A study of late Babylonian planetary records

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Abstract

Observations of planets within the Late Babylonian Astronomical Texts record passages of the planets by reference stars, and synodic phenomena such as first visibilities, stations, etc. known "Greek-Letter phenomena". In addition to acting as useful shorthand, use of the Greek-Letter designations for these phenomena allows us to avoid the problem of the exact interpretation of these phenomena. For example, Huber has argued that Ω should probably be understood as the first date on which a planet was not seen, rather than the last day on which it was seen. These observations sometimes have a remark about the 'ideal' date when the phenomena was supposed to occur. This often appears with a measurement of the time from sunrise/set to the observed phenomena.

The aim of this thesis is to study two aspects of Babylonian observational astronomy. One is the interpretation of Θ, one of the 'Greek letter' phenomenon, and proving through analysis of the texts that its precise meaning should be understood as acronycal rising as opposed to opposition. The other is to go some way towards finding the system for correcting an observation when a time measurement of the difference in the time between the planet and the sun rising or setting is recorded along with an 'ideal' or 'true' date.

DECLARATION

This study was undertaken between October 2001 and September 2002 under the supervision of Dr J Steele. No part of this work has previously been submitted for a degree in this or any other university. Part of the material presented in this thesis will be published in the following paper:

Louise Hollywood and J.M. Steele, "Acronycal risings in Babylonian Astronomy" (forthcoming).

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List of Abbreviations

A	Almanac from LBAT.
AaB	Astronomisches aus Babylon. Epping, J, 1889, (Freiberg im Breisgau:Herder'sche).
ACT	Astronomical Cuneiform Texts. Neuegbauer, O., 1955, (London: Lund Humphries).
ADT	Astronomical Diaries and Related Texts from Babylonia. Edited by Abraham Sachs and Hermann Hunger, 1988-2001, (Österrieichischen Akademie:Wien).
ASM	Astral Sciences in Mesopotamia. Hunger, Hermann., and Pingree, David., 1999, (Brill:Leiden).
D V1	Astronomical diary from ADT, volume 1.
G	Goal year text from LBAT.
LBAT	Late Babylonian Astronomical and Related Texts. A.J. Sachs, 1955, (Brown University:Rhode Island)
NMAT	Non mathematical astronomical texts.
P	Planetary text from ADT volume 5.
NSA	Normal star almanac from LBAT.
SE	Seleucid Era.
SSB	Sternkunde und Sterndienst in Babel. Kugler, Franz Xaver, 1907-1935, (Münster: Aschendorffsche).

INTRODUCTION

Mesopotamia is a land that has yet to reveal all its secrets to the modern world. It was left untouched for a thousand years, hidden by dust and sand. Its story regained interest in 1625 after an Italian nobleman, named Pietro della Valle, returned from travelling with an entertaining story of his journey across Mesopotamia. He brought with him bricks from Ur covered with writing, much to the delight of the libraries of Europe. So began a new enthusiasm for the forgotten history of Iraq.

In 1761 the first scientific mission was sent by the King of Denmark to Persopolis and more inscriptions were brought back for study. Many others ensued and soon the treasures of Babylon and Assyria were in the museums of nations around the world[1]. However until 1843 only the visible ruins of Mesopotamia had been examined, the dusty mounds seen so often throughout the landscape were ignored, until the French consul Paul Emille Botta started excavations of these tells.

Expeditions from abroad and Baghdad itself, were soon excavating and examining both ruins and tells, and many more tablets were found and sent back to the libraries in the hope that the symbols on them could be deciphered and the history of the culture more fully understood. By 1848 the Akkadian language was understood, and more thorough translations were now possible.

The tablets are most commonly hand sized and rectangular[2]. They are made of clay that has had the stylised cuneiform inscribed on it and been left in the sun to dry. There are estimated to be around 150,000 tablets in the British Museum, of which at least 3000 are astronomical, and this is only a small fraction of what would have been written.

Between 1895 and 1900 Pinches drew copies of many tablets, which included many astronomical ones, whilst working at the British Museum. Previously, (1880-1952) only drawings by J.N.Strassmaier, made prior to 1893[3], were available and these were only preliminary sketches to be used for identification, classification and later study. This new source of copies also had the advantage that Pinches had often been able to piece together many fragments of the same tablet.

Much work has been done to interpret, translate and decipher the astronomical tablets over the years. The aim of this thesis is to study two aspects of Babylonian observational astronomy. One aspect is the interpretation of Θ, which is one of the 'Greek letter[4]' phenomena observed and predicted by the Babylonians, and proving through analysis of the texts that it should be understood as acronycal rising as opposed to opposition. The other is to go some way towards finding the system for correcting an observation when a time measurement of the difference in rising or setting time compared to the sun is recorded along with an 'ideal' or 'true' date.

[1] See Roux (1992), ch2, for a more detailed discussion.
[2] Oates, (1986), 15.
[3] LBAT, vi.
[4] Greek letter phenomena defined by Neugebauer in ACT. See page 10 below.

CUNEIFORM ASTRONOMICAL TEXTS

The cuneiform astronomical tablets fall into two main categories, mathematical astronomical texts, which are theoretical, and non-mathematical astronomical texts, which contain observations and predictions.

