	Adad-nêrârî II	912-891	21	-	
100	Tukultî-Ninurta II	891-884	7	-	
101	Aššurnaṣirpal II	884-859	25	-	
102	Salmanazar III	859-824	35	-	
103	Šamšî-Adad V	824-811	13	-	
104	Adad-nêrârî III	811-783	28	-	
105	Salmanazar IV	783-773	10	-	
106	Aššur-dân III	773-755	18	-	
107	Aššur-nêrârî V	755-745	10	-	
108	Tiglath-phalazar III	745-727	18	-	
109	Salmanazar V	727-722	5	-	
110	Sargon II	722-705	17	-	
111	Sennacherib	705-681	24	-	
112	Assarhaddon	**681-669**	12	(72)	-
113	Aššurbanipal	669-627	42		-
	[Aššur-etel-ilâni]	[630-627]	[3]		-
114	Aššur-etel-ilâni	627-626	1		-
115	Sin-šar-iškun	626-612	14		-
116	Aššur-uballiṭ II	612-**609**	3		-

The synchronism: year 33 of Šamšî-Adad I (1712-1680) = year 17 of Hammurabi (1697-1654) enables the dating of Babylonian reigns before Samsuditana (1530-1499), the last Babylonian king before the sack of Babylon by the Hittite king Mursili I, which is considered crucial to calculations of the early chronology[172] of the ancient Near East. 15 royal chronicles enable one to reconstruct the Babylonian and Kassite chronologies:

n°	KASSITE KING	Reign	#	King Lists	Highest date	BABYLONIAN KING	Reign	#
						Sûmû-abum	1799-1785	14
						Sûmû-la-Il	1785-1749	36
						Sâbium	1749-1735	14
						Apil-Sîn	1735-1717	18
						Sîn-muballiṭ	1717-1697	20
						Hammurabi	**1697**-1654	43
1	Gandaš	*1661-1635*	26	**[2]6**		Samsu-iluna	1654 - -1616	38
2	Agum I	*1635-1613*	22	**22**				
3	Kaštiliaš I	*1613-1591*	22	**22**		Abi-ešuḫ	1616-1588	28
4	Ušši	*1591-1583*	8	**8**		Ammiditana	1588 - -1551	37
5	Abirattaš	*1583-1567*	*[16]*					
6	Kaštiliaš II (?)	*1567-1551*	*[16]*					
7	Urzigurumaš (?)	*1551-1535*	*[16]*			Ammiṣaduqa	**1551-1530**	21
8	Harbašihu (?)	*1535-1519*	*[16]*			Samsuditana	1530 - **-1499**	31
9	Tiptakzi	*1519-1503*	*[16]*					
10	Agum II	*1503-1487*	*[16]*			*"Babylon's restoration"*	**1498** - -1457	41
11	Burna-Buriaš I	*1487-1471*	*[16]*					
12	Kaštiliaš III	*1471-1455*	*[16]*					
13	Ulam-Buriaš	*1455-1439*	*[16]*				**1457** -	
14	Agum III	*1439-1423*	*[16]*					
15	Kadašman-Harbe I	*1423-1407*	*[16]*					
16	Kara-indaš	*1407-1391*	*[16]*					
17	Kurigalzu I	*1391-1375*	*[16]*					
18	Kadašman-Enlil I	**1375**-1360	15		**15**			
19	Burna-Buriaš II	1360-1333	27		**27**			
20	Kara-ḫardaš	1333	0		**0**			
21	Nazi-Bugaš	1333	0		**0**			
22	Kurigalzu II	1333-1308	25	**[25]**	24			
23	Nazi-Maruttaš	1308-1282	26	**26**	24			

[172] R. PRUZSINSKY – Mesopotamian Chronology of the 2nd Millennium B.C. Wien 2009 Ed. Österreichischen Akademie der Wissenschaften pp. 17-104.

24	Kadašman-Turgu	1282-1264	18	**18**	17			
25	Kadašman-Enlil II	1264-1255	9	[10 (+x)]	8 [**9**?]			
26	Kudur-Enlil	1255-1246	9	[6]	**9**			
27	Šagarakti-šuriaš	1246-1233	13	13	**13**			
28	Kaštiliašu IV	1233-1225	8	**8**	8			
	[Tukulti-Ninurta I]	[1225-1224]	[1]		**[1]**			
29	Enlil-nâdin-šumi	1225-1224	1	1,5	**1**			
30	Kadašman-Harbe II	1224-1223	1	1,5	**1**			
31	Adad-šuma-iddina	1223-1217	6	**6**	0			
32	Adad-šuma-uṣur	1217-1187	30	**30**	13			
33	Meli-Šipak	1187-1172	15	**15**	12			
34	Marduk-apla-iddina	1172-1159	13	**13**	6			
35	Zababa-šuma-iddina	1159-1158	1	**1**				
36	Enlil-nâdin-ahi	1158-**1155**	3	**3**				
						Marduk-kabit-aḫḫešu	**1155**-1141	14
						Itti-Marduk-balaṭu	1141-**1133**	8

However the fall of Babylon is set in 1595 BCE instead of 1499 BCE by a majority of Assyriologists[173]. This date, based on the Venus Tablet (astronomical tablet), is chosen mainly as it is consistent with the chronology accepted by most historians of the late 20th century, hence the name of "Middle chronology". According to the Venus Tablet, there are only four possible dates for the sacking of Babylon. This astronomical tablet (*Enuma Anu Enlil 63*)[174], copied in 7th century BCE, describes the rising and setting of Venus during the reign of Ammisaduqa (a descendant of Hammurabi):

Year 1 inferior Venus sets on Shabatu 15 and after 3 days rises on Shabatu 18
Year 2 superior Venus vanishes E. on Arahsamnu 21 and after 1 month 25 days appears W. on Tebetu 16
Year 3 inferior Venus sets on Ululu 29 and after 16 days rises on Tashritu 15
Year 4 superior Venus vanishes E. on Dumuzi 3 and after 2 months 6 days appears W. on Ululu 9
Year 5 inferior Venus sets on Nisan 29 and after 12 days rises on Ayar 11
Year 5 superior Venus vanishes E. on Kislimu 27 and after 2 months 3 days appears W. on Shabatu 30
Year 6 inferior Venus sets on Arahsamnu 28 and after 3 days rises on Kislimu 1
Year 7 superior Venus vanishes E. on Abu 30 and after 2 months appears W. on Tashritu 30
Year 8 inferior Venus sets on Dumuzi 9 and after 17 days rises on Dumuzi 26
Year 8 superior Venus vanishes E. on Adar 27 and after 2 months 16 days appears W. on Simanu 13
Year 9 inferior Venus sets on Adar 12 and after 2 days rises on Adar 14
Year 10 superior Venus vanishes E. on Arahsamnu 17 and after 1 month 25 days appears W. on Tebetu 12
Year 11 inferior Venus sets on Ululu 25 and after 16 days rises on II Ululu 11
Year 12 superior Venus vanishes E. on Ayar 29 and after 2 months 6 days appears W. on Abu 5
Year 13 inferior Venus sets on Nisan 25 and after 12 days rises on Ayar 7
Year 13 superior Venus vanishes E. on Tebetu 23 and after 2 months 3 days appears W. on Adar 26
Year 14 inferior Venus sets on Arahsamnu 24 and after 3 days rises on Arahsamnu 27
Year 15 superior Venus vanishes E. on Abu 26 and after 2 months appears W. on Tashritu 26
Year 16 inferior Venus sets on Dumuzi 5 and after 16 days rises on Dumuzi 21
Year 16 superior Venus vanishes E. on Adar 24 and after 2 months 15 days appears W. on Simanu 9
Year 17 inferior Venus sets on Adar 8 and after 3 days rises on Adar 11
Year 18 superior Venus vanishes E. on Arahsamnu 13 and after 1 month 25 days appears W. on Tebetu 8
Year 19 inferior Venus sets on II Ululu 20 and after 17 days rises on Tashritu 8
Year 20 superior Venus vanishes E. on Simanu 25 and after 2 months 6 days appears W. on Ululu 1
Year 21 inferior Venus sets on Nisan 22 and after 11 days rises on Ayar 3
Year 21 superior Venus vanishes E. on Tebetu 19 and after 2 months 3 days appears W. on Adar 22

[173] F. JOANNÈS - Dictionnaire de la civilisation mésopotamienne
Paris 2001 Éd. Robert Laffont pp. 164,522,565,758.
F. JOANNÈS - La Mésopotamie au 1er millénaire avant J.C.
2000 Paris Ed. Armand Colin pp. 186-187.
J.A. BRINKMAN – Materials and Studies for Kassite History Vol. I
Chicago 1976 Ed. The Oriental Institute of the University of Chicago pp. 6-34.
J.J. GLASSNER – Chroniques mésopotamiennes (n°22)
Paris 1993 Éd. Belles Lettres pp. 137-179.
[174] E. REINER, D. PINGREE – Babylonian Planetary Omens. Part 1. The Venus Tablet of Ammisaduqa
Malibu 1975 Ed. Undena Publications pp. 17-62.

Although the interpretation of this astronomical tablet is difficult[175], because much data appears to have been poorly copied, the fall of Babylon can be dated to the period 1500-1700 only according to four possibilities[176] (below):

Chronology (BCE):	Ultra-Low	#	Low	#	Middle	#	High	#
Fall of Ur	1912		1944		2004		2064	
Reign of Hammurabi	1697-1654		1729-1686		1793-1750		1849-1806	
Reign of Ammisaduqa	**1551-1530**		1583-1562		1647-1626		1703-1682	
Venus rises Year 1 (computed)	14-Feb 1549	0	24-Feb 1581	0	14-Mar 1645	0	31-Mar 1701	0
Shabatu 18 Year 1 (observed)	27-Feb 1549	+13	19-Feb 1581	-5	9-Mar 1645	-6	28-Mar 1701	-3
Fall of Babylon	1499		1531		1595		1651	

Despite the excellent agreement with the fall of Babylon in 1499 BCE[177] the Ultra-Low chronology is considered too low compared to Kassite and Hittite chronologies. This criticism is unfounded[178] (below synchronisms are highligthed), because these chronologies are very approximate: most durations of reigns are unknown and they have no link with any astronomical events. In addition, dendrochronological dating of the Acemhöyüke palace requires locating the death of Šamšî-Adad I after 1752 BCE[179] eliminating the Middle Chronology which dates this reign 1807-1775, at least 23 years too early.

AKKADIAN			BABYLONIAN	Reign	#	SUMERIAN ISINIAN	Reign	#
			Sâbium	1749 - -1735	14	Iter-piša	1740-1736	[4]
						Ur-dukuga	1736-1732	[4]
			Apil-Sîn	1735-1717	18	Sîn-mâgir	1732-1721	11
			Sîn-muballiṭ	1717-1697	20	Damiq-ilîšu I	1721-1698	23
KASSITE	Reign	#	Hammurabi	1697-1654	43	SEALAND	Reign	#
Gandaš	*1661-1635*	[2]6	Samsu-iluna	1654 - -1616	38	Ilum-maz-ilî	*1654 - -1594*	60
Agum I	*1635-1613*	22						
Kaštiliaš I	*1613-1591*	22	Abi-ešuḫ	1616-1588	28			
Uššı	*1591-1583*	8	Ammiditana	1588 - -1551	37	Itti-ili-nîbî	*1594-1578*	*[16]*
Abirattaš	*1583-1567*	*[16]*				Damqi-ilišu II	*1578-1562*	*[16]*
Kaštiliaš II (?)	*1567-1551*	*[16]*				Iškibal	*1562-1546*	*[16]*
Urzigurumaš (?)	*1551-1535*	*[16]*	Ammiṣaduqa	1551-1530	21	Šušši	*1546-1530*	*[16]*
Harbašihu (?)	*1535-1519*	*[16]*	Samsuditana	1530 - **-1499**	31	Gulkišar	*1530-1514*	*[16]*
Tiptakzi	*1519-1503*	*[16]*				Pešgaldarameš	*1514-1498*	*[16]*
Agum II	*1503-1487*	*[16]*			300	Ayadaragalama	*1498-1482*	*[16]*
Burna-Buriaš I	*1487-1471*	*[16]*				Akurulana	*1482-1466*	*[16]*
Kaštiliaš III	*1471 - -1455*	*[16]*				Melamkukurra	*1466-1459*	7
						Ea-gam[il]	*1459 - -1450*	9
Ulam-Buriaš	*1455-1439*	*[16]*						
Agum III	*1439-1423*	*[16]*						
Kadašman-Harbe I	*1423-1407*	*[16]*						
Kara-indaš	*1407-1391*	*[16]*						
Kurigalzu I	*1391-1375*	*[16]*						
Kadašman-Enlil I	**1375**-1360	15						
Burna-Buriaš II	1360-1333	27						
Kara-ḫardaš	1333	0						
Nazi-Bugaš	1333	0						
Kurigalzu II	1333-1308	25						

[175] V.G. GURZADYAN – The Venus Tablet and Refraction
in: *Akkadica 124* (2003) pp. 13-17 (http://arxiv.org/pdf/physics/0311036).
[176] V.G. GURZADYAN – On the Astronomical Records and Babylonian Chronology
in: *Akkadica* 119-120 (2000) pp. 175-184.
[177] H. GASCHE – La fin de la première dynastie de Babylone : une chute difficile
in: *Akkadica* 124 (2003) pp. 205-221.
[178] G. GERTOUX – Moses and the Exodus: Chronological, Historical and Archaeological Evidence
Raleigh 2015, Ed. Lulu.com, pp.183-248.
[179] C. MICHEL, P. ROCHER – La chronologie du IIe millénaire revue à l'ombre d'une éclipse de soleil
in: *Jaarbericht (...) Ex Oriente Lux* N° 35/36 (1997-2000) Chicago pp. 111-126.

How does one read the Venus Tablet? For example the line: *Year **8** superior Venus vanishes East on Adar 27 and after 2 months 16 days appears West on Simanu 13*, can be dated as follows if we suppose the year 1543 BCE (-1542):

-1542	1 Adar	Spring equinox	1 Nisan	1 Iyyar	1 Siwan		1 Tammuz	1 Ab
	3 March	4 April	2 April	1 May	30 May		29 June	29 July
	27 Adar		29 Nisan	29 Iyyar	13 Siwan	30 Siwan	30 Tammuz	29 Ab
	29 March		30 April	29 May	11 June	28 June	28 July	26 August

It is thus possible to reconstruct the 25 months of the astronomical tablet and to compare them with those of the inscription, unfortunately no solution, depending on the selected year, gives a perfect fit[180]. Consequently another way of dating is used, it is based on the Venus cycle. Indeed, we can see that years 5, 13 and 21 (with a periodicity of 8 years) give substantially the same values with a 4-day shift, which comes from the cycles of the moon and Venus. If an astronomical phenomenon occurs at exactly the same time each year it will be noted with an advance of 2 days[181] at the end of eight years. The same pattern repeats a 1-day shift every 8 years because 8 sidereal orbital periods of the Earth (365.25636 days - slightly longer than the tropical year) is 2922.06 days, and 13 sidereal orbital periods of Venus (224.701 days) is 2921.11 days. Thus, after this period both Venus and Earth have returned to very nearly the same point (1 day) in each of their respective orbits. If the Sun and Venus are perfectly aligned (Transit of Venus), the heliacal rising and setting of Venus occur on the same dates shifted by 2 or 3 days every 8 years. A transit of Venus[182] across the Sun takes place when the planet Venus passes directly between the Sun and Earth (or another planet), becoming visible against (and hence obscuring a small portion of) the solar disk. During a transit, Venus can be seen from Earth as a small black disk moving across the face of the Sun. The duration of such transits is usually measured in hours (the transit of 2012 lasted 6 hours and 40 minutes). A transit is similar to a solar eclipse by the Moon. While the diameter of Venus is more than 3 times that of the Moon, Venus appears smaller, and travels more slowly across the face of the Sun, because it is much farther away from Earth. Transits of Venus are among the rarest of predictable astronomical phenomena. They occur in a pattern that generally repeats itself every 243 years, with pairs of transits 8 years apart separated by long gaps of 121.5 years and 105.5 years[183]. Given that the astronomical data during Ammisaduqa's 21-year reign over the period of 8 years are shifted 4 days, instead of 2 or 3 when the transit of Venus exactly occurs, it means that it was close to this transit. Transits of Venus are as follows:[184]

Date	greatest (UT)	Ammisaduqa	Date	greatest (UT)	Ammisaduqa
-1998 Nov 18	11:20		-1641 May 20	18:02	1582-1561 (L)
-1892 May 21	19:26		-1520 Nov 20	23:44	1550-1529 (UL)
-1884 May 19	12:30		-1512 Nov 18	12:51	
-1763 Nov 20	22:56	1702-1681 (H)	-1406 May 23	05:57	
-1755 Nov 18	12:18		-1398 May 20	23:03	
-1649 May 23	00:45	1646-1625 (M)	-1277 Nov 22	00:09	

[180] http://arxiv.org/abs/physics/0311035v1

[181] 2 days = 8x365.24519 days – (8x12 + 3)x29.530588 days (= -1.6)

[182] http://en.wikipedia.org/wiki/Transit_of_Venus

[183] Venus, with an orbit inclined by 3.4° relative to the Earth's, usually appears to pass under (or over) the Sun at inferior conjunction. A transit occurs when Venus reaches conjunction with the Sun at or near one of its nodes —the longitude where Venus passes through the Earth's orbital plane (the ecliptic)— and appears to pass directly across the Sun. Although the inclination between these two orbital planes is only 3.4°, Venus can be as far as 9.6° from the Sun when viewed from the Earth at inferior conjunction. Since the angular diameter of the Sun is about 0.5° degree, Venus may appear to pass above or below the Sun by more than 18 solar diameters during an ordinary conjunction.

[184] http://eclipse.gsfc.nasa.gov/transit/catalog/VenusCatalog.html

The best fit is with the "Middle chronology (M)", but it contradicts the chronology obtained from the Assyrian eponyms. The fit with the "Ultra-Low chronology (UL)" is good because there is only a shift of an 8-year cycle. For this, one has to check the alignment gap between Venus and the sun relative to its position during transit. For example during the transit of Venus in 1513 BCE (= -1512*), this planet "crossed" the sun (see opposite figure). The observations were performed in Babylon[185]. Actually the best way for dating the fall of Babylon[186] is to use a couple of well known lunar eclipses. A tablet of astronomical omens[187] (*Enuma Anu Enlil 20*) mentions a lunar eclipse, dated 14 Siwanu, at the end of the reign of Šulgi (14/III/**48**) and another (*Enuma Anu Enlil 21*) mentions a lunar eclipse, dated 14 Addaru, at the end of the Ur III dynasty ending with the reign of Ibbi-Sin (14/XII/**24**). These two lunar eclipses were separated by 42 years of reign (42 = 9 years of Amar-Sin + 9 years of Šu-Sîn + 24 years of Ibbi-Sin). Over the period 2200-1850 there were only three couples of eclipses[188], spaced by 42 years, matching the description of astronomical omens[189]:

1st eclipse (14/III/**48**)	Magnitude	2nd eclipse (14/XII/**24**)	Magnitude	gap (1st - 2nd)		Chronology
13/08/2189	1.21	12/03/2107	1.00	82 years		
12/05/2175	1.80	"	"	68 years		
04/07/2150	1.32	"	"	43 years	≈	
25/07/2095	1.32	04/05/2063	1.78	32 years		
[2106]#		[2064]#				High
"	"	13/04/2053	0.63	**42** years	**OK**	
"	"	11/02/2031	1.14	64 years		
[2046]#		[2004]#				Middle
26/06/2019	1.07	24/04/2016	1.84	3 years		
"	"	15/03/1977	0.82	**42** years	**OK**	
"	"	04/03/1976	1.47	43 years	≈	
25/05/2008	0.96	15/04/1969	1.84	39 years		
18/07/2002	1.08	23/02/1929	1.63	73 years		
[1986]#		[1944]#				Low
27/06/1954	1.39	06/03/1911	1.72	**42** years	**OK**	**Ultra Low**
18/07/1937	0.75	14/02/1901	0.94	36, years		
18/05/1915	1.47	14/02/1882	1.58	33 years		
"	"	27/03/1875	1.82	40 years		
28/06/1908	1.04	"	"	33 years		

185 http://www.fourmilab.ch/cgi-bin/Yourhorizon
latitude 32°33' North; longitude 44°26' East; Universal Time: -1512-11-18 12:51; Azimuth: 240°; Field of view: 45°.
186 B. BANJEVIC – Ancient Eclipses and Dating the Fall of Babylon
in: *Publ. Astron. Obs. Belgrade* N° 80 (2006) pp. 251-257.
187 The series was probably compiled in its canonical form during the Kassite period but there was certainly some form of prototype in the Old Babylonian period.
188 http://xjubier.free.fr/en/site_pages/lunar_eclipses/5MCLE/xLE_Five_Millennium_Canon.html
189 P.J. HUBER – Astronomy and Ancient Chronology
in: *Akkadica* 119-120 (2000) pp. 159-176.

Teije de Jong regards Šamšî-Adad I's death dated 1776 BCE +/- 10 indirectly by C14 (instead of 1680 BCE) as an absolute date[190] but C14 dating is not absolute. It is noteworthy that in a tablet of Mari, Ašqudum (eponym N°193) mentions a [total] lunar eclipse[191] dated: day 14 [month Dagan], (14 August -1686?) but unfortunately we don't know for which year it is referred (a short timee before or during his eponymy).

Lunar eclipse matching the (# = NO):			Fall of Babylon	Chronology
Last year of Šulgi (14/III/**48**)	Fall of Ur III (14/XII/**24**)	Year 12/13 of Hammurabi	According to Venus Tablet	
[2106]#	[2064]#	[1836]#	1651	High
25/07/2095	13/04/2053		#	
[2046]#	[2004]#	[1780]#	1595	Middle
26/06/2019	15/03/1977		#	
[1986]#	[1944]#	03/09/1716	1531	Low
27/06/1954	06/03/1911	07/12/1684	**1499**	Ultra-Low

Anyone who has a scientific background would be amazed to learn that most current historians support the Middle Chronology in spite of the fact that they know it is false. This may seem strange, but they prefer to join a consensus that still prevails rather than to defend a minority truth. It is easy to make fun of this choice, not very brave, but challenging a truth means challenging the authority which validated it. We are in a world where truth is polytheistic with scientific truths ("real truths") but also historical, religious, political, legal, etc. For example, for scientists man appeared by chance a few millions of years ago ("*once upon a time in a far away country*"), for historians History begins around -3000 (after prehistory which belongs to Dark Ages), for Orthodox believers man was created by God around 5509 BCE "according to the Bible", for Catholics around 4024 BCE "according to the Bible", for Jews in 3761 BCE "according to the Bible", etc. If you are both scientific and religious or scientific and historian you risk to become schizophrenic as shown by the famous Galileo affair when this scholar tried to solve the conflict between his astronomical observations and the biblical interpretation of his Church (Catholic). In 1610, Galileo published his *Sidereus Nuncius* in which he argued that the tides were evidence of the motion of the Earth and promoted the theory of Copernicus. These ideas created conflicts with other scientists and Catholic scholars. Galileo's part in the controversies culminated in his trial and sentencing by the Roman Inquisition in 1633 on a grave suspicion of heresy. Galileo was considered as a heretic by his Church because his assertions contradicted the Bible which says "clearly" that the sun is setting and rising and, sometimes, motionless (Jos 1:4,15; 10:12). Consequently for its own safety it was more comfortable to accept a polytheist truth rather than a monotheist truth. Egyptologists in this area are favoured because each one has his own chronology and consequently his own truth. The accuracy of Egyptian chronology being considered according to the reputation of Egyptologists (new Pharaohs?) not according to astronomy.

It is unfortunate that Egyptologists are not interested in scientific chronology because Egyptian documents contain many heliacal risings of Sirius and lunar dates that enable one to get absolute dates until 2774 BCE. Egyptologists know it is possible to date Djer's reign by means of a heliacal rising of Sirius[192] (18 July 2774 BCE) but they prefer to refer to educated guesses for dating his reign as follows: 3100-3055 (Grimal); 2999-2949 (von Beckerath); 2939-2892 (Malek); 2870-2823 (Krauss); xxx-xxx (your favourite).

[190] T. DE JONG – Astronomical Fine-tuning of the Chronology of the Hammurabi Age
in: *Jaarbericht (...) Ex Oriente Lux* N° 44 (2012-2013) pp. 147-163.
[191] W. HEIMPEL – Letters to the King of Mari: A New Translation, With Historical Introduction, Notes, and Commentary
Leiden 2003 Ed. Eisenbrauns pp. 190, 209-210.
[192] J. VERCOUTTER – L'Égypte et la vallée du Nil Tome 1 Des origines à la fin de l'Ancien Empire
Paris 1992 Éd. Presses Universitaires de France p. 213.

DATING THE REIGN OF THUTMOSE III THROUGH ASTRONOMY

The relative chronology of Thutmoses III's reign is approximate due to numerous variants in the sequence of pharaohs and also in the length of certain reigns[193]:

	Redford	Hornung	Carbon 14	Krauss	Dodson	[Gertoux]	Helck
Thutmose III	1504-1452	1490-1436	1486-1434	1479-1425	1479-1424	1472-1418	1467-1413

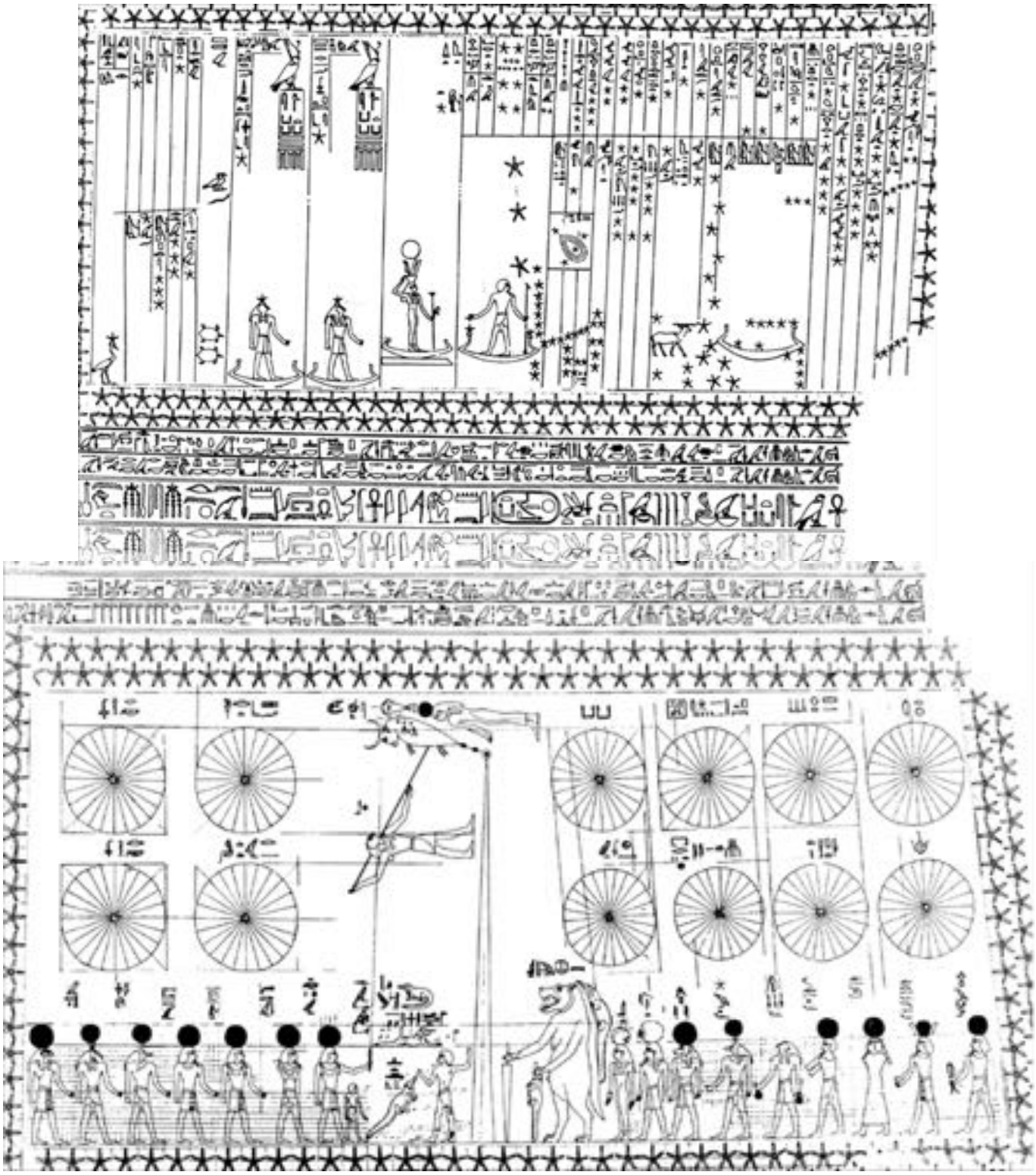
There is thus a 37-year gap between these chronologies. What is quite ironic is that all these Egyptologists claim to rely on astronomy to calculate their chronology. Where is the bug? The reign of Thutmose III is based on the following chronological data:

- It is dated 1486-1434 BCE +/- 15 years by Carbon 14[194].
- The date of accession is: year 1, I Shemu 4, and date of death is: year 54, III Peret 30 (length of his reign: 53 years 11 months)[195]. Years of reign are counted from the date of accession (I Shemu 4) and not from 1st Thoth (I Akhet 1). Moreover, Thutmose III began to reign independently, without Hatshepsut, presumably from year 22, II Peret 10, according to the Armant Stela.
- The astronomical ceiling of Senenmut's tomb gives the position of several constellations and planets, known at this time. Some of them are easy to identify as the Big Dipper, Orion, Venus, Mars, Mercury, Saturn and Jupiter. This ceiling describes a right ascension of Jupiter between 75° and 95° where Mars is not visible, which could occur in the period from 1455 to 1505, only during the night on 14 November 1463 BCE according to astronomy[196]. Senenmut was a very important person under Hatshepsut, thus it is possible to find the year of the reign when the ceiling of his grave was designed. Senenmut received the prestigious title of "Grand Steward of Amun" probably around the 5th or the 7th year of Thutmose III and also had the rare privilege for an individual of developing a royal tomb and appending his own grave. The ostraca of this tomb[197] can set the year in which the ceiling was realized, because masonry and stone cutting started on IV Peret 2, year 7 of Thutmose III and spread out through year 9. As ostracon No. 80 states that the door of the chapel was opened on III Akhet 27, year 11, we can assume that the development work and decoration, such as the astronomical ceiling design (from the observation) were performed at the end of the development work in year 9 or 10. According to Dorman[198], Senenmut monuments and those of the vast complex of Deir el-Bahari were probably built in parallel. The posthumous disgraces of Senenmut and Queen Hatshepsut led to a hammering and rewriting of their cartouches, which creates conflicting dates[199]. These two disgraces are unexplained since the mummy of Thutmose I was placed (in year 16) in the sarcophagus of Hatshepsut beside another which was built after his death[200] (in year 22). However, the start date of the tomb is Year 7. As

193 M. DESSOUDEIX – Chronique de l'Égypte ancienne
Paris 2008 Éd. Actes Sud p. 267.
194 C.B. RAMSEY, M.W. DEE, J.M. ROWLAND, T.F. G. HIGHAM, S.A. HARRIS, F. BROCK, A. QUILES, E.M. WILD, E.S. MARCUS, A.J. SHORTLAND - Radiocarbon - Based Chronology for Dynastic Egypt in: *Science* Vol 328 (10 june 2010) pp. 1554-1557.
http://www.sciencemag.org/cgi/data/328/5985/1554/DC1/1
195 C. VANDERSLEYEN - L'Egypte et la vallée du Nil Tome 2
Paris 1995 Éd. Presses Universitaires de France pp. 271-318.
196 C. LEITZ – Le premier plafond astronomique dans la tombe de Senmout
in: *Les dossiers d'archéologie* n°187 S (Novembre 1993) pp. 116,117.
197 W.C. HAYES – Ostraka and Name Stones from the Tomb of Sen-mut (TT71) at Thebes
New York 1942 Ed. Arno Press pp. 7,21-23.
198 P.F. DORMAN – The Monuments of Senenmut. Problems in Historical Methodology
New York Ed. Kegan Paul International pp. 66-109.
199 C. DESROCHES NOBLECOURT – La reine mystérieuse Hatshepsout
Paris 2002 Éd. Pygmalion p. 58.
200 C. LALOUETTE – Thèbes ou la naissance d'un empire
Paris 1995 Éd. Flammarion pp. 270-271.

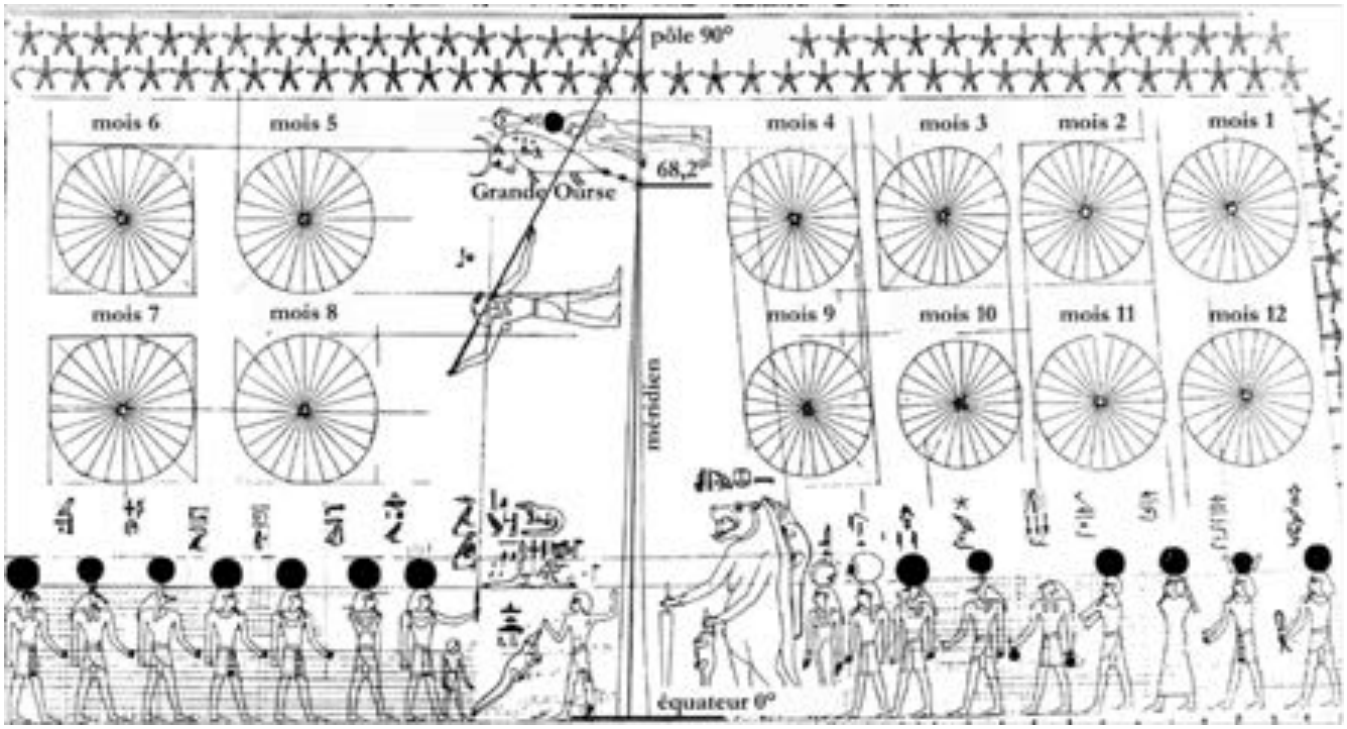
Senenmut's tomb is only a small part of the vast complex, 2 years of construction seem to have been sufficient to complete the ceiling. The famous expedition to Punt, for example, which is represented on a retaining wall of the temple[201], is dated year 9. Astronomical observation represented on the ceiling must therefore date from this year 9 of Thutmose III, which sets the accession of the pharaoh in 1472 (= 1463 + 9) BCE and his reign from 08/1472 to 03/1418, according to the accession date.

This scientific dating is unanimously rejected by Egyptologists because it does not fit with their own chronologies. Some of them even dare to argue that the astronomical ceiling of Senenmut (below) cannot be dated with certainty.



[201] C. GRAINDORGE – Deir El Bahari le temple de millions d'années
in: *Les dossiers d'archéologie* n°187 S (11/1993) pp. 72-75.

The vertical line in the middle represents the meridian, the floor line (horizon) represents the equator (0°) and the ceiling line (zenith) represents the pole (90°). By extending the inclined side of the meridian in the upper part, this line intersects the toes of Orion's left foot (equidistant from the left and right edges), that is to say Rigel (*β Orionis*). The line that crosses the Big Dipper and pointing to the pole is directed towards the month 8. The Egyptians identified Orion to Osiris and its main star Rigel ("foot" in Arabic) gave its name to the whole constellation, *s3ḥ* meaning "Orion" as well as "Toes." The arrangement of 12 months in 3 groups of 4 can be used to date events because these 360 days (= 36 decans of 10 days) are divided by the meridian into 3 equal parts of 120 days.