The original classification of texts was made in an article by Sachs (1948) where he studied the 37 texts known at that time. Despite much more new material becoming available these classifications remain valid. The different types of NMAT are astronomical diaries, normal star almanacs, almanacs, goal year texts and planetary texts.

The astronomical phenomena in the diaries are mostly observations; exceptions are entries regarding solstices, equinoxes, and Sirius data, all of which were computed. Observations recorded in the diaries were of lunar six, planetary phases and conjunctions of the planets and moon with the normal stars. Some planetary and lunar data is predicted when the observation could not be made; when this occurs a remark such as "I did not watch" is added. The diaries also contain summaries at the end of each month stating where the planets had travelled with respect to the zodiac. All the dated astronomical diaries are published in ADT.

The almanacs contain lunar three, the planetary phases, positions of the planets at the beginning of each month and subsequent entries into zodiacal signs, the sun and Sirius. The normal star almanacs contain lunar six or lunar three, the planet's phases, Sirius phenomena, solstices and equinoxes, and conjunctions of the planets with normal stars. They both contain the predictions that would be obtained from using the goal year texts. Copies of many almanacs and normal star almanacs are published in LBAT, SSB, and AaB. A handful of English translations have been published by Sachs (1976), Sachs and Walker (1984), and Hunger (1999).

The goal year texts are collected data of phases and conjunctions of the planets with normal stars, lunar six and eclipses. The data is observations for the required year less one characteristic period[5] (see table 1), which could then be used with an appropriate correction to make the almanacs an normal star almanac.

Table 1.	Characteristic period, years
Mars	47 years for conjunctions with Normal Stars
	79 years for Greek-Letter Phenomena
Jupiter	71 years for Greek-Letter Phenomena
	83 years for conjunctions with Normal Stars
Saturn	59 years
Mercury	46 years
Venus	8 years

The planetary texts simply contain observations regarding a specific planet, often arranged in periods appropriate to the planet, i.e. the length of one synodic period. If an observation could not be made due to bad weather, a computed value was entered followed the remark "I did not see it" or "I did not watch"[6]. All known planetary texts have recently been published in ADT V. 5.

It is possible that all the data in the goal year texts and planetary texts was taken directly from the diaries. For the almanacs and normal star almanacs it would have been the data taken from the goal year texts that was then modified and documented. This would have been a lengthy

[5] Synodic period is the interval between successive similar alignments of a celestial body with the sun, e.g. between oppositions.
[6] E.g. ADT V2, 249.

process, as many diaries would have had to be read and sifted through to get the relevant entries to make the new tablet[7].

Knowledge of the general format of the texts is often useful in completing a sentence which is partially broken away. For example in goal year text number LBAT 1220 the month for the entry has broken away. The next entry is for month IV, which could suggest it was month III but using this date to compute the phenomenon generates an incorrect answer, using month II gives the correct answer. This dating is most likely correct as the format of the goal year texts would only have recorded data of interest and not necessarily something for every month.

Mathematical astronomical texts include procedure texts, ephemerides and auxiliary tables. Most known texts are published in ACT. Procedure texts explain the theoretical systems. They do not explain the physical theory behind the schemes but instead explain the numerous mathematical rules for computing the ephemerides step by step.

Auxiliary tables contain the various numerical functions arranged in separate columns which are needed to calculate the ephemerides. The ephemerides are tables of data giving the position of the heavenly bodies at specific moments. For the moon, these are conjunctions and oppositions which occur each month. For the planets they are runs of greek letter phenomenon. They can be used not only to find the position of a body at regular intervals but ultimately to use the available data to predict its motion.

Predictions in Babylonian astronomy were not always of observable events; instead they were meant to be read as possibilities. For example numerous eclipse possibilities were not observed but the scheme for predicting them continued to be used.[8]

LUNAR PHENOMENA

There are two groups of lunar data observed: lunar three and lunar six. Table 2[9] describes lunar six, and lunar three[10] is a similar group being the length of the previous month, the date in the middle of the month when the moon set for the first time after sunrise and the date when the moon was visible for the last time before sunrise.

Table 2. Lunar six.

Name	Meaning
NA	Day when the moon is visible for the first time after conjunction, time between time sunset → moonset.
ŠÚ	Day when the moon sets for the last time before sunset, time between time moonset → sunrise.
NA	Day when the moon sets for the first time after sunrise, time between time sunrise → moonset.
ME	Day when the moon rises for last time before sunset, time between moonrise → sunset.
GE_6	Day when moon rises for first time after sunset, time between sunset → moonrise.
KUR	Day when moon visible for last time before conjunction, time between date and time moonrise → sunrise.

[7] Hunger(1999), 79.
[8] See Steele (2000b).
[9] Steele (2000a), 29.
[10] Hunger (1999), 79.

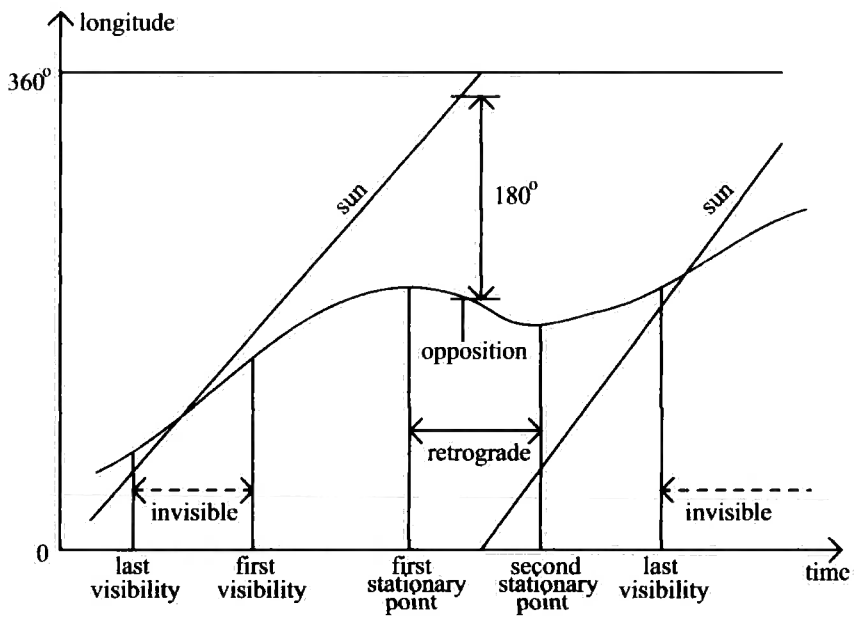
Conjunctions of the moon with normal stars were also observed along with eclipses of the sun and moon. Eclipse accounts would sometimes give various measurements that included timings of the eclipse to sunset or sunrise, its position relative to a normal star, a measurement of the extent of the eclipse in fingers, how long the eclipse lasted and remarks regarding the weather. Predicted eclipses, as found in the A or NSA would simply give the time when the eclipse was supposed to occur.[11]

PLANETARY PHENOMENA

There are several major phenomena of the planets observed by the Babylonian astronomers. These have been termed the 'Greek letter phenomena' and are, for the outer planets[12] (see figure 1):

Γ	first visibility in the east
Φ	first stationary point
Θ	"opposition"
Ψ	second stationary point
Ω	last visibility in the west

Figure 1. Motion of the outer planets.[13]

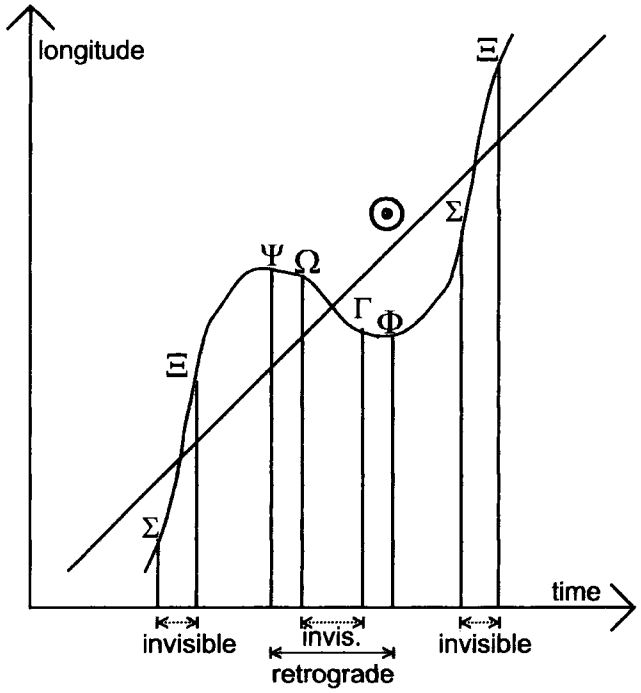


For the inner planets[14] (see figure 2):

Γ	first visibility in the east
Φ	stationary point in the east
Σ	last visibility in the east
Ξ	first visibility in the west
Ψ	stationary point in the west
Ω	last visibility in the west.

[11] See Steele (2000a) for a detailed discussion.
[12] ACT, 280.
[13] Diagram adapted from ACT, 281.
[14] ACT, 280.

Figure 2. Motion of the inner planets.[15]



First visibility in the east is the first day the planet is observed before sunrise. For a planet to be visible the sun must be far enough below the horizon for the sunlight not to overwhelm it and make the planet indistinguishable. This distance is called the *arcus visionus*[16]. A stationary point is when the planet appears to stop in the sky and occurs as the planet "turns" on its retrograde path.

Θ was defined by Neugebauer in ACT[17] to signify an opposition, which is when the sun and planet are 180° apart. This definition would make sense when defining important theoretical phenomena but ancient astronomy is primarily about observed phenomena. With regard to this an acronycal rising, which occurs a few days before opposition and is the first night when the planet rises on the eastern horizon as the sun sets in the west, is just as important. As it occurs so close to opposition it is possible that Θ could signify an acronycal rising.