On the lower part, one recognized 12 circles thanks to their names in hieroglyphs, they represent the 12 Egyptian months. In the centre of this panel, separating the 12 circles into two unequal groups, a long and narrow triangle symbolizes the meridian. On the tip of the meridian there is a small circle which is connected to the schematic drawing of a bull called Big Dipper by a hieroglyph inscribed on its body. The Egyptians believed that the 7 main stars of this constellation embodied a bull or rather its thigh and that the star (*η*) at the tip of the meridian was *Ursae majoris*, the Big Dipper. If we extend the spear of the falcon-headed god figured under the Big Dipper and the meridian, the two lines meet at the North Pole (90° altitude or declination), the meridian crossing vertically the ceiling reaches the equator, a line describing the horizon (0°). The star in the small circle (*η Ursae majoris*) is located at 68.2° (altitude). This value is obtained by precisely measuring the length going from the equator to the pole, knowing that the total distance from the equator to the pole is 90°. When a star is on the meridian, it holds the highest position (if it is a circumpolar star it is also its lowest position), one says that it culminates. The culmination played an important role among the Egyptians and the culmination of the star *η Ursae majoris* was done on the night of 18/19 March at midnight with a declination of 68.2° at that time (which confirms that it is indeed the culmination of this star). Moreover, if one extends the spear backwards it leads on the month 8 (IV Peret) which began in mid-March at that time (c. 1470 BCE), which again confirms the identification. If the boundary between the 2nd and the 3rd part was the night of 18/19 March (culmination of the star *η Ursae majoris*), the one between the 3rd and the 1st was 120 days later, on the night of 16/17 July which corresponds to the

heliacal rising of Sirius, the brightest star in the sky, and the Egyptian New Year celebration. That day, began the first season of the Egyptian year, and the Nile began to flood the Lower Egypt in mid-July. The boundary between the 1st and the 2nd part was located 120 days later, on the night of 14/15 November. During that night unfolded another major astronomical event: the culmination of Rigel (*β Orionis*) at midnight. To reconstitute the calendar for an entire year (excluding the 5 epagomenal days, is divided into 36 decans, each covering a period of 10 days) one must first verify that the 8th month (IV Peret 1) actually began around 19 March[202] in 1460 BCE and then adding 3 times 10 days one gets the beginning of each month:

month 8			month 9			month 10			month 11		
1	2	3	4	5	6	7	8	9	10	11	12
19 Mar.	29 Mar.	8 Apr.	18 Apr.	28 Apr.	8 May	18 May	28 May	7 June	17 June	27 June	7 July
month 12			month 1			month 2			month 3		
13	14	15	16	17	18	19	20	21	22	23	24
17 Jul.	27 Jul.	6 Aug.	16 Aug.	26 Aug.	5 Sep.	15 Sep.	25 Sep.	5 Oct.	15 Oct.	25 Oct.	4 Nov.
month 4			month 5			month 6			month 7		
25	26	27	28	29	30	31	32	33	34	35	36
14 Nov.	24 Nov.	4 Dec.	14 Dec.	24 Dec.	3 Jan.	13 Jan.	23 Jan.	2 Feb.	12 Feb.	22 Feb.	4 Mar.

From the foregoing it is possible to find the place of observation because a heliacal rising of Sirius on 17 July was only possible (at that time) at a latitude of 30° North (near Heliopolis). Similarly, the simultaneous passage on the meridian of Rigel (*β Orionis*) and the star of the Big Dipper (*η Ursae majoris*) also gives a latitude of 30° North[203]. To check this first point one has to know what is a heliacal rising of Sirius.

As Sirius is the brightest star in the sky it is easy to spot. A heliacal rising is a coincidence between the sunrise (Helios was Sun god) and the rising of a star (see video[204]). But because of the overwhelming brightness of the sun there must be a minimum angle between the star above the horizon and the sun below the horizon, this angle is called *arcus visionis*, which is an observational data. A set of measures showed that it could be modelled by the equation[205]: *arcus visionis* = 10.5 + 1.44x(magnitude). The *arcus visionis* of Sirius (magnitude -1.46) is theoretically 8.4° (but usually around 9.2°)[206]. Then one must use astronomy software to know the heliacal rising of Sirius[207] based on a given latitude[208]:

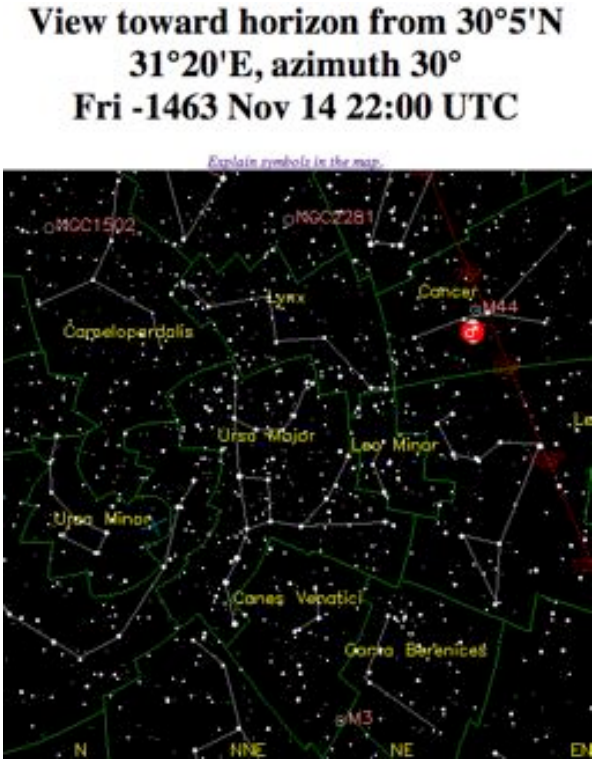
City	Longitude	Latitude	Heliacal rising (9.2°)
Alexandria	29°55' E	31°12' N	18 July 2:07 UT
Buto	31°12' E	30°45' N	17 July 2:03 UT
Heliopolis	31°20' E	30°05' N	17 July 2:05 UT
Memphis	31°15' E	29°52' N	16 July 2:06 UT
Thebes (Deir el-Bahari)	32°39' E	25°42' N	12 July 2:10 UT
Elephantine	32°53' E	24°05' N	10 July 2:13 UT

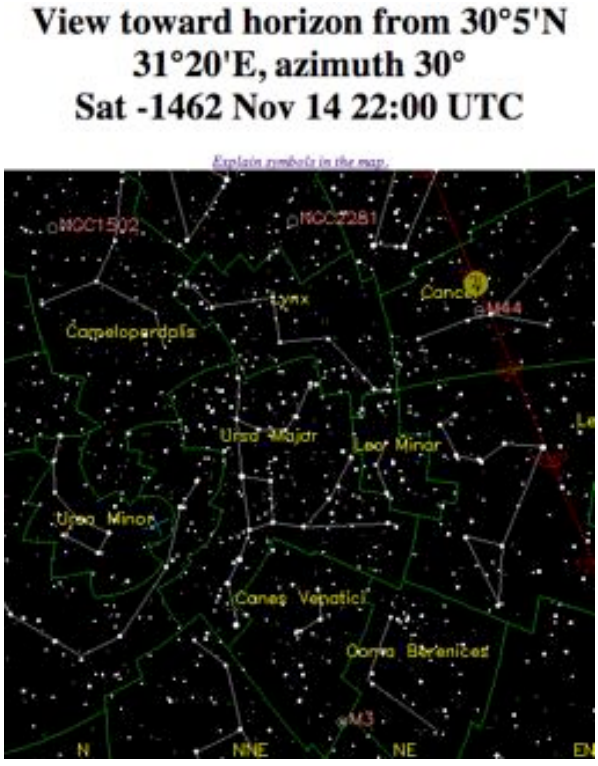
Because of the precession of the equinoxes[209], the apparent position of the Sun relative to the backdrop of the stars at some seasonally fixed time slowly regresses a full 360° through all 12 traditional constellations of the zodiac, at the rate of about 50.3 seconds of arc per year (approximately 360 degrees divided by 25,772), or 1 degree every 71.6 years. The constellation or house of the zodiac in front of which the Sun rises at the vernal

[202] http://www.chronosynchro.net/wordpress/convertisseur/
[203] É. TISSOT – Etude de l'astronomie égyptienne et ses implications dans la symbolique astrale de la constellation d'Orion dans la religion égyptienne Lyon 1990 Mémoire de maîtrise : Histoire de l'art - Maison de l'Orient Université Lyon 2, pp. 112-114.
[204] http://solar-center.stanford.edu/AO/Sirius.mov
[205] http://www.alcyone.de/PVis/documentation/accuracy.html
[206] T. DE JONG – The Heliacal Rising of Sirius
in: Ancient Egyptian Chronology (Leiden 2006) Ed. Brill pp. 432-438.
[207] http://www.imcce.fr/fr/grandpublic/phenomenes/sothis/index.php
[208] http://www.astro.com/cgi/aq.cgi?lang=e
[209] See video: http://www.youtube.com/watch?v=0qHjtp4cdCA

equinox is therefore changed[210]. This phenomenon enables the dating of the ceiling in 1460 BCE +/- 10 years because the value of the declination was 68.4° +/- 0.1°(6'). The accuracy is not very good but the "absence of Mars" on the ceiling allows its dating with a high precision (the name of the 12 months of the year as well as of 5 planets is written alongside in hieroglyph)[211].

For example in the upper part of the drawing of the southern sky, one recognizes the god Orion standing in a boat. On the left there is a woman standing too in a boat. It is Isis identified with the goddess Sothis. Follow two falcon-headed gods with a star on their head. The hieroglyphs above them identify them as Jupiter and Saturn. At the extreme left is Venus who the Egyptians represented in the guise of a heron (*bnw*). Mercury is also present in the form of a small Sethian figure, above to the right of Venus. Mars, the last of the five planets known in antiquity, is missing[212]. Its absence (empty boat) in a celestial map so neat is all the more remarkable in that in all later cards and, without exception, even more schematic, Mars follows in a ship Jupiter and Saturn as a 3rd falcon-headed god. The only possible conclusion is that Mars was not visible during the night represented in the tomb of Senenmut. Another detail makes it possible to calculate the year of the astronomical ceiling. We note that near the figures of Orion and Jupiter there are small dots determining the exact position of the two stars. The line near Jupiter corresponds on the map to all points of the same longitude which have the same rise between 73° and 95°. However, among the 50 years between 1505 and 1455 there is only one[213] in which Jupiter had a right ascension between 75° and 95°, on the night of 14/15 November, and Mars was not visible (right below)[214]: it is the year 1463 BCE.





[210] http://en.wikipedia.org/wiki/Axial_precession

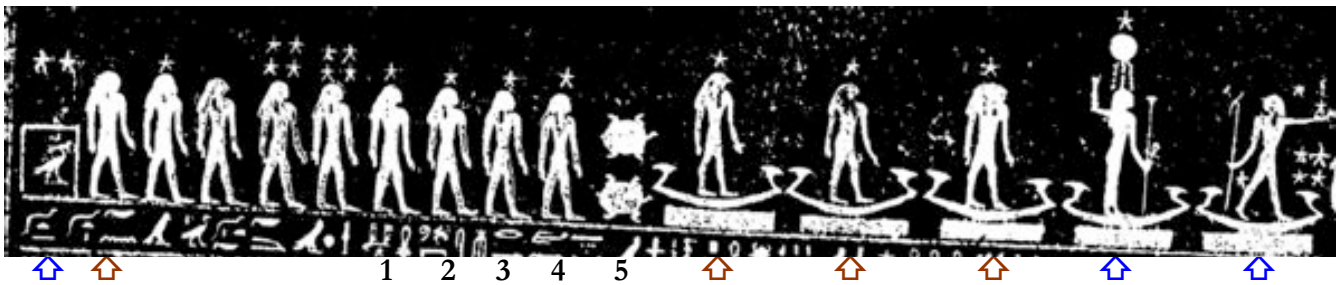
[211] A.S. VON BOMHARD – Le calendrier égyptien une œuvre d'éternité
London 1999 Ed. Periplus pp. 72-76, 90-91.

[212] C. LEITZ – Remarks about the Appearance of Mars in the Tomb of Senenmut in Western Thebes
in: *Centaurus* Vol. 44 (2002) pp. 140-142.

[213] C. LEITZ – Le premier plafond astronomique dans la tombe de Senmout
in: *Les dossiers d'archéologie* n°187 S (Novembre 1993) pp. 116-117.

[214] http://www.fourmilab.ch/cgi-bin/Yourhorizon (in 1464 BCE Universal Time: -1463-11-14 22:00; Azimuth: 30°; Field of view: 90°; in 1463 BCE Universal Time: -1462-11-14 22:00).

The previous result is surprising, because the Egyptian priest astronomers, usually very accurate in their representations, were particularly ill-advised to choose this year when Mars was absent, unique in Egyptian representations because Mars always appears in its boat like on the Sarcophagus of Nectanebo II (below)[215], however it is not so.



In fact, observation of the shape and the position of Orion's constellations, Sirius and Venus explain the reason for their choice. If Rigel corresponds to Orion's toes with the three stars aligned in its belt, Sirius is located consequently on the level of Sothis' ankles which are at the same level of the head of the heron (*benu*) representing Venus. This heron, called Phoenix by the Greeks, inaugurates the beginning of the ceiling at the upper left and month 1 inaugurates the beginning of the ceiling at the bottom right. If the culmination of the Big Dipper can be dated 14 November 1463 BCE, this year began with the heliacal rising of Sirius (on 16 July 1464 BCE) at month 1. But on this day occurred an exceptional phenomenon which only occurs every 103 years: the heliacal rising of Sirius, the brightest star in the sky, coincided with the heliacal setting of Venus, the brightest planet[216]. This coincidence of dates inaugurated a new era called "Great year" or "Phoenix rebirth" by the Greeks. The dates in this table can be shifted +/- 8 years because of Venus period[217].

Heliopolis (cycle 243 years):	-1558	-1315	-1072	-829	-586	**-343**	**-100**	**143**
+103 years	**-1455**	-1202	-969	-726	-483	**-240**	3	246
Thebes (cycle 243 years):	**-1542**	**-1299**	**-1056**	-813	**-570**	-327	-84	159
+103 years	-1439	**-1196**	-953	-710	-467	-224	19	262

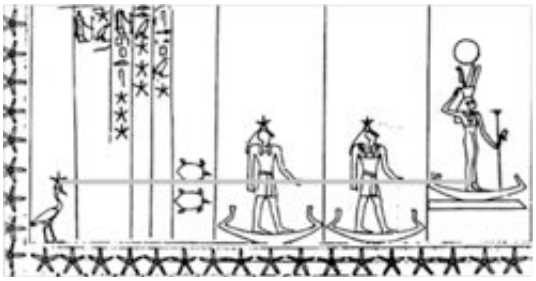
These dates have played a special role, since some have been commemorated and those in bold have left a historical record and some eras of the Phoenix were pictured[218]. This Greek word matches the Egyptian expression *rnpt* "year" or "regeneration". Some historians such as Tacitus (Annals VI:28), cited these "eras of the Phoenix[219]" without understanding their meaning. Some Coins of Antoninus Pius dated year 6 of his reign commemorated a double helical rising of Sirius and Venus (19 July 143 CE) because they have been marked with a phoenix[220] and Αἰών "lifespan". In his biography the Egyptian astronomer Harkhebi (c. 300 BCE) explained that he was observing stars in order to announce in which decan rose [heliacally] beside Benu (Venus), predicting and observing the heliacal rising of Sothis, (...) and he knew everything on the 1st day of every month[221].

215 A.S. VON BOMHARD - Le calendrier Égyptien. Une œuvre d'éternité
London 1999 Ed. Periplus pp. 72-74.
216 G.W. VAN OOSTERHOUT – Sirius, Venus and the Egyptian Calendar
in: *Discussions in Egyptology* 27 (1993) pp. 83-96.
217 Heliopolis (lat 30°05' N) ; Thebes (lat 25°42' N) ; 8 sidereal orbital periods of the Earth (365.25636 days) is 2922.06 days and 13 periods of Venus (224.701 days) is 2921.11 days.
218 O. NEUGEBAUER, R.A. PARKER – Egyptian Astronomical Texts
London 1969 Ed. Brown University Press pp. 6-11, plates 3, 9, 16, 25, 28.
219 Some eras of the Phoenix were commemorated in -1299 by Seti I; in -1196 by Tausert; in -1056 by Psusennes I (whose name means *the star that rises over the city [Thebes]*); in -343 by Nectanebo II and in -240 (?) on Harendotes' sarcophagus.
220 R. VAN DEN BROEK – The Myth of the Phoenix
Leiden 1972 Ed. E.J. Brill pp. 66-73, 103-109, 428-433.
221 J. DIELEMAN -Claiming the stars – Egyptian Priests facing the Sky
in: *Aegyptiaca Helvetica* 17 (Basel 2003) pp. 277-289.

The heliacal rising of Sirius at Heliopolis in 1464 BCE (-1463) was on 16 July[222] and coincided with the heliacal rising of Venus[223] (below). An *arcus visionis* of around 8.5° means that Sirius and Venus may be seen 2° above the horizon and the sun was 6° beneath the horizon and consequently there was a sunrise 24 minutes later (= 6°x4min) at 5:35 (LT).

View toward horizon from 30°5'N
31°20'E, azimuth 90° (E)
Wed -1463 Jul 16 2:20 UTC

Venus Jupiter Mars Sirius



One can see that the Egyptian drawings of celestial maps were extremely accurate. The star above the head of the heron (phoenix) represents the heliacal setting of Venus coinciding with the heliacal rising of Sirius, located at the ankles of Sothis (associated with Isis representing Venus), Rigel being located at the toes of Orion (*s3ḥ*) which means "toes". Sirius is a shining star, which belongs to the Canis Major constellation. This star is just before Procyon (belonging to Canis Minor) and after Rigel, which belongs to Orion constellation. Canis Major was chosen by the Egyptians as the first constellation because the rising of Sirius, its brightest star, was matched the beginning of the Nile's flood at summer solstice. These heliacal risings occurred every year at the same time, they were therefore not noted unless they occurred with another remarkable astronomical event. Two other Sothic (heliacal rising of Sirius) dates

[222] http://www.imcce.fr/fr/grandpublic/phenomenes/sothis/index.php Long 31°20' E; Lat 30°05'; *arcus visionis* 8.9

[223] Universal Time = -1463-07-16 2:20 (= Local Time 5:10), Azimuth 90° (E); Field of view 90°; latitude = 30°05' North; longitude = 31°19' East; http://www.fourmilab.ch/cgi-bin/Yourhorizon one can see that Jupiter and Mars have a right accession about 40°.

appear during the reign of Thutmose III. Their regnal years are not known[224] but it is likely after the II Peret 10 of Thutmose III's year 22 without Hatshepsut. The Elephantine Stone, from the temple of Khnum that Thutmose had built, mentions a Sothic rising dated III Shemu 28 and the Buto Stela has a Sothic setting dated immediately before the I Shemu 30 (penultimate line).

Sothic rising (III Shemu 28)

Sothic setting (I Shemu 30)

It is indeed a setting (with sunset), not a Sothic rising (with sunrise), for the following reason: between III Shemu 28 and I Shemu 30 there are 62 days, this duration would correspond to a difference of 244 years (= 4x61)[225] in case of Sothic dates, which is impossible for the same king. In addition, the hieroglyph representing the "rising" actually means "leave" (two legs walking surmounted by a horizontal bar "bolt") and not "arrive", confirming the representation (very rare) of a Sothic setting which occurs 61 days before the rising. Between the Sothic setting dated I Shemu 30 and the Sothic rising dated III Shemu 28 there was a period of invisibility of 62 days and not 70 days. This difference could be explained by the fact that this period decreased by about 1.5 day for 1° latitude southward, which implies 67 days in Buto (lat 31.1°) and 59 days in Thebes (lati 25.7°). This period of invisibility is different from Egyptian texts, which always indicate 70 days. This discrepancy with astronomy illustrates the role of religious Egyptian astronomy. Indeed, at this time[226], the period of invisibility of Sirius was about 65 days at the latitude of Buto, 63 days at the latitude of Memphis. Even assuming good observing conditions[227] there was a period of 67 days at the latitude of Buto and not 70 days as Egyptian texts indicate. This period of 70 days covered in fact a symbolic period of 7 decans[228], the Egyptian year being covered by 36 decans, or 360 (= 12x30) days. The 28 Shemu III also belongs to the effective reign of Thutmose, after his 22 years of co-regency with Hatshepsut. In addition, the Palestine campaign which occurred from years 23 to 25 is mentioned in the Buto Stela: *It is a brave king who, in the melee, made great slaughters among Asiatic coalitions. He is the one that makes rulers of Retenu's land, in their entirety, to be required to provide their tribute*[229]. Sothic dates appearing on the Buto Stela and on the Elephantine Stone likely date to year 25. Why have these two Sothic dates been engraved? As Thebes was the capital of Egypt at this time (1470 BCE) the Sothic rising was on 12 July in this place[230]. The III Shemu 28 coincides with 13 July on the period 1448-1445 BCE[231], which matches effectively to year 25 of Thutmose III since his year 9 is dated 1464 BCE. Given that the accession of Thutmose III

[224] A.S. VON BOMHARD - Le calendrier Égyptien. Une œuvre d'éternité
London 1999 Ed. Periplus pp. 41-44.
[225] As the Egyptian calendar has exactly 365 days it shifts 1 day every 4 years compared to the solar year (365.25 days).
[226] M.F. INGHAM – The Lenght of the Sothic Cycle
in: *The Journal of Egyptian Archaeology* 55 (1969) pp. 36-40.
J. CONMAN – It's About Time: Ancient Egyptian Cosmology
in: *Studien zur Altägyptischen Kultur Band* 31 (2003) pp. 42-47.
[227] *arcus visionis* of 8° for Sothic rising and 6.5° for Sothic setting.
[228] A.S. VON BOMHARD – Le livre du ciel. De l'observation astronomique à la mythologie
in: *Orientalia Lovaniensia Analecta* 150 (2007) Ed. Uitgeverij Peeters pp. 202-205.
[229] A.S. VON BOMHARD - Le calendrier Égyptien. Une œuvre d'éternité
London 1999 Ed. Periplus pp. 41-44.
[230] http://www.imcce.fr/fr/grandpublic/phenomenes/sothis/index.php Long 32°39' E; Lat 25°42'; *arcus visionis* 8.9
[231] http://www.chronosynchro.net/wordpress/convertisseur/

was on I Shemu 4 his year 25 was going from 20 April 1448 BCE to 19 April 1447 BCE. The full moons during this period of time (1448 BCE) have been highlighted in yellow[232].

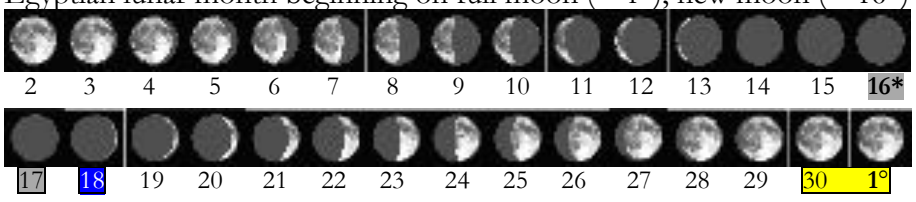
Year	Egyptian	I Shemu 4	II Shemu 28	II Shemu 29	III Shemu 27	III Shemu 28	III Shemu 29
-1447	Julian	20 April	13 June	14 June	**12 July**	13 July	14 July
	Lunar day	**year 25**	30	1	29	**1**	2

One can see that the heliacal rising of Sirius dated 12 July 1448 BCE coincided with a full moon, which was no doubt a remarkable event. However the event was dated III Shemu 28 instead of III Shemu 27 because the full moon was the last day in the Egyptian lunar calendar (based on lunar months of 29 or 30 days). In practice the 1st day of the Egyptian lunar calendar was also considered as a full moon (the "two eyes" of Horus) that's why the coincidence was dated on 1st day of the lunar month. Similarly, the Sothic setting mentioned in the Buto Stela dated I Shemu 30 (16 May 1448 BCE) coincided with a full moon dated a day before on I Shemu 29 (15 May 1448 BCE).

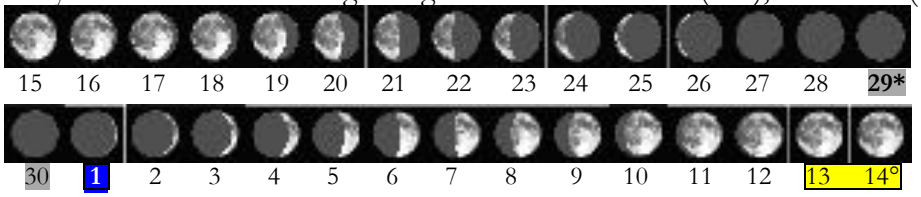
Year	Egyptian	IV Peret 29	IV Peret 30	I Shemu 4	I Shemu 28	I Shemu 29	I Shemu 30
-1447	Julian	15 April	16 April	20 April	14 May	**15 May**	16 May
	Lunar day	29	1	**year 25**	29	**1**	2

These exceptional coincidences with the full moon may explain why these two Sothic dates were mentioned on inscriptions. The Egyptians considered the full moon as an auspicious day as the 1st lunar crescent, that is why these two days have played an important role in religious festivals or inaugurations. For example, the beginning of the works in Senenmut's tomb is dated IV Peret 2, year 7 of Thutmose III (24 March 1465 BCE) which was a full moon and the door of the chapel was opened on III Akhet 27, year 11 (18 November 1461) which was a 1st lunar crescent (new moon + 2). The Egyptians considered the 17th day of the month to be associated with the death of Osiris, a lunar god, and the 18th day was called "day of the moon" because it marked the beginning of the re-parcelling of Osiris symbolizing his resurrection. Egyptian reckoning of lunar months:

Egyptian lunar month beginning on full moon (= 1°), new moon (= 16*)



Babylonian lunar month beginning on 1st lunar crescent (= 1), full moon (= 14°)



The Egyptian lunar calendar was not used for the dating of documents contrary to its Babylonian counterpart, but it served only to fix the beginning of religious festivals related to the moon. Its working was very simple: the 1st lunar day (*psḏntyw*) was fixed by an observation (of the full moon) which allowed one to determine the whole cycle of festivals during this lunar month. The names of the lunar months were the same as the calendar months with usually one month advance. When the full moon (lunar day 1) fell in the same civil month, or on an epagomenal day, the name of the lunar month remained the same. It happened as if the Egyptian calendar had nine intercalary months (highlighted). In the

[232] http://www.fourmilab.ch/earthview/pacalc.html
http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php

Egyptian papyrus Carlsberg 9 (column III lines 9-21), dated 144 CE, there is a list of 9 "great" years of 13 months (highlighted) and of the 16 "small" years of 12 months[233]:

Babylonian	Egyptian	AKHET				PERET				SHEMU				
cycle	cycle	I	II	III	IV	I	II	III	IV	I	II	III	IV	(5)
14A	**1**	1/30	30	29	29	28	28	27	27	26	26	25	25	
15	**2**	19	19	18	18	18	17	17	16	16	15	15	14	
16	**3**	9	8	8	7	7	6	6	6	5	5	4	4	3
17U	**4**	28	27	27	26	26	25	25	24	24	23	23	23	
18	**5**	17	17	16	16	15	15	14	14	13	13	12	12	
19A	**6**	6	6	6	5	5	4	4	3	3	2	2	1	1
1	**7**	25	25	24	24	23	23	23	22	22	21	21	20	
2	**8**	15	14	14	13	13	12	12	11	11	10	10	10	
3A	**9**	4	4	3	3	2	2	1	1/30	30	29	29	28	
4	**10**	23	23	22	22	21	21	20	20	19	19	18	18	
5	**11**	12	12	11	11	10	10	10	9	9	8	8	7	
6A	**12**	2	1	1/30	30	30	29	28	28	27	27	27	26	
7	**13**	21	20	20	19	19	18	18	17	17	16	16	15	
8A	**14**	10	9	9	9	8	8	7	7	6	6	5	5	4
9	**15**	29	28	28	27	27	27	26	26	25	25	24	24	
10	**16**	18	18	17	17	16	16	15	15	14	14	14	13	
11A	**17**	8	7	7	6	6	5	5	4	4	3	3	2	2
12	**18**	26	26	26	25	25	24	24	23	23	22	22	21	
13	**19**	16	15	15	14	14	14	13	13	12	12	11	11	
14A	**20**	5	5	4	4	3	3	2	2	1	1	1/30	30	
15	**21**	24	24	23	23	22	22	21	21	20	20	19	19	
16	**22**	13	13	13	12	12	11	11	10	10	9	9	8	
17U	**23**	3	2	2	1	1/30	30	30	29	29	28	28	27	
18	**24**	22	21	21	20	20	19	19	18	18	18	17	17	
19A	**25**	11	11	10	10	9	9	8	8	7	7	6	6	

This Egyptian lunar cycle of 25 years remained stable over at least 525 years since there appears only a slight difference of 0.0483 day at the end of the cycle[234] (which implies 1 day more after 21 cycles). Coincidentally the ratio of intercalary years compared to normal years was the same in both systems: 0.36 (9/25) for the Egyptian cycle and 0.37 for the Babylonian cycle (7/19). Intercalary years had no role in the Egyptian lunar calendar since it was only a rough correspondence with the months of the calendar which was almost solar. From the Ptolemaic era, Egyptian astronomers used a lunar cycle starting on the new moon instead of the full moon, but the coincidences remained almost the same as can be seen in the papyrus *Rylands Inv. 666*[235] (dated October 180 BCE). Parker has compiled and explained the 30 days of the Egyptian lunar month (red colour means nonsense):

½ month	n°	Day of the month		Moon phase according to:	
		Name	**Meaning**	**Macnaughton**	**Parker**
(15)	1	*psḏntyw*	Shining ones	Full moon	First invisibility
	2	*3bd*	Month	After full moon	First crescent
	7	*dnit*	Quarter	Last quarter	First quarter
	14	*si3w*	Perceptions	Last crescent	Before full moon
	15	*smdt*	Subordinate	Before new moon	Full moon
1	17	*si3w*	Perceptions	Before first crescent	-
2	18	*i'ḫ*	Moon	First crescent	-
7	23	*dnit*	Quarter	First quarter	Last quarter
14	30	*prt Mn*	Min going-forth	Before full moon	New moon

[233] L. DEPUYDT - The Demotic Mathematical Astronomical Papyrus Carlsberg 9 Reinterpreted in: Egyptian Religion the Last Thousand Years (Peeters, 1998) pp. 1277-1297.

[234] 25 civil years = 25x365 = 9125 days and 25 lunar years = (25x12 + 9)x29.530588 = 9124.9517 days.

[235] E.G. TURNER, O. NEUGEBAUER - Gymnasium Debts and New Moons in: *Bulletin of the John Rylands Library* Vol. 32 (1949) pp. 80-96.

A lunar cycle of 25 years began in 1471 BCE (-1470*) on 1st Thoth (I Akhet 1)[236] (highlighted in blue) matching a full moon dated 26 August[237], the 1st lunar day *psḏntyw* of the lunar month. Two lunar days 1 (*psḏntyw*)[238] respectively dated I Shemu 21 year 23 of Thutmose III (Urk.IV 657.2) and II Peret 30 year 24[239], confirm the dating of Thutmose's reign. According to astronomy these lunar days (*psḏntyw*)[240] coincided with the full moons of 7 May in 1450 BCE and of 16 February in 1448 BCE. The year 1 of Thutmose III starting on I Shemu 4 (May in 1472 BCE), the year 23 must have begun on 21 April 1450 BCE (I Shemu 4). The date I Shemu 21, year 23 of Thutmose III is on 8 May 1450 BCE and the II Peret 30, year 24, is on 15 February 1448 BCE. Thutmose III chose this specific lunar day to attack Megiddo because he considered it an auspicious day of shining full moon. He explains: *Now that illuminates the moon, that encircles the solar disk when it shines, that surround Geb and Nut, he placed them in the circle of his arms. His Majesty stands at the entrance to the earth, ready to defeat the Asiatics*[241]. Reign of Thutmose III:

SEASON:	BCE			AKHET				PERET				SHEMU				
				I	II	III	IV	I	II	III	IV	I	II	III	IV	5
	1473			Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Thutmose III	1472	**1**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	1471	**2**	25	11	11	10	10	9	9	8	8	7	7	6	6	
	1470	**3**	1	1	30	29	29	28	28	27	27	26	26	25	25	
	1469	**4**	2	19	19	18	18	18	17	17	16	16	15	15	14	
	1468	**5**	3	9	8	8	7	7	6	6	6	5	5	4	4	3
	1467	**6**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1466	**7**	5	17	17	16	16	15	15	14	14	13	13	12	12	
	1465	**8**	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1464	**9**	7	25	25	24	24	23	23	23	22	22	21	21	20	
	1463	**10**	8	15	14	14	13	13	12	12	11	11	10	10	10	
	1462	**11**	9	4	4	3	3	2	2	1	1	30	29	29	28	
	1461	**12**	10	23	23	22	22	21	21	20	20	19	19	18	18	
	1460	**13**	11	12	12	11	11	10	10	10	9	9	8	8	7	
	1459	**14**	12	2	1	1	30	30	29	28	28	27	27	27	26	
	1458	**15**	13	21	20	20	19	19	18	18	17	17	16	16	15	
	1457	**16**	14	10	9	9	9	8	8	7	7	6	6	5	5	4
	1456	**17**	15	29	28	28	27	27	27	26	26	25	25	24	24	
	1455	**18**	16	18	18	17	17	16	16	15	15	14	14	14	13	
	1454	**19**	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	1453	**20**	18	26	26	26	25	25	24	24	23	23	22	22	21	
	1452	**21**	19	16	15	15	14	14	14	13	13	12	12	11	11	
	1451	**22**	20	5	5	4	4	3	3	2	2	1	1	1	30	
	1450	**23**	21	24	24	23	23	22	22	21	21	20	20	19	19	
	1449	**24**	22	13	13	13	12	12	11	11	10	10	9	9	8	
	1448	**25**	23	3	2	2	1	1	1/30	30	29	29	28	28	27	
	1447	**26**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	1446	**27**	25	11	11	10	10	9	9	8	8	7	7	6	6	

	Lunar dates I Shemu 21 year 23 in 1450 BCE and II Peret 30 year 24 in 1448 BCE
	Sothic setting on I Shemu 29 and Sothic rising on III Shemu 28 in 1448 BCE (year 25)
	Heliacal risings of Sirius and Venus on 16 July 1464 BCE (year 9 III Shemu 21)
	Right ascension of Jupiter 80° without Mars on 14 November 1463 BCE (year 10)

[236] http://www.chronosynchro.net/wordpress/convertisseur/
[237] http://www.fourmilab.ch/earthview/pacalc.html
http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php
[238] K. SETHE – Urkunden der 18. Dynastie
Leipzig 1907 Ed. J.C. Hinrichs'sche Buchhandlung pp. IV 657, 807-809, 836.
[239] Thutmose III inaugurated a sanctuary on II Peret year 24 he called Akh-menu "brilliant monument" (Urk.IV 836.1-3).
[240] R.A. PARKER - The Lunar Dates of Thutmose III and Ramesses II
in: *Journal of Eastern Studies* XVI (1957) pp. 39-43.
[241] C. LALOUETTE – Thèbes. La naissance d'un empire
Paris 1995 Éd. Flammarion pp. 276-279, 371-372).

Similarly, a heliacal rising of Sirius during Seti I's reign and several dated lunar days (*psḏntyw*) allow an absolute dating of the 19th and 20th Dynasties.

DATING OF THE XIXTH AND XXTH DYNASTIES THROUGH ASTRONOMY

The helical rising of Sirius during Seti's reign is dated I Akhet 1 year 4[242], given that the astronomical ceiling of Seti I starts by a Sothic rising dated on I Akhet [1] according to his cenotaph: *All these stars begin on I Akhet when Sirius appears*[243]. This Sothic rising is dated (around -1300)[244] either on 12 July (Thebes) or 17 July (Heliopolis), which matched a full moon[245] (I Akhet 6 in the 25-year lunar cycle). The 2nd coincidence of a full moon with a heliacal rising of Sirius is not suitable because it occurred in Seti I's year 10 (1285 BCE).