The *arcus visionus* is less for an acronycal rising than for a first visibility as the planet is brighter at acronycal rising when it is nearer conjunction, and because the eastern horizon is darker in the evening than in the morning.[18]

Last visibility is the day before the planet is too close to the sun to be observable.

[15] Diagram adapted from ACT, 280.
[16] Swerdlow (1999), 61.
[17] ACT, 280.
[18] For a diagram and more mathematical description, see Swerdlow (1999).

NORMAL STARS

Non-mathematical astronomical texts often contain references to fixed stars near the ecliptic in order to provide a more accurate description of a planet's location. Epping[19] originally called them 'Normalsterne' and the term has been used ever since.

Sachs and Hunger (1988) describe their meaning and use:

> In order to give the position of the moon and the planets a number of stars close to the ecliptic are used for reference. ... The Akkadian word for them is MUL ŠID^{meš} ... which seems to means something like "stars of counting, predictable stars"

Sachs (1974) explained their distribution:

> ... the 'conjunctions' of the Moon and each of the planets with some thirty so-called 'normal stars' (i.e. reference stars) scattered about the zodiacal belt are recorded as they occur, and the distance 'above' or 'below' is given in cubits of 2° and fingerbreadths of 5'. ... The reference stars are fairly well distributed in longitude until approximately 230°, after which there is a gap of more than 40°; after about 290° there is an even bigger gap of more than 60°.

THE BABYLONIAN CALENDAR

The Babylonian calendar is made up of 12 lunar months of 30 or 29 days. A new month is signified by the first day when the crescent of the new moon is visible at sunset. At the beginning of any month in the diaries a remark is made as to whether the preceding month was a full month, of 30 days, or a hollow month, of 29 days.

During most of the Late Babylonian period a system of adding 7 intercalary months over 19 years was used[20]. This works because 235 lunar months is almost exactly equal to 19 solar years. The extra month could be a VI_2, second Ululus, or XII_2, second Addarus. Initially deciding whether a VI_2 or XII_2 was added was done empirically, and could be by royal command or by a priest who had noticed that the new month was going to occur at the wrong time – i.e. the moons crescent appeared too early or too late. In later periods intercalations became standardised[21].

The year count until 311BC restarted at the beginning of each new king's reign. 311BC was the start of the reign of Seleucus I, and from this point onwards the year count did not restart and instead simply counted continuously. This is known as the start of the Seleucid Era.

In order to analyse data from cuneiform texts it is necessary to convert the Babylonian dates into Julian dates. This is because any computer program used to obtain the longitudes of planets on specific dates require them to be in the Julian calendar. To convert the Babylonian dates into Julian dates the tables by Parker and Dubberstein (1956) were used. They contain the Julian equivalent for every date from 626BC until AD75.

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[19] Epping (1889).
[20] Britton (1993), 212.
[21] See Parker and Dubberstein(1956) for further discussion.

MODERN COMPUTATIONS

Part of this study involved the use of computations of planetary and stellar positions using modern theory. A number of computer programs were used for this purpose. For planetary positions, the main two were Steve Moshier's Ephemeris Program V5.1 (1995) AA0, and Kevin Yau's (1989) BRETAGNON which is a Fortran version of a program by Simon for calculating planetary positions using the Bretagnon ephemeris. When calculating the longitude for Sirius, two programs by F. R. Stephenson were used, so that precession could be accounted for.

Precession causes the longitude of a fixed star to increase at a slow uniform rate of 1° in 72.6 years[22], thus over a period of 2300 years this will be an important factor to consider when determining the position of a star. It occurs because the moon causes the earth to have an equatorial bulge. This means that when the earth is spinning its axis of rotation should move in a circle, but because it is oblate it must counteract the force trying to displace it from its spatial orientation. It does this by a precession of its axis and means the earth's axis describes a circle roughly every 26,000 years[23]. It is also important to consider as it causes the equinoctial points to move slowly west with respect to the zodiac.

One consequence of this is the difference between a sidereal year and a tropical year. A sidereal year is the time if takes for the sun to return to a fixed star and is 365.256 days in length. A tropical year is the length of time it takes for the sun to return to the same longitude and is 365.242 days[24].

[22] Aaboe (2001), 20.
[23] Zeilik (1997), 74.
[24] Aaboe (2001), 21.

THE INTERPRETATION OF Θ AS ACRONYCAL RISING

Babylonian observations of planets fall into two main types: (i) passages of the planets by one of the Normal Stars, and (ii) synodic phenomena such as first visibilities, stations, etc. known "Greek-Letter phenomena".

In addition to acting as useful shorthand, use of the Greek-Letter designations for these phenomena allows us to avoid the problem of the exact interpretation of these phenomena. For example, Ω should probably be understood as the first date on which a planet was not seen, rather than the last day on which it was seen.[25] Nevertheless, it is important to attempt to identify the precise meaning of these phenomena if we are to try to understand the Babylonian observational record and, in particular, its role in the development of mathematical astronomy.

It is not immediately obvious what Θ relates to. It is possible that it is either an astronomical opposition of the planet and the sun, or a nearby phenomenon such as acronycal rising. At opposition the planet is 180° to the sun with respect to the observer, which is difficult to accurately observe as the planet will be low on the horizon and the sky will be too bright. However, an acronycal rising requires the planet to be rising directly opposite the setting sun on the horizon, an easily observable phenomenon since the sky is much darker (see figure 3). There is no exact method to calculate when this occurs as it depends on the observer's eyesight, location, and how the light refracts through the atmosphere[26], but when calculating the difference in longitude between the sun and planet, $\lambda_{\odot}$-λ_{p}, we would ideally expect an acronycal rising to be about 175°, assuming negligible latitude. So a preliminary range of 170-180° would seem appropriate to allow for these variations.

Several statements of the meaning of Θ have appeared in the literature. Epping (1889), p. 113 initially interprets the phenomenon as "opposition of the outer planets with the sun", when listing the phenomena he wishes to discuss:

> b. Opposition der äußeren Planeten mit der Sonne.

But later (p. 135), when discussing opposition, he describes a position where the planet is opposite the setting sun on the horizon:

> Eine bemertensmerthe Stellung am himmel nimmt ein Planet dann ein, wenn er der Sonne gerabe gegenübersteht, oder, was dasselbe ist, wenn er beim Untergange der Sonne ber den horizont sich erhebt.

Kugler (1907) p. 15 also simply translates the phenomena as 'opposition with the sun', in a list of important appearances that demand attention:

> Vor allem fesselten alle jene Erscheinungen ihre Aufmerksamkeit, die von der wechselnden Stellung der Planeten zur Sonne und Erde .....ihre Opposition mit der Sonne, Ihr zweiter Stillstand, und ihr Verschwinden in den Sonnenstrahlen (heliakischer Untergang).

But in Kugler (1909), p. 490 he translates

> 8 AN *aná* ME.E.A

[25] Huber et al. (1982).
[26] Swerdlow (1999), 50.

as

> 8 Mars im akronychischen Aufgang (kurz vor der Opposition)

So translating the *aná* ME.E.A as acronycal rising, remarking that this phenomena is short of opposition.

In an article discussing Sirius phenomena, Sachs (1952), p. 105 writes:

> ... the other is a triplet of dates for the heliacal rising (igi), "opposition" (actually apparent acronycal rising; aná ME (-E) (-A)) ...

Neugebauer (1952), p. 93 stated:

> Disappearance and reappearance of the planets are phenomena close to the horizon and it seems also "opposition" of a planet was defined as rising or setting at sunset and sunrise respectively.

Later, in ACT (1955) he summed up the assumption as:

> All phenomena under consideration, with the sole exception of stationary points, are phenomena in the horizon. This also holds for Θ which we simply call "opposition" but which, in all probability, is "acronycal rising", i.e. rising of the planet at sunset.

Then in HAMA (1975), p. 399 he refers to a translation of Sachs' within a discussion of the procedure texts:

> ...Θ is not the "opposition" in the strict sense of Greek or modern astronomy but that it corresponds to the "*akronycal rising*" of the planet. The planet is then just visible in the east shortly after sunset; the Babylonian term means in fact "opposition in the east." [*Ana* ME-a *ina* kur, or similar (Sachs).]

EVIDENCE FROM THE TEXTS OF MATHEMATICAL ASTRONOMY

Within ACT schemes it has been shown for Mars and Jupiter that Θ occurs closer to closer to Φ than to Ψ which means that Θ has an elongation from the sun of less than 180°. This implies that Θ corresponds to an acronycal rising.[27] Also studies comparing the synodic arc for the planets to the mean sun show Θ falling consistently short of opposition and support the translation of Θ as acronycal rising[28].

EVIDENCE FROM THE TEXTS OF NON-MATHEMATICAL ASTRONOMY

I have collected together all recorded entries for Θ from the available Non-Mathematical Astronomical Texts. For the Diaries and Planetary Texts I have used the editions by Sachs and Hunger (1988, 1989, 1996) and Hunger (2001). Data from the Goal Year Texts was read from the copies by Pinches and Strassmaier in LBAT. For the Almanacs and Normal Star Almanacs, I have collected data from the copies in LBAT[29], AaB, SSB, and editions of individual texts by Sachs (1976), Sachs and Walker (1984), and Hunger (1999).

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[27] See Hollywood and Steele (forthcoming) for further discussion.
[28] Swerdlow (1999), 58-61.
[29] See appendix for translation of the relevant entries in LBAT.

Before beginning this analysis it is worth noting that the data is limited by those tablets that have survived (and have been published) and is by no means a standardised cross section. Consequently we have an uneven distribution over the years, and for the Almanacs, Normal Star Almanacs and Goal Year Texts we have a very limited number of relevant entries.

EVIDENCE FROM DATA CONCERNING THE PLANETS

A total of 125 usable observations were collected for the outer planets. Of them, most were recorded 400BC-100BC. From the observed dates of Θ the difference in longitude with the sun was calculated. It was seen that nearly all the values for $\lambda_{\odot}-\lambda_{p}$ ranged from 165-195°. There were three exceptions:

Table 3. Erroneous data for acronycal risings.