Pharaoh	Year			I Akhet 1	Full moon in:		Sothic rising	
Dynasty XIX	BCE			Julian	Lunar cycle	Julian	Thebes	Heliopolis
	1296		1	13 July	I Akhet 1	13 July	12 July	17 July
	1295		2	13 July	I Akhet 19	1 August	12 July	17 July
Seti I	1294	**1**	3	13 July	I Akhet 9	21 July	13 July	17 July
	1293	**2**	4	12 July	I Akhet 28	8 August	12 July	16 July
	1292	**3**	5	12 July	I Akhet 17	28 July	12 July	17 July
	1291	**4**	6	12 July	I Akhet 6	17 July	12 July	17 July
	1290	**5**	7	12 July	I Akhet 25	4 August	13 July	17 July
	1289	**6**	8	11 July	I Akhet 15	25 July	12 July	16 July
	1288	**7**	9	11 July	I Akhet 4	14 July	12 July	17 July
	1287	**8**	10	11 July	I Akhet 23	2 August	12 July	17 July
	1286	**9**	11	11 July	I Akhet 12	21 July	13 July	17 July
	1285	**10**	12	10 July	I Akhet 2	11 July	12 July	16 July
	1284	**11**	13	10 July	I Akhet 21	30 July	12 July	17 July

Seti I's accession occurred in 1294 BCE on III Shemu 24? (1 June). His reign lasted 11 years and a few days as shown by the autobiography[246] of the priest Bakenkhons who stated: *I spent 4 years as an excellent youngster, 11 years as a youth, as a trainee stable-master for king Men[maat]re (Seti I), wab priest of Amun for 4 years, god's father of Amun for 12 years, third pries of Amun for 15 years, second priest of Amun for 12.* In addition, the 11 years of Seti I were all reported, except year 10, which confirms the 11-year reign[247]. Consequently Ramses II's accession must be dated in 1283 (= 1294 - 11), more exactly on III Shemu 27 (1 June 1283 BCE). The lunar day *psḏntyw* dated II Peret 27, year 52 of Ramses II[248], which occurred on 20 December 1232 BCE, confirms the accession in 1283 (= 1232 + 52 – 1). Furthermore, the accession of Kadašman-Enlil II (1264-1255) occurred in year 19 of Ramses II[249], implying again dating the accession of Ramses II in 1283 (= 1264 + 19 + 0). Accession[250]

[242] K. SETHE - Sethos I und die Erneuerung der Hundssternperiode
in: *Zeitschrift für Ägyptische Sprache* 66 (1931) pp. 1-7.
[243] O. NEUGEBAUER, R.A. PARKER – Egyptian Astronomical Texts I
London 1960 Ed. Brown University Press pp. 44, 54 (Text T_2 plate 47).
[244] http://www.imcce.fr/fr/grandpublic/phenomenes/sothis/index.php
arcus visionis 8.9 Heliopolis Long 31°20' E Lat 30°05' N Thebes; Long 32°39' E Lat 25°42' N
[245] http://www.fourmilab.ch/earthview/pacalc.html
http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php
[246] E. FLOOD – Biographical Texts from Ramessid Egypt
Atlanta 2007 Ed. Society of Biblical Literature p. 41.
[247] E. HORNUNG – The New Kingdom
in: Ancient Egyptian Chronology (Leiden 2006) Ed. Brill pp. 210-211.
[248] J.J. JANSSEN – Two Ancient Egyptian Ship's Logs
Leiden 1961 Ed. E.J. Brill p. 12.
[249] W.A. WARD - The Present Status of Egyptian Chronology
in: *Bulletin of the American Schools of Oriental Research* 288 (1991) pp. 55,56.
[250] E. HORNUNG – The New Kingdom
in: Ancient Egyptian Chronology. Leiden 2006 Ed. Brill pp. 208-211.
C. VANDERSLEYEN - L'Egypte et la vallée du Nil Tome 2
Paris 1995 Éd. Presses Universitaires de France pp. 467-512.
J. VON BECKERATH – Chronologie des pharaonischen ägypten
1997 Ed. Verlag Philipp von Zabern pp. 201-202.

dates and years of reign enable one to reconstitute the following chronology (Seti I's reign with a Sothic rising has been highlighted in pink and reigns with lunar dates in deep blue):

Dynasty XIX	Length of reign	accession date	highest date	Reign
Ramses I	1 year 4 months	**1** III Peret ?	**2** II Peret 20	01/1295-05/1294
Seti I	11 years	**1** III Shemu 24 ?	**11** IV Shemu 13	06/**1294**-06/1283
Ramses II	67 years 2 months	**1** III Shemu 27	**67** I Akhet 18	06/**1283**-07/1216
Merenptah	9 years 3 months	**1** II Akhet 5-13?	**10** IV Akhet 7	08/1216-10/1207
Seti II	5 years	**1** I Peret ?	**6** I Peret 19	11/1207-10/1202
[Amenmes]	[4 years]	**1** [II Shemu ?]	[**4** III Shemu 29 ?]	[04/1206-03/1202]
Siptah	6 years	**1** I Peret 2?	**7** IV Akhet 22	11/**1202**-10/1196
(Siptah)-Tausert	1 year 6 months	"	**8** II Shemu 29	11/1196-04/1194
Dynasty XX				
Sethnakht	3 years 5 months	"	**4**	11/1196-03/1192
Ramses III	31 years 1 month	**1** I Shemu 26	**32** III Shemu 14	04/**1192**-04/1161
Ramses IV	6 years 8 months	**1** III Shemu 15	**7** III Akhet 29?	05/**1161**-12/1155

The durations of reign fit quite well with those of Manetho (via Flavius Josephus). However, because of the uncertainty on some accession dates three of these reigns may have an additional year if we place it at the end of the last year of reign instead of the beginning. Thus, Seti II may have reigned 6 years instead of 5 (the most likely)[251] and Ramses II may have reigned 67 years and 2 months instead of 66 years and 2 months. In his stele dated beginning of year 4, Ramses IV compares his 3 years of reign with the 67 years (not 66) of Ramses II, which involves the death of Ramses II at the beginning of his year 68 in accordance with the number of his jubilees (*sed* festivals). In fact, 14 jubilees were attested, the first one being celebrated in year 30 and the others every 3 years: the 11th in year 60 (=2x30), the 12th in year 61 and the 14th in year 66. The most delicate case being the 4-year reign of pharaoh Amenmes, that some place between Merenptah and Seti II, and others in parallel with Seti II (and delay it by approximately 5 months). Several synchronisms and lunar dates, dated by astronomy, can resolve these uncertainties.

The violent crisis that hit the eastern Mediterranean caused the ruin of the great empires of the Bronze Age, which the Trojan War is the most famous episode, is exactly dated year 8 of Ramses III. Thebes, Lefkandi, Tiryns, Mycenae and Pylos in mainland Greece and Chania in Crete, were ransacked and some completely destroyed. Most of these cities and their palaces were burned. In Anatolia, among the most important sites, several archaeological levels similarly destroyed are found which date from the same period. Hattusha, the Hittite capital, was sacked and burned just like the major cities of Cyprus. On the north coast of Syria, the flourishing city of Ugarit was destroyed and never inhabited thereafter. Mesopotamia was preserved as the wave of devastation did not extend to the east, and it was the Egyptians who alone could stop it. The temple of Ramses III at Medinet Habu contains an account of this victory over the Sea Peoples. The identification of these peoples and their reasons for migration are poorly understood, however, these events are precisely dated. The great Alexandrian scholar Eratosthenes (276-193), for example, dated the Trojan War in 1184 BCE. Manetho[252], while confirming the 7-year reign of Queen [Siptah]/Tausert (1202-1194) states: *Thouôris, (...) at the time when Troy was taken, reigned 7 years*[253]. Tausert reigned (1195-1194) at the beginning of the war, 10 years before the destruction of Troy. This destruction coincides with the fall of the Hittite Empire dated

[251] H. ALTENMÜLLER – Bemerkunden zu den königsgräbern des neuen reiches in: *Studien zur Altägyptischen Kultur* 10 (1983) pp. 43-61.

[252] W.G. WADDELL – Manetho Massachusetts 1956 Ed. Harvard University Press pp. 101-119.

[253] According to Thucydides, the Trojan War was the result of an expedition of disparate tribes of pirates (Odyssey III:71-74), living on islands around Achaia, who were united by King Agamemnon of Mycenae. This expedition against the Trojans was the culmination of 10 years of battle (The Peloponnesian War I:8-12), a battle in Egypt is mentioned in the year 5 of Ramses III.

indirectly in year 8 of Ramses III and in year 2 of Meli-Shipak (October 1185 BCE) [254]. This war led by the Sea Peoples must have been spread over less than one year because, according to the inscription of Ramses III, all countries (Hatti, the coast of Cilicia, Carchemish, Cyprus, etc.) were "destroyed all at once" and, according to Homer (Odyssey XIV:240-280), the sacking of the city of Priam [Troy], after 10 years of fighting, was followed "in less than 1 month" by the sailing of Achaeans to Egypt and the sacking of its wonderful fields. As year 2 of Meli-Shipak is dated in 1185 BCE, Ramses III's accession has to be dated in 1192 (= 1185 +8 – 2 +1)[255]. This date is consistent with the accession of Ramses II in 1283 (= 1192 + 3+5 m. +6 + 5 + 9+3 m. + 67+2 m.).

The reign of Tausert is well known[256]. Wife of Seti II, she exercised after his death a strong influence on his son Siptah (Regency?) then, at the latter's death, she continued his reign instead of inaugurating a new one (Sethnakht also began his reign from Siptah's death)[257]. Egyptian women, as wife or daughter of a Pharaoh, could access the deity, which authorized them to embody and so prolong the reign of a dead pharaoh without successor, but not to begin a new reign. This case occurred three times over the period 1500-1200: Tausert, wife of Seti II, continuing the reign of his son Siptah, Ankhkheperure continued the reign of Semenkhkare her husband and Hatshepsut continued the reign of her husband Thutmose II (which was in turn extended by Thutmose III at Hatshepsut's death). These extended reigns were interpreted by some as co-regencies, which distorts the chronology. Another source of error comes from the change of name by some pharaohs, interpreted as the reign of new sovereign. In fact it is not the case, since for no apparent reason Ramses-Siptah (Sekhâenre-Meryamun) was then called Merenptah Siptah (Akhenrê-Setepenre) from the year 3 of his reign. It is possible to anchor Tausert's reign, and consequently the one of Ramses III, thanks to a graffito a scribe named Thotemhab left at the Theban temple of Deir el-Bahari, in memory of his participation in the Festival of the Valley. During this annual celebration, the processional statue of Amon passed two nights at the funerary temple of the reigning monarch. The graffito of Thotemhab tells us that in the II Shemu 28 Year 7 of Tausert, the statue of Amon was transported to the mortuary temple. The Beautiful Festival of the Valley was celebrated the day after the 1st lunar day, which implies dating that day 1 (*psḏntyw*) to II Shemu 27 Year 7 of Tausert[258]. The reign of Amenmes[259] cannot be placed between that of Merenptah and Seti II, but only in parallel with the one of Seti II, as can be deduced from the lunar dates (see table hereafter), because the insertion of 4-year reign of Amenmes would push the lunar date, either in II Peret 21 (in 1236 BCE) if the reign of Seti II is 5 years long, or in II Peret 2 (in 1237 BCE) if this reign is 6 years long, yet the only possibility is that of II Peret 27 in 1232 BCE. The reign of Ramses III began at I Shemu 26 year 1 (9 March 1192 BCE). This reconstruction also confirms the 2-year reign of Sethnakht because the duration of 3 years[260] would imply a lunar date II Shemu 7 (c.

[254] The last texts from Emar are dated [-]/VI$_2$/**2** and 6/VII/[**2**] of Meli-Shipak (Y. COHEN, I. SINGER – A Late Synchronism between Ugarit and Emar in: Essays on Ancient Israel in Its Near Eastern Context, Ed. Eisenbrauns 2006, p. 134.

[255] Year 2 of Meli-Shipak beginning on Nisan 1, or on April 4, 1185 BCE, and year 8 of Ramesses III starts at I Shemu 26 or so in April at that time. The accession is counted as year 0 by the Babylonians and as a year 1 by the Egyptians.

[256] V.G. CALLENDER – Queen Tausret and the End of Dynasty 19
in: *Studien zur Altägyptischen Kultur* 32 (2004) pp. 81-104.

[257] C. VANDERSLEYEN - L'Egypte et la vallée du Nil Tome 2
Paris 1995 Éd. Presses Universitaires de France pp. 591-593.

[258] R. KRAUSS – Moïse le pharaon
Monaco 2005 Éd. Rocher pp. 125-127.

[259] T. SCHNEIDER – Conjectures about Amenmesse
in: Ramesside Studies in Honour of K.A. itchen (Rutherford Press, 2011) pp. 445-451.

[260] If the Elephantine Stele (KRI V:671-672) states that all the enemies of Egypt were eliminated on II Shemu 1 in year 2 of Sethnakht, there is no explicit link with a accession date, but it could correspond to the time of the disappearance of Tausert (whose highest date is the II Shemu 29 year 8 of Siptah).

April in 1196 BCE), incompatible with that of II Shemu 27 from the graffito. This date II Shemu 27 Year 7 of Siptah corresponds to 10 April in 1195 BCE[261] and actually coincides with a full moon (saw on 9 April -1194)[262]. A good indication of the rivalry between the two kings, Setnakht and Amenmes (later considered as usurper), comes from their cartouche, each having had erased the name of the other[263].

We also note that the two lunar dates (*psḏntyw*) of Ramses III (I Shemu 11 and IV Peret 1)[264] fall at the beginning and end of year 5. Moreover, the *beautiful feast of the valley*[265] [probably at the end of year 5], celebrated just after the lunar day 1(*psḏntyw*), is dated II Shemu 1 and 2, which implies dating this lunar day I Shemu 30 on 12 March in 1187 BCE (full moon). The lunar day *psḏntyw* has always played an important role in Egyptian cult. On the stele from Abydos dated Year 4 of Ramses IV, Pharaoh says: *My heart has not forgotten the day of my psḏntyw feast*[266] and this stele is dated 10 Akhet III, which implies a connection with this lunar day. The year 4 of Ramses IV began at III Shemu 15 (the day of his accession)[267] and in 1158 BCE according to the previous scheme, one can also verify that the year 4 of Ramses IV began with a lunar day 1 dated III Shemu 16, which explains the choice of year 4 for this inscription. The III Shemu 15 corresponds to 19 April in 1158 BCE (full moon) and the III Akhet 10 which corresponds to 16 August 1158 BCE (full moon).

Dynasty XIX	accession date	Julian date (BCE)	highest date	Julian date (BCE)
Ramses I	**1** III Peret ?	09 Jan-07 Feb. 1295	**2** II Peret 20	29 Dec. 1295
Seti I	**1** III Shemu 24 ?	01? Jun. 1294	**11** IV Shemu 13	23 May 1283
Ramses II	**1** III Shemu 27	01 Jun. 1283	**67** I Akhet 18	10 Jul. 1216
Merenptah	**1** II Akhet 5-13?	27 Jul-04 Aug. 1216	**10** IV Akhet 7	25 Sep. 1207
Seti II	**1** I Peret ?	19 Oct-17 Nov. 1207	**6** I Peret 19	05 Nov. 1202
[Amenmes]	**1** [II Shemu ?]	18 Mar-16 Apr. 1206	[**4** III Shemu 29 ?]	[14? May 1202]
Siptah	**1** I Peret 2?	19? Oct. 1202	**7** IV Akhet 22	07 Oct. 1196
(Siptah)-Tausert	"	17? Oct. 1196	**8** II Shemu 29	12 Apr. 1194
Dynast XX				
Sethnakht	"	17? Oct. 1196	**4**	[Jun. 1191-1192]
Ramses III	**1** I Shemu 26	09 Mar. 1192	**32** III Shemu 14	19 Apr. 1161
Ramses IV	**1** III Shemu 15	20 Apr. 1161	**7** III Akhet 29?	04? Sep. 1155

	Sothic rising	Lunar day 1 (*psḏntyw*)	Date (BCE)	Full moon
Seti I	**4** I Akhet 1	**4** [I Akhet 6]	12 Jul. 1291	[17 Jul. 1291]
Ramses II		**52** II Peret 27	20 Dec. 1262	21 Dec. 1262
(Siptah)-Tausert		**7** II Shemu 27	10 Apr. 1195	9 Apr. 1195
Ramses III		**5** I Shemu 11	22 Feb. 1188	21 Feb. 1188
		5 IV Peret 1	12 Jan. 1187	11 Jan. 1187
		6 I Shemu 30	12 Mar. 1187	11 Mar. 1187
Ramses IV		**4** III Shemu 15	19 Apr. 1158	19 Apr. 1158
		4 III Akhet 10	16 Aug. 1158	15 Aug. 1158

The complete reconstruction of all Egyptian reigns in the period 1295-1155 BCE (Dynasties XIX-XX), based on the Sothic rising of Seti I and lunar dates (*psḏntyw*), allows one to check the coincidences of these dates which occur only once every 25 years[268]:

[261] http://www.chronosynchro.net/wordpress/convertisseur/
[262] http://www.fourmilab.ch/earthview/pacalc.html
http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php
[263] Year 4 of Sethnakht involves at least 3 years of reign (Al-Ahram Weekly 11-17 January 2007 No. 827), but as this reign began with the death of Siptah, Tausert's reign (1 year 6 months) must be subtracted.
[264] A. SPALINGER – Egyptian Festival Dating and the Moon
in: Under One Sky (Münster 2002) Ed. Ugarit-Verlag pp. 385-389.
[265] S. EL-SABBAN – Temple Festival Calendars of Ancient Egypt
Liverpol 2000 Ed. Liverpool University Press pp. 67,68.
[266] A.J. PEDEN – The Reign of Ramesses IV
Warminster 1994 Ed. Aris & Phillips Ltd pp. 91-94.
[267] C. VANDERSLEYEN - L'Egypte et la vallée du Nil Tome 2
Paris 1995 Éd. Presses Universitaires de France p. 616.
[268] Or every 11/14 years if there is an error of 1 day.

	Legend of colours:
	Year 1 of Ramses I from IV Peret, June in 1294 BCE, to III Peret, May in 1293 BCE.
	Synchronism with the Sothic rising dated I Akhet 1 in year 4 of Seti I (12 July 1291 BCE).
	Synchronism with Babylonian chronology: years 19 and 42 of Ramses II (in 1264 and 1241 BCE); year 8 of Ramesses III (in 1185 BCE).
	Lunar dates: year 52 de Ramses II (in 1232); year 7 de Siptah (in 1195); year 4 de Ramses IV (in 1158).

SEASON	BCE			AKHET				PERET				SHEMU				
				I	II	III	IV	I	II	III	IV	I	II	III	IV	5
month	1296			Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	
Ramses I	1295	**1**	1	1	30	29	29	28	28	27	27	26	26	25	25	
Seti I	1294	**2**	2	19	19	18	18	18	17	17	16	16	15	15	14	
	1293	**1**	3	9	8	8	7	7	6	6	6	5	5	4	4	3
	1292	**2**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1291	**3**	5	17	17	16	16	15	15	14	14	13	13	12	12	
	1290	**4**	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1289	**5**	7	25	25	24	24	23	23	23	22	22	21	21	20	
	1288	**6**	8	15	14	14	13	13	12	12	11	11	10	10	10	
	1287	**7**	9	4	4	3	3	2	2	1	1	30	29	29	28	
	1286	**8**	10	23	23	22	22	21	21	20	20	19	19	18	18	
	1285	**9**	11	12	12	11	11	10	10	10	9	9	8	8	7	
	1284	**10**	12	2	1	1	30	30	29	28	28	27	27	27	26	
Ramses II	1283	**11**	13	21	20	20	19	19	18	18	17	17	16	16	15	
	1282	**1**	14	10	9	9	9	8	8	7	7	6	6	5	5	4
	1281	**2**	15	29	28	28	27	27	27	26	26	25	25	24	24	
	1280	**3**	16	18	18	17	17	16	16	15	15	14	14	14	13	
	1279	**4**	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	1278	**5**	18	26	26	26	25	25	24	24	23	23	22	22	21	
	1277	**6**	19	16	15	15	14	14	14	13	13	12	12	11	11	
	1276	**7**	20	5	5	4	4	3	3	2	2	1	1	1	30	
	1275	**8**	21	24	24	23	23	22	22	21	21	20	20	19	19	
	1274	**9**	22	13	13	13	12	12	11	11	10	10	9	9	8	
	1273	**10**	23	3	2	2	1	1	30	30	29	29	28	28	27	
	1272	**11**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	1271	**12**	25	11	11	10	10	9	9	8	8	7	7	6	6	
	1270	**13**	1	1	30	29	29	28	28	27	27	26	26	25	25	
	1269	**14**	2	19	19	18	18	18	17	17	16	16	15	15	14	
	1268	**15**	3	9	8	8	7	7	6	6	6	5	5	4	4	3
	1267	**16**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1266	**17**	5	17	17	16	16	15	15	14	14	13	13	12	12	
	1265	**18**	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1264	**19**	7	25	25	24	24	23	23	23	22	22	21	21	20	
	1263	**20**	8	15	14	14	13	13	12	12	11	11	10	10	10	
	1262	**21**	9	4	4	3	3	2	2	1	1	30	29	29	28	
	1261	**22**	10	23	23	22	22	21	21	20	20	19	19	18	18	
	1260	**23**	11	12	12	11	11	10	10	10	9	9	8	8	7	
	1259	**24**	12	2	1	1	30	30	29	28	28	27	27	27	26	
	1258	**25**	13	21	20	20	19	19	18	18	17	17	16	16	15	
	1257	**26**	14	10	9	9	9	8	8	7	7	6	6	5	5	4
	1256	**27**	15	29	28	28	27	27	27	26	26	25	25	24	24	
	1255	**28**	16	18	18	17	17	16	16	15	15	14	14	14	13	
	1254	**29**	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	1253	**30**	18	26	26	26	25	25	24	24	23	23	22	22	21	
	1252	**31**	19	16	15	15	14	14	14	13	13	12	12	11	11	
	1251	**32**	20	5	5	4	4	3	3	2	2	1	1	1	30	
	1250	**33**	21	24	24	23	23	22	22	21	21	20	20	19	19	
	1249	**34**	22	13	13	13	12	12	11	11	10	10	9	9	8	
	1248	**35**	23	3	2	2	1	1	30	30	29	29	28	28	27	
	1247	**36**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	1246	**37**	25	11	11	10	10	9	9	8	8	7	7	6	6	
	1245	**38**	1	1	30	29	29	28	28	27	27	26	26	25	25	
	1244	**39**	2	19	19	18	18	18	17	17	16	16	15	15	14	

	1243	40	3	9	8	8	7	7	6	6	6	5	5	4	4	3
	1242	41	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1241	42	5	17	17	16	16	15	15	14	14	13	13	12	12	
	1240	43	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1239	44	7	25	25	24	24	23	23	23	22	22	21	21	20	
	1238	45	8	15	14	14	13	13	12	12	11	11	10	10	10	
	1237	46	9	4	4	3	3	2	2	1	1	30	29	29	28	
	1236	47	10	23	23	22	22	21	21	20	20	19	19	18	18	
	1235	48	11	12	12	11	11	10	10	10	9	9	8	8	7	
	1234	49	12	2	1	1	30	30	29	28	28	27	27	27	26	
	1233	50	13	21	20	20	19	19	18	18	17	17	16	16	15	
	1232	51	14	10	9	9	9	8	8	7	7	6	6	5	5	4
	1231	52	15	29	28	28	27	27	27	26	26	25	25	24	24	
	1230	53	16	18	18	17	17	16	16	15	15	14	14	14	13	
	1229	54	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	1228	55	18	26	26	26	25	25	24	24	23	23	22	22	21	
	1227	56	19	16	15	15	14	14	14	13	13	12	12	11	11	
	1226	57	20	5	5	4	4	3	3	2	2	1	1	1	30	
	1225	58	21	24	24	23	23	22	22	21	21	20	20	19	19	
	1224	59	22	13	13	13	12	12	11	11	10	10	9	9	8	
	1223	60	23	3	2	2	1	1	30	30	29	29	28	28	27	
	1222	61	24	22	21	21	20	20	19	19	18	18	18	17	17	
	1221	62	25	11	11	10	10	9	9	8	8	7	7	6	6	
	1220	63	1	1	30	29	29	28	28	27	27	26	26	25	25	
	1219	64	2	19	19	18	18	18	17	17	16	16	15	15	14	
	1218	65	3	9	8	8	7	7	6	6	6	5	5	4	4	3
	1217	66	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1216	67	5	17	17	16	16	15	15	14	14	13	13	12	12	
Merenptah	1215	1	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1214	2	7	25	25	24	24	23	23	23	22	22	21	21	20	
	1213	3	8	15	14	14	13	13	12	12	11	11	10	10	10	
	1212	4	9	4	4	3	3	2	2	1	1	30	29	29	28	
	1211	5	10	23	23	22	22	21	21	20	20	19	19	18	18	
	1210	6	11	12	12	11	11	10	10	10	9	9	8	8	7	
	1209	7	12	2	1	1	30	30	29	28	28	27	27	27	26	
	1208	8	13	21	20	20	19	19	18	18	17	17	16	16	15	
	1207	9	14	10	9	9	9	8	8	7	7	6	6	5	5	4
Seti II	1206	1	15	29	28	28	27	27	27	26	26	25	25	24	24	
	1205	2	16	18	18	17	17	16	16	15	15	14	14	14	13	
	1204	3	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	1203	4	18	26	26	26	25	25	24	24	23	23	22	22	21	
	1202	5	19	16	15	15	14	14	14	13	13	12	12	11	11	
Siptah	1201	1	20	5	5	4	4	3	3	2	2	1	1	1	30	
	1200	2	21	24	24	23	23	22	22	21	21	20	20	19	19	
	1199	3	22	13	13	13	12	12	11	11	10	10	9	9	8	
	1198	4	23	3	2	2	1	1	30	30	29	29	28	28	27	
	1197	5	24	22	21	21	20	20	19	19	18	18	18	17	17	
	1196	6	25	11	11	10	10	9	9	8	8	7	7	6	6	
Tausert	1195	7	1	1	30	29	29	28	28	27	27	26	26	25	25	
Sethnakht	1194	2	2	19	19	18	18	18	17	17	16	16	15	15	14	
	1193	3	3	9	8	8	7	7	6	6	6	5	5	4	4	3
Ramses III	1192	1	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1191	2	5	17	17	16	16	15	15	14	14	13	13	12	12	
	1190	3	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1189	4	7	25	25	24	24	23	23	23	22	22	21	21	20	
	1188	5	8	15	14	14	13	13	12	12	11	11	10	10	10	
	1187	6	9	4	4	3	3	2	2	1	1	30	29	29	28	
	1186	7	10	23	23	22	22	21	21	20	20	19	19	18	18	
	1185	8	11	12	12	11	11	10	10	10	9	9	8	8	7	
	1184	9	12	2	1	1	30	30	29	28	28	27	27	27	26	
	1183	10	13	21	20	20	19	19	18	18	17	17	16	16	15	
	1182	11	14	10	9	9	9	8	8	7	7	6	6	5	5	4

	1181	**12**	15	29	28	28	27	27	27	26	26	25	25	24	24		
	1180	**13**	16	18	18	17	17	16	16	15	15	14	14	14	13		
	1179	**14**	17	8	7	7	6	6	5	5	4	4	3	3	2	2	
	1178	**15**	18	26	26	26	25	25	24	24	23	23	22	22	21		
	1177	**16**	19	16	15	15	14	14	14	13	13	12	12	11	11		
	1176	**17**	20	5	5	4	4	3	3	2	2	1	1	1	30		
	1175	**18**	21	24	24	23	23	22	22	21	21	20	20	19	19		
	1174	**19**	22	13	13	13	12	12	11	11	10	10	9	9	8		
	1173	**20**	23	3	2	2	1	1	30	30	29	29	28	28	27		
	1172	**21**	24	22	21	21	20	20	19	19	18	18	18	17	17		
	1171	**22**	25	11	11	10	10	9	9	8	8	7	7	6	6		
	1170	**23**	1	1	30	29	29	28	28	27	27	26	26	25	25		
	1169	**24**	2	19	19	18	18	18	17	17	16	16	15	15	14		
	1168	**25**	3	9	8	8	7	7	6	6	6	5	5	4	4	3	
	1167	**26**	4	28	27	27	26	26	25	25	24	24	23	23	23		
	1166	**27**	5	17	17	16	16	15	15	14	14	13	13	12	12		
	1165	**28**	6	6	6	6	5	5	4	4	3	3	2	2	1	1	
	1164	**29**	7	25	25	24	24	23	23	23	22	22	21	21	20		
	1163	**30**	8	15	14	14	13	13	12	12	11	11	10	10	10		
	1162	**31**	9	4	4	3	3	2	2	1	1	30	29	29	28		
	1161	**32**	10	23	23	22	22	21	21	20	20	19	19	18	18		
Ramses IV	1160	**1**	11	12	12	11	11	10	10	10	9	9	8	8	7		
	1159	**2**	12	2	1	1	30	30	29	28	28	27	27	27	26		
	1158	**3**	13	21	20	20	19	19	18	18	17	17	16	16	15		
	1157	**4**	14	10	9	9	9	8	8	7	7	6	6	5	5	4	
	1156	**5**	15	29	28	28	27	27	27	26	26	25	25	24	24		
	1155	**6**	14	18	18	17	17	16	16	15	15	14	14	14	13		
	1154	**7**	15	8	7	7	6	6	5	5	4	4	3	3	2	2	
	1153			Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.		
SEASON	BCE			AKHET				PERET				SHEMU					
month				I	II	III	IV	I	II	III	IV	I	II	III	IV	5	

DATING OF THE XXVII[TH] DYNASTY THROUGH ASTRONOMY

The calendar at Elephantine (in the far south of Egypt) with its system of double dates, Egyptian and Babylonian, was used by Persians officials and Jewish scribes only during a short period from 500 to 400 BCE. For example, a Persian official erected a votive stele stating: *This temple, (W)id(arnaga) head of the garrison at Syene was done in the month of Siwan, that is to say Mehir, year 7 of King Artaxerxes, (to) Osirnahty, the god. Peace*[269]. After the conquest of Egypt by Cambyses Egypt became a Persian satrapy but most of the scribes were Egyptians or Jews[270]. Persian officials at Elephantine were familiar with three kinds of lunar calendar (Elamite, Old-Persian, Babylonian), which appear Darius I's inscriptions at Behistun[271]. Jewish scribes at Elephantine were familiar with different calendars[272], but they mainly used a calendar based on the Babylonian calendar after their return to Judea from Babylon (538 BCE). At that time there were the following equivalences among calendars[273]:

[269] A. LEMAIRE – Recherches d'épigraphie araméenne en Asie mineure et en Égypte
in: *Achaemenid History* V (1991) Ed. Nederlands Instituut Leiden pp.199-201.

[270] According to Herodotus (The Histories II:152-154), Psammetichus I, dynasts of Sais, called on foreign mercenaries, including Ionians and Carians, to consolidate his power in Egypt, he then installed these mercenary garrisons in Daphne west of Delta and Elephantine, on the border in the south (The Histories II:30-31). The Letter of Aristeas to Philocrates III:13 states that among these mercenaries there were Jews. According to the biblical text, the massive emigration of Jews into Egypt began shortly after the pharaoh Necho II established King Jehoiakim (in 609 BCE) on the throne in Jerusalem (2Ki 23:34, Jr 26:21-23, 42:14). After the murder of Gedaliah, many of these Jews immigrated to Egypt (Jr 43:7, 44:1) especially in the country of Patros (meaning "the Land of the South" in Egyptian) the southern province in which Elephantine was the main town.

[271] P. LECOQ - Les inscriptions de la Perse achéménide
Paris 1997 Éd. Gallimard pp. 171-174.

[272] P. GRELOT – Documents araméens d'Égypte
in: *Littératures anciennes du proche orient* n°5 (Cerf, 1972) pp. 33-63, 509-510.

[273] A. KUHRT - The Persian Empire
London 2010 Ed. Routeledge pp. 885-886.

EGYPTIAN				JEWISH/ PERSIAN		BABYLONIAN		JULIAN	
SECULAR		RELIGIOUS		HEBREW	ARAMAIC				
I Akhet	30	Thoth (1)	30					January	31
II Akhet	30	Paopi (2)	29					February	28
III Akhet	30	Hathor (3)	30					March	31
IV Akhet	30	Koyak (4)	29	*month* I	Nisan	Nisanu	30	April	30
I Peret	30	Teobi (5)	30	*month* II	Iyyar	Ayyaru	29	May	31
II Peret	30	**Mehir (6)**	29	*month* III	**Siwan**	Simanu	30	June	30
III Peret	30	Pamenotep (7)	29	*month* IV	Tammuz	Dumuzu	29	July	31
IV Peret	30	Parmuti (8)	29	*month* V	Ab	Abu	30	August	31
I Shemu	30	Pahons (9)	29	*month* VI	Elul	Ululu	29	September	30
II Shemu	30	Paoni (10)	29	*month* VII	Tishri	Tashritu	30	October	31
III Shemu	30	Epipi (11)	30	*month* VIII	Marheshwan	Arahsamna	29	November	30
IV Shemu	30	Mesore (12)	29	*month* IX	Kislew	Kislimu	30	December	31
Epagomen	5	[xxx2] (13)	30						
				month X	Tebeth	Tebetu	29	January	31
				month XI	Shebat	Shabatu	30	February	28
				month XII	Adar	Addaru			
				month XIII	[Adar2]	[Addaru2]	29	March	31

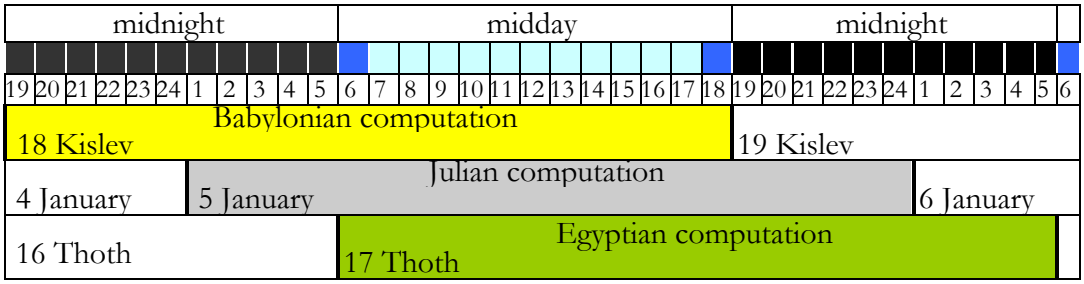
As the Egyptian calendar had 12 months of 30 days, plus 5 days at the end (called *epagomenon* in Greek), it was not lunar. As the Jews of Elephantine were in an Egyptian environment they used the Egyptian lunar calendar for the dating of their religious festivals. It is noteworthy that those Jews used only the word *yerah* "lunation" (implying the [full] moon)[274], to designate the month while at the same time, in Judea, the Jews of Arad used only the word *hodesh* "new" (implying the new [moon])[275]. We read for example on the ostracon n°7 (c. 600 BCE): *for the 10th [month], the 1st of the month to the 6th of the month*[276]. In the Hebrew Scriptures[277], the words *hodesh* and *yerah* are often used in the sense of "month", but they are not synonymous since some sentences are found in Canaanite inscriptions[278] like: *hodesh yerah Etanim*, which can be translated as "new moon of Etanim (1Ki 8:2)". If the two words *hodesh* and *yerah* were synonymous the translation would be "month of the month of Etanim", which does not make sense[279]. This semantic distinction is important. Indeed, in a lunar calendar starting at the new moon, the two words *hodesh* "new [moon]" and *yerah* "lunation" to refer to one month may be suitable. But in a schedule starting at the full moon, only the word "lunation" is appropriate. Following the religious reform carried out by Nehemiah in Jerusalem about 440 BCE (Ne 13:6-9), the Jews of Elephantine would celebrate the Passover again using the Aramaic calendar based on a Babylonian pattern[280], because this festival was to be celebrated 14 days after the new moon. It was indeed a reform of the calendar, not a reform of worship, because the Jews were in contact with the priesthood in Jerusalem and they had celebrated the Passover since at least 450 BCE[281]. The reform of the calendar (reforms carried out by Nehemiah in Jerusalem) is dated the 5th year

274 B. PORTEN A. YARDENI - Textbook of Aramaic Documents from Ancient Egypt, 3
1993 Ed. Israel Academy of Sciences and Humanities pp. XXXVI.
275 G.I. DAVIES - Ancient Hebrew Inscriptions, Corpus and Concordance
Cambridge 1991 Ed. Cambridge University Press pp. 14,15,348.
276 A. LEMAIRE -Inscriptions hébraïques Tome I, Les Ostraca
In: *Littératures anciennes du proche orient* n°9 Paris 1977 Ed. Cerf pp. 168,231.
277 The word "full moon (Pr 7:20)" is *kese* in Hebrew or *lebanah* "the white one (Is 30:26)".
278 H. DONNER, W. RÖLLING - Kanaanäische und Aramäische Inschriften
Wiesbaden 2002 Ed. Harrassowitzp. 9 N°3.
279 J.A. WAGENAAR - Post-Exilic Calendar Innovations
in: *Zeitschrift für die alttestamentliche Wissenschaft* 115 (2003) p. 7 note 9.
280 J. MÉLÈZE MODRZEJEWSKI - Les Juifs d'Égypte de Ramsès II à Hadrien
Paris 1991 Éd. Errance p. 37
281 A. VINCENT - La religion des judéo-araméens d'Éléphantine
Paris 1937 Éd. Librairie orientaliste P. Geuthner pp. 267-274.

of Darius II (419 BCE)[282]. At Elephantine the main system of dating was the Egyptian calendar (secular), but as numerous religious festivals in Egypt were based on moon phases a lunar calendar was used to fix these dates. The Jews, then the Persians, naturally used this calendar for their own festivals based on a lunar calendar (as the Passover for the Jews). The language of administration being either Egyptian or Persian, it was necessary to convert the names of the Egyptian lunar months to the common language understood by all, Aramaic. For example, the Jews converted into Aramaic the name of the months of their Hebrew calendar: *It came about that in the 4th year of Darius (...) on the 4th [day] of the 9th month, [that is] in Kislev* (Zc 7:1). Given that Egyptian name of lunar months were the same as the ones from the secular calendar, it is clear that if the Jews had only transcribed the lunar date and the current date, the double dating would have been incomprehensible (except for the Egyptians). For example the papyrus Louvre 7848[283] is dated (line 5): *in year 12, 2nd month of Shemu, (day) 13, on the 15th day of the 1st month of Shemu*. In 558 BCE the year 12 of Amasis began on I Akhet 1 (10 January) and I Shemu 1 is dated 7 September[284] and as the II Shemu 1 (lunar) began on full moon (10 September)[285], consequently I Shemu 15 (secular) and II Shemu 13 (lunar) are both dated 21 September 558 BCE:

August							September 558 BCE																						
25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
IV Peret (secular)													I Shemu (secular)																	
18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
I Shemu (lunar)															II Shemu (lunar)														
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

For reasons of clarity the scribes of Elephantine (both Jews and Persians) used the Egyptian lunar calendar by replacing the names of months by their Aramaic equivalent, which were familiar to them. However, like the Babylonians, they counted the new day after sunset (c. 18 p.m.) while the Egyptians counted it from the vanishing of stars (c. 5 a.m.). If a Jewish scribe wrote on (in 475 BCE) 17 Thoth around 16:00 he dated his document on 17 Kislev[286], but if he wrote about 20:00 he would have dated it on 18 Kislev.