Source	No.	Planet	Date SE	Date BC	Planet λ	Sun λ	$\lambda_{\odot}-\lambda_{p}$
Planetary text	76	Mars	51 XII 12	260 MAR 21	2.9089	356.797	353.8881
Planetary text	70	Jupiter	22 IX 22	290 DEC 24	41.009	269.02	228.011
Diary V2	253	Jupiter	58 IX 29	254 DEC 23	62.67977	268.2545	205.5747

The entry for Mars, which came from a planetary text, is written with the remark "around, I did not watch". This would imply that the number was calculated. However, for it to be so far beyond what is expected would suggest that there was either an error in the calculation or that the record contains a scribal error. For example if the year was SE52 then $\lambda_{\odot}-\lambda_{p}$ =175.8 which is what we would expect for an acronycal rising.

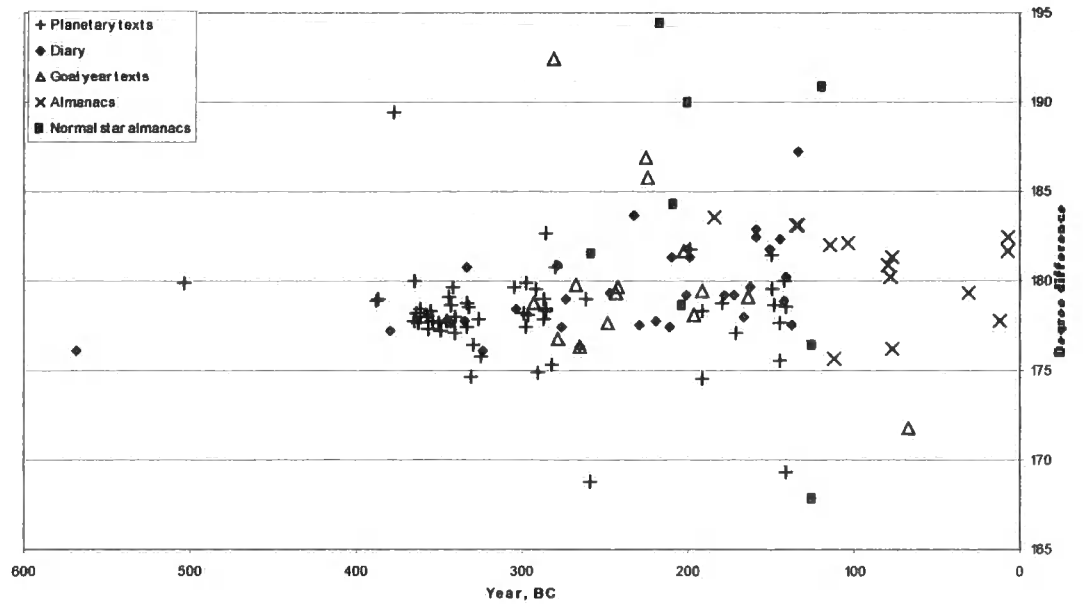
The two entries for Jupiter did not have an attached comment; however, for the entry from a diary the end of the sentence was broken away. These may also therefore be scribal errors.

Examining the data first by source (figure 3) it is clear that there is a large variation in the number of different types of text. The overall spread of the data from the various sources is based around 180° but on initial inspection it is clear that this spread varies greatly with each source.

Table 4. Acronycal risings data with respect to source.

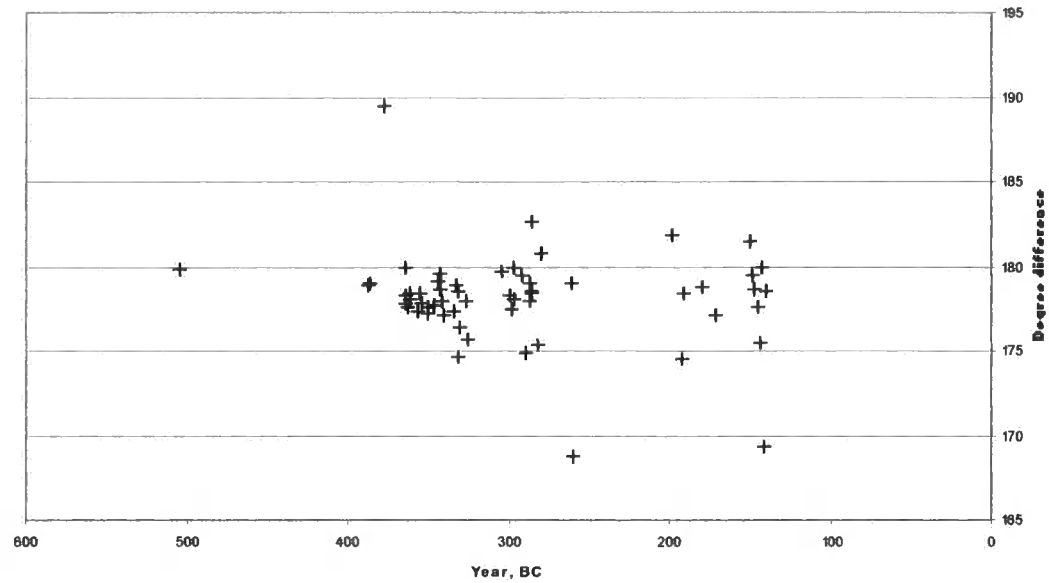
Source	Average	Standard Deviation	No. records
Planetary texts	178.1	2.8	58
Diaries	179.2	2.0	35
Goal year texts	178.1	9.9	16
Almanacs	180.7	2.5	14
Normal star almanacs	183.0	8.8	8

Figure 3. All the data divided into sources.



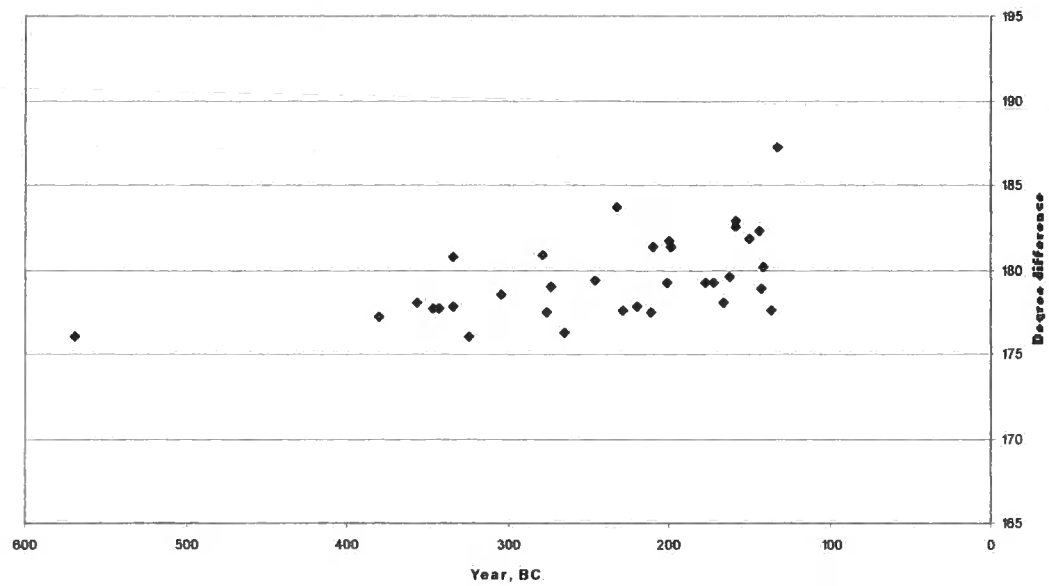
The largest proportion of the data was abstracted from planetary texts (Figure 4) something to be expected since they are compilations of such datum, and ☿ would have been one of the phenomena of note. The data was mainly distributed from 390BC – 140 BC, with one point from around 500BC in one of the oldest planetary tablets. The planetary data shows most of the points have elongations below 180°. This would appear to confirm an acronycal rising and is one of the more reliable results due to the relatively large amount of source data.

Figure 4. Data from the planetary texts.



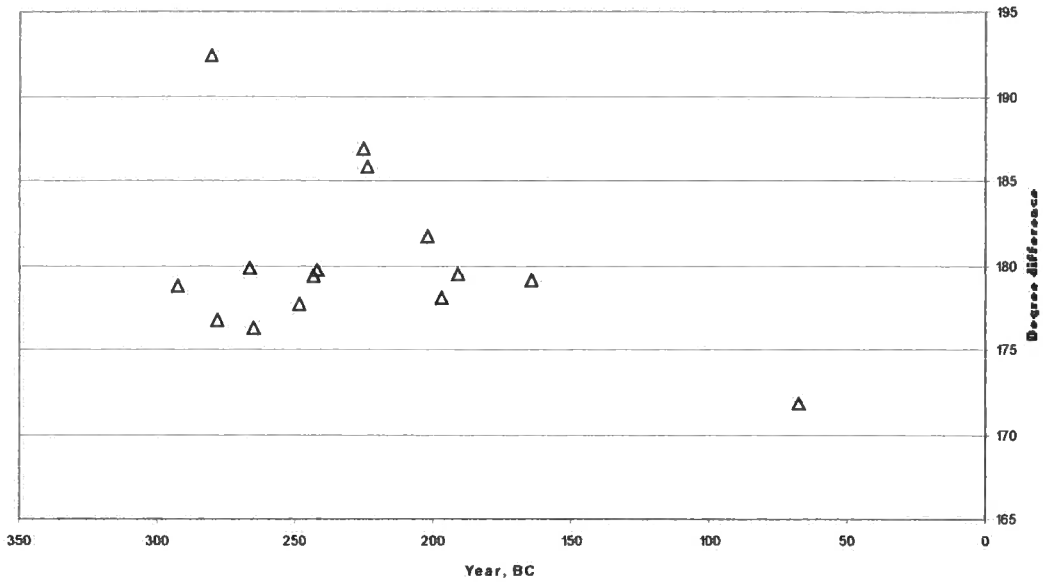
The entries for the diaries (Figure 5) ranged 176-187°. This data was spread from 390BC to 140BC with one point from 580BC, found in one of the oldest diaries known to date. The average is just within what we would expect for an 'acronycal rising' but since about a third of the points are above 180° this result is not irrefutable.