An Elephantine Papyri (B24) is dated: *[17] Thoth, which is 17 Kislev, year 21 (of Xerxes), accession year of Artaxerxes*[287]. As Xerxes died on 14/V/**21** (24 August) the 1st Thoth (I Akhet 1) in 475 BCE is dated 20 December and the 17 Thoth, on 5 January 474 BCE:

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[282] As often happens, reforms are not fully followed. Yefet ben Eli, a Karaite living in Iraq (c. 950 CE) recalled that while the Karaites determined the 1st lunar day according to the observation of the new moon and Rabbinites determined it by calculations, those who had determined it in the past as the full moon did not exist (S. POZNANSKI – Les écrits d'Anan in: *Revue des Études Juives* 44 (1902) pp. 171-172). By contrast, Jacob Qirqisani, a contemporary of Yefet ben Eli, also known Jewish supporters of the full moon: the "Margariya" and Yeshua ben Yehuda (c. 1050 CE) mentions them as the "Albedaryah".

[283] K. DONKER VAN HEEL – Abnormal Hieratic and Early Demotic Texts collected by the Theban Choachytes in the reign of Amasis: Papyrus from the Louvre Eisenlohr Lot (Thesis). Leiden 1996 Ed. Rijksuniversiteit pp. 93-99.

[284] http://www.chronosynchro.net/wordpress/convertisseur/

[285] http://www.fourmilab.ch/earthview/pacalc.html
http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php

[286] P. GRELOT – Documents araméens d'Égypte
in: *Littératures anciennes du proche orient* n°5 (Cerf, 1972) pp. 174-178.

[287] B. PORTEN - The Elephantine Papyri in English
Leiden 1996 Ed E.J. Brill pp. 164-165.

BCE							
475	1	X	*I*	21	20		
	2	XI	*II*				
	3	XII	*III*				
	4	I	*IV*		21		**Xerxes I**
	5	II	*V*				
	6	III	*VI*				*(Total lunar eclipse dated 26 June)*
	7	IV	*VII*				
	8	V	*VIII*				*Xerxes died on 24 August*
	9	VI	*IX*	(21)		1	**(Xerxes I) / Artabanus**
	10	VII	*X*			2	
	11	VIII	*XI*			3	*(Partial lunar eclipse dated 20 December)*
	12	IX	*XII*			4	
474	1	X	*I*	1	0	5	**Artaxerxes I** *(pap. B24 dated on 5 January)*
	2	XI	*II*			6	
	3	XII	*III*			7	
	4	I	*IV*		1		
	5	II	*V*				
	6	III	*VI*				
	7	IV	*VII*				
	8	V	*VIII*				
	9	VI	*IX*				
	10	VII	*X*				

The reckoning of regnal years is different depending on its referring pattern: Egyptian or Babylonian. For example the 21st year of Xerxes' reign began on 1st Nisan (month I) at Babylon but on 1st Thoth (month *I*) at Elephantine. The 1st Nisan is dated 14 April in 475 BCE, which was the first lunar crescent[288] after the spring equinox (26 March)[289], and as the 1st Thoth is dated 20 December[290], the 1st Kislev as well. In the Babylonian pattern the 1st Kislev (month IX) is dated 6 December (first lunar crescent) while in the Egyptian pattern the 1st Kislev is dated 20 December (full moon).

November							December 475 BCE																								
24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Mesore																					Epagomen					Thoth					
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	1	2	3	4	5	6
Arahsamna												Kislimu (*Babylon*)																			
18	19	20	21	22	23	24	25	26	27	28	29	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Marheshwan																										Kislev (*Elephantine*)					
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	1	2	3	4	5	6

The 20 documents from Elephantine with a dual date enable us to reconstruct the chronology of the reigns of the XXVIIth dynasty. For example the papyrus B23 is dated: *year 15 [of Xerxes] 18 Elul, which is 28 Pahons*, hence the 1st lunar day is dated 11 Pahons (= 28 - 17), which was a full moon in 481 BCE (30 August). The 11 Pahons or I Shemu 11 matches exactly to day 11, column I Shemu, in the 25-year lunar cycle (year 8 of the cycle):

Papyrus	**year**	Lunar date	Egyptian calendar	**BCE**	1st lunar day	Full moon
Xerxes I		1 Elul	11 Pahons (I Shemu)		29 Aug.	30 Aug.
B23	**15**	18 Elul	28 Pahons	15 Sept. **481**		

SEASON					AKHET				PERET				SHEMU				
	BCE				I	II	III	IV	I	II	III	IV	I	II	III	IV	5
month	483				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	
Xerxes I	482		**14**	7	25	25	24	24	23	23	23	22	22	21	21	20	
	481		**15**	8	15	14	14	13	13	12	12	11	11	10	10	10	
	480		**16**	9	4	4	3	3	2	2	1	1	30	29	29	28	

[288] http://www.fourmilab.ch/earthview/pacalc.html
http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php
[289] http://www.imcce.fr/fr/grandpublic/temps/saisons.php
[290] http://www.chronosynchro.net/wordpress/convertisseur/

Papyrus	year	Lunar date	Egyptian calendar	BCE	1st lunar day	Full moon
Darius I						
N°1	**7**		6 Mehir	3 Jun. **515**		
N°2	**27**		2 Epipi	22 Oct. **495**		
Xerxes I		1 Elul	11 Pahons (I Shemu)		29 Aug.	30 Aug.
B23	**15**	18 Elul	28 Pahons	15 Sept. **481**		
Artaxerxes I	[0]	1 Kislev	5 epagomen	[475]	19 Dec.	20 Dec.
B24	**1**	18 Kislev	[17] Thoth	5 Jan. **474**		
		1 Kislev	[1] Mesore (IV Shemu)		14 Nov.	14 Nov.
B25/26	**6**	21 Kislev	[21] Mesore	4 Dec. **469**		
		1 Kislev	28 Mesore (IV Shemu)		10 Dec.	11 Dec.
B34	**9**	7 Kislev	4 epagomen*	16 Dec. **466**		
		1 Siwan	6 Pamenot (III Peret)		20 Jun.	21 Jun.
B35	**14**	20 Siwan	25 Pamenot	9 Jul. **461**		
		1 Tammuz	16 Pamenot (III Peret)		29 Jun.	28 Jun.
N°43	**16**	18 Tammuz	3 Parmuti	16 Jul. **459**		
		1 Ab	[13] Parmuti (IV Peret)		26 Jul.	28 Jul.
B36	**16**	18 Ab	[30] Parmuti	12 Aug. **459**		
		1 Tishri	13 Paoni (II Shemu)		24 Sep.	25 Sep.
B28	**16**	24 Tishri	6 Epipi	17 Oct. **459**		
		1 Kislev	9 Mesore (IV Shemu)		18 Nov.	20 Nov.
B29	**19**	2 Kislev	10 Mesore	19 Nov. **456**		
		1 Ab	6 Pahons (I Shemu)		16 Aug.	17 Aug.
B30	**25**	14 Ab	19 Pahons	29 Aug. **450**		
		1 Elul	3 Paoni (II Shemu)		11 Sep.	13 Sep.
B37	**28**	7 Elul	9 Paoni	17 Sep. **447**		
		1 Tishri	1 Epipi (III Shemu)		8 Oct.	9 Oct.
B38	**31**	25 Tishri	25 Epipi	1 Nov. **444**		
		1 Siwan	18 Mehir (II Peret)		27 May	27 May
B39	**38**	20 Siwan	7 Pamenotep	15 Jun. **437**		
Darius B		1 Tammuz	1 Parmuti (IV Peret)		7 Jul.	8 Jul.
B40	**4**	8 Tammuz	8 Parmuti	14 Jul. **430**		
		1 Elul	1 Paoni (II Shemu)		5 Sep.	5 Sep.
B31	**4**	30 Elul	30 Paoni	4 Oct. **430**		
		1 Tishri	17 Paoni (II Shemu)		20 Sep.	20 Sep.
B42	**8**	6 Tishri	22 Paoni	25 Sep. **426**		

After year 5 of Darius II (419 BCE) when a document is dated between Thoth and Koyak (December to March) the accession year is indicated[291] (see below), for example (papyrus N°40): *3 Kislev, year 8 [Babylonian reckoning], which is 12 Thoth, year 9 [Egyptian reckoning] of king Darius*. The Egyptian lunar calendar began on the full moon while the Babylonian lunar calendar was beginning on the 1st crescent, consequently the 25-year lunar cycle had to be shifted by 10 years (later). For example, a 25-year lunar cycle began in 439 BCE on the full moon dated I Akhet 1 (11 December), while the new 25-year lunar cycle in 429 BCE began on 1st lunar crescent dated I Akhet 1 (9 December).

Papyrus	year	Lunar date	Egyptian calendar	BCE	1st lunar day	1st crescent
Darius II		1 Kislev	10 Thoth (I Akhet) **[9]**		14 Dec.	13 Dec.
B32 (N°40)	**8**	3 Kislev	12 Thoth **[9]**	16 Dec. **416**		
		1 Shebat	16 Paopi (II Akhet) **[14]**		18 Jan.	18 Jan.
B33 (N°41)	**13**	24 Shebat	9 Hathor **[14]**	10 Feb. **410**		
Artaxerxes II		1 Heshwan	6 Mesore (IV Shemu)		2 Nov.	2 Nov.
B43	**1**	24 Heshwan	29 Mesore	25 Nov. **404**		
		1 Adar	19 Hathor (III Akhet)		18 Feb.	17 Feb.
B44	**3**	20 Adar	8 Koyak	9 Mar. **402**		
Amartaeus						
N°7	**5**		21? Pamenhotep	19 Jun. **400**		

[291] P. GRELOT – Documents araméens d'Égypte
in: *Littératures anciennes du proche orient* n°5 (Cerf, 1972) pp. 198-207.

	Legend of colours (I Akhet 1 in 489 BCE is dated 24 December, which was a full moon)
1	Lunar dates dated by Egyptian calendar (secular) in the 25-year lunar cycle based on full moon
1	Lunar dates dated by Egyptian calendar (secular) in the 25-year lunar cycle based on first lunar crescent
36	Darius I died on 10/IX/**36** (8 December 486 BCE) just before I Akhet 1 (23 December)

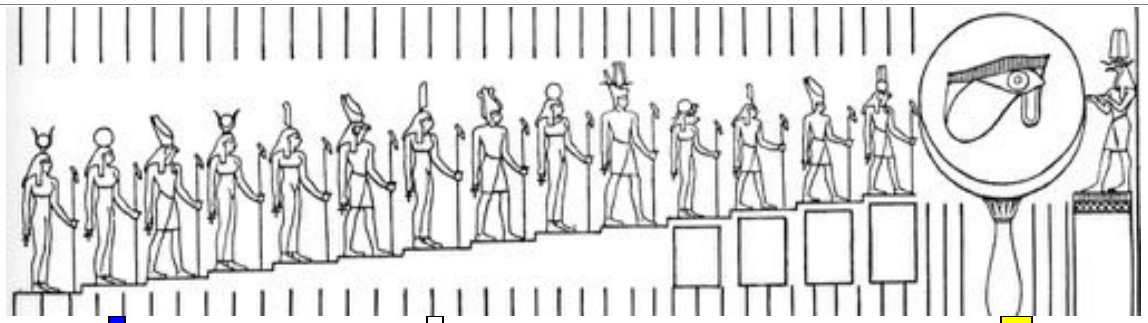
SEASON					AKHET				PERET				SHEMU				
	BCE				I	II	III	IV	I	II	III	IV	I	II	III	IV	5
month	491				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	
Darius I	490	**32**	**6**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	489	**33**	**7**	25	11	11	10	10	9	9	8	8	7	7	6	6	
	488	**34**	**8**	1	1	30	29	29	28	28	27	27	26	26	25	25	
	487	**35**	**9**	2	19	19	18	18	18	17	17	16	16	15	15	14	
	486	**36**	**10**	3	9	8	8	7	7	6	6	6	5	5	4	4	3
Xerxes I	485		**11**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	484		**12**	5	17	17	16	16	15	15	14	14	13	13	12	12	
	483		**13**	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	482		**14**	7	25	25	24	24	23	23	23	22	22	21	21	20	
	481		**15**	8	15	14	14	13	13	12	12	11	11	10	10	10	
	480		**16**	9	4	4	3	3	2	2	1	1	30	29	29	28	
	479		**17**	10	23	23	22	22	21	21	20	20	19	19	18	18	
	478		**18**	11	12	12	11	11	10	10	10	9	9	8	8	7	
	477		**19**	12	2	1	1	30	30	29	28	28	27	27	27	26	
	476		**20**	13	21	20	20	19	19	18	18	17	17	16	16	15	
	475	**0**	**21**	14	10	9	9	9	8	8	7	7	6	6	5	5	4
Artaxerxes I	474		**1**	15	29	28	28	27	27	27	26	26	25	25	24	24	
	473		**2**	16	18	18	17	17	16	16	15	15	14	14	14	13	
	472		**3**	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	471		**4**	18	26	26	26	25	25	24	24	23	23	22	22	21	
	470		**5**	19	16	15	15	14	14	14	13	13	12	12	11	11	
	469		**6**	20	5	5	4	4	3	3	2	2	1	1	1	30	
	468		**7**	21	24	24	23	23	22	22	21	21	20	20	19	19	
	467		**8**	22	13	13	13	12	12	11	11	10	10	9	9	8	
	466		**9**	23	3	2	2	1	1	30	30	29	29	28	28	27	
	465		**10**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	464		**11**	25	11	11	10	10	9	9	8	8	7	7	6	6	
	463		**12**	1	1	30	29	29	28	28	27	27	26	26	25	25	
	462		**13**	2	19	19	18	18	18	17	17	16	16	15	15	14	
	461		**14**	3	9	8	8	7	7	6	6	6	5	5	4	4	3
	460		**15**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	459		**16**	5	17	17	16	16	15	15	14	14	13	13	12	12	
	458		**17**	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	457		**18**	7	25	25	24	24	23	23	23	22	22	21	21	20	
	456		**19**	8	15	14	14	13	13	12	12	11	11	10	10	10	
	455		**20**	9	4	4	3	3	2	2	1	1	30	29	29	28	
	454		**21**	10	23	23	22	22	21	21	20	20	19	19	18	18	
	453		**22**	11	12	12	11	11	10	10	10	9	9	8	8	7	
	452		**23**	12	2	1	1	30	30	29	28	28	27	27	27	26	
	451		**24**	13	21	20	20	19	19	18	18	17	17	16	16	15	
	450		**25**	14	10	9	9	9	8	8	7	7	6	6	5	5	4
	449		**26**	15	29	28	28	27	27	27	26	26	25	25	24	24	
	448		**27**	16	18	18	17	17	16	16	15	15	14	14	14	13	
	447		**28**	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	446		**29**	18	26	26	26	25	25	24	24	23	23	22	22	21	
	445		**30**	19	16	15	15	14	14	14	13	13	12	12	11	11	
	444		**31**	20	5	5	4	4	3	3	2	2	1	1	1	30	
	443		**32**	21	24	24	23	23	22	22	21	21	20	20	19	19	
	442		**33**	22	13	13	13	12	12	11	11	10	10	9	9	8	
	441		**34**	23	3	2	2	1	1	30	30	29	29	28	28	27	
	440		**35**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	439		**36**	25	11	11	10	10	9	9	8	8	7	7	6	6	
	438		**37**	1	1	30	29	29	28	28	27	27	26	26	25	25	

	437		**38**	2	19	19	18	18	18	17	17	16	16	15	15	14	
	436		**39**	3	9	8	8	7	7	6	6	6	5	5	4	4	3
	435		**40**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	434	**0**	**41**	5	17	17	16	16	15	15	14	14	13	13	12	12	
Darius B	433	**1**	42	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	432	**2**		7	25	25	24	24	23	23	23	22	22	21	21	20	
	431	**3**		8	15	14	14	13	13	12	12	11	11	10	10	10	
	430	**4**		9	4	4	3	3	2	2	1	1	30	29	29	28	
	429	**5**		10	23	23	22	22	21	21	20	20	19	19	18	18	
	428	**6**		11	12	12	11	11	10	10	10	9	9	8	8	7	
	427	**7**		12	2	1	1	30	30	29	28	28	27	27	27	26	
	426	**8**		13	21	20	20	19	19	18	18	17	17	16	16	15	
	425		**50**	14	10	9	9	9	8	8	7	7	6	6	5	5	4
	424	**0**	**51**	15	29	28	28	27	27	27	26	26	25	25	24	24	
Darius II	423		**1**	16	18	18	17	17	16	16	15	15	14	14	14	13	
	422		**2**	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	421		**3**	18	26	26	26	25	25	24	24	23	23	22	22	21	
	420		**4**	19	16	15	15	14	14	14	13	13	12	12	11	11	
	419		**5**	20	5	5	4	4	3	3	2	2	1	1	1	30	
	418		**6**	21	24	24	23	23	22	22	21	21	20	20	19	19	
	417		**7**	*12*	2	1	1	30	30	29	28	28	27	27	27	26	
	416		**8**	*13*	21	20	20	19	19	18	18	17	17	16	16	15	
	415		**9**	*14*	10	9	9	9	8	8	7	7	6	6	5	5	
	414		**10**	*15*	29	28	28	27	27	27	26	26	25	25	24	24	
	413		**11**	*16*	18	18	17	17	16	16	15	15	14	14	14	13	
	412		**12**	*17*	8	7	7	6	6	5	5	4	4	3	3	2	2
	411		**13**	*18*	26	26	26	25	25	24	24	23	23	22	22	21	
	410		**14**	*19*	16	15	15	14	14	14	13	13	12	12	11	11	
	409		**15**	*20*	5	5	4	4	3	3	2	2	1	1	1	30	
	408		**16**	*21*	24	24	23	23	22	22	21	21	20	20	19	19	
	407		**17**	*22*	13	13	13	12	12	11	11	10	10	9	9	8	
	406		**18**	*23*	3	2	2	1	1	30	30	29	29	28	28	27	
	405	**0**	**19**	*24*	22	21	21	20	20	19	19	18	18	18	17	17	
Artaxerxes II	404		**1**	*25*	11	11	10	10	9	9	8	8	7	7	6	6	
	403		**2**	*1*	1	30	29	29	28	28	27	27	26	26	25	25	
	402		**3**	*2*	19	19	18	18	18	17	17	16	16	15	15	14	
Armataeus	401		**4**	*3*	9	8	8	7	7	6	6	6	5	5	4	4	3
	400		**5**	*4*	28	27	27	26	26	25	25	24	24	23	23	23	
SEASON					AKHET				PERET				SHEMU				
					I	II	III	IV	I	II	III	IV	I	II	III	IV	5
month					Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	

Very early (at least since the V[th] Dynasty) the Egyptians used two calendars: a secular calendar[292] used to date their documents and a religious schedule to determine the days of their festivals linked to the moon[293]. They distinguished some "seasonal festivals", celebrated in their calendar, from "sky festivals" related to the lunar cycle. A major point has to be noted: the Egyptians were concerned only by the increasing part of the lunar cycle, never by its decreasing part. So they celebrated their lunar festivals during the 15 last days of the full lunar month ("½ month"). The feast of *psḏntyw* "shining ones" was the starting point (day 1 of the full month) corresponding to day 15 of the ½ month, which was sometimes dated in the civil calendar, as well as the *wag* feast (day 18 of the full month) called "day of the moon" and corresponding to day 2 ("month day") of the ½ month.

[292] with a year of 365 days consisting of 12 months of 30 days and completed by 5 days "in addition".
[293] A. SPALINGER - The Private Feast Lists of Ancient Egypt
Wiesbaden 1996 Ed. Harrassowitz pp. 9-72.
A. SPALINGER - The Lunar System in Festival Calendars from the New Kingdom Onwards
in: *Société d'Égyptologie* N°19 (1995) Genève pp. 25-40.

Lunar phases were symbolized at Dendera (c. 50 BCE) by 14 deities climbing stairs to achieve the filling of the eye Wedjat[294] (safe eye) the 15th day at the full moon, the lunar day 1 (*psḏntyw*). But this cycle of 15 days was only a ½ month, the next full month had to begin at the end of this cycle, which was a full moon. Thus, the Egyptians were able to reckon lunar months almost in the same manner as the Babylonians.



DATING OF THE XIITH DYNASTY THROUGH ASTRONOMY

The dating of the XIIth dynasty is at the present time based only on the notoriety of a few well-known Egyptologists who give for its first king Amenemhat I, for example, a reign which was going from 1994-1964 (Dodson) to 1938-1908 (Krauss). In fact one can get a chronology based on three scientific criteria: the carbon-14 dating[295], the likely duration of reigns evaluated from the best documents[296] and a Sirius heliacal rising which is precisely dated during Senwosret III's reign.

Dynasty XII	Carbon 14		Turin King List	Date ++	Manetho	Duration	Reign
Amenemhat I	**1975**-1948	27 years	[2]9	30	16 years	29 years	**1975**-1946
Senwosret I	1948-1903	45 years	45	45	46 years	45 years	1946-1901
Amenemhat II	1903-1870	33 years	3[8?]	35	38 years	38 years	1901-1863
Senwosret II	1870-1863	7 years	1[8?]	8	48 years	8 years	1863-1855
Senwosret III	1863-1825	38 years	1[9]	19	8 years	19 years	1855-1836
Amenemhat III	1825-1781	44 years	[45?]	46	8 years	45 years	1836-1791
Amenemhat IV	1781-1773	8 years	9 years 4 m. 27 d.	9	8 years	9.4 years	1791-1782
Neferusebek	1773-1770	3 years	3 years 10 m. 24 d.	3	4 years	3.9 years	1782-1778
Total:	*1975-1770*	205 years	213 years	195 years	176 years	197 years	*1975-1778*

Through an Egyptian document, which describes numerous lunar festivals[297] that occurred in the 19 years of Senwosret III's reign then the 45 years of Amenemhat III[298], it is possible to get an absolute dating. This document shows that the lunar days *psḏntyw* which are dated fit together[299] in a lunar 25-year cycle. In addition, a few *wag* feasts have been

294 E.A.W. BUDGE - Gods of the Egyptian Vol II
1969 Ed. Dover Publications p. 321.
295 C.B. RAMSEY, M.W. DEE, J.M. ROWLAND, T.F. G. HIGHAM, S.A. HARRIS, F. BROCK, A. QUILES, E.M. WILD, E.S. MARCUS, A.J. SHORTLAND - Radiocarbon - Based Chronology for Dynastic Egypt in: *Science* Vol 328 (10 june 2010) pp. 1554-1557.
http://www.sciencemag.org/cgi/data/328/5985/1554/DC1/1
296 C. VANDERSLEYEN - L'Egypte et la vallée du Nil Tome 2
Paris 1995 Éd. Presses Universitaires de France pp. 43-122.
297 R.A. PARKER - The Calendars of Ancient Egypt
in: *Studies in Ancient Oriental Civilization* N°26 (1950) Ed. University of Chicago pp. 63-67.
298 C. OBSOMER - Sésostris Ier. Étude chronologique et historique du règne
Bruxelles 1995 Éd. Connaissance ancienne de l'Égypte p. 149.
299 U. LUFT – Die chronologische Fixierung des ägyptischen Mittleren Reiches
Wien 1992 Ed. Akademie der Wissenschaften pp. 150,151.
R. KRAUSS - Arguments in Favor of a Low Chronology for the Middle and New Kingdom
in: The Synchronisation of Civilisations in the Eastern (M. Bietak 2003) pp. 175-197

dated on the 16th/17th lunar day, instead of the theoretical 18th day named "moon day", implying that the lunar day 1 (*psḏntyw*) was anchored not on the full moon but on the day after the full moon (= full moon + 1 or 2). These dates are shifted by one day in relation to those of Parker who translated the word "up to" in an inclusive way[300], not exclusive. This document can be dated precisely thanks to the Sothic rising dated IV Peret 16, Year 7 of Senwosret III (the Sothic rising predicted by an officer named Nebkaure)[301]. The anchoring by Carbon 14 dating gives only an accuracy of around +/- 25 years as regards that period (1975-1770), consequently year 7 of Senwosret III (1863-1825) has to be inside the interval 1857-1832 BCE. Over this period there is a very good agreement in 1848 BCE between the dating of IV Peret 16 (11 July)[302], the Sothic rising in Thebes (11 July)[303] and the lunar day 1 (*psḏntyw*) dated IV Peret 1 (26 July) with a full moon + 1 day (25 July)[304].

	Carbon 14	IV Akhet 16	Sothic rising		
	BCE	Julian	Thebes	Heliopolis	Elephantine
Senwosret III (year 7)	1857 -	14 July	11 July	16 July	10 July
	1848	11 July	11 July	16 July	10 July
	-1832	7 July	11 July	16 July	10 July

Year	BCE			Akhet				Peret				Shemu				
				I	II	III	IV	I	II	III	IV	I	II	III	IV	5
1882	**1857**			Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov	
1881	**1856**		1	1	30	29	29	28	28	27	27	26	26	25	25	
1880	**1855**		2	19	19	18	18	18	17	17	16	16	15	15	14	
1879	**1854**	1	3	9	8	8	7	7	6	6	6	5	5	4	4	3
1878	**1853**	2	4	28	27	27	26	26	25	25	24	24	23	23	23	
1877	**1852**	3	5	17	17	16	16	15	15	14	14	13	13	12	12	
1876	**1851**	4	6	6	6	6	5	5	4	4	3	3	2	2	1	1
1875	**1850**	5	7	25	25	24	24	23	23	23	22	22	21	21	20	
1874	**1849**	6	8	15	14	14	13	13	12	12	11	11	10	10	10	
1873	**1848**	7	9	4	4	3	3	2	2	1	1	30	29	29	28	
1872	**1847**	8	10	23	23	22	22	21	21	20	20	19	19	18	18	
1871	**1846**	9	11	12	12	11	11	10	10	10	9	9	8	8	7	
1870	**1845**	10	12	2	1	1	30	30	29	28	28	27	27	27	26	
1869	**1844**	11	13	21	20	20	19	19	18	18	17	17	16	16	15	
1868	**1843**	12	14	10	9	9	9	8	8	7	7	6	6	5	5	4
1867	**1842**	13	15	29	28	28	27	27	27	26	26	25	25	24	24	
1866	**1841**	14	16	18	18	17	17	16	16	15	15	14	14	14	13	
1865	**1840**	15	17	8	7	7	6	6	5	5	4	4	3	3	2	2
1864	**1839**	16	18	26	26	26	25	25	24	24	23	23	22	22	21	
1863	**1838**	17	19	16	15	15	14	14	14	13	13	12	12	11	11	
1862	**1837**	18	20	5	5	4	4	3	3	2	2	1	1 17	1	30	
1861	**1836**	19	21	24	24	23	23	22	22	21	21	20	20	19	19	
1860	**1835**	1	22	13	13	13	12	12	11	11	10	10	9	9	8	
1859	**1834**	2	23	3	2	2	1	1	1	30	29	29	28	28	27	
1858	**1833**	3	24	22	21	21	20	20	19	19	18	18	18	17	17	
1857	**1832**	4	25	11	11	10	10	9	9	8	8	7	7	6	6	

One can check that the lunar day 1 (*psḏntyw*) in year 18 of Senwosret III (1837 BCE) dated II Shemu 1 (24 June) was a full moon + 1 day (24 June) and the *wag* feast dated II Shemu 17 (10 July) was a 1st lunar crescent (9 July).

300 L.E. ROSE – The Astronomical Evidence for Dating the End of the Middle Kingdom in: *Journal of Near Eastern Studies* 53 (1994) pp. 247-248.

301 P. TALLET – Sésostris et la fin de la XIIe dynastie Paris 2005 Éd. Pygmalion pp. 24-27, 283-285.

302 http://www.chronosynchro.net/wordpress/convertisseur/

303 *Arcus visionis* 8.5°; Thebes (Lon. 32°39' E, Lat. 25°42' N); Heliopolis (Lon. 31°20' E, Lat. 30°05' N); Elephantine (Lon. 32°53' E, Lat. 24°05' N) http://www.imcce.fr/fr/grandpublic/phenomenes/sothis/index.php

304 http://www.fourmilab.ch/earthview/pacalc.html http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php

Although the duration of the reign of Senwosret III is estimated around 38 years by carbon-14 dating, it should be rather 19 years because of the following reasons: the Turin King List gives 1[9], its highest date of reign is 19 and the only king with a reign longer than 36 years just after a 19-year reign was Amenemhat III (below):

Dynasty XII	**Year**			AKHET				PERET				SHEMU				
				I	II	III	IV	I	II	III	IV	I	II	III	IV	5
Pharaoh	**1837**			Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov	
[Senwosret III]	**1836**	**19**	21	24	24	23	23	22	22	21	21	20	20	19	19	
	1837	**18**	20	5	5	4	4	3	3	2	2	1	1 17	1	30	
	1836	**19**	21	24	24	23	23	22	22	21	21	20	20	19	19	
[Amenemhat III]	**1835**	**1**	22	13	13	13	12	12	11	11	10	10	9	9	8	
	1834	**2**	23	3	2	2	1	1	1	30	29	29	28	28	27	
	1833	**3**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	1832	**4**	25	11	11	10	10	9	9	8	8	7	7	6	6	
	1831	**5**	1	1	30	29	29	28	28	27	27	26	26	25	25	
	1830	**6**	2	19	19	18	18	18	17	17	16	16	15	15	14	
	1829	**7**	3	9	8	8	7	7	6	6	6	5	5	4	4	3
	1828	**8**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1827	**9**	5	17	17	16	16	15	15	14	14	13	13 29	12	12	
	1826	**10**	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1825	**11**	7	25	25	25	24	23	23	23	22	22	21	21	20	
	1824	**12**	8	15	14	14	13	13	12	12	11	11	10	10	10	
	1823	**13**	9	4	4	3	3	2	2	1	1	30	29	29	28	
	1822	**14**	10	23	23	22	22	21	21	20	20	19	19	18	18	
	1821	**15**	11	12	12	11	11	10	10	10	9	9	8	8	7	
	1820	**16**	12	2	1	1	30	30	29	28	28	27	27	27	26	
	1819	**17**	13	21	20	20	19	19	18	18	17	17	16	16	15	
	1818	**18**	14	10	9	9	9	8	8	7	7	6	6	5	5	4
	1817	**19**	15	29	28	28	27	27	27	26	26	25	25	24	24	
	1816	**20**	16	18	18	17	17	16	16	15	15	14	14	14	13	
	1815	**21**	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	1814	**22**	18	26	26	26	25	25	24	24	23	23	22	22	21	
	1813	**23**	19	16	15	15	14	14	14	13	13	12	12	11	11	
	1812	**24**	20	6	5	4	4	3	3	3	2	1	1	1	30	
	1811	**25**	21	24	24	23	23	22	22	21	21	20	20	19	19	
	1810	**26**	22	13	13	13	12	12	11	11	10	10	9	9	8	
	1809	**27**	23	3	2	2	1	1	1	30	29	29	28	28	27	
	1808	**28**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	1807	**29**	25	11	11	10	10	9	9	8	8	8	7	6	6	
	1806	**30**	1	1	30	29	29	28	28	27	27	26	26	25	25	
	1805	**31**	2	19	20	19	19	18	18	17	17	16	15	15	14	
	1804	**32**	3	9	9	8	7	7	6	6	6	5	5	4	4	3
	1803	**33**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1802	**34**	5	17	17	16	16	15	15	14	14	13	13	12	12	
	1801	**35**	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1800	**36**	7	25	25	24	24	23	23	23	22	22	21	21	20	
	1799	**37**	8	15	14	14	13	13	12	12	11	11	10	10	10	

The reconstruction of the chronology for the XII[th] Dynasty is quite good with the exception of the reign of Senwosret II which was 8 years according to carbon-14 as well as the highest dates of his reign, whereas the Turin King List gives a reign of 1[4?] years (in agreement with the total of 213 years). This gap between the two durations could be explained by a co-regency of 6 years between Senwosret II (1868-1855) and Amenemhat II because in the inscription of Hapu at Aswan there is a mention of year 35 of Amenemhat III (1901-1863), which corresponds to year 3 of Senwosret II[305] (1866 BCE). Another means for checking chronology through astronomy is the use of buildings aligned on stars.

[305] C. VANDERSLEYEN - L'Egypte et la vallée du Nil Tome 2
Paris 1995 Éd. Presses Universitaires de France pp. 79-83.

DATING OF THE IVTH DYNASTY THROUGH ASTRONOMY

Carbon-14 dating provides a relative Egyptian chronology[306] but the astronomical dating from the precise orientation of the pyramids[307] of Dynasties IV and V (with the exception of that of Khephren, which is interpreted differently[308]) gives an absolute chronology (below). The accuracy of astronomical dates is about +/- 5 years[309] based on a calculated difference of 19" per year due to the precession of the equinoxes. This angle variation is very low but if a building is now aligned on the pole star (celestial north), in 95 years it will be shifted relative to this star by approximately 0.5 degree, which is the apparent diameter of the moon.

Dynasty	Pharaoh	TC	Astronomy		C14 calibrated	Duration	
IV	Snefru	**24**	2526-2480	**46**	2612-2594	18	#
	Kheops	**23**	2480-2457	**23**	2594-2573	21	
	Djedefre	**8**	2457-2448	**9**	2573-2566	7	
	Khephren	**2[9]**	2448-2415	**33**	2566-2543	23	
	Baka		2415-2415	**-**	2543-2543		
	Mykerinos	18/**28**	2415-2388	**27**	2543-2516	27	
	Shepseskaf	**4**	2388 -	**8**	2516-2508	8	
	Thamphthis	**2**	-2380	**-**	-		
V	Userkaf	**7**	2380-2372	**8**	2508-2501	7	
	Sahure	1[2]	2372-2359	**13**	2501-2443	58	#
	Neferirkare (Kakai)	?	2359-23[**]	?	2443-[***]	[*]	

The duration as well as order of the reigns according to astronomy is in good agreement with the data coming from the Turin Canon (TC) except for Snefru. However even in this case the astronomical dating is better because it is confirmed by the number of cattle censuses, which were not bi-annual, as Egyptologists claim. The reconstruction[310] of the early years of the reign of Djedkare Isesi (2323-2285) shows that cattle censuses were on a ratio[311] of 1.7 (= 30/18). The ratio of "years after" compared to normal years, for the first 8 years of the reign is 0.37 (= 11/30) the same ratio of 0.36 (= 9/25) of intercalary years of the 25 years lunar cycle. The date of the first *sed* festival (= 30 years of reign) of Pepi I coincided with his 18th livestock census[312], which confirms the theoretical ratio of 1.7 (= 25/14) between census years and regnal years (= 30/18). Years "after" (= intercalar) are consistent with reign durations[313] according to the equation: minimum duration of reign = number of census years x 1.7. The comparison is excellent between the durations calculated by astronomy and those from the Turin Royal Canon, which confirms the reliability of this document on chronology (but values from Manetho are often too high). A few durations in the Turin Canon (TC*) have been corrected. Snefru's reign is dated 2526-2480 and lasted 46 years, which is in agreement with the minimum length of 41 years (= 24x1.7) coming from

[306] C.B. RAMSEY, M.W. DEE, J.M. ROWLAND, T.F. G. HIGHAM, S.A. HARRIS, F. BROCK, A. QUILES, E.M. WILD, E.S. MARCUS, A.J. SHORTLAND - Radiocarbon - Based Chronology for Dynastic Egypt in: *Science* Vol 328 (10 june 2010) pp. 1554-1557. http://www.sciencemag.org/cgi/data/328/5985/1554/DC1/1

[307] K. SPENCE – Ancient Egyptian Chronology and Astronomical Orientation of the Pyramids in: *Nature* Vol. 408 (November 2000) pp. 320-324.

[308] G. MAGLI – On the Astronomical Orientation of the IV Dynasty Egyptian Pyramids and the Dating of the Second Giza Pyramid in: http://arxiv.org/pdf/physics/0307100

[309] This figure may be optimistic because Egyptian observations were depending on visual acuity of human eye which has only a resolution of 1' (60") which is 3 times higher than the value of the difference.

[310] M. VERNER – Archaeological Remarks on the 4th and 5th Dynasty Chronology in: *Archiv Orientalni* 69:3 (2001) Ed. Brill pp. 363-418.

[311] J.S. NOLAN – Lunar intercalations and "cattle counts" during the Old Kingdom: the Hebsed in context in: Chronology and Archaeology in Ancient Egypt. Ed. Czech Institute of Egyptology, Prague 2008, pp. 44-60.

[312] M. BAUD – The Relative Chronology of Dynasties 6 and 8 in: Ancient Egyptian Chronology (Leiden 2006) Ed. Brill pp. 144-157.

[313] G. GREENBERG – Manetho. A Study in Egyptian Chronology. Pennsylvania 2004 Ed. MPM8 pp. 147,171,184.

the number of censuses. The ancient harbour of Kheops (Wadi el-Jarf) delivered some papyri describing shipments of stones for his pyramid of which the highest date, corresponding to the end of his reign, is: *after the 13th census*[314] (= year 23, like in the TC), which confirms the ratio 1.7 (= 23/13) between the years of reign and the number of censuses. If this ratio was 2, Kheops' reign (50 years in Herodotus II:127!) would have lasted 28 years instead of 23 years.

Dynasty		Astronomy	#	TC	Man.	cens	x1.7	date +	TC*	Reign
IV	Snefru	2526-2480	**46**	24	29	24≤	**≥41**		**44**	2523-2479
	Kheops	2480-2457	**23**	**23**	63	13+≤	**≥23**		**23**	2479-2456
	Djedefre	2457-2448	**9**	**8**	25	11?≤	≥18?		**8**	2456-2448
	Khephren	2448-2415	**33**	**2[9]**	66	13≤	**≥22**		**29**	2448-2419
	Baka	2415-2415	-						**0**	2419-2419
	Mykerinos	2415-2388	**27**	18/**28**	63	11≤	**≥19**		**28**	2419-2391
	Shepseskaf	2388 -	**8**	**4**	7	1+≤	≥3	1	**4**	2391-2387
	Thamphthis	-2380	**-**	**2**					**2**	2387-2385
V	Userkaf	2380-2372	**8**	**7**	28	3≤	≥5	7	**7**	2385-2378
	Sahure	2372-2359	**13**	**12***	13	7+≤	≥12	15	**14**	2378-2364
	Neferirkar (Kakaï)	2359-23[**]	?	?	20	5≤	**≥9**	**11**	**10**	2364-2354
	Shepseskare			**7**	7				**7**	2354-2347
	Neferrefre			**1**	20	1≤	≥1		**1**	2347-2346
	Niuserre (Ini)			11+x	44	7≤	≥12	sed*	**14**	2346-2332
	Menkauhor			**8**	9				**8**	2332-2324
	Djedkare (Isesi)			**28**	44	22≤	**≥38**	sed	**38**	2324-2286
	Unas			**30**	33	8≤	≥14	sed	**30**	2286-2256
VI	Teti			?	30	11≤	**≥18**		18	2256-2238
	Userkare								0	2238-2238
	Pepi I	2243-2200	**43**	20	53	25≤	**≥43**	**42**	**43**	2238-2195
	Merenre I			44	7	5+≤	≥10		14	2195-2181
	Pepi II			9[**4**]	94	31+≤	**≥54**		54?	2181-2127
	Merenre II			**1**	1				1	2127-2126

Pepi I's reign (2238-2195) is confirmed by astronomy (2243-2200). This pharaoh and Sargon of Akkad must have been contemporaries[315], because an alabaster vase on behalf of Pepi I was discovered in the palace of Iš'ar-Damu (2245-2210), the last king of Ebla. We know that Sargon (2243-2187) destroyed the city of Ebla near the middle of his reign. The fact that Pepi I's birth name (above)[316] is preceded by the title *nsw-bity* (to indicate the enthronement) proves that the alabaster vase had been offered to Iš'ar-Damu, a mighty Syrian king associated to Byblos, at the beginning of Pepi I's reign (c. 2238 BCE).

Mesopotamian chronology can be reconstructed up to Sargon of Akkad (2243-2187). This period has few synchronisms which are precisely datable by astronomy (highlighted in blue) but reign durations of the dynasties of Akkad, Uruk IV-V and Ur III are accurately known[317]. The chronology of dynasties IX to XII is locked to the beginning of the XIIth in 1975 BCE and based on the sum of regnal years. The duration of the dynasties VII and VIII was brief because, according to Manetho, 70 kings would have ruled 70 days each (70x70 days = around 13 years) or a period about 8? years of instability (2126-2118?)

[314] « Le port de Kheops ressurgit des sables » in: *Sciences et Avenir* N°796 (juin 2013) pp. 52-53.
[315] P. MATTHIAE- Recherches archéologiques à Ébla, 1977 : le quartier administratif du palais royaI G in: *Comptes rendus des séances de l'Académie des Inscriptions et Belles-Lettres*, 122e année, N. 2, (1978) pp. 204-236.
[316] From right to left we read: *[mr]y t3.wy* (Horus name) *nsw-bity* (King title) *s3 ḥw.t-ḥr nb.t iwn.t pp[y]* (Birth name).
[317] J.-J. GLASSNER – Chroniques mésopotamiennes Paris 2004 Éd. Les Belles Lettres pp. 137-141.

EGYPT			Reign	MESOPOTAMIA	Reign	
Unas		30	2286-2256	En-metena (LAGASH)	2282 - -2252	30
Dynasty VI						
Teti	Seheteptawy	18	2256-2238	En-anatum II	2252-2245	7
Userkare		<1	2238-2238	En-entarzi	2245-2240	5
Pepi I	Nefersahor	43	**2238-2195**	**Sargon** (AKKAD)	**2243-2187**	56
Merenre I		14	2195-2181	Rimuš	2187-2178	9
Pepi II	Neferkare	54?	2181-2127	Maništusu	2178-2163	15
Merenre II	Antiemsaf	1	2127-2126	Narâm-Sîn	2163 - -2126	37
Nitocris		<1?	2126-2126	(*insurrections*)		
Dynasties VII-VIII	(*instability*)	8?	2126-2118	Šar-kali-šarri	2126 - -2101	25
Dynasty XI	(Dynasties IX-X)					
Mentuhotep I	-	16	2118 - - 2102			
Antef I	Sehertauy					
Antef II	Uahankh	49	2102 - -2053	Irgigi/ Imi/ Nanum/ Ilulu	2101-2098	3
				Dudu	2098-2077	21
				Šu-Turul	2077-2062	15
				Ur-Nigin (URUK IV)	2062-2055	7
Antef III	Nekhtnetepnefer	8	2053 - -2045	Ur-Gigir	2055-2049	6
				Kuda	2049-2043	6
Mentuhotep II	Nebhepetre	51	2045 - -1994	Puzur-ili	2043-2038	5
				Ur-Utu	2038-2032	6
				Utu-hegal	2032-**2021**	[11]
				Ur-Nammu (UR III)	**2020**-2002	18
				Šulgi	2002 - -1954	48
Mentuhotep III	Seankhkare	12	1994-1982			
Mentuhotep IV	Nebtauyre	7	1982-1975			
Dynasty XII						
Amenemhat I	Sehetepibre	29	1975-1946	Amar-Sîn	1954-1945	9
Senwosret I	Kheparkare	45	1946 - -1901	Šu-Sîn	1945-1936	9
				Ibbi-Sîn	1936-**1912**	24
Amenemhat II	Nebkaure	38	1901-1863	*Collapse of Ur*	1912 - -1799	113
Senwosret II	Khakheperre	8	1863-1855			
Senwosret III	Khakaure	19	**1855**-1836			
Amenemhat III	Nimaatre	45	1836-1791	Sûmû-abum (BABEL)	1799 - -1785	14
Amenemhat IV	Maakherure	9	1791-1782			
Neferusebek	Sebekkare	4	1782-1778	Sûmû-la-Il	1785 - -1749	36
Dynasty XIII						
			1778 - -1573	Sâbium	1749-1735	14
				Apil-Sîn	1735-1717	18
				Sîn-muballiṭ	1717-1697	20
				Hammurabi	**1697**-1654	43
				Samsu-iluna	1654-1616	38
				Abi-ešuḫ	1616-1588	28
Dynasty XVII				Ammiditana	1588 - -1530	37
Rahotep	Sekhemra-wahkhau	4?	1573-1569			
Sobekemsaf I	Sekhemra-Shedtawy	2?	1569-1567			
Sobekemsaf II	Sekhemra-wadjkhau	10?	1567-1557			
Antef VI	Sekhemra-wepmaat	2?	1557-1555			
Antef VII	Nubkheperra	10?	1555-1545	Ammiṣaduqa	**1551 - -1530**	21
Antef VIII	SekhemraHeruhermaat	<1	1545-1545			
Ahmose	Senakhtenre	1?	1545-1544			
Taa	Seqenenre	11	1544-**1533**			
Kamose	Wadjkheperre	3	**1533**-1530			
Dynasty XVIII				Samsuditana	1530 - -**1499**	31
Ahmose	Nebpehtyre	25	1530-1505			
Amenhotep I	Djeserkare	21	1505-1484			

DATING OF THE I^ST DYNASTY THROUGH ASTRONOMY

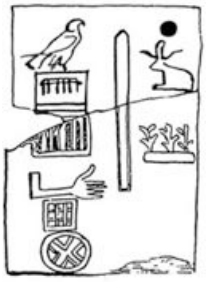
The relative chronology of the I^st Dynasty is very approximate due to uncertainty in the names of pharaohs as well as the length of their reigns[318]:

Dynasty I	Grimal	Carbon 14	Vercoutter	von Beckerath	Malek	Krauss
Âha - Atoti	3125-3100	3100 -	3125-3095	3007-2975 +/- 25	2972-2939	[?]-2870
Djer	3100-3055	-3080	3095-3040	2975-2927 +/- 25	2939-2892	2870-2823
Djet - Wadji	3055-3050	3080-3000	3040-3030	2927-2914 +/- 25	2892-2879	2822-2815
Den	3050-2995	3000 -	3030-2985	2914-2867 +/- 25	2879-2832	2814-2772

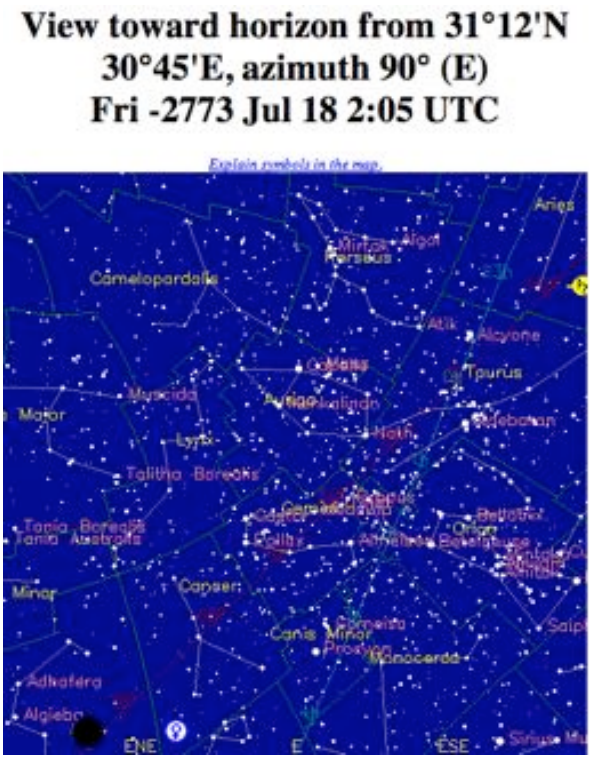
These chronologies (above) of the I^st dynasty were reconstructed using data from Manetho (Man.), calibrated carbon 14 dating (C14 calib.) and information from the Turin Canon (TC) and Palermo Stone (PS). Although the exceptional Sothic rising during the reign of Djer (2774 BCE) is known it is not used for dating[319]. These chronologies are improved if they are based on the astronomical dating of the reign of Snefru (2523-2479) and using a mean reign of 15 years (calculated from the III^rd Dynasty) for the reigns of the two first dynasties. The II^nd dynasty includes several pharaohs at Abydos in parallel with those at Memphis[320] and the reigns calculated from the Palermo Stone are hypothetical[321] (PS*) or speculative (bracketed). The reign of 40 years assigned to Ninetjer seems excessive compared with other pharaohs of the II^nd Dynasty, in addition, it had no *Sed* festival (celebrated when a reign is above 30 years)[322].

Dynasty I		Astronomy	#	TC	Man.	PS*	date+	TC*	Reign
(Memphis)	(Abydos)	C14 calib.	#						
	Menes/Narmer				60				*2840-2820*
	Âha - Atoti	3100 -			27				*2820-2810*
	Djer	-2774			29	41	Sed	41	*2810-2769*
	Djet (Wadji)	3080-3000			42	[10]		[10]	*2769-2759*
	Den	3000 -			20	32	31	32	*2759-2727*
	Andjib				26	10		10	*2727-2717*
	Semerkhet				18	9		9	*2717-2708*
	Qaa	2925 -			26	33	Sed	33	*2708-2675*
Dynasty II									
Hotepsekhemwy					38			[10]	*2675-2665*
Nebra (Raneb)					39			[10]	*2665-2655*
Ninetjer	/ Peribsen				47	40	7	[24]	*2655-2631*
Uneg(nebti)	/ Senedj (?)				17			[7]	*2631-2624*
Neferkara	/ Sekhemid				25	[2]		2	2624-2622
Neferkasokar		-2679		8	48	[9]		**8**	2622-2614
Khasekhemwy		2679-2658	11	27	30	18		**17**	2614-2597
Dynasty III									
Djoser - Netjerikhet		2658-2641	17	19	29	28		**19**	2597-2578
Sekhemkhet		2641 -		6	7	7		**6**	2578-2572
Nebka[ra]/ Sanakht				19	28			**19**	2572-2553
Khaba				6	17	7		**6**	2553-2547
Huni				24	42			**24**	2547-2523
Dynasty IV									
Snefru		2526-2480	**46**	24	29		41	**44**	2523-2479

[318] M. DESSOUDEIX – Chronique de l'Égypte ancienne
Paris 2008 Éd. Actes Sud p. 31.
[319] J. VERCOUTTER – L'Égypte et la vallée du Nil Tome 1 Des origines à la fin de l'Ancien Empire
Paris 1992 Éd. Presses Universitaires de France pp. 199-263.
[320] P. VERNUS, J. YOYOTTE - Dictionnaire des pharaons
Paris 1998 Éd. Noésis pp. 177-179.
[321] T.A.H. WILKINSON – Royal Annals of Ancient Egypt
London 2000 Ed. Kegan Paul International pp. 75-81, 256-259.
[322] Semerkhet celebrated a Sed festival (not mentioned in the Palermo Stone) which was probably the same one of his father Den.



According to the previous reconstruction, the reign of Djer is assessed as 2810-2769. The Djer's plate mentions the oldest known heliacal rising of Sirius[323] dated at the beginning of the flood (I Akhet 1) and summer solstice. The origin of the Egyptian civil calendar is difficult to establish because of the lack of documents. We can make some probable conjectures. The name of the first 4 months being those of the season called *Akhet* "flooding" it is logical to conclude that this calendar started with the flooding of the Nile, which coincided itself with the summer solstice (July 17 at that time). The name of the next two periods of the calendar: *Peret* "offspring" and *Shemu* "heat", is also in agreement with the seasons. From the I[st] dynasties the sign of the year appears on ivory labels which implies the existence of a calendar and also annals were to be held from the beginning of historical times. On the ivory plate of king Djer there is a connection between the rising of Sirius in Buto (north of Heliopolis), represented as a cow (Hathor-sek associated with Isis), like in Denderah, and the beginning of the flood recorded by the sign *Akhet*.



The coincidence between the beginning of the flooding of the Nile at the summer solstice (July 17)[324] and the heliacal rising of Sirius[325] (the brightest star in the sky) was performed only at Buto in 2774 BCE[326] (18 July), which also coincides with the heliacal rising of Venus (the brightest planet in the solar system), which coincidentally happens every 243 years[327]. In addition, there was also the heliacal rising of the new moon[328] on I Akhet 1 (= July 18)[329]. All these coincidences had impressed the Egyptians. This double heliacal rising was often represented by a heron (associated to Isis) with a star above the head (Venus) at the same level as the ankles of Sothis (Sirius). On the opposite picture (90°x90°) Sirius is 2° above the horizon (on the right), Venus and the new moon are 4° above the horizon[330] (on the left). The celestial equator is in light blue and the ecliptic is in dark red. By extrapolating the previous results, the carbon-14 dating gives older reigns in an exponential way (4 times the gap, 7454 BCE instead of 3214 BCE through astronomy):

Pharaoh	C14 calib.	Astronomy	Gap
	[7454 -]	[3214 -]	+4240 (= 4x1060)
	[4074 -]	[3014 -]	+1060 (= 4x265)
Djer	**3080** -	**2814**-2773	+ 266 (= 4x66)
Khasekhemwy	**2679**-2658	**2614**-2597	+ 65 (= 4x16)

323 A.S. VON BOMHARD - Le calendrier Égyptien. Une œuvre d'éternité
London 1999 Ed. Periplus pp. 48-49.
324 http://www.imcce.fr/fr/grandpublic/temps/saisons.php
325 http://www.imcce.fr/fr/grandpublic/phenomenes/sothis/index.php (*arcus visionis* = 8.9; Buto: Lat 31°12' N 30°45' E).
326 http://www.fourmilab.ch/cgi-bin/Yourhorizon (Universal Time: -2773-07-18 2:05; Field of view: 90°).
327 G.W. VAN OOSTERHOUT – Sirius, Venus and the Egyptian Calendar
in: *Discussions in Egyptology* 27 (1993) pp. 83-96.
328 http://www.fourmilab.ch/earthview/pacalc.html
http://www.imcce.fr/fr/grandpublic/phenomenes/phases_lune/index.php
329 http://www.chronosynchro.net/wordpress/convertisseur/
330 Given that Venus is less brighter than Sirius its *arcus visionis* is a little higher (11° instead of 9°).

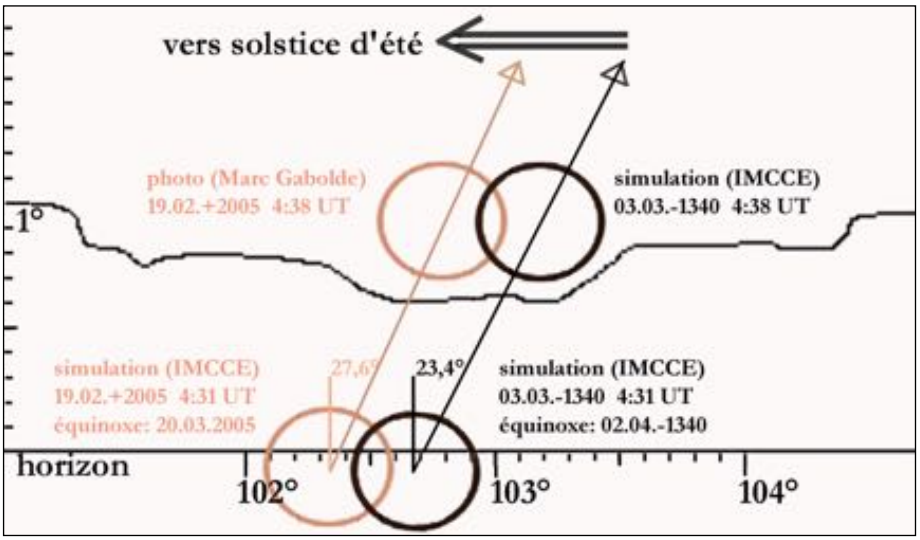
THE DATING OF AKHENATEN'S REIGN THROUGH ASTRONOMY

Amenhotep IV (1356-1340) died after a 17-year reign in year 6 of Akhetaten (1345-1340). This city also lasted 6 years as long as Akhenaten's reign without his co-regency (= 17 - 11). The reign can be dated through an indication coming from a temple dedicated to the solar cult which he built in El-Amarna (small Aten temple) used for celebrating the rise of Aten, the deified solar disc (several temples of the ancient Egyptian civilization were astronomically orientated)[331]. This temple is directed precisely toward a notch in the mountains[332] (azimuth 103° on the horizon)[333]. In the photograph (right below) the axis of the temple is oriented in the direction of the notch (hidden by a column) on the horizon.

The name of the new capital built by Akhenaten, called Akhetaten (*3ḫt-'itn*) "where the sun disk rises [Aten's horizon]" which was represented by the hieroglyph 𓇳 exactly imitating the sun appearing in the notch of the mountain in Amarna. The temple in the city was inaugurated on IV Peret 13 in Year 5 of Akhenaten and commemorated in Year 6 at the same date[334]. The fact that the temple is oriented exactly in line with the Royal Wadi[335] suggests that Akhenaten chose to inaugurate the city, the precise day when the sun rose[336] in the notch of the mountain, illuminating the temple like a laser beam. The simulation of sunrise observed at that location[337] (14th century BCE) indicates that it appeared at 4:38 UT in the notch of the mountain (its apparent diameter is 0.9°, the one of the sun is 0.5°) only two days in the year: 3/4 March and 5/6 November, as the apparent path of the sun drift by about 0.4° per day at the horizon (0° altitude) to go back and forth between the two extreme positions reached at solstices on 1st January and 5 July (spring equinox was on 2 April[338] at that time). This implies that the equation: IV Peret 13 = 3 March[339] [day of solar illumination in the temple] was satisfied only for 4 years, from 1341 to 1338 BCE. As the commemoration of IV Peret 13 stopped at the 6th year of Akhenaten (no 7th year), one can assume that it was the last year of his reign (matching the 17th year from his co-regency). The posthumous stela of year 8 was completed in the last year of the 4-year cycle, in 1338 BCE. His father Amenhotep III died on April 1345 BCE during year 38 of his reign. Letter EA 106 was written 5 years after the beginning of the war (1352 BCE) and EA 116 after Akhenaten sat on the throne.

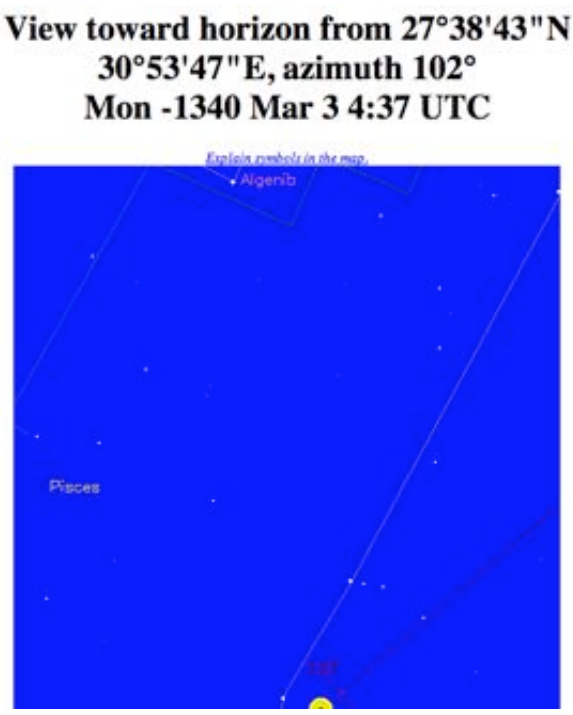
331 M. SHALTOUT, J.A. BELMONTE, M. FEKRI - On the orientation of ancient Egyptian temples: in: *Journal for the History of Astronomy* XXXVIII (2007) pp. 313-333.
332 http://en.wikipedia.org/wiki/Amarna
333 http://earth.google.fr/ Longitude 30°53'47" E Latitude 27°38'43" N (Small Temple of Aten)
334 W.J. MURNANE - The "First Occasion of the Discovery" of Akhet-Aton in: *Studien zur Altägyptischen Kultur* 14 (1987) pp. 239-246.
335 D.P. SILVERMAN, J.W. WEGNER, J.H. WEGNER – Akhenaten and Tutankhamun Revolution and Restoration Philadelphia 2006 Ed. University of Pennsylvania Museum of Archaeology pp. 43-55.
336 L. GABOLDE – Mise au point sur l'orientation du temple d'Amon-Rê à Karnak en direction du lever du soleil au solstice d'hiver in: *Cahier de Karnak* 13 (Presses du Conseil Suprême des Antiquités de l'Égypte, 2010), pp. 243-256.
337 R.A. WELLS - The Amarna M,X,K Boundary Stelae Date: A Modern Calendar Equivalent in: *Studien zur Altägyptischen Kultur* 14 (1987) pp. 313-333.
338 http://www.imcce.fr/fr/grandpublic/temps/saisons.php
339 The other possibility IV Peret 13 = 5 November has no solution in the 14th century BCE.

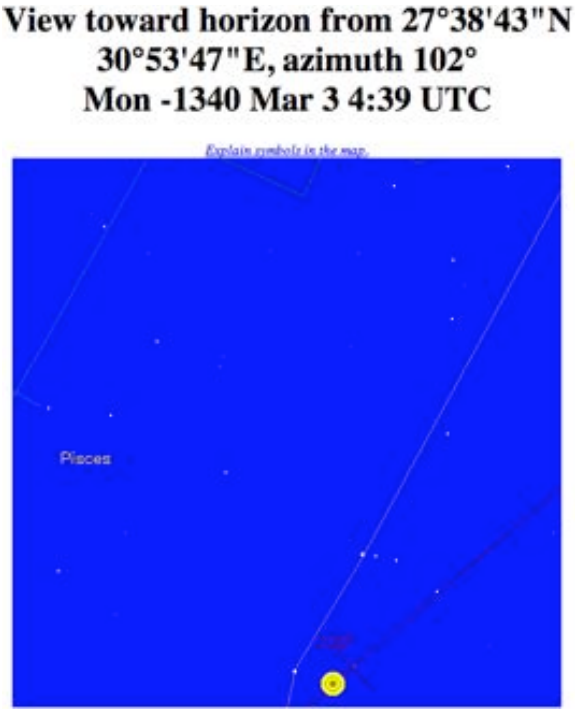
For example the sunrise on 3 March -1340 occurred in 2005 (below) on 18 February (at 4:32, altitude 0°, azimuth 102.8° which became visible at 4:36, altitude 1°, azimuth 103.2°)[340] then on 19 February (at 4:35, altitude 1°, azimuth 102.8°), the apparent path of the sun moving towards the summer solstice, on 21 June 2005 (5 July in -1340). The Egyptian calendar of 365 days drifted 1 day every 4 years compared to the true solar year of 365.24 days which caused an offset of about 0.1° per year. [341]



period:	2005 CE	1344-1341	1340-1337	1336-1333
Sunrise at the azimuth 102.8°	**18 February**	3 March	**3 March**	3 March
IV Peret 13 (in Julian calendar)	[*18 November*]	4 March	**3 March**	2 March
Spring equinox	20 March	2 April	2 April	2 April

The sunrise was seen at the horizon (left below)[342] at 4:37 UT, altitude 0°, azimuth 102.8° (= 180° - 77.2°) then in the small Aten temple through the notch 2 minutes later (right below) at 4:39 UT; altitude 1°, azimuth 103.2°.





[340] http://www.esrl.noaa.gov/gmd/grad/solcalc/ Location: Lat 27.645 (=27°38'43" N) Lng 30.913 (=30°53'47" E); Time Zone 0; Date: 18 Feb 2005; Local Time 04:35 = 04:31 Apparent Sunrise + 4 minutes (=1° altitude); Azimuth 103.12°.
[341] http://www.chronosynchro.net/wordpress/convertisseur/
[342] http://www.fourmilab.ch/cgi-bin/Yourhorizon

The dating of Amenhotep IV's reign (1356-1340) through astronomy is a fine example to illustrate why all Egyptologists refuse to use it. Normally searching the truth should be the fundamental purpose of any honest historian, but "What is truth" said Pilate, who was a high official (Jn 18:38). For all honest historians, "truth" is based on two main pillars: an accurate chronology (Herodotus' principle) anchored on absolute dates and reliable documents (Thucydides' principle) coming from critical editions. Unfortunately, not only mainstream historians (including archaeologists and Egyptologists) refuse to anchor chronology thanks to some astronomical dates, but those who do so are systematically victim of dishonest bullying. For example, Hermann Gasche succeeded in dating the fall of Babylon in 1499 BCE by means of several lunar eclipses but Cécile Michel, President of the International Association for Assyriology (2014), claimed that the darkening of the sun mentioned during the Puzur-Ištar eponym, the year just after the birth of Šamšî-Adad I, could be interpreted as a solar eclipse[343]. However, there was no total solar eclipse visible in Assyria (between Ashur and Nineveh) over the period 1800-1700 BCE, but only two partial eclipses slightly visible[344]. Worse, the term used *[n]a-ah-du-ur*, means an eclipse in a metaphorical way and is different from the usual *antalûm* used in Mari[345]. The comments in the list of eponyms have been added later because Šamšî-Adad I was initially an Amorite king who became part of the Assyrian dynasty only at the end of his glorious reign. Thus for the Assyrian copyist of that time, the birth of Šamšî-Adad I actually marked the end or the eclipse of the authentic Assyrian dynasty and thus had nothing to do with astronomy. In fact the scientific way of reconstructing an absolute chronology is first to establish a relative chronology thanks to Babylonian and Assyrian reigns and afterwards to anchor it with an absolute date obtained from an astronomical event, not the contrary (in fixing first a date obtained from an astronomical event and afterwards adjusting the relative chronology) because solar and lunar phenomena are not unique in time but occur cyclically. For example Šamšî-Adad I's reign (1712-1680) can be dated thanks to the relative chronology of Assyrian kings then, given that we know that Year 33 of Šamšî-Adad I corresponds to Year 17 of Hammurabi (1697-1680), it is easy to check that the astronomical tablet (*Enuma Anu Enlil 63*), which describes the rising and setting of Venus during the reign of Ammisaduqa (a descendant of Hammurabi), fits exactly his reign (1551-1530).

WHY THE CO-REGENCY OF AKHENATEN IS SO VILIFIED?

Dimitri Laboury, senior research fellow in History of Art and Archaeology of Pharaonic Egypt at the University of Liege, wrote in his deep study about Akhenaten: *Before discussing the rise and the commencement of the reign of prince Amenhotep (subject of the next chapter), it is necessary to polish off —even briefly— an issue that has long divided Egyptology: that of the co-regency between Amenhotep III and his son Amenhotep IV. The theory that the two sovereigns would for a time ruled jointly, unleashed, it is true, the passions of the last century, but has lived and today is primarily the history of the discipline, even if it still has very few followers today. Insofar as it has recently been the subject of a particularly detailed analysis —and sometimes quite technical— by Marc Gabolde, who showed the complete absence of probative evidence in its favour, I will only mention here two types of arguments that lead to recognize in this case, in vogue long ago, an Egyptological fiction*[346]. In clear, only a few simple-minded still believe in this Egyptological fiction, which was an old delirious passion. As I

[343] C. MICHEL, P. ROCHER – La chronologie du IIe millénaire revue à l'ombre d'une éclipse de soleil in: *Jaarbericht (...) Ex Oriente Lux* N° 35/36 (1997-2000) Chicago pp. 111-126.

[344] On October 10, 1737 BCE (of magnitude 0.92) and that on September 8, 1791 BCE (of magnitude 0.92)

[345] As the sentence: *on the 26th day of the month Sivan, in the 7th year [of Simbar-šipak], the day turned to night*, did not describe a solar eclipse but there was no solar eclipse on 2 July 1020 BCE and solar eclipses occur only on the last day of month (not 26th).

[346] D. LABOURY - Akhénaton
Paris 2010 Éd. Pygmalion p. 87.

don't like to be considered as a simple-minded (and probably you as well) I am going to demonstrate the absurdity of such dogmatic claims.

What is this *particularly detailed and sometimes quite technical analysis*? The answer is quite simple: Despite the fact that chronology is the backbone of history, each Egyptologist uses his own chronology which is based only on scholarly assumptions. In addition, when Tutankhamun claims to be the son of Amenhotep III, it would be a lie (because he dares to contradict Gabolde —life, prosperity, health). Marc Gabolde explains his "bold method" in his study about Akhenaten: *The proposal that seemed, at the outset, the most likely explanation for the [previous] monument is therefore the one that should be rejected (...) I have assumed that a text found in the Hittite capital was reporting statements perhaps deliberately deceptive from the Queen of Egypt (...) This attitude requires sometimes using more imaginative explanations from documents.* And he concludes*: Speculation on the subject is necessarily a part of the method (...) the efforts to align the elements of a relative chronology and dates that appear here and there are often desperate*[347]. Chronology and historical testimonies being fully rejected (both foundations of history!) Egyptologists rely on science for resolving the controversy over the co-regency. For example, the "great" Egyptologist Zahi Hawass chairman of the Egyptian Supreme Council of Antiquities —life, prosperity, health— and a great friend and minister of President Hosni Mubarak —life, health, force— was able to prove, thanks to 14 carbon measurements and analysis of DNA, that Tutankhamun was the son of Akhenaten. The study, published February 17, 2010 in the Journal of the American Medical Association (vol 303:7, pp. 638-647), concluded that Tutankhamun's father was the pharaoh Akhenaten, that his parents were brother and sister, and that two mummified foetuses found in Tutankhamun's tomb were probably his stillborn daughters —conclusions that have since become received wisdom. But many geneticists complain that the team used inappropriate analysis techniques. Far from being definitive, the study is "not seen as rigorous or convincing", says Eline Lorenzen of the Center for GeoGenetics at the Natural History Museum in Copenhagen, Denmark. "Many of us in the DNA community are surprised that this has been published."

The doggedness of some Egyptologists to want proving against all logic, and despite numerous historical and chronological evidence, the absence of co-regency between Amenhotep IV and Amenhotep III, defies common sense. Why is it so crucial for them to defend such an absurdity? In fact, they explain clearly their motive and the goal of the propagation of their teaching (which is the very essence of a religious propaganda!). For example Dimitri Laboury —life, prosperity, health— wrote: *In one of his most brilliant contribution of historical reconstruction, Eduard Meyer in 1904 shown that some reminiscences of Akhenaten had actually survived in the Egyptian oral tradition and resurfaced after nearly a millennium of latency. He showed that a rather fantastic story about Jews and lepers kept in Aïgyptiaka of Manetho could only refer to Akhenaten and his monotheistic revolution. And, as Assmann insists, even if the theory of Meyer was criticized, adjusted and completed, it nonetheless remains perfectly convincing and today is unanimously accepted, at least in its outline. The story in question, quoted Manetho by Josephus in his Against Apion (I:228-252), can be summarized as follows: a pharaoh named Amenophis, who wanted to see the gods, summoned his namesake; son of Paapis, the royal advisor then suggested to clean Egypt of its lepers, what the king did in penning them in careers "east of the Nile, in order they work apart from the rest of the Egyptians." But the lepers finally revolted and took as chief a priest of the sun named Osarsiph who wrote new laws which were "totally opposite to the Egyptian customs." This Osarsiph then associated to foreign invaders (similar to Hyksos of the Second Intermediate Period) and, pushing the king of Egypt and his followers into Nubia, he reigned over the Nile for 13 years of terror, or, with his "polluted" Egyptians and his foreigners, he plundered the temples, mutilated the divine image and made roast the sacred animals.*

[347] M. GABOLDE - D'Akhenaton à Toutânkhamon
Lyon 1998 Éd. Institut d'Archéologie et d'Histoire de l'Antiquité pp. 5-6, 278-280.

An end was put to this reign of horror by the expelling of lepers and their foreign allies, and their leader who had taken the name of Moses. The Jewish historian protests of course against such slanders uttered about his people by his pairs of Egypt, Manetho and Apion. It is absolutely clear that this is a legend that accumulates confuses and distorts a whole series of events more or less real and disjoint of Egyptian history, but we can not fail to be struck as was Eduard Meyer, by the points that evoke a memory —albeit altered— from the Atenist episode: the time after the reign of Amenhotep III, the irreligious attitude and contrary to the rites of the Egyptians, the cult of the sun, the persecution of temples and godly images, and even the intense activity in quarries, are a reminiscent from Akhenaten's reign. I will not go further here in the comparison between the two stories, one of Akhenaten and that of Osarsiph alias Moses, the future leader of the Jewish people, but rather I would refer the reader to the magisterial study that proposes J. Assmann in his now famous Moses the Egyptian. *What interests me most here is that traumatic and repressed memories of Akhenaten, as qualifies J. Assmann, built probably on some form of true feeling vis-a-vis of the Atonism at the very time of the "perfect child of Aten", but nevertheless largely built by the post-amarnian ideology (as soon as Tutankhamun's reign), this collective memory and culturally determined of the Atenist Pharaoh, therefore, will experience a very large spread clearly in the literary world of the ancient Mediterranean. Indeed, the legend of which Manetho echoes down to us through Josephus is also mentioned in various forms and variations, by authors as read during the Greco-Roman antiquity as Hecataeus of Abdera, Lysimachus, Chaeremon (Egyptian priest who was the tutor of Emperor Nero), Appian, Strabo, Tacitus and many others, replacing some leprosy by a plague (!)*[348].

Jan Assmann, a German Egyptologist with many awards as Max Planck Award for Research, Honorary Doctorate in Theology from the Theology Faculty, Munster, Soc.Sc.D. (honoris causa), Yale University, PhD (honoris causa), Hebrew University of Jerusalem, Alfried Krupp Prize for Scholarship and son on —life, prosperity, health—, is known beyond Egyptology circles for his interpretation of the origins of monotheism, which he considers as a break from earlier cosmotheism, first with Atenism and later with the Exodus from Egypt of the Israelites. He wrote[349] in his "Moses the Egyptian": *Let us call the distinction between true and false in religion the "Mosaic distinction" became tradition ascribes it to Moses. We cannot be sure that Moses ever lived because there are no traces of his earthly existence outside the tradition. But we can be sure that he was not the first to draw the distinction. There was a precursor in the person of an Egyptian king who called himself Akhenaten and instituted a monotheistic religion in the fourteenth century B.C.E. His religion, however, spawned no tradition but was forgotten immediately after his death. Moses is a figure of memory but not of history, while Akhenaten is a figure of history but not of memory. Since memory is all that counts in the sphere of cultural distinctions and constructions, we are justified in speaking not of Akhenaten's distinction but of the Mosaic distinction. The space severed or cloven by this distinction is the space of Western monotheism. It is this constructed mental or cultural space that has been inhabited by Europeans for nearly two millennia (...) Whereas the Jews depicted idolatry as a land of mental aberration, of madness, the Egyptians associated iconoclasm with the idea of a highly contagious and bodily disfiguring epidemic. The language of illness continues to typify the debate on the Mosaic distinction down to the days of Sigmund Freud. In the following chapter, I try to show that this story about the lepers originally referred not to Moses, but to Akhenaten, who was the first to establish a monotheistic counter-religion and to draw the distinction between true and false. But after his death, his religion was abolished, and his name fell into complete oblivion. The traumatic memories of his revolution were encrypted and dislocated; eventually, they came to be fixed on the Jews (...) Unlike Moses, Akhenaten, Pharaoh Amenophis IV, was a figure exclusively of history and not of memory. Shortly after his death, his name was erased from the king-lists, his monuments were dismantled, his inscriptions and representations were destroyed, and almost every trace of*

348 D. LABOURY - Akhénaton
Paris 2010 Éd. Pygmalion pp. 362-364.
349 J. ASSMANN – Moses the Egyptian : the memory of Egypt in western monotheism
Harward 1998 Ed. First Harvard University Press pp. 1-2, 5, 23-24, 151-152, 169, 255.

his existence was obliterated. For centuries no one knew of his extraordinary revolution. Until his rediscovery in the nineteenth century, there was virtually no memory of Akhenaten. Moses represents the reverse case. No traces have ever been found of his historical existence. He grew and developed only as a figure of memory, absorbing and embodying all traditions that pertained to legislation, liberation, and monotheism. Immediately after the first publication of the rediscovered inscriptions of Akhenaten it was realized that he had done something very similar to what memory had ascribed to Moses: he had abolished the cults and idols of Egyptian polytheism and established a purely monotheistic worship of a new god of light, whom he called "Aten." In his Berlin dissertation, De hymnis in Solem sub Rege Amenophide IV. Redactis (1894), the young American scholar James Henry Breasted demonstrated the importance of Akhenaten's monotheistic revolution for the interpretation of Biblical monotheism. Arthur Weigall, another Egyptologist with a less solid philological background, established the parallel between Egyptian and Biblical monotheism or between Akhenaten and Moses even more closely. Was Psalm 104 not a Hebrew translation of Akhenaten's hymn? Were not the Egyptian "Aten" and the Hebrew "Adonai" the same name? When Sigmund Freud embarked on his "historical novel" about Moses and monotheism, he followed these lines and made Moses an Atonist, close to the throne but not identical with the king himself. This identification did not fail to be made by several other authors working in a field which could be characterized as "science fiction" applied to the past instead of the future (...) One could perhaps go even further back in history to the seventeenth century B.C.E., when the Hyksos, a population of Palestinian invaders, settled in the eastern delta and went out to rule Egypt for more than a hundred years. The Jewish historian Flavius Josephus saw the ancestors of Israel in these foreign rulers of Egypt. But there was certainly no religious conflict between the Hyksos and the Egyptians. The Hyksos were neither monotheists nor iconoclasts. On the contrary, their remaining monuments show them in conformity with the religious obligations of traditional Egyptian pharaohs, whose role they assumed in the same way as did later foreign rulers of Egypt such as the Persians, the Macedonians, and the Romans. They adhered to the cult of Baal ["my Lord"], who was a familiar figure for the Egyptians, and they did not try to convert the Egyptians to the cult of their god. The whole concept of conversion seems absurd in the context of polytheistic religions. No —if we look for the first outbreak of a purely religious conflict in the historical records, we find something very different (...) Only now does he seem to realize that Moses' being an Egyptian could have something to do with "Ikhnaton" and his monotheistic revolution. This could be explained if Freud had learned about these events only after completing his historical studies. But Freud knew about Akhenaten as early as 1912, when he suggested this subject to Karl Abraham and published Abraham's important article on Akhenaten in the first volume of his newly founded journal, Imago. In this article, Abraham drew a portrait of Akhenaten and his religion which closely anticipates the one that Freud himself would postulate. But Freud never mentions Abraham in the book. Is it possible that Freud was devising his "historischen Roman" as a serialized novel, breaking off at the point of highest suspense so that he could continue in the following issue? Did he consciously postpone the obvious conclusion that Moses, if he was an Egyptian, must have been an Atenist, saving it for another article? I do not think so. The remembrance of Akhenaten and the discovery that Moses was an Atenist must have struck him like a revelation between the first and second issues of Imago, volume 23 (1937). (...) Therefore, two things remain for an Egyptologist to do. He should complement Freud's passing and superficial remarks on Akhenaten's religious revolution with a close reading of at least the most important text and discuss the contributions Egyptology can make concerning the counter-religious character of that monotheism. Second, he should assist Cudworth in his quest for any pre-Trismegistick" testimonies of Egyptian theology (...) There is much to be said in support of Freud's description of monotheism as a "religion of the father." This seems to apply to Atenism. What Freud did not know, because Breasted and Weigall did not mention it, was that the name of Akhenaten's god ("Yati") sounded very much like the Egyptian word for "my father ("yat-i") and that the text constantly play on this assonance. The god even bears the royal title "my father.' Akhenaten enacted his monotheism as a coregency between himself and the sun god, who acted as a senior partner in this theocracy. Akhenaten's Aten religion

was very much a father-religion, except that the concept of fatherhood was related exclusively to the king, not to the people or to humankind at large. The previous verbose explanations can be summed up as follows: Moses is a figure of memory but not of history, while Akhenaten is a figure of history but not of memory according to Freudian's theories.

Although these Egyptologists like to present themselves as enlightened minds, their comments on Akhenaten and Moses are only a deplorable propaganda. How to believe that the co-regency of Akhenaten with his father would have been a co-regency with God the Father. This is not science, but a mystic delirium that reaches many Egyptologists. For example Dr Rolf Krauss, a renowned German Egyptologist who worked as a researcher at the Berlin Museum of Prehistory and Early History and as a lecturer at Humboldt University —life, prosperity, health— explained in his book "The Moses Mystery[350]" why Akhenaten was never monotheistic because throughout his reign many other gods continued to be worshiped as Re-Harakhty, Osiris, Ptah, Thoth, the goddess Hathor, the four sons Horus, etc., in addition, Akhenaten's monotheism had nothing to do with the monotheism of Moses given that the biblical god is depicted as the creator of the sun whose the worshiping was forbidden. Where the story takes a comic turn, is when one discovers that Rolf Krauss has finally found the historical truth about Moses, it was actually the pharaoh Amenesse who reigned from 1206 to 1203 BCE (new egyptological delirium).

Although Egyptologists are divided about points of detail regarding Akhenaten and Moses they agree with the following points: 1) Akhenaten, although he is not the inventor of monotheism is nevertheless the inspirer and he owes nothing to his predecessors (consequently there was no co-regency); 2) The story of Moses is a biblical myth[351] and there is no link to be made between the Hyksos and the Hebrews. For example, one reads:

- *As the history of unclean ones is devoid of any historical basis it is difficult to agree with Manetho and Josephus that the forcibly expelling from Avaris by Pharaoh and his congeners is the same event as the liberation of the Hebrews pulled out by Moses with God's help ... The gross invention of Egyptian scribes, worthy of the trash, can not remain in the folder of historians of Bible times (...) The apologetical travesty imagined by Josephus is not better than the libelous travesty of the Egyptian priest*[352]. Jean Yoyotte (1927-2009), Egyptologist, he was Chairholder of Egyptology at the Collège de France and director of studies at the Ecole Pratique des Hautes Etudes.
- *Modern archeology has shown that the concept of archives kept in Jerusalem with writings of the tenth century, is an absurdity based on a biblical witness and not on factual evidence. Bible stories would rank therefore among national mythologies, and would have no more historical foundation that Homeric saga of Ulysses, or that of Aeneas, founder of Rome, sung by Virgil*[353]. Israel Finkelstein, Israeli

350 R. KRAUSS – Moïse le pharaon
Monaco 2005 Éd. du Rocher pp. 57-84 141-157.

351 *It is absurd on the one hand, taking the biblical text for a historical document, on the other hand reversing the importance of protagonists: Israel is mentioned only once on a stela of Merneptah while the word Egypt is used 680 times in the Bible (...) The references to Egypt in the Bible are mainly used to feed the internal history of the Hebrews, giving a vague backdrop for some episodes, and are unrelated with current history teaches* (C. DESROCHES NOBLECOURT - Symboles de l'Égypte. Paris 2004 Éd. Desclée de Brouwer pp. 125-126). Christiane Desroches Noblecourt (1913-2011), Egyptologist, Emeritus Chief Curator of Egyptian Antiquities (Louvre) and former professor of archeology at the Ecole du Louvre. *In general, no serious archaeologist believes today that the events described in the Book of Joshua have any accurate historical basis. Archaeological surveys in the early 1990s, in particular, showed that the Israelite culture emerged in the central hills of the country, in continuity with the Canaanite culture of the previous period* (P. DE MIROSCHEDJI – Les archéologues réécrivent la Bible in: *La Recherche* n°391, 2005, p. 32) Pierre de Miroschedji, archaeologist, director of research at CNRS. *The departure from Egypt, known as the Exodus, is an essential vicissitude of this story [Exodus 13:14] (...) We almost forget one fundamental fact: nothing in the present state of Egyptian literature, more or less contemporary with these events, confirms this story, or even alluded, only fleetingly, to one of the episodes where some characters are mentioned. Nothing!* (A. ZIVIE – Les Hébreux en Egypte: réalités et fantasmes in: *Historia* n°698, 2005, p. 59) Alain Zivie, Egyptologist, Director of Research at CNRS.

352 R. KRAUSS – Moïse le pharaon
Monaco 2005 Éd. du Rocher pp. 57-84 141-157.

353 I. FINKELSTEIN, N.A. SILBERMAN - La Bible dévoilée
Paris 2002 Éd. Bayard pp. 51-53.

archaeologist, Director of the Institute of Archaeology of Tel Aviv University, author of the famous book The Bible Unearthed.

- *How should ultimately consider the source that is the biblical text to serve as a gateway for talking about people of the Bible? (...) There are so many layers of myths, they should not be taken for historical narratives. The Exodus, episode presented in history books of college as a real historic event, provides a good illustration. According to the Bible (...) this is the long journey of the Hebrews from Egypt and Canaan which is called the Exodus. However, it is highly unlikely that such an event ever took place. The first reason to doubt results from the considerable chronological gap between the time of writing from books that mention it and the supposed date of the event, clearly located in a mythical past. The second reason is the absence of any explicit data in the biblical text to place Exodus in the time and to follow it in space, so the name of the Pharaoh is not given. The third reason is the silence of the Egyptian sources. A final argument is the absence of any reference to the Exodus in the oldest strata of the Bible*[354]. Christian Robin, Director of the Laboratory of ancient Semitic Studies (Collège de France Paris IV Sorbonne), member of the Académie des Inscriptions et Belles-Lettres.
- *The biblical writers and editors had some genuine sources, but they did not hesitate to manipulate them. They did this not only with exaggerations and embellishments, but also with additions and even outright inventions, in order to make the stories serve their own ideological agenda. In this regard, they were like most ancient historians. Nevertheless, they still need not be regarded as charlatans, even though their view of history was naive. They, too, thought that they were telling the operative truth — that is, they were simply writing well-intentioned propaganda. This may be called "historicized myth," and that is how much of modem, liberal, critical scholarship regards the Hebrew Bible. Nevertheless, even propaganda and myth, like caricature, must necessarily contain some objective truths, lest they be completely unbelievable and thus ineffective (...) Rather than attempt to defend the factual historicity of the Exodus traditions, I suggest that we must understand the Exodus story precisely as a myth, specifically as a "metaphor for liberation".* William G. Dever, American archaeologist (University of Arizona), specialist and defender (*sic*) of the history of biblical Israel[355].
- *Stories and history (...) It would be absurd requesting the rigor that would use a modern historian (...), although we can not specify the contours in the mythical garment that has been given, in accordance with the mentality of the time and the environment (...) For the date of the Exodus, we can not rely on chronological indications of 1 K 6:1 and Jg 11:26, which are secondary and derived from artificial computations (...) Certainly neither the apostles nor other evangelical preachers and storytellers have tried to make « history » in the technical sense of the word, their purpose was less profane and more theological.* Jerusalem Bible (Paris 1986 Ed. Cerf pp. 27, 1410), which is the official Bible of the Catholic world.

An objective reader should note that most reasons put forward by these prestigious scholars are ideological, not based on any verifiable factual data: *absurd, no serious archaeologist believes; worthy of the garbage, fundamental fact: nothing, pious legend, there was no mass exodus from Egypt; nonsense based on a biblical witness; very type of myth, history does not support the amazing and miraculous story of Exodus, etc.* Some of these scholars, in order to prove their claims, quote the work of the archaeologist Finkelstein explaining[356], but his critics against the Pentateuch are all based on absence of evidence that would be evidence of the absence. In fact, the reign of Akhenaten is ideal for disclosing the imposture of archaeology and Egyptology.

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354 C. ROBIN – Les peuples de la Bible quelle(s) lecture(s) ?
in: *Les Cahiers de Science&Vie* n°89 (octobre 2005) pp. 6-8.

355 W.G. DEVER – Who Were the Early Israelites and Where Did They Come From?
Grand Rapids 2003 Ed. Eerdmans Publishing pp. 226,233.

356 I. FINKELSTEIN, N.A. SILBERMAN -The Bible Unearthed: Archaeology's New Vision of Ancient Isreal and the Origin of Sacred Texts. New York 2001 Ed. The Free Press pp. 36-38.

EGYPTOLOGY AND ARCHAEOLOGY UNMASKED THANKS TO AKHENATEN'S REIGN

This reign is one of the most controversial of all Egyptian history since only about the co-regency with Amenhotep III there are more than 1200 books and academic articles that have been written. He has thus become the centre of many other controversies: 1) although he had only (six) daughters he would be the father of Tutankhamun (a boy!) and despite the fact that the latter had clearly stated to be the son of Amenhotep III, 2) although he had worshiped the sun under different shapes (Aten, Re, Amun) he would be the true father of monotheism that inspired the biblical myth of Moses as well as the Jewish god Adon "Lord", a plagiarism of Aten, 3) although he was the sovereign pontiff of Egypt, a delegation of priests of Amun would have plotted a religious rebellion in order to remove the heretic worship of Aten, etc. All this doesn't seem seriousness. The eminent Egyptologist Marc Gabolde is a representative example of all these impostor historians. The only way of knowing the (historical) truth is to use a chronology anchored on absolute dates (coming from astronomy). For example, in his comprehensive study of Tutankhamun, Marc Gabolde gives an extremely precise chronology[357] (to within one day!) of the reigns of Thutmose III up to Merneptah despite the chronology[358] of the reigns from Amenhotep III to Tutankhamun (Amarna period) remains controversial (co-regencies are highlighted):

King:	Amenhotep III	Amenhotep IV	Semenkhkare	Neferneferuaten	Tutankhamun
highest date:	**38**	**17**	**1**	**3**	**10**
Carbon 14:	1397-1359	1359-1345	1345-	-1342	1342-1333
Dodson	1388-1348	1360-1343	1346-1343	1346-1343	1343-1333
Gabolde	1382-1346	1346-1329	-	1329-1327	1327-1318
[Gertoux]	1383-1345	1356-1340	1340-1338	1338-1336	1336-1327
Grimal	1390-1352	1352-1338	1338-1336	1338-1336	1336-1327
Helck	1379-1340	1340-1324	1324-1319	1324-1319	1319-1309
Hornung	1402-1364	1364-1347	1351-1348	1351-1348	1347-1338
Kitchen	1386-1349	1356-1340	1342-1340	1342-1340	1340-1331
Krauss	1390-1353	1353-1336	1336-1334	1334-1333?	1333-1323?
Malek	1391-1353	1353-1337	1338-1336	1338-1336	1336-1327
Redford	1410-1372	1372-1355	1335-1335	1335-1335	1355-1346
Vandersleyen	1387-1348	1359-1342?	1341-1339?	1342-1341?	1339-1329
von Beckerath	1388-1350	1355-1337	1338-1335	1338-1335	1335-1325

Although he claims to rely on a set of dates astronomically keyed "to get a fairly reliable absolute chronology" (page 492), Gabolde's chronology, which has many anomalies and incongruities, is actually completely fanciful for the following reasons:

- His astronomical calculations are solely based on his own use from an IMCCE software without any evidence (you must trust him), worse, it is easy to check (for astronomers, but most of his readers are not) that all his so-called calculations are wrong (see hereafter).
- For (mysterious) historical reasons (page 492), the reigns of Horemheb and Seti I, which were 27 and 11 years respectively, according to dated inscriptions, must be shrunk to 15 and 10 years. What is funny is that these two new durations disagree with those of his table (page 494): 13 years to Horembed (1314-1301) and 9 years to Seti I (1300-1291). In addition, Horemheb's reign is dated from 1330 to 1302 by carbon-14 implying a reign of about 28 years and his last inscription is dated 9/IX/**27**.
- There was no co-regency between Amenhotep III and Amenhotep IV because the arguments in favour of such a co-regency are insignificant and do not stand up to examination of sources (page 55). What is this evidence? Gabolde refuses to give it

[357] M. GABOLDE - Toutankhamon
2015 Paris, Ed. Pygmalion, pp. 489-493.
[358] M. DESSOUDEIX – Chronique de l'Égypte ancienne
Paris 2008 Éd. Actes Sud pp. 293-316.

because he does not want to bore his readers with tedious demonstrations (page 56). However he adds in an endnote (page 544) that the inscription found in the tomb of vizier Amenhotep-Huy, which was dated Amenhotep III's sed festival (year 30) and Amenhotep IV, was not a proof implying a co-regency of at least 8 years between the two kings[359], because he already had proved in his PhD (gospel truth) that there was no co-regency! In the same manner, Tutankhamun's inscription in which he wrote that Amenhotep III was his father is wrong because, as all Egyptologists know (contrary to naive ones like me), this kind of Egyptian documents is not truthful (contrary to Gabolde of course).

From a scientific point of view, Gabolde's method is nonsensical because when an inscription disagrees with his interpretation of Egyptian history, he claims that this is a mistake (p. 544 n. 4) and when a colleague has a different interpretation of his own, he shows that this approach is not acceptable because it is contrary to normal historical method implying to trust in inscriptions (p. 566 n. 67). In fact, Gabolde clearly explains in his introduction that the only method of historical interpretation is imagination, he adds "imagination is not a perversion of the historical method, but its very essence" (page 10). This explains why the public loves so much these tales of the Arabian Nights.

The only way to establish a scientific chronology of the reign of Akhenaten is to reconstruct, first a relative chronology based on carbon 14 dating supplemented by all known dated inscriptions, then to anchor this chronology on absolute dating coming from some astronomical events clearly described in ancient documents. As the accuracy on dates is about +/- 15 years according to the Carbon 14 dating[360], the year 1 of Amenhotep III has to be between 1412 and 1382 and his reign lasted at least 37 years according to the highest date. The short period 1360-1330 is one of the best documented about Canaan, Palestine and Egypt through the Amarna letters (almost 400), but paradoxically some parts remain controversial[361] because of the following:

- Most protagonists are rarely mentioned by name but almost exclusively by their title (king, mayor) or function (ruler, commissioner). The boundaries of some small countries (Amurru, Palestine) have been very volatile. Transcription of Egyptian names into Akkadian is often quite confusing[362]. It is difficult to distinguish ethnic vs common names, but a link exists between them[363], depending on their language[364]. Canaanite mayors all accuse each other of treachery to the pharaoh (who are the liars?). There were several simultaneous wars: 1) Hatti against Mitanni (ally of Egypt) then against Amurru (former ally of Egypt); 2) Apiru mercenaries (EA 195) around Amurru's area in the North and around Shechem's area in the South against Canaanite kings.

359 F.M. VALENTIN, T. BEDMAN – Proof of a "Long coregency" between Amenhotep III & Amenhotep IV in: *Kmt A Modern Journal of Ancient Egypt* Vol 24:2 (September 2014) pp. 17-27.

360 C.B. RAMSEY, M.W. DEE, J.M. ROWLAND, T.F. G. HIGHAM, S.A. HARRIS, F. BROCK, A. QUILES, E.M. WILD, E.S. MARCUS, A.J. SHORTLAND - Radiocarbon - Based Chronology for Dynastic Egypt in: *Science* Vol 328 (10 june 2010) pp. 1554-1557.

361 D. KAHN – One Step Forward, Two Steps Backward: The Relations between Amenhotep III and Tushratta, King of Mitanni in: Egypt, Canaan and Israel: History, Imperialism, Ideology and Literature (Brill, 2011) pp. 136-152.

362 The land of *Mitanni* (Hittite) is called *Meteni* (Egyptian), *Ḫanigalbat* (Assyrian), *Aram-Naharaim* (Hebrew), *Naharina* "[between the] rivers [Tigris and Euphrates]" (Babylonian), *Neherine* (Egyptian), *Mesopotamia* "between rivers" (Greek). The people of Mitanni are called *Ḫurri*. Transcrition of Egyptian names into Akkadian: Thutmose III (*Menḫeperre* / *Manaḫpiya*); Amenhotep III (*Nebmaatre* / *Ni[b]muariya*); Akhenaten (*Neferḫeperure* / *Napḫuriya*); Tutankhamun (*Nebḫeperure* / *Nibḫururiya*); Semenkhkare (*Anḫḫeperure* / *[Nip]Ḫuriya*), see A. DODSON – Were Nefertiti & Tutankhamen Coregents? in: *KMT a Modern Journal of Ancient Egypt* n° 20:3, 2009, p. 48.

363 W.L. MORAN - Les lettres d'El Amarna in: *LIPO* n°13 Paris 1987 Éd. Cerf pp. 569, 604-605.

364 *ʿAperu* "crew members/workmen", *Šasu* "Bedouins", *ʿA[l]amu* "Asiatics"; in Babylonian: *ʿApiru* "factious", *Ḫapiru* SA.GAZ "nomads", *Ḫabiru* "migrants", *Aḫlamaiu* "Arameans"; in Hebrew: *ʿIbrim* "Hebrews/those of Eber", *ʿeber* means migrant! These terms often refer to people in the same place at the same time. In Middle Assyrian *apâru*/*epêru* means "put crown on the head". In Amarna letters Apiru are compared to: a runaway dog (EA 67); mercenaries (EA 71); a rebel (EA 288); robbers (EA 318). In Akkadian *Ḫapirû*/*Ḫabbâtu* ^{lu}SA.GAZ means "nomads/looters".

If the dates obtained by ^{14}C (calibrated by dendrochronology) are imprecise (+/- 15 years) they nevertheless allow setting a relative chronology over the period 1500-1000. Dates obtained both by ^{14}C and astronomy (dates in bold) have been highlighted (the astronomical dating is given as an indication, because it will be calculated afterward):

	According to:	^{14}C dating	length of reign	astronomical dating	gap
	17th Dynasty			(date in bold)	
8	Taa Seqenenre	-	11 years	/1544-04/1533	
9	Kamose	-	2 years 11 months	05/1533-04/1530	
	18th Dynasty				
1	Ahmose	1557-1532	25 years 4 months	04/**1530**-07/1505	+27
2	Amenhotep I	1532-1511	20 years 7 months	08/**1505**-02/1484	+27
3	Thutmose I	1511-1499	12 years 9 months	02/1484-11/1472	+27
4	Thutmose II	1499-1486	3 years	08/1472-07/1469	+27
	[-Hatshepsut]	1480-	[21 years 9 months]	[08/1472-04/1450]	+8
5	Thutmose III /[Amenhotep II]	1486-1434	53 years 11 months [2 years 4 months]	[08/**1472**-03/1418] [11/**1420**-03/1418]	+14
6	Amenhotep II	1434-1407	25 years 10 months	04/1418-02/1392	+16
7	Thutmose IV	1407-1397	9 years 8 months	02/1392-10/1383	+15
8	Amenhotep III /[Amenhotep IV] Akhenaten	1397-1359 1359-1345	37 years 10 months [11 years 5 months] 5 years 2 months	10/1383-07/**1345** [03/1356-07/1345] 08/1345-10/**1340**	+14
9	Semenkhkare	1345-1342	1 year 4 months	10/1340-02/**1338**	+5
10	-Ankhkheperure		2 years 1 months	02/1338-03/1336	
11	Tutankhamun	1342-1333	9 years 8 months	03/1336-10/**1327**	+6
12	Aÿ	1333-1330	4 years 1 month	10/1327-11/1323	+6
13	Horemheb I [former regent] Horemheb II [pharaoh]	1330-1302	14 years 13 years 2 months	11/1323-11/1309 12/1309-01/1295	+7
	19th Dynasty				
1	Ramses I	1302-1302	1 year 4 months	01/1295-05/1294	+7
2	Sety I	1302-1285	11 years	06/**1294**-06/1283	+8
3	Ramses II	1285-1219	67 years 2 months	**06/1283**-07/1216	+2
4	Merenptah	1219-1206	9 years 3 months	08/1216-10/1207	+3
5	Sethy II	1206-	5 years	11/1207-10/1202	-1
6	[Amenmes]	1209-	[4 years]	[04/1206-03/1202]	+3
7	Siptah	1200-1194	6 years	**11/1202**-10/1196	-2
	Siptah-Tausert / [Setnakht]	1194-1192	1 year 6 months	11/1196-04/1194	-2
	20th Dynasty				
1	Sethnakht	1192-1189	3 years 5 months	11/1196-03/1192	-4
2	Ramses III	1189-1158	31 years 1 months	**04/1192**-04/1161	-3
3	Ramses IV	1158-1152	6 years 8 months	**05/1161**-12/1155	-3
4	Ramses V	1152-1148	3 years 2 months	01/1154-02/1151	-2
5	Ramses VI	1148-1140	7 years	03/1151-02/1144	-3
6	Ramses VII	1140-1133	7 years 1 month	03/1144-03/1137	-4
7	Ramses VIII	1133-1130	3 months ?	04/1137-06/1137	-4
8	Ramses IX	1130-1112	18 years 4 months	07/1137-10/1119	-7
9	Ramses X	1112-1103	2 years 5 months	11/1119-03/1116	-7
10	Ramses XI	1103-1073	26 years 1 month ?	04/1116-04/1090	-13
	[Herihor]	[1098-1085]			
	21st Dynasty				
1	Smendes	1090-1064	26 years		
2	Amenemnesut	[1064-1060]	4 years		
3	Psusennes I	1064-1018	46 years		
4	Amenemope	1018-1009	9 years		
5	Osorkon the Elder	1009-1003	6 years		
6	Siamun	1003-984	19 years		
7	Psusennes II/III	994-980	14 years		

The chronology of dynasties 22-24 is drawn up by numerous synchronisms[365]. The reigns of the 21st dynasty come from Africanus, which is considered a reliable document. The great priest Psusennes II and the Pharaoh Psusennes III were the same character. The reign of Osorkon II is disputed, but it lasted 44 years instead of 24 years[366].

	22nd Dynasty (Tanis)				
1	Shoshenq I	**980**-959	21 years		
2	Osorkon I	959-924	35 years		
3	Shoshenq II	924-922	2 years		
	Shoshenq IIb	922			
4	Takelot I	922-909	13 years		
5	Osorkon II	909-865	44 years		
6	Takelot II	**865**-840	25 years		
7	Shoshenq III	840-800	40 years		
	Shoshenq IV	800-788	12 years		
8	Pamiu	788-782	6 years		
9	Shoshenq V	782-745	37 years		
10	Osorkon IV (Sô)	745-**712**	33 years		
11	Gemenefkhonsubak	[710-680]	30 years		
12	Petubastis II	[680-665]	15 years		
	23nd Dynasty (Leontopolis)				
1	Petubastis I	833-811	22 years		
2	Iuput I	819-808	11 years		
	Shoshenq VI	808-802	6 years		
3	Osorkon III	802-774	28 years		
4	Takelot III	779-765	14 years		
5	Rudamun	765-762	3 years		
	Shoshenq VIa	762-749	13 years		
6	Iuput II	749-729	20 years		
	24th Dynasty (Sais)				
1	Tefnakht	742-735	7 years		
2	Bocchoris	735-729	6 years		
	25th Dynasty (Nubia)				
1	Alara	[800-781]	20 years		
2	Kashta	[781-761]	20 years		
3	Piye	761-730	31 years		
4	Shabaka	730-712	18 years		
5	Shabataka	**712**-689	23 years	[/**712**-01/689]	
6	Taharqa	689-**663**	26 years	[01/689-01/663]	
7	Tantamani	663-655	8 years		
	26th Dynasty				
	Neshepso	678-672	6 years		
1	Necho I	672-664	8 years		
2	Psammetichus I	**663**-609	54 years	02/**663**-01/609	
3	Necho II	**609**-594	15 years 10 months	02/**609**-10/594	
4	Psammetichus I	594-588	6 years 1 month	11/594-01/588	
5	Apries	588-570	19 years	02/588-12/570	
	Apries/ Amasis	569-567	[3 years]	01/569-12/567	
6	Amasis	569-526	43 years 10 months	01/569-10/526	
7	Psammetichus III	526-**525**	6 months	11/526-04/**525**	
	27th Dynasty (Persian)				
1	Cambyses II	526-**522**	4 years		
2	Darius I	**522**-486	36 years		

365 K. JANSEN-WINKELN – The Chronology of the Third Intermediate Period: Dyns. 22-24 in: Ancient Egyptian Chronology. Leiden 2006 Ed. Brill pp. 234-264.

366 G. GERTOUX – Kings David and Solomon: Chronological, Historical and Archaeological Evidence Raleigh 2015, Ed. Lulu.com, pp.25-44.

The period of time (1490-1320) that goes from Thutmose III to Tutankhamun has six dates (in bold) anchored by astronomy. As the accuracy of Carbon 14 measurements is small it does not allow deciding between the reigns with or without co-regency. Reigns prior Thutmose III can be reconstructed by combining the length of reigns with accession dates[367]. These data are insufficient to reconstruct the chronology, but the information provided by Manetho[368], transmitted by Josephus (Against Apion I:93-98), which seem fairly reliable over this period, can complete this table:

Pharaoh	Accession date	Highest date	Duration (min.)	Manetho	Reign duration
Taa Seqenenre	?	**11** II Shemu	10 years	-	10 years x m.
Kamose	II Shemu	**3** III Shemu 10	2 years	-	3 years
Ahmose		**22**	21 years	25 years 4 m.	25 years 4 m.
Amenhotep I	III/IV Shemu ?	**21**	20 years	20 years 7 m.	20 years 7 m.
Thutmose I	III Peret 21	**11 ?**	10 years	12 years 9 m.	12 years 9 m.
Thutmose II		**1** II Akhet 8	1 year	13 years	3 years
[Hatshepsut]	[coregency]	**20** III Peret 2	[20 years]	[21 years 9 m.]	[21 years 9 m.]
Thutmose III	I Shemu 4	**54** III Peret 30	53 years 11 m.	-	53 years 11 m.

Durations of reign are obtained by matching the highest dates of the reign with accession dates[369]. The length of the reign of Thutmose II can be checked by listing the number of scarabs assigned to each pharaoh[370] and assuming a normal statistical distribution (constant average production rate):

Pharaoh	Reign duration		Number of scarabs	Average per year
Thutmose I	12 years 9 months		241 / 290	18,9 / 22,7
Thutmose II	[3 years]		65 / 90	[20] / [30][371]
Hatshepsut	21 years 9 months		463 / ----	21,3 / ----
Thutmose III		08/1472-03/1418		
Thutmose IV	9 years 8 months		---- / 374	---- / 38,7

Assuming an annual average of 20/30, we obtain a reign of about 3 years (= 65/20 or 90/30) for Thutmose II, not 13 years. A second way to check the approximate length of this reign comes from the biography of Ahmose Pen-Nekhbet who claims to have reached a good old age after serving several pharaohs from Ahmose until the death of Hatshepsut, or 82 years (25 + 20 + 12 + 3 + 22). If he had started at the age of 18, he would have reached 100 years (110 years old with 13 years of reign). Even if the co-regency between Hatshepsut and Thutmose III is well documented since Thutmose III ruled with her until year 22 (then he ruled alone), it is more complicated than it seems[372]. Thutmose III argues, for example, having ruled alongside his father Thutmose II[373], in fact Queen Hatshepsut. In addition, she celebrated in the year 16 of Thutmose III a jubilee commemorating the 30

367 E. HORNUNG – The New Kingdom
in: Ancient Egyptian Chronology. Leiden 2006 Ed. Brill pp. 198-201.
J. VON BECKERATH – Chronologie des pharaonischen ägypten
1997 Ed. Verlag Philipp von Zabern pp. 201,202.

368 W.G. WADDELL - Manetho
Massachusetts 1956 Ed. Harvard University Press pp. 101-119.

369 The 13 years attributed to Thutmose II by Manetho result either from a miscalculation in the subtraction of co-regencies, or a scribal error "/ 3 years" being read "13 years."

370 L. GABOLDE – La chronologie du règne de Thoutmosis II
in: *Studien zur Altägyptischen Kultur* Band 14 (1987) pp. 61-81.

371 [20] = [18,9 + 21,3]/2 ; [30] = [22,7 + 38,7]/2.

372 The date of accession being I Shemu 4 and his death being dated III Peret 30 year 54, that implies a total duration of 53 years and 11 months, including 32 years for the reign alone (subtracting his co-regency with Hatshepsut). However, Josephus seems making two mistakes: forgetting the reign of Thutmose III and giving a wrong sonship, because Hatshepsut was the daughter of Thutmose I, not Amenhotep I. This could be due to a misinterpretation of the reign of Hatshepsut, because the queen dated her reign in the name of her son Thutmose III in continuity of the reign of her husband Thutmose II.

373 C. LALOUETTE – Thèbes ou la naissance d'un empire
Paris 1986 Éd. Fayard pp. 201-203, 257-260.

years of reign of her father Thutmose I (who reigned 12 years and 9 months), which proves that her reign began (in fact Thutmose III's reign) in year 1 of Thutmose II[374]. This way of proceeding is classical, as shown in the case of the female pharaoh Tausert who pursued the reign of Siptah, her husband, after his death. Hatshepsut claimed, when her husband died, having received a right to the regency from her father Thutmose I, who would also ordered the two obelisks of year 16 (Urk. IV, 358). Therefore, she dated her years of reign in the name of Thutmose III but in continuation of the reign of her ex-husband Thutmose II, which led to believe a co-regency between these two pharaohs[375]. Indeed, her commemoration of a jubilee in year 16 for the 30-year reign of his father Thutmose I proves that she began her reign (actually that of Thutmose III) in year 1 of Thutmose II, because the 30 years include the combination of 13 years of Thutmose I, the 3 years of Thutmose II and the first 13 years of his actual reign. In fact, the 30 years of this jubilee are shorter than those of a traditional jubilee, because it actually covers the reigns of three successive pharaohs. Two of these years of reign are shorter because they are counted from Pharaoh's accession to the accession of next Pharaoh (starting at death of previous Pharaoh). Some Egyptologists consider this jubilee (*sed* festival celebrated after 30 years of reign) is fanciful, but this assumption is illogical, because the Pharaohs were guarantor of ceremonial and they would not changed it without compelling (and explained) reason. In addition, we find that adding the successive reigns of Thutmose I (13 years) and the first 16 years of Thutmose III we obtain 29 years (= 13 + 16) necessary to celebrate a jubilee.

Hatshepsut's reign begins not in year 1 but in year 4 as she continued the reign of her husband. Stelas dated from Thutmose III (under the regency of his aunt Hatshepsut) are from year 4 to year 20. Furthermore, this ambiguity in the reign of Thutmose III has sometimes been interpreted as a co-regency[376] between Hatshepsut and Thutmose I or between Thutmose II and Thutmose I, but the most logical explanation is to accept a regency on her nephew Thutmose III in the name of her husband Thutmose II. This scenario would explain the confusion of Manetho. Hatshepsut who ruled in Thutmose's name, could be considered as the daughter of Amenhotep I, Thutmose I's predecessor, and the 30-year rule in her name could be mixed with the 32 years of Thutmose III. Tutor of Hatshepsut, Ahmose Pen-Nekhbet, did not consider her as a pharaoh since after her death he did not mention her on the list of pharaohs he had served: Ahmose, Amenhotep I, Thutmose I, Thutmose II and Tuthmose III. Ineni stating that after the death of Thutmose II: "Thutmose III reigned through Hatshepsut[377]".

Using durations from Manetho for the reigns of Amenhotep I and Thutmose I (reigned 12 years 5 months, died around Egyptian month XI) and that obtained from the frequency of scarabs for Thutmose II (3 years), it is possible to reconstruct a chronology of the reign of Amenhotep I. The reign of Thutmose III pursuing Thutmose II's reign (through the proxy of Hatshepsut) his accession's date of I Shemu 4 does not match that of Thutmose II, which prevents calculating the month of accession in 1472 BCE, probably around month XI (as the construction of two obelisks lasted 7 months, from 15/VI/15 to 30/XII/16, the accession must be just before month XII).

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374 E. WENTE, C. VAN SICLEN - Studies in Honor of George R. Hughes
in: *Studies in Ancient Oriental Civilization* 39 (Chicago, 1977) pp. 220,221.
375 L. GABOLDE – La chronologie du règne de Thoutmosis II
in: *Studien zur Altägyptischen Kultur* Band 14 (1987) pp. 61-81.
M. GABOLDE – Les portraits d'une reine pharaon
in: Akhénaton et l'époque amarnienne, Éd. Khéops et centre d'égyptologie (2005) pp. 261-286.
376 W.J. MURNANE - Ancient Egyptian Coregencies
in: *Studies in Ancient Oriental Civilization* 40 (Chicago, 1977) pp. 35-39,115-117,230.
377 C. DESROCHES NOBLECOURT – La reine mystérieuse Hatshepsout
Paris 2002 Éd. Pygmalion pp. 408-411.

BCE	year	year	year	Pharaoh
1486	20/21			**Amenhotep I**
1485	21/ 1		*1*	
1484	1/2		*1/2*	**Thutmose I** accession date III Peret 21 (17 February 1484)
1483	2/3		*2/3*	
1482	3/4		*3/4*	
1481	4/5		*4/5*	
1480	5/6		*5/6*	
1479	6/7		*6/7*	
1478	7/8		*7/8*	
1477	8/9		*8/9*	
1476	9/10		*9/10*	
1475	10/11		*10/11*	
1474	11/12		*11/12*	
1473	12/13		*12/13*	
1472	13/ 1		*13/14*	
1471	1/2		14/15	**Thutmose II,** accession date [-]/XI/**13** (September 1472)
1470	2/3		15/16	
1469	3/(1)	3/4	16/17	Death of Thutmose II dated around [-]/XI/**3** (July 1469)
1468	*4*	4/5	17/18	**Hatshepsut** extends the reign of her husband on behalf of
1467	*5*	5/6	18/19	**Thutmose III**
1466	*6*	6/7	19/20	
1465	*7*	**7**/8	20/21	Senenmut's tomb began on 2/VIII/**7** (full moon dated 23 March 1465)
1464	*8*	8/**9**	21/22	**Great Year** began on 16 July 1464 (heliacal risings of Sirius and Venus)
1463	*9*	**9**/10	22/23	astronomical ceiling of the tomb of Senenmut. Culmination of
1462	*10*	10/11	23/24	the Big Dipper, in the absence of Mars (14 November 1463).
1461	*11*	11/12	24/25	
1460	*12*	12/13	25/26	
1459	*13*	13/14	26/27	
1458	*14*	14/15	27/28	construction of two obelisks ordered by **Thutmose I** (!)
1457	*15*	**15/16**	28/29	from 15/VI/**15** (02 February 1457) to 30/XII/**16** (16 August 1457)
1456	*16*	**16**/17	29/**30**	year **30** of **Jubilee**[378] began at the end of year **16** (le 18 July 1456)
1455	*17*	17/18		
1454	*18*	18/19		
1453	*19*	19/20		
1452	*20*	20/21		
1451	*21*	21/22		Hatshepsut died on 10/VI/**22** (27 January 1451)
1450	*22*	22/**23**		year 22 of **Thutmose III** began on I Shemu 4, 4/IX/**22** (21 April 1450)
1449	23/24			lunar days *psḏntyw* dated 21/IX/**23** (full moon dated 07 May 1450)
1448	**24/25**			and 30/VI/**24** (full moon dated 16 February 1448), Sothic rising dated
1447	25/26			28/XI/[**25**] (full moon dated 12 July 1448)
1446	26/27			

The dating of Thutmose III's reign by several astronomical phenomena allows anchoring the chronological beginning of the 18th Dynasty. The helical rising of Sirius during the 11-year reign of Sety I, dated I Akhet 1, year 4[379] fixes the end of the 18th Dynasty. This astronomical event fixes his accession in 1294 (+/- 4)[380]. The astronomical ceiling of Sety I actually started by a Sothic rising and according to his Cenotaph: *All these stars begin on 1st Akhet when Sirius appears*[381]. These two reigns dated by astronomy are used for anchoring the chronology of the 18th dynasty:

[378] That Jubilee was celebrated during the festival of Opet dated from II Akhet 15 to 26 (J.C. DARNELL – Opet Festival in: *UCLA Encyclopedia of Egyptology* 12-10-2010, pp. 1-15) The period dated 15-26/II/**16** was around November 1457 BCE.

[379] K. SETHE - Sethos I und die Erneuerung der Hundssternperiode
in: *Zeitschrift für Ägyptische Sprache* 66 (1931) pp. 1-7.

[380] At Thebes (Longitude 32°39' Latitude 25°42') with an *arcus visionis* of 8.7 the Sothiac rising is dated 12 July on the period 1370-600 (see http://www.imcce.fr/fr/grandpublic/phenomenes/sothis/index.php) and I Akhet 1 = 12 July in 1293-1290.

[381] O. NEUGEBAUER, R.A. PARKER – Egyptian Astronomical Texts I
London 1960 Ed. Brown University Press pp. 44, 54 (Text T_2 plate 47).
K. SETHE - Sethos I und die Erneuerung der Hundssternperiode
in: *Zeitschrift für Ägyptische Sprache* 66 (1931) pp. 1-7.

18th Dynasty	Name (Manetho via Josephus)	Reign duration	anchor dates
Ahmose	Tethmôsis	25 years 4 months	
Amenhotep I	Amenophis	20 years 7 months	
Thutmose I	Mephres	12 years 9 months	
Thutmose II	Chebron	13 years	
Hatshepsut	Amessis, daughter of Amenophis	21 years 9 months	
Thutmose III	[co-regency?]	-	08/1472-03/1418
Amenhotep II	Mephragmouthôsis	25 years 10 months	
Thutmose IV	Thoutmosis	9 years 8 months	
Amenhotep III	Amenophis	30 years 10 months	
Amenhotep IV Akhenaten	[co-regency?] Orus	36 years 5 months	
Semenkhkare		-	
Ankhkheperure	Akencheris, daughter of Orus	12 years 1 month	
Tutankhamun	Rhathotis, brother of Akencheris	9 years	
Aÿ	Harmais	4 years 1 month	
Horemheb	Akencheres I Akencheres II	12 years 5 months 12 years 3 months	
19th Dynasty			
Ramses I	Ramesses	1 year 4 months	01/1295-05/**1294**
Sety I	[-][382] to Sethos, 59 years		06/1294-06/1283

The next step consists to verify Manetho's data through highest regnal dates combined with dates of accession and death. As Thutmose III died on III Peret 30 Year 54 (10 March 1418), the accession of Amenhotep II, his successor, should have dated on IV Peret 1. However it is dated IV Akhet 1, implying a gap of 4 months. Some authors consider that one of these dates is wrong but the chronology of the Asiatic campaigns of Amenhotep II, as his first campaign dated year 3 can only be explained if there is a co-regency of 2 years and 4 months at the end of the reign of Thutmose III[383]. During this co-regency Amenhotep II built the temple of Amada in Nubia whose decoration shares harmoniously between Thutmose III —depicted in the lower registers scenes— and Amenhotep II —featured in the upper registers. This co-regency[384] is confirmed by a lunar date found in a papyrus (Leningrad 1116A) which mentions a grain delivery dated III Shemu 6 Year 19 of Amenhotep II for an offering of beer matching the 1st lunar day *psḏntyw*[385]. According to Egyptian papyri, beer could be produced in 3 or 4 days and storage could not exceed 15 days for conservation reasons (if it was meant to be consumed, not offered in sacrifice). These technical considerations set the date of *psḏntyw* day between 10 and 25 of III Shemu. In fact, since the grain offering was for worship, a beer storage for several days after the brewing was not necessary. The sequence had to be the following: recording the grain stock on 6 of III Shemu, then brewing of beer from 7 to 10 and offering on 11 (*psḏntyw* day is therefore dated III Shemu 11 Year 19). Thus the co-regency of Amenhotep II which began 2 years and 4 months before the death of Thutmose III (10 March 1418), the IV Akhet 1 corresponds to 11 November in 1420 BCE, so the reign of 25 years and 10 months is the duration without the co-regency. The date of III Shemu 11 Year

382 A word is missing, maybe the name "Orus".

383 W.J. MURNANE - Ancient Egyptian Coregencies
in: *Studies in Ancient Oriental Civilization* 40 (Chicago, 1977) pp. 44-57.
P. DER MANUELIAN – Studies in the reign of Amenophis II
in: *Hildesheimer Ägyptologische Beiträge* 26 (1987) pp. 19-40.
P. DER MANUELIAN – The End of the Reign and the Accession of Amenhotep II
in: Thutmose III A New Biography Ed. The University of Michigan Press (2005) pp. 414-429.

384 N. GRIMAL - Histoire de l'Égypte ancienne
Paris 1988 Éd. Fayard p. 279.
P. VERNUS, J. YOYOTTE - Dictionnaire des pharaons
Paris 1998 Éd. Noésis p. 19.

385 J.G. READ – Chronological Placements for Thutmose II, Amenhotep II, Ramesses II
in: *Discussions in Egyptology* 36 (1996) p. 105.

19 of Amenhotep II matches the full moon of June 15, 1402 BCE[386]. The next two reigns, those of Thutmose IV and Amenhotep III, do not present difficulty (no co-regency) and can be placed after that of Amenhotep II (III Shemu 11 is a lunar date in 1402)

				AKHET				PERET				SHEMU				
				I	II	III	IV	I	II	III	IV	I	II	III	IV	I
	BCE			Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
Thutmose III	1422	**51**		22	21	21	20	20	19	19	18	18	18	17	17	
	1421	**52**		11	11	10	10	9	9	8	8	7	7	6	6	
Amenhotep II	1420	**53**	1	1	30	29	29	28	28	27	27	26	26	25	25	
	1419	**54**	2	19	19	18	18	18	17	17	16	16	15	15	14	
	1418	**3**	3	9	8	8	7	7	6	6	6	5	5	4	4	3
	1417	**4**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1416	**5**	5	17	17	16	16	15	15	14	14	13	13	12	12	
	1415	**6**	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1414	**7**	7	25	25	24	24	23	23	23	22	22	21	21	20	
	1413	**8**	8	15	14	14	13	13	12	12	11	11	10	10	10	
	1412	**9**	9	4	4	3	3	2	2	1	1	30	29	29	28	
	1411	**10**	10	23	23	22	22	21	21	20	20	19	19	18	18	
	1410	**11**	11	12	12	11	11	10	10	10	9	9	8	8	7	
	1409	**12**	12	2	1	1	30	30	29	28	28	27	27	27	26	
	1408	**13**	13	21	20	20	19	19	18	18	17	17	16	16	15	
	1407	**14**	14	10	9	9	9	8	8	7	7	6	6	5	5	4
	1406	**15**	15	29	28	28	27	27	27	26	26	25	25	24	24	
	1405	**16**	16	18	18	17	17	16	16	15	15	14	14	14	13	
	1404	**17**	17	8	7	7	6	6	5	5	4	4	3	3	2	2
	1403	**18**	18	26	26	26	25	25	24	24	23	23	22	22	21	
	1402	**19**	19	16	15	15	14	14	14	13	13	12	12	11	11	
	1401	**20**	20	5	5	4	4	3	3	2	2	1	1	1	30	
	1400	**21**	21	24	24	23	23	22	22	21	21	20	20	19	19	
	1399	**22**	22	13	13	13	12	12	11	11	10	10	9	9	8	
	1398	**23**	23	3	2	2	1	1	1/30	30	29	29	28	28	27	
	1397	**24**	24	22	21	21	20	20	19	19	18	18	18	17	17	
	1396	**25**	25	11	11	10	10	9	9	8	8	7	7	6	6	
	1395	**26**	1	1	30	29	29	28	28	27	27	26	26	25	25	
	1394	**27**	2	19	19	18	18	18	17	17	16	16	15	15	14	
	1393	**28**	3	9	8	8	7	7	6	6	6	5	5	4	4	3
Thutmose IV	1392	**1**	4	28	27	27	26	26	25	25	24	24	23	23	23	
	1391	**2**	5	17	17	16	16	15	15	14	14	13	13	12	12	
	1390	**3**	6	6	6	6	5	5	4	4	3	3	2	2	1	1
	1389	**4**	7	25	25	24	24	23	23	23	22	22	21	21	20	

As Thutmose III died in March 1418 BCE, Amenhotep III's death must be in April 1345 = 1418 - (37 years 10 months) - (9 years 8 months) - (25 years 10 months). The missing reign of Semenkhkare can be reconstituted through the 6 rings made during his reign, compared to the 18 issued during the 4 years and 1 month of Ay's reign, implying a period of 1 year and 4 months (= 4 years x 6/18)[387]. The Josephus' remark: *Akencheris, daughter of Orus [Akhenaten], reigned [1]2 years and 1 month*, shows that he was well informed[388] because Semenkhkare appears married with Meritaten (who was indeed a daughter of Akhenaten, her name is transcribed Mayati in Akkadian) in the tomb of Meryre and this queen reigned 2 years 1 month after the death of her husband under the name of [Semenkhkare]-Ankhkheperure. One notes however that several reigns have some ten too much and the duration of reigns with co-regencies is systematically wrong. Horemheb's

[386] Lunar cycles of 25 years begin at I Akhet 1 at the full moon of 13 August 1421 BCE and 7 August 1396 BCE. One can also note that the co-regency of Amenhotep II started from a new lunar cycle of 25 years.

[387] M. GABOLDE - D'Akhenaton à Toutânkhamon
Lyon 1998 Éd. Institut d'Archéologie et d'Histoire de l'Antiquité p. 220.

[388] G. GREENBERG – Manetho. A Study in Egyptian Chronology
Pennsylvania 2004, Marco Polo Monographs 8 pp. 78-86.

reign is oddly divided into two parts, but Horemheb is indeed referred to his birth name (Ar-ma-a in Akkadian) in the annals of Mursili II until his year 10 (1322-1312), instead his throne name (Djoser-kheperu[setepen]re), as it is usually the case for pharaohs in title. This anomaly shows that this Pharaoh initially reigned as a former representative of Pharaoh before being a full-fledged Pharaoh. The reigns indicated by Manetho are reliable except for periods of co-regencies (highlighted in orange).

Pharao	Accession date	Highest date	Duration (min.)	Manetho	Reign duration
18th Dynasty	(Year **1**)				
Ahmose		**22**	21 years	25 years 4 m.	25 years 4 m.
Amenhotep I	III/IV Shemu?	**21**	20 years	20 years 7 m.	20 years 7 m.
Thutmose I	III Peret 21	**11 ?**	10 years	12 years 9 m.	12 years 9 m.
Thutmose II		**1** II Akhet 8	1 year	[1]3 years	3 years
Hatshepsut	co-regency	**20** III Peret 2	20 years	21 years 9 m.	21 years 9 m.
Thutmose III	I Shemu 4	**54** III Peret 30	53 years 11 m.	[co-regency?]	53 years 11 m.
Amenhotep II	IV Akhet 1 ?	**26**	25 years	25 years 10 m.	25 years 10 m.
Thutmose IV		**8** III Peret 2	7 years	9 years 8 m.	9 years 8 m.
Amenhotep III	II/III Shemu ?	**38** III Shemu 1	37 years 10 m.	30 years 10 m.	37 years 10 m.
Amenhotep IV Akhenaten	I Peret 1-8 ?	**17** II Akhet **6** IV Peret 13	16 years 7 m. 5 years	36 years 5 m. [co-regency?]	16 years 7 m.
Semenkhkare		**1**	1 year	-	1 year 4 m.
Ankhkheperure		**3** III Akhet 10	2 years	[1]2 years 1 m.	2 years 1 m.
Tutankhamun	IV Akhet 19	**10** [III Akhet]	9 years	9 years	9 years
Aÿ		**4** IV Akhet 1	3 years	4 years 1 m.	4 years 1 m.
Horemheb	III Akhet [5]? (*Opet Festival*)	**27** I Shemu 9	27 years	12 years 5 m. 12 years 3 m.	27 years 2 m.
Ramses I	III Peret ?	**2** II Peret 20	1 year 4 m.	1 year 4 m.	1 year 4 m.
Sety I	III Shemu 24 ?	**11** IV Shemu 13	11 years		11 years

The durations of the two reigns: 37 years 10 months for Amenhotep III and 16 years 7 months of Amenhotep IV are admitted, only the 11-year co-regency of Akhenaten with his father is disputed. Elements that support the co-regency are as follows[389]:

- The context in the chapel of Vizier Amenhotep-Huy indicates clearly the unit on the time of destruction of the decoration, carried out by order of the Royal House in a date after the year 30 of Amenhotep III, happened year 35 of Amenhotep III (the last known date is 1/IX/**35**). There is a space enclosed with no more 2 metres between each of the columns that show the inscriptions sculpted by the same craftsmen, at the same time, paired, Amenhotep III/ Amenhotep IV. In one of the columns with the inscription of Amenhotep III it's the mention, about the appearance of the King in the *Tjentjat* "at the beginning of the year 30 Jubilee". That date, is collected in Kheruef's TT192 as referring to 27/X/**30** of Amenhotep III. Consequently, the 38-year reign of Amenhotep III implies a co-regency of at least 8 years between the two kings[390] (from year **30** to **38**) because the inscription in the vizier's chapel was made before the death of Amenhotep III.
- The transactions between Mesy and the shepherd Nebmehy (Berlin Papyrus 9784) dated III Shemu 20, year 27 of Amenhotep III then [?] Peret 27, year 2 of Amenhotep IV (not Akhenaten) implies a co-regency of 11 years between the two transactions separated of 1 year (without co-regency it would have been 12 years of silence).
- The mention of a *sed* feast in the year 30 of Amenhotep III[391], as reported by Amenhotep IV during his 3rd year, confirms the 11-year co-regency. Those who refuse this co-regency

389 P.F. DORMAN – The Long Coregency Revisited: Architectural and Iconographic Conundra in the Tomb of Kheruef in: *Causing His Name to Live: Studies in Egyptian Epigraphy and History in Memory of William J. Murnane* 2006 The University of Memphis.
390 F.M. VALENTIN, T. BEDMAN – Proof of a "Long coregency" between Amenhotep III & Amenhotep IV in: *Kmt A Modern Journal of Ancient Egypt* Vol 24:2 (September 2014) pp. 17-27.
391 L.E. BAILEY – Amenhotep III and Akhenaten : an Examination of the Coregency Issues Chicago 2000 E. University of Chicago pp. 14,26-28,38.

are obliged to say that this *sed* festival commemorating 30 years of reign, mentioned by Amenhotep IV, would have been anachronistic[392]. This Pharaoh would used the festival only in order to proclaim his "divine" quality and would have violated the ancestral ritual of commemorations, which is very unlikely.

- Amenhotep IV in front of Amenhotep III (*stela Berlin 20716*), recognizable through their headdress, is represented in the process of serving a beverage to his father[393] (below).

26	**Amenhotep III**			
27			Change of name:	
28	**Amenhotep IV**	**1**	Amun is pleased (*Amenhotep III's son*)	
29		2		
30	**Jubilee**	**3**	Re-Horakhty (...) who is Aten	
34	Jubilee (of year 33)	7		
37	Jubilee (of year 36)	10	Re (...) who comes back as Aten	
38		11	(*birth of Tutankhamun*)	1
12	**Akhenaten**	1	Life of Aten *(transfer to Akhetaten)*	2
17/1		6		7
2	**Semenkhkare**	[7]	(*brother of Akhenaten*)	8
3	**-Ankhkheperure**	[8]	(*wife of Semenkhkare*)	9
1	**Tutankhamun**		(*younger brother of Akhenaten*)	10

- Among the dated jar-labels from the 8th to the 38th regnal years of Amenhotep III there are seven dated year 28 including five examples dated year 1 [of Amenhotep IV][394].
- In the year 12 of Amenhotep IV, Tiy (wife of Amenhotep III) moved to Akhetaten[395].
- Changes of name (Aten instead of Amun) in the titular of Amenhotep IV at the years 3 and 9 of his reign should be linked to the jubilees of year 30 and 36 of Amenhotep III[396].
- Tutankhamun says clearly to be a son of Amenhotep III and, as he died at the age of 20 +/- 2 years (according to the state of his mummy), his statement can only be true if there was a co-regency of at least 11 years. Without co-regency, Amenhotep III's death is separated from Tutankhamun by 30 years (= 17+3+10) and he could not be his son because he died when he was 20 as confirmed by his coronation chair made for a 10 years old child. With the co-regency, the gap of 19 years (= 6+3+10) is in agreement with his birth to the end of Amenhotep III's reign in 1347 (= 1327 + 20). Thus the successor of Akhenaten was first Semenkhkare (his brother) then Tutankhamun (his younger brother) 3 years later. There is a paradox for those who refuse the co-regency and Gabolde agrees: *then why, if Tutankhamun was the son of Akhenaten, would have he hidden it in this way his real ancestry to proclaim, on occasion, he was the «son» of Amenhotep III? (...) The legitimacy of Amenhotep IV/Akhenaten has never been questioned under Tutankhamun and continuity was maintained during his reign in the traditional pattern: a son succeeded his father.* To assume that Tutankhamun would have denied his "father" Akhenaten, who had only 6 girls!, for religious reasons is unprecedented and leads to an absurdity: *Admittedly, it is paradoxical to consider that Tutankhamun may seemingly, in the same spirit, honor his father and deny him all at once and there is no obvious explanation for this contradiction*[397]. The obvious explanation exists: as he claimed

[392] M. GABOLDE - D'Akhenaton à Toutânkhamon
Lyon 1998 Éd. Institut d'Archéologie et d'Histoire de l'Antiquité pp. 26-28.
[393] C. DESROCHES-NOBLECOURT - Toutankhamon
Paris 1965 Éd.Hachette pp. 110-111.
[394] W.C. HAYES - Inscriptions from the Palace of Amenhotep III
in: *Journal of Near Eastern Studies* 10:1 (Jan. 1951), pp. 35-56.
[395] N. GRIMAL - Histoire de l'Égypte ancienne
Paris 1988 Éd. Fayard pp. 301-302.
[396] J. GOHARY – Akhenaten's Sed-Festival at Karnak
London 1992 Ed. Kegan Paul International pp. 29-33.
[397] M. GABOLDE - D'Akhenaton à Toutânkhamon
Lyon 1998 Éd. Institut d'Archéologie et d'Histoire de l'Antiquité p. 293.

Tutankhamun was the son of Amenhotep III. In addition if Tutankhamun was the son of Akhenaten why Semenkhkare succeeded his brother Akhetaten instead of his own son? Once again, there is a new anomaly!

The 11-year co-regency between the two pharaohs is therefore well established. Amenhotep IV probably expected the death of Amenhotep III for transferring the whole court in the new city (Akhetaten) and to favor the promoting of Aten's worship (Toutankhaten, later Tutankhamun, will choose again the ancient Amun's worship). The receipt of foreign tributes at Amarna is dated IV Peret 8 Year 12 of Amenhotep IV[398]. This celebration inaugurated in fact Aten's worship in Amarna. The date was well chosen because it was a few days before the solar beam appearing the IV Peret 13. The numerous jars of wine excavated in the city dated years 1-4 as well as the boundary stelae dated years 5 and 6 seem to refer to Akhenaten's reign officially appearing at the 12th year of Amenhotep IV, which was the 1st year of Akhenaten (stelae of year 8 are posthumous and contemporary of Semenkhkare)[399]. Inasmuch Akhenaten stated in the stela year 5 that the situation is worse in his time than the one of Amenhotep III, it was not the Amenohotep IV's year 5 but Akhenaten's year 5 because he would not have spoken in such terms of the reign of Amenohotep III if he was still alive and shared power with him. Semenkhkare being Akhenaten's successor, the jars dating year 1 just after year 17 should be attributed to him rather than Akhenaten[400]. Despite evidence of the co-regency between Amenhotep III and his son Amenhotep IV the reconstitution without co-regency is favored by most egyptologists of the 32nd Dynasty (those affected by pharaonic megalomania). However chronological synchronisms, as well as calculation by astronomy (highlighted in sky blue) of the dates of Akhenaten's death in October 1340 BCE and of Tutankhamen in October 1327 BCE[401], confirm the 11-year co-regency.

King	Reign duration	Reign
Ahmose	25 years 4 months	04/1530-07/1505
Amenhotep I	20 years 7 months	08/1505-02/1484
Thutmose I	12 years 5 months	03/1484-07/1472
Thutmose II	3 years	08/1472-07/1469
Thutmose III	53 years 11 months	08/1472-03/1418
[Thutmose III/Amenhotep II]	[2 years 4 months]	[11/1420-03/1418]
Amenhotep II	25 years 10 months	04/**1418**-02/1392
Thutmose IV	9 years 8 months	02/1392-10/1383
Amenhotep III	37 years 10 months	10/1383-07/**1345**
[Amenhotep III/Amenhotep IV]	[11 years 5 months]	[03/1356-07/1345]
Akhenaten	5 years 2 months	08/1345-10/1340
Semenkhkare	1 year 4 months	10/1340-02/1338
-Ankhkheperure	2 years 1 month	02/1338-03/1336
Tutankhamun	9 years 8 months	03/1336-10/1327
Aÿ	4 years 1 month	10/1327-11/1323
Horemheb I [former regent]	14 years	11/1323-11/1309
Horemheb II [pharaoh]	13 years 2 months	12/1309-01/1295
Ramses I		01/1295-05/**1294**
Sety I	11 years	06/1294-06/1283
Total:	124 years	04/1418-05/1294

[398] M. GABOLDE - D'Akhenaton à Toutânkhamon
Lyon 1998 Éd. Institut d'Archéologie et d'Histoire de l'Antiquité pp. 281-283.
[399] F.J. GILES – The Amarna Age: Egypt
2001 Ed. Aris & Phillips pp. 43-45.
[400] W.J. MURNANE - Ancient Egyptian Coregencies
in: *Studies in Ancient Oriental Civilization* 40 (Chicago, 1977) pp. 215-225.
[401] The month of Akhenaten's death must be around October because a label on a jar dated year 17 (partially erased and changed to 1) refers to honey and honey harvesting in Egypt, in the valley, was carried out in September (P.T. NICHOLSON, I. SHAW – *Ancient Materials and Technology*, Cambridge, 2000, pp. 410-411). In addition, Suppiluliuma I was informed of Tutankhamun's death at the end of his campaign which ended before the onset of winter (November).

Between Thutmose III's death on March 10, 1418 BCE and the beginning of Sety I's reign in June 1294 BCE there are 124 years (= 1418 - 1294), a difference that exactly matches the sum of reigns: 124 years (= 25 years 10 months of Amenhotep II + 9 years 8 months of Thutmose IV + 37 years 10 months of Amenhotep III + 5 years 2 months of Akhenaten + 1 year 4 month of Semenkhkare + 2 years 1 month of Ankhkheperure + 9 years 8 months of Tutankhamun + 4 years 1 month of Ay + 27 years 2 months of Horemheb + 1 year 4 month of Ramses I) provided the 11 years of co-regency between Amenhotep III and Amenhotep IV are not counted. To dispute this coincidence, egyptologists of the 32nd Dynasty assume that the reign of Horemheb lasted only 16 years (or 14!) instead of 27. This assumption defies common sense.

Even if the duration of Horemheb's reign is controversial because of the low number of dated inscriptions between years 14 to 27 (which is not unusual), only years 1-4, 6-9, and 12-14 are attested in his grave (unfinished!)[402], this reign is dated from 1330 to 1302 by carbon-14 implying a reign of about 28 years. Kitchen also observed[403] that Horemheb's extensive building projects at Karnak supported the theory of a long reign for this Pharaoh and stressed that "a good number of the undated 'late 18th Dynasty' private monuments that are in both Egypt and the world's Museums must, in fact, belong to his reign. There are only two dated inscriptions after the Year 14: a decree on a section of wall dated Year [2]5[404] and a graffito on a fragment of a statue dated year 27. The ink graffito reads: *Year 27, I Shemu 9, the day*[405] *on which Horemheb, who loves Amun and hates his enemies, entered the temple for this event*. The use of Horemheb's name and the addition of a long "Meryamun" (Beloved of Amun) epithet in the graffito suggests a living, eulogised king rather than a long deceased one[406]. If the reading of the year [2]5 is only the most likely[407] (figure above), that of 27 year is indisputable and requires a period of reign of at least 26 years. A second element supports the period of 27 years. Mes' inscription[408] describes a complaint during the year 18 of Ramses II about a land inherited from the time of Horemheb, which is finally judged and dated in the year 59 of Horemheb[409]. Sety I's reign lasted 11 years (actually 11 years and a few days) as shown in the autobiography of the priest Bakenkhons[410]. Hari, in his thesis

402 J. VAN DIJK – New Evidence of the Length of the Reign of Horemheb
in: *Journal of the American Research Center in Egypt* vol. 44 (2008) pp. 193-200.

403 K.A. KITCHEN – The Basis of Egyptian Chronology in Relation to the Bronze Age in: "*High, Middle or Low? Acts of International Colloquim on Absolute Chronology held at the University of Gothenburg 20-22 August 1987*" Ed. Paul Aström Vol 1 pp. 37-55.

404 Petrie Collection (UC 14391),the part where appeared the year [2]5 has been chipped and is now illegible.

405 This date I Shemu 9 Year 27 corresponds to March 18 in 1296 BCE and coincides with a 1st lunar crescent.

406 D. REDFORD in: JNES 25 (1966), p. 123; in BASOR 211 (1973) No. 37 footnote.

407 R. HARI – Horemheb et la reine Moutnedjemet ou la fin d'une dynastie
Genève 1964 Imprimerie La Sirène. Thèse n°179 fig. 82, 84.

408 A.H. GARDINER – The Inscription of Mes
Leipzig 1905 in: *Untersuchungen zur Geschichte und Altertumskunde Ägyptens* 4:3.

409 The only plausible explanation for this unusual year 59 is to assume that the 58-year reign posthumously attributed to Horemheb corresponds in fact to 27 years 2 months of Horemheb's actual reign + 1 year 4 months of Ramses I's reign + 11 years of Sety I's reign + 18 years from the beginning of Ramses II's reign. The reign of Horemheb was extended posthumously because the year 28 is followed by years 1-2 of Ramses I (years 29-30 of Horemheb) then by years 1-11 of Seti I (years 31-41 of Horemheb) and finally with years 1-18 of Ramses II (42-59 years of Horemheb).

410 *Bakenkhonsu states that he spent 4 years as an excellent youngster, 11 years as a youth, as a trainee stable-master for king Men[maat]re (Sety I), wab priest of Amun for 4 years, god's father of Amun for 12 years, third pries of Amun for 15 years, second priest of Amun for 12* (E. FLOOD – Biographical Texts from Ramessid Egypt Atlanta 2007 Ed. Society of Biblical Literature p. 41). The 11 years of Sety I are all represented, except 10, which confirms the 11 years reign (E. HORNUNG -The New Kingdom in: Ancient Egyptian Chronology (Leiden 2006) Ed. Brill pp. 210-211).

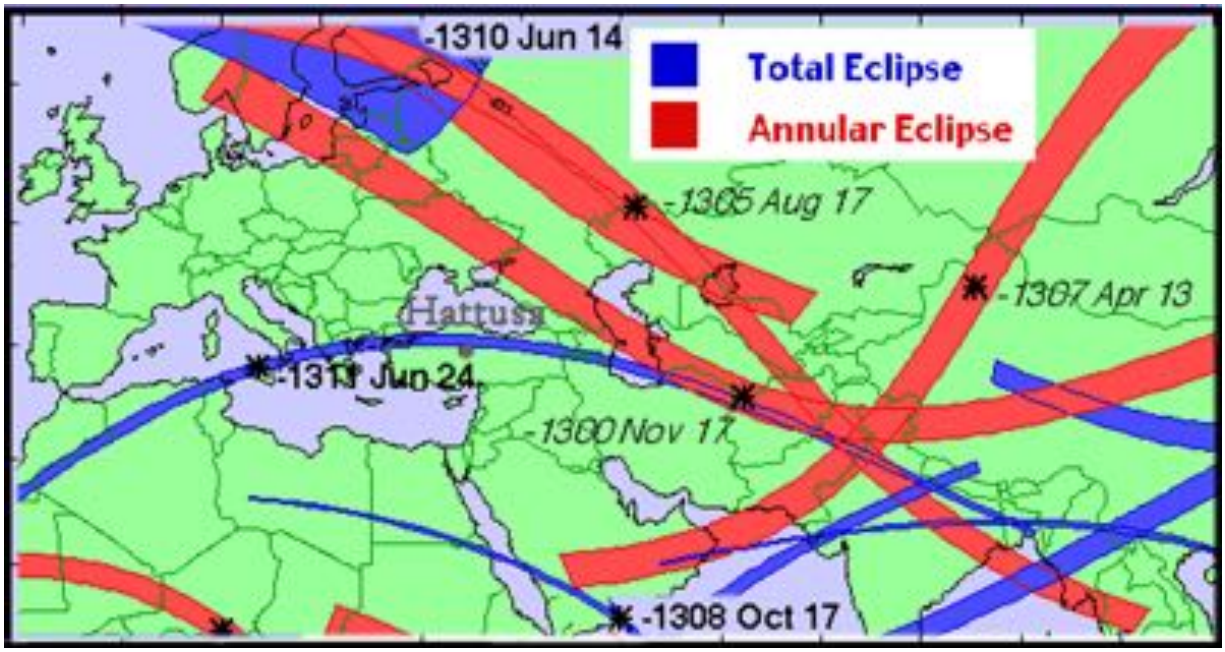
about Horemheb, noted that the usual explanations about this pharaoh are romanticized and baseless. After reviewing overall enrollments and representations, he concluded that transitions between pharaohs were based solely on the "principle of legitimacy." General Horemheb had been appointed as "representative of the Pharaoh" by Tutankhamun, but not as co-regent, and after the death of Tutankhamun, Ay was his legitimate successor. Ay having no children when he died, Horemheb remained only the representative of a dead pharaoh. To extend his function of representing the Pharaoh, Queen Mutnodjmet, divine Ay's daughter, got married Horemheb (as did in the past Queen Hatshepsut, daughter of Thutmose I, with his half-brother Thutmose II). Thus Horemheb reigned about 14 years as a "representative (*idenu*) of Pharaoh" and after the death of the queen he was enthroned as Pharaoh and started a "new reign" of about 13 years (year 1 succeeding year 14). In his "Decree of Coronation" Horemheb reminds that he had been designated as "representative" by King (unnamed) and it was in this way that: *he ruled the country for a period of many years [more than 10 years] before eventually be designated as "king" by the "eldest son of Horus"* ("son of Horus" meant the king in title, ie Mutnodjmet's husband?). Manetho has rightly separated the reign of Horemheb into two roughly equal parts (14 years as a representative of pharaoh then 13 years as pharaoh, 27 years in total, hence the oddity of the reckoning).

Tutankhamun died the year Hittite king Šuppiluliuma I conquered the Mitannian kingdom of Carchemish. This victory took place 5 years before Šuppiluliuma I's death, who died during his 6th year of war. Muršili II, youngest son of Šuppiluliuma, succeeded his father after the brief reign of Arnuwanda II the eldest son. Šuppiluliuma learned of the death of Pharaoh during his 1st year of war[411] which lasted 6 years and that ended with his own death[412]. The presence of the brief reign of Arnuwanda II, whose duration is not specified, complicates this chronology, but luckily the account of Šuppiluliuma's deeds states that the king died with the plague, as well as his son Arnuwanda, transmitted by some Egyptian captives he had deported into Hittite country. This detail allows a dating because plague epidemics in Europe have shown that the average mortality rate was about 30% of the total population and 60 to 100% of the population was infected, thus the weakest were quickly killed and the plague in a given location therefore lasted on average 6-9 months. One can deduce from this epidemiological observation that Arnuwanda II could reign only 6 months (max) during the accession year of Muršili II. In his annals, the king mentions the death of his father and older brother during his accession, therefore all these events occurred during a single campaign between April and November in 1322 BCE[413].

Muršili II's reign can be dated precisely[414] because at the beginning of his 10th year there was "a solar omen[415]" (total eclipse on the Hittite capital Ḫattuša). During this period 1330-1310 BCE there was only one total solar eclipse on Hittite territory, that of 24 June 1312 BCE[416]. The eclipse of -1307* (1308 BCE) April 13, can not be accepted because it was an annular eclipse 95% of magnitude, which means that it was not noticed by a casual observer, because eclipses of a magnitude less than 98 % go unnoticed. In addition, the

411 J.B. PRITCHARD - Ancient Near Eastern Texts
Princeton 1969 Ed. Princeton University Press p. 319.
412 K.A. KITCHEN – Suppiluliuma and the Amarna Pharaohs
Liverpool 1962 Ed. Liverpool University Press pp. 3-5,22,23.
413 T. BRYCE – The Kingdom of the Hittites.
Oxford 2005 Ed. Oxford University Press pp. 154-220.
414 E. WENTE, C. VAN SICLEN - Studies in Honor of George R. Hughes
in: *Studies in Ancient Oriental Civilization* 39 (Chicago, 1976) p. 249.
415 I. SINGER – Hittite Prayers
Atlanta 2002 Ed. Society of Biblical Litterature pp. 75,77.
P.J. HUBER -The Solar Omen of Mursili II
in: *Journal of the American Oriental Society* 121 (2001) pp. 640-644.
416 http://eclipse.gsfc.nasa.gov/SEcat5/SE-1399--1300.html

trajectory of this eclipse did not pass on the Hittite territory. The eclipse of 1312, which occurred shortly after the beginning of the year, as the text of the omen suggests, is the only one to fulfill two key criteria: it was total (magnitude 102%) and its path passed near Hattuša, the Hittite capital. Given the year 10 of Mursili II is dated 1312, that means its accession has to be dated between April 1322 and March 1321. Thus Tutankhamun's death took place in 1327 BCE, 5 years before the brief reign of Arnuwanda II[417] and the accession of Mursili II dated 1322/1321. Trajectories of eclipses between 1320 and 1300 (below)[418], only the one of -1311 (1312 BCE) June 24 matches the two key criteria.



Tutankhamun's death in 1327 BCE can be deduced from the following (Egyptian, Mitannian and Hittite) synchronisms:

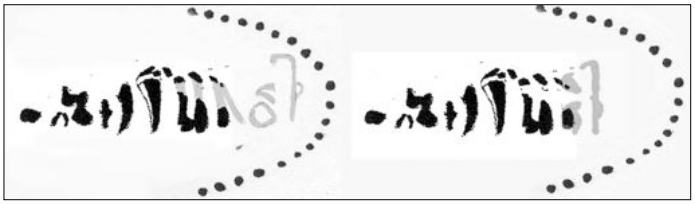
- Amenhotep III died in April 1345 BCE in the 38th year of his reign.
- Tušratta wrote 7 letters[419] to Amenhotep III (EA 17 to 26) then 3 letters to Amenhotep IV (EA 27 to 29). He relates in his first letter (EA 17) his accession to the throne after the murder of his brother Artašuwara, then the following year the attack of Hittite king [Šuppiluliuma] that he managed to repel. EA 23 letter (BM 29793) is dated IV Peret 1 Year 36 and 27 EA letter is dated I Peret [5] Year [1]2 of Amenhotep IV. Correspondence with Amenhotep III was intense because the EA 20 letter stated that the following letter will be sent 6 months later, involving a total period of 4 or 5 years between his first and last letter. Correspondence with Amenhotep IV was more relaxed since the last letter written to Amenhotep IV (EA 29) states "*my messengers for 4 years*", involving a period of at least 4 years between his first and last letter.
- Šuppiluliuma I congratulated Semenkhkare (*Ḫureya*) when he ascended Egypt's throne (EA 41), then mentions the murder of Tušratta in a letter to Semenkhkare (EA 43).
- Šuppiluliuma died in 1322, as well as his son Arnuwanda II, during the 6th and final year of the war. The deeds of Šuppiluliuma mention a period of 20 years between this Hurrian war of 6 years and the Syrian war of 1 year (KUB 19:9 I). The preparation of the Syrian war covered a period of 3 or 4 years after the first unsuccessful attack against Tušratta at the beginning of his reign (KBo I:1).

417 W.L. MORAN - Les lettres d'El Amarna
in: *LIPO* n°13 Paris 1987 Éd. Cerf pp. 55 note 137.
418 http://eclipse.gsfc.nasa.gov/SEatlas/SEatlas-2/SEatlas-1319.GIF
419 W.L. MORAN - Les lettres d'El Amarna
in: *LIPO* n°13 Paris 1987 Éd. Cerf pp. 48, 110-190.

Astronomical dating		EGYPT		MITANNI		HATTI
	BCE	**Amenhotep III**		**Šutarna II**		**Tuthaliya III**
	1357	**27**	*P. Berlin 9784*			
	1356	**28**	**Amenhotep IV**	**Artašumara**		
	1355	29	**2**			
	1354	30	3	**Tušratta**		
	1353	31	4	[1]		**Šuppiluliuma I**
first letters	**1352**	**32 (EA 254)**	5	[2]		**1st attack**
	1351	33	[6]	**EA 17,** *EA 18*	1	2
	1350	34	[7]	*EA 19, EA 20*	2	3
	1349	35	8	*EA 21, EA 22*	3	4
	1348	**36 (EA 75)**	9	**EA 23,** *EA 24*	**4**	**'1-year War'**
	1347	37 (EA 106)	[10]	*EA 25*	**5**	6/1
	1346	**38**	[11]	**EA 26**		2
	1345	**Akhenaten**	**12 (EA 116)**	**EA 27**	1	3
	1344	[2]	[13]		2	4
	1343	[3]	14	*EA 28*	3	5
	1342	[4]	[15]		**4**	6
3 March	**1341**	**5**	16	**EA 29**		7
3 March	**1340**	**6**	**17**			8
	1339	[-]	**Semenkhkare**	[15]		9 **(EA 41)**
14 May	**1338**	*8*	2	**(EA 43)**		10
	1337		**-Ankhkheperure**			11
last letters	**1336**	*Akhetaten abandoned*	**Tutankhamun**	**(EA 9)**	24	12
	1335		2		25	13
	1334		3		26	14
	1333		3	**(Burna-Buriaš II)**	**27**	15
	1332		5	**(Kurigalzu II)**	1	16
	1331		6		2	17
	1330		7			18
	1329		8			19
	1328		9	CARCHEMISH		20
	1327		**10**		0	**'6-year War'**
	1326		**Ay**	**Šarri-Kušuh**	1	2
	1325		2		2	3
	1324		3		3	4
	1323		4		4	5
	1322		**Horemheb**		5	**Arnuwanda II**
	1321		2		6	**Muršili II**
	1320		3		7	2
	1319		4		8	3
	1318		5		9	4
	1317		6		10	5
	1316		7		11	6
	1315		8		12	7
	1314		9		13	8
	1313		10		14	9
24 June	**1312**		11		15	10
	1311		12		16	11
	1310		13	**Šahurunuwa**	1	12
	1309	**Mutnodjmet** died	14		2	13
	1308		1/[15]		3	14
	1307		2/[16]		4	15
	1306		3/[17]		5	16
	1305		4/[18]		6	17

The reconstruction of the succession of reigns is possible only through the use of a precise chronology, for the same reason, the succession of the numerous events, that occurred during the co-regency of Amenhotep IV with his father Amenhotep III, may only be reconstructed from this chronology. Šuppiluliuma's 1-year war (April 1347 BCE) against the powerful kingdom of Mitanni ruled by Tušratta (1354-1339), an ally of Egypt, to the end of the reign of Amenhotep III, triggered a profound destabilization of the entire Middle East, especially in Canaan. Thus Abdi-Aširta (1370-1347) the king of Amurru, a former ally of Egypt, took advantage of the disorder to conquer several small kingdoms in the north of Canaan which were vassals of Egypt. Similarly, Labayu, the powerful mayor of Shechem, conducted a series of raids against the other Canaanite mayors in his region. It is worth noting that Barak, an Israelite judge, took this opportunity to get rid of the authority exerted by Jabin II (1366-1346), the great king of Hazor, through Sisera (1370-1345) an army chief Phoenician ruler (Jg 4:1-25) of Ušnatu[420].

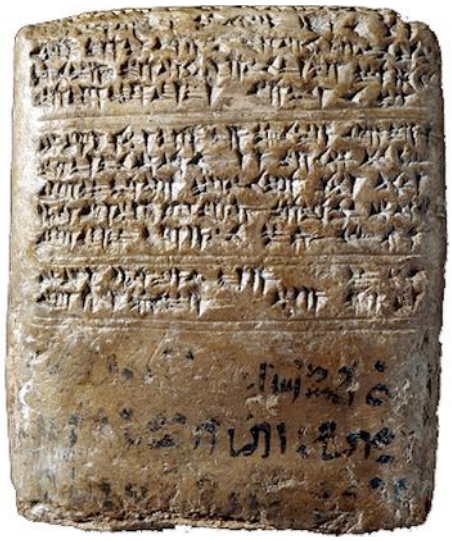
The letter EA 17 written just after the attack by Suppiluliuma (1353-1322), which was repelled by Tušratta (1354-1339), must be dated 1351, which means dating the letter EA 23 in 1348, a year which exactly coincides with year 36 of Amenhotep III. Another synchronism again confirms this date[421]. The correspondence from the mayor of Byblos attests that Tušratta and the Hurrians led a vigorous counterattack during the months that followed the Hittite raid (mentioned in EA 75), before their entering into Amurru and their advance towards Byblos (EA 85:51-55). Amurru was plundered (EA 86:8-12) and despite Abdi-Aširta was sick (EA 95:41-42) he negotiated with Tušratta (EA 90:19-20). The latter recognized that Amurru, too large for him, was a "possession" of Pharaoh (EA 95:27-31). The information with numbers (as 1, 2 or 3 years) allow us to date these events in the year 35 and 36 of Amenhotep III (1349-1348), which coincided with the marriage between him and Taduhepa, Tušratta's daughter (EA 22-23-24). The letter EA 27 must be dated in 1345 and corresponds therefore to Year 12 of Amenhotep IV since the latter died in 1340 in his 17th year of reign (Year 6 of Akhenaten = year 17 of Amenhotep IV). The contents of this letter supports this conclusion. Indeed, the demand for Tušratta may be explained only if Amenhotep III, Amenhotep IV's father, had died recently (a few months at most)[422], in addition, the preparation of a wide celebration *kimru*, with sending of gifts, corresponds to foreign tributes that were received on year 12 the IV Peret 8. Letter EA 27 has a hieratic inscription: *[year 1]2 I Peret [5 ..]* (shaded areas are reconstructions):



[year 1]**2 I Peret** [5 [year]**2 I Peret** [5

The reading "year 2" would imply a co-regency of only 1 year because 2 years, not 1, follow year 38 of Amenhotep III. Furthermore the reading "year 12" is better than "year 2" for the following reason: the sign that appears before the "2" is a remnant of the sign "10" and not the sign "year" because among the 99 hieratic inscriptions found at El-Amarna only two (No. 27, 37) may correspond to the reconstitution "year 2". This exceptional and

420 G. GERTOUX – Moses and the Exodus: Chronological, Historical and Archaeological Evidence Raleigh 2015, Ed. Lulu.com, pp. 152-166.
421 J. FREU – La chronologie du règne de Suppiluliuma in: Silva Anatolica. Anatolian Studies Presented to Maciej Popko (Warsaw 2002) pp. 87-107.
422 W.L. MORAN - Les lettres d'El Amarna in: *LIPO* n°13 Paris 1987 Éd. Cerf pp. 53,171-176.



therefore abnormal reading, used for a reconstitution that would be also abnormal, eliminates this choice. In addition, the Egyptian scribe who wrote the letters EA 23 and EA 27[423] wrote "year 36" with the usual hieroglyph **ô**, not • (EA 23, opposite figure right bottom). Anyway as the letter EA 27 is dated 1345 this year matches exactly the year 12 of Amenhotep IV. The set of previous synchronisms implies dating Amenhotep IV's death in 1340 and Semenkhkare's death around 1338. Akhenaten died after 6 years of reign (1340 BCE), or 17 years from his co-regency, and as he had no son his brother Semenkhare succeeded him (as had happened before with Kamose, Seqenenre Taa's brother, who succeeded him after his death and the death of Crown Prince Ahmose Sapaïr). Semenkhkare died around 1338 BCE after a reign of 1 year and 4 months. His widow Meritaten then reigned 2 years and 1 month on behalf of her husband (as Hatshepsut had done after her husband's death), first under the feminine name Ankh[et]kheperure then under Ankhkheperure the same name but in the masculine The precision transmitted by Josephus "Akencheris, daughter of Orus [Akhenaten], reigned [1]2 years and 1 month" proves accurate because Semenkhkare appears married to Meritaten, a daughter of Akhenaten, on an anonymous stela (Aegyptisches Berlin museum 15000). As he also appears on another stela under an effeminate shape accompanied by Akhenaten, this has led some to believe a possible co-regency. Similarly, Akhenaten and Nefertiti are sometimes depicted on stelae as two partner kings (Berlin 17813, Cairo JE 59294). This imbroglio could explain the difficulty that Manetho encountered, or a precursor thereof, to extract a precise duration of these reigns. In fact, Ankhkheperure died around 1336 BCE, after 2 years and 1 month of reign, and having no heir the last son of Amenhotep III, the young Tutankhamun aged 10, became a new pharaoh. The reconstruction of the interregnum between Akhenaten and Tutankhamun is controversial because of the many changes in titulatures (not to mention usurpations). The simplest explanation is to admit that since Akhenaten had no son, Semenkhkare his brother had to succeed him for a short reign of about 1 year and 4 months. On Semenkhkare's death, Meritaten[424] his widow continued the reign of her husband (for 2 years 1 month) under the name Ankhkheperure, a female name which was then masculinized[425] (similar case with queen Tausert, wife of Seti II who continued the reign of Siptah after his death, likewise Hatshepsut, wife of Thutmose II, who continued the reign of her deceased husband on behalf of his nephew Thutmose III).

The hectic succession of Akhenaten's reign has generated many extravagant scenari by most Egyptologists. In fact, the plague which was becoming endemic in this part of Egypt could explain why the mortality was so high during that period of time (1344-1337). The plague was probably brought into the city of Akhetaten by a foreign delegation during the receiving tribute in the year 12 of Amenhotep IV (1345 BCE), or year 1 of Akhenaten. In the letter (EA 10) from Burna-Buriaš II sent to Napḫurareya (Akhenaten), we learn that

[423] L. WATERMAN – Royal Correspondence of the Assyrian Empire Vol. 4
Ann Arbor 1936 Ed. University of Michigan Press plate 4 n°11.
[424] C. ALDRED – Akhenaton roi d'Égypte
Paris 1988 Éd. Seuil, pp. 160-161, 284-296.
[425] J.-L. BOVOT – La tombe KV 55 un imbroglio archéologique
in: Akhénaton et l'époque amarnienne, Éd. Khéops et centre d'égyptologie (2005) pp. 183-224.
M. GABOLDE – Pour qui fut confectionné le mobilier funéraire de Toutânkhamon
in: Akhénaton et l'époque amarnienne, Éd. Khéops et centre d'égyptologie (2005) pp. 273-286.

the plague had affected the royal house and the death of a royal wife (Nefertiti) had just been mourned (1341/1340). Burna-Buriaš II had just heard about Mayati (Meritaten) and so sent her a greeting gift of a necklace containing 1048 lapis lazuli gems. Greeting gifts are usually sent to the king, his wife or mother, so here Burna-Buriaš had presumably learnt that Meritaten had become the royal spouse of Akhenaten (presumably after the death of Nefertiti to whom Burna-Buriaš never sent greeting gifts —at least in the preserved letters). But it appears Meritaten did not acknowledge nor make an enquiry about Burna-Buriaš' health. So in his next letter (EA 11) he sent only 20 gems to the "mistress of the house" as Meritaten had shown no concern for him[426]. Given that Akhenaten died (September 1340) soon after his wife and because he had had no son, consequently no heir, Semenkhkare his brother succeeded him for a short reign. Likely because of the plague Semenkhkare died soon after his brother. On Semenkhkare's death (February 1338), Meritaten his widow continued the reign of her husband under the name Ankhkheperure.

The total solar eclipse of 14 May 1338 BCE upon the city of Akhenaten (named Akhetaten), cited in allusion on the Amun's priest graffito[427] dated III Akhet 10, Year 3 of Ankhkheperure[428] (1st October 1338 BCE), and which was understood as a terrible omen against the Pharaoh (understood as "Aten" is going to die), could explain easily the strange behaviour of the queen to get a king on the throne of Egypt. The deeds of Šuppiluliuma (28 III:11-15) tell that after Akhenaten's death the scared widow of Semenkhkare (written *[Nip]Ḫururiya* in cuneiform) asked a son to Šuppiluliuma for becoming a "Sun" in Egypt (likely in order to get an heir). However this unprecedented marriage never took place because the Hitite prince Zannanza (third son of Šuppiluliuma) was assassinated when he came into Egypt. Thus Ankhkheperure remained a widow as indicated by a jar inscription dated Year 3 of her reign[429]: *Jar 17½ hin (8 liters). Year III, wine for the house of the solitary king of West River. Head of winemakers, Pencha.* The total solar eclipse was interpreted by Egyptian priests as a curse against Aten. For example, we read in the graffito dated 10/III/3 of Ankhkheperure: *Make worship to Amun, sniff the earth for Unnefer (Osiris) the part of scribes of the divine offerings of Amun.* Thus Aten is no longer mentioned and was replaced by Amun. The seemingly incomprehensible choice of Ankhkheperure who wanted to choose a husband who was not Egyptian is likely due to her fear of seeing him die if he would have been a son of Aten (the Sun). This incongruous choice had to be disapproved by the high priest of Amun, who asked General Ay (later became Pharaoh) to murder Zannanza discreetly, in order to favour a normal succession with Tuthankamun (third and last son of Amenhotep III). It may be noted that the queen died shortly after the solar eclipse (she was either murdered or she died of the plague). The transition between Ankhkheperure and Tutankhamun was therefore performed in a dramatic context.

Ankhkheperure's reign can be assessed thanks to the 50 shards inscribed in hieratic found in Amarna and dated year 2 as well as 13 shards dated to year 3. As Akhenaten inaugurated the city of Akhetaten (Amarna) in year 5 of his reign, all jar bearing a regnal year lower than 5 belongs to his successor Ankhkheperure[430]. Assuming dated inscriptions were produced at a constant rate of about 4 per month (= 50/12), Year 3 lasted about 1

426 Moran, following Na'aman, makes the comment: *By sending the gift (and a small one) to Mayatu under her title it is perhaps suggested that the demands of propriety rather than those of friendship are being met* (W.L. MORAN – The Amarna Letters, Baltimore 1992, Ed. The John Hopkins University Press, pp. 19-23).

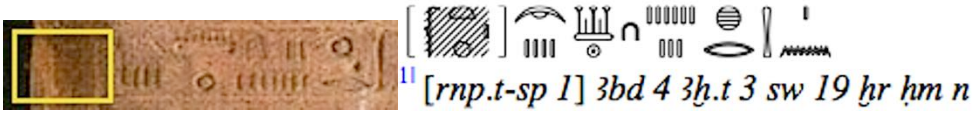
427 « As you [Amun-Re] made me see the darkness which are yours to give, make it for me light so I can see you ».

428 W.J. MURNANE – Texts from the Amarna Period
Atlanta 1995 Ed. Society of Biblical Literature pp. 207-208.

429 M. GABOLDE - Toutankhamon
Paris 2015, Ed. Pygmalion, pp. 77-86.

430 M. GABOLDE - Toutankhamon
Paris 2015, Ed. Pygmalion, pp. 81,552.

month (= 13/12). This reign's duration, going from October 1340 to Novenber 1338, is identical to that given by Manetho (2 years 1 month) and ends in the Egyptian month IV in 1338, which is the accession month of Tutankhamun appearing in the Restoration Stela (CGC 34183): *[Year 1], IV Akhet, day 19, under his majesty of Horus Strong Bull Beautiful of Births, the Two Ladies Effective of Laws who Pacifies the Two Lands, Golden Horus Young of Appearance Satisfying the Gods, king of Upper and Lower Egypt Nebkheperure, Son of Re Tutankhamen, ruler of Heliopolis of the South, who is given life for all eternity like Re, beloved of Amen-Re, Lord of the Thrones of the Two Lands from Ipet-esut, beloved of Atem. Lord of the Two Lands, the Heliopolitan, of Re-Harakhte, of Ptah south of his Wall, Lord of the life of the Two Lands, of Thoth, lord of the words of the gods, who appeared on the Horus throne of the living daily like his father Re. The Good God, son of Amen, child of the Bull of his mother; useful seed; holy egg created by Amen himself; father of the Two Lands, creator of the one who created him and former of him who had formed him. The bas of Heliopolis were assembled in order to form him to make a king for eternity, Horus existing forever.* The spatial reconstruction of the beginning of the stela (below) confirms the Year 1 of Tutankhamun.



The date mentioned at the beginning of the Restoration Stela (19/IV/**1**) is that of the accession of Tutankhamun because it is the same month of Ankhkheperure's death. Given that the text of the stela mentions that the enthronement took place in the *perfect palace (in Memphis) located in the area of Aakheperkare (Thutmose I)*, which was usually used for the enthronement of kings, it describes an accession. In addition, the text of the stela develops a long program of government which was generally announced on the day of accession. However this text has apparently three serious anomalies: Tutankhamun has changed his birth name into Toutakhaten in the first three years of his reign, not at his accession to the throne[431]. According to astronomical dates, Tutankhamun's reign begins at the end of 1337 and not at the end of 1338. If the accession of Tutankhamun took place immediately after Ankhkhaperure's death it should have had to occur in Akhetaten, not in Memphis. The only way to solve these anomalies is to assume that immediately after the death of Ankhkheperure there was Tutankhaten's accession in Akhetaten (Amarna) on 19/IV/1 and exactly one year later took place the enthronement of Tutankhamun which opened a new era and closed the catastrophic parenthesis dedicated to Aten[432] (plague and solar eclipse). The last wine jars are dated: *Year 1, Master of vintage*[433] (The city of Akhenaten III, no 35,55-57). All these absolute dates (highlighted in blue) allow the following reconstitution:

King	Reign duration	Reign	Complete reign	Total
Amenhotep III	37 years 10 months	10/1383-07/1345	10/1383-07/1345	37 years 10 months
Amenhotep IV	11 years 5 months	03/1356-07/1345	03/1356 -	
Akhenaten	5 years 2 months	08/1345-10/1340	-10/1340	16 years 7 months
Semenkhkare	1 year 4 months	10/1340-02/1338	10/1340 -	
-**Ankhkheperure**	7 month	02/1338-11/1338	-11/1338	2 years 1 month
Tutankhaten	1 year	11/1338-11/1337	-	[1 year]
Tutankhamun	10 years 2 months	11/1337-10/1327	11/1337-10/1327	10 years 2 months
Aÿ	4 years 1 month	10/1327-11/1323	10/1327-11/1323	4 years 1 month
Horemheb I	14 years	11/1323-11/1309	11/1323 -	
Horemheb II	13 years 2 months	12/1309-01/1295	-01/1295	27 years 2 months
Ramses I	1 year 4 months	01/1295-05/1294	01/1295-05/1294	1 year 4 months

[431] M. GABOLDE - Toutankhamon
Paris 2015, Ed. Pygmalion, pp. 115-119, 124-133.
[432] Tutankh-Amen is viewed as the genuine successor of Amen-hotep III.
[433] C. VANDERSLEYEN - L'Egypte et la vallée du Nil Tome 2
Paris 1995 Éd. Presses Universitaires de France pp. 469-472.

1347	1	*VI*	**36**		**Amenhotep III**
	2	*VII*			**Amenhotep IV**
	3	*VIII*	***	[10]	Letter EA 23 from Tušratta to Amenhotep III (Nimmureya) dated 1/VIII/**36**
	4	*IX*			
	5	*X*			
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			
	10	*III*	**37**		Jar-label dated **Sed** festival year **37** see JNES 10:1 (1951) p. 36
	11	*IV*			
	12	*V*			
1346	1	*VI*			
	2	*VII*			
	3	*VIII*		[11]	
	4	*IX*			
	5	*X*			
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			
	10	*III*	**38**		
	11	*IV*			
	12	*V*			
1345	1	*VI*			
	2	*VII*			
	3	*VIII*		**12**	
	4	*IX*			
	5	*X*			
	6	*XI*			Labels from Molkata ending on 1/XI/**38**
	7	*XII*			Death of Amenhotep III
	8	*I*	[1]		**Akhenaten [Amenhotep IV]**
	9	*II*			Transfer into Akhetaten
	10	*III*			
	11	*IV*			
	12	*V*		***	Letter EA 27 from Tušratta to Amenhotep IV (Napḫurreya) dated [5]/V/**12**
1344	1	*VI*			Tribute scenes in the tomb of Meryre and Huya dated 8/VI/**12**
	2	*VII*			Reception of foreign tributes on 8/VIII/**12**
	3	*VIII*	[2]	**[13]**	(Beginning of the year on 13/VIII)
	4	*IX*			
	5	*X*			
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			
	10	*III*			
	11	*IV*			
	12	*V*			
1343	1	*VI*			
	2	*VII*			
	3	*VIII*	[3]	**14**	
	4	*IX*			
	5	*X*			
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			
	10	*III*			
	11	*IV*			
	12	*V*			
1342	1	*VI*			Graffito at Saqqara dated 2?/VI/**14**
	2	*VII*			
	3	*VIII*	[4]	**15**	
	4	*IX*			
	5	*X*			
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			Jar-label dated [II]/**15** see JNES 10:2 (1951) p. 99
	10	*III*			
	11	*IV*			
	12	*V*			

1341	1	*VI*			
	2	*VII*			
	3	*VIII*	**5**	**16**	Sunrise at azimuth 103° dated 13/VIII/**5** (3 March 1341 BCE) Temple's inauguration, stela of year 5 in Akhetaten
	4	*IX*			
	5	*X*			
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			
	10	*III*			Hieratic text dated 15/III/**16** of Amenhotep IV stating: "*Great King's Wife, his beloved, mistress of the two lands, Neferneferuaten Nefertiti*"
	11	*IV*			Letter EA 10 from Burna-Buriaš II sent to Akhenaten (Napḫurureya)
	12	*V*			regarding Neferti's death and the new "Mistress of the House" Meritaten.
1340	1	*VI*			
	2	*VII*			
	3	*VIII*	**6**	**17**	Sunrise at azimuth 103° dated 13/VIII/**6** (3 March 1340 BCE) stela of year 6 in Akhetaten
	4	*IX*			
	5	*X*			
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			Last label of wine jar dated II/**17**. Death of Akhenaten
	10	*III*		**1**	**Semenkhkare** (reigned 1 year 4 months)
	11	*IV*			Wine jar date Year **1**, *Master of flooding* (*The city of Akhenaten III, no 279*)
	12	*V*			
1339	1	*VI*			
	2	*VII*			
	3	*VIII*	**[7]**		(no stela Year 7 of Akhenaten) letter EA 41 from Suppiluliuma I to
	4	*IX*			Semenkhkare (Ḫuriya) congratulating him to be king
	5	*X*			
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			Letter EA 43 from Suppiluliuma I to Semenkhkare who mentions the
	10	*III*		**2**	murder of Tušratta
	11	*IV*			
	12	*V*			
1338	1	*VI*			Death of Semenkhkare, his wife continues his reign
	2	*VII*			**[Semenkhkare] Ankhkeperure** (reigned 2 years 1 month)
	3	*VIII*	**8**		Posthumous stela of the year 8 of Akhenaten in Akhetaten city
	4	*IX*			
	5	*X*		***	Total solar eclipse upon Akhetaten on May 14, 1338 BCE
	6	*XI*			Ankhkeperure writes to Suppiluliuma I asking him one of his son as husband
	7	*XII*			(*Deeds of Suppiluliuma* frag. 28 III:11-15). Zannanza, 3[ra] son of Suppiluliuma, is
	8	*I*			murdered during his coming into Egypt.
	9	*II*			
	10	*III*		**3**	Graffito dated 10/III/**3** of Ankhkeperure mentioning a solar eclipse
	11	*IV*		**1**	**Tutankhaten** accession in Akhetaten (Amarna) on 19/IV/**1**
	12	*V*			Wine jar dated Year **1**, *Master of vintage* (*The city of Akhenaten III, no 35,55-57*)
1337	1	*VI*			
	2	*VII*			
	3	*VIII*			
	4	*IX*			Letter EA 9 from Burna-Buriaš II to Tutankhaten (Nibḫurrereya)
	5	*X*			congratulating him to be king
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			The city of Akhenaten is abandoned
	10	*III*			
	11	*IV*		**1**	**Tutankhamun** accession in Memphis on 19/IV/**1**
	12	*V*			Restoration Stela (CGC 34183)
1336	1	*VI*			
	2	*VII*			
	3	*VIII*			
	4	*IX*			
	5	*X*			
	6	*XI*			
	7	*XII*			
	8	*I*			
	9	*II*			
	10	*III*			
	11	*IV*		**2**	
	12	*V*			

Those who refuse to use chronology as well as synchronisms and reject all inscriptions that antagonize their speculations can not succeed even to assess the length of a reign (the case of Horemheb's reign is a good example[434]). The reigns of the Amarna period are therefore accurately dated. This scientific dating was obtained using first the reigns of Amenhotep III (1383-1345) and Burna-Buriaš II (1360-1333), which are anchored on astronomical dates. Then the many synchronisms of the Amarna period allow us to date the reigns of Šuppiluliuma I (1353-1322), Tušratta (1354-1339) and Amenhotep IV (1356-1340), knowing that the 1st year of the Hurrian 6-year war goes back in 1327, year of Tutankhamun's death. The Syrian 1-year war against Amurru is dated 1348 and Šuppiluliuma's attack against Tušratta in 1352. Tušratta likely to have begun to reign one year before the attack and died[435] during the brief reign of Semenkhkare (1340-1339). The succession of reigns between Amenhotep III and Tutankhamun, based on the synchronism and astronomical dates, can be reconstructed as follows[436]: in the year 27 of his reign, Amenhotep III established his son Amenhotep IV as co-regent (as already done before Thutmose III with his son Amenhotep II). Amenhotep III died after 38 years of reign, thus Amenhotep IV began a new reign under the name Akhenaten (1345-1340) in his new city of Akhetaten (Amarna). Horemheb also began a new reign after the death of Queen Mutnodjmet in the year 14 of his reign (1309 BCE).

If Tutankhamun was about 9 years old (as indicated by the size of his throne and his crown) on 8 November 1337, the day of his enthronement (19/IV/**1**), he was born in 1345 in the final year of reign of Amenhotep III. So Tutankhamun was the rightful son of Amenhotep III, as indicate several dedications inscribed on monuments for his father (like the Soleb lion), similarly on an astronomical instrument (OI 12144) which was dedicated by Tutankhamun to Thutmose IV his grandfather[437] (*it itw*). It should finally be noted that a lock of hair of Queen Tiye (a symbol of filiation) had been placed in Tutankhamun's tomb[438]. Consequently, Amenhotep IV (Akhenaten) but also Smenkhkare and Tutankhaten (Tutankhamun) were the sons of Amenhotep III (and Queen Tiye). Unlike the extravagant speculations whose Egyptologists are fond, there is no need to seek a mysterious princess (the "Young Lady") who would have slept with Akhenaten to give birth to a hidden son, Tutankhamun, protected by the clergy of Amun priests, which would have prepared in secret to replace a heretic pharaoh, inventor of monotheism, by a pharaoh who would be again a defender of Egyptian cults. The truth, based on chronology as well as documents, is much more banal: When Amenhotep IV was installed in his new city (Akhetaten) after the death of his father (Amenhotep III) he was the victim of plague that caused the death of his wife (Nefertiti), his, that of his brother Semenkhkare as well as that of his wife (Ankhkeperure). The total solar eclipse (dated 14 May 1338) during the brief reign of Ankhkeperure, a widowed queen, was perceived by the priests of Amun as a curse on the town ruled by Aten. Amenhotep IV who was a mystic pharaoh, he greatly promoted the idolatry of the god Aten, but not monotheism which was unknown of Egyptians (in addition, the worship of other gods had continued in the rest of Egypt), was considered retrospectively as having angered the other gods by his favouritism. On the death of

434 L.D. BELL – New Evidence on the Length of the Reign of Horemheb
in: *Journal of the American Research Center in Egypt* 44 (2008), pp. 193-200.
435 J. FREU, M. MAZOYER – Les débuts du nouvel empire hittite. Les Hittites et leur histoire
Paris 2007 Éd. L'Harmattan p. 271.
436 M. GABOLDE - Les portraits d'une reine pharaon
in: Akhénaton et l'époque amarnienne, Éd. Khéops et centre d'égyptologie (2005) pp. 261-286.
437 E.F. WENTE, J.E. HARRIS – Royal Mummies of the Eighteenth Dynasty
in: After Tut'ankhamūn, Ed. Routledge (London, 1992), pp. 13-15.
438 L.D. BELL – La parenté de Toutankhamon
in: *Les dossiers Histoire et Archéologie* n°101 (1986), pp. 47-49.

Ankhkeperure the priests of Amun decided to abandon the city of Akhetaten (September 1337) and return to old values by the cult of Amun in renaming Tutankh-Aten, the last son of Amen-hotep III, into Tutankh-Amen. Noteworthy when he became pharaoh, General Ay built a temple for Toutankhamen[439] he considered as "his son" likely because he had preserved him his right to the throne when he murdered Zannanza who had been promoted as Pharaoh by Ankhkeperure.

[439] M. GABOLDE - Toutankhamon
Paris 2015, Ed. Pygmalion, pp. 89-92, 409-432.

Regarding my skills as astronomer member of the International Association for Assyriologists (from September 2013):

Dr. Hermann Hunger
Professor of Assyriology (retired)
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1090 Wien
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7. Mai 2015

To whom it may concern:

I have read the manuscript „Basic astronomy for historians to get a chronology" of Gerard Gertoux and found it a well-informed and informative introduction to this complicated subject. It clearly explains what is required from a historian who wants to establish the chronology of historical events.

The author shows by examples how different chronologies can be evaluated or refuted. He also explains the astronomical phenomena that can be used for dating events, and the pitfalls in using ancient calendars. For some cases, he offers new conclusions or refutes chronologies proposed by other scholars.

The manuscript forces the reader to be very attentive, but this attention is well worth it.

Hermann Hunger

As editor, Hermann Hunger wrote[440] in the preface of Mesopotamian Chronology of the 2nd Millennium B.C. (2009): *It was therefore natural to include a study on Mesopotamian chronology within SCIEM 2000, and Regine Pruzsinszky was entrusted with it. From her investigations it became clear that a solution for Mesopotamian chronology could not yet be achieved.*

I would like to thank my friend Norman Cleworth for his corrections.

[440] R. PRUZSINSKY – Mesopotamian Chronology of the 2nd Millennium B.C. Wien 2009 Ed. Österreichischen Akademie der Wissenschaften p. 13.