Figure 5. Data taken from the diaries.



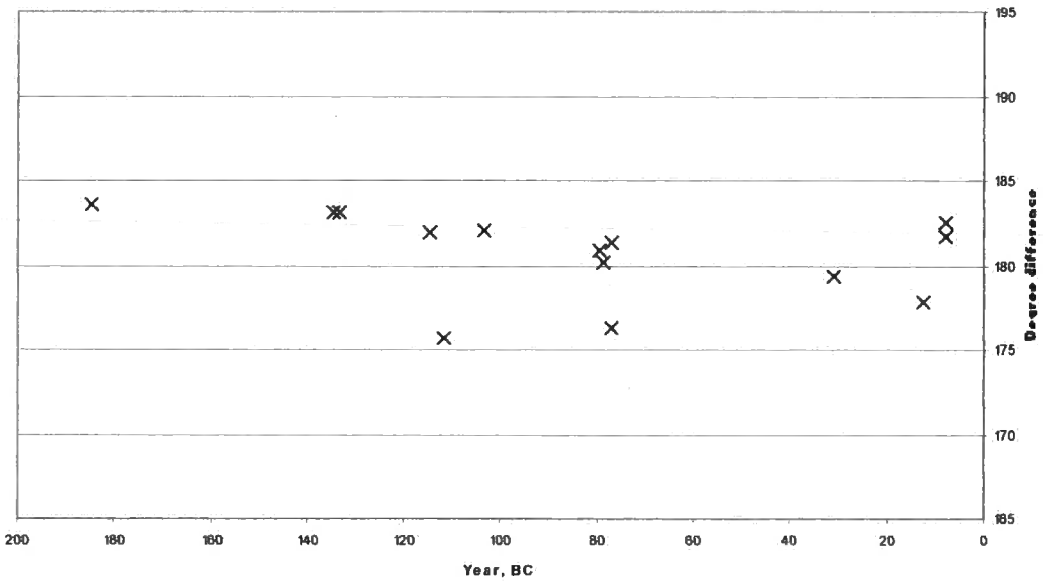
For the goal year texts (Figure 6), the data is spread from 293BC to 67BC. Two thirds of the points are between 176° and 180° which is what we expect for an acronycal rising. However the other points vary widely, from 171-192°, so this result is not conclusive.

Figure 6. Data from the goal year texts.



For the almanacs (Figure 7) the data ranged in date from 184BC to 7BC, and in elongation from 175-184°. They are not widely spread, and the average of 180.7 is on the boundary of our limiting range.

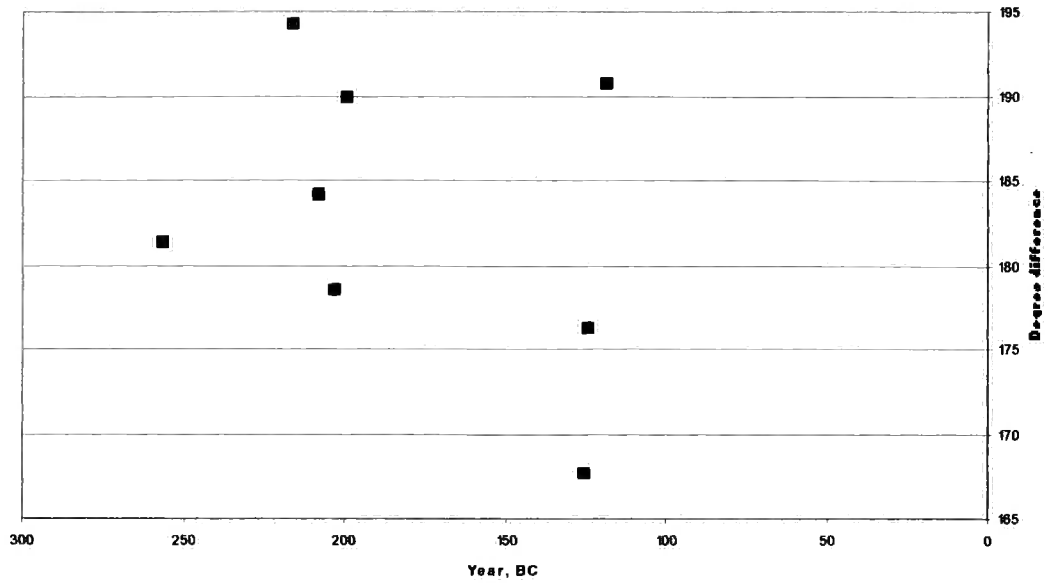
Figure 7. Data from the almanacs.



In the case of the normal star almanacs (Figure 8) no results can be drawn since the data ranges 167-194° with only 7 points.

The lack of data for the almanacs and normal star almanacs is due to the fact that there are not very many large tablets available. The ones that have survived are fragmentary and thus a degree of luck is necessary to acquire the relevant information.

Figure 8. Data from the normal star almanacs.



Overall it is clear that due to the lack of data in other sources, conclusions can only be drawn for the diaries and planetary texts. The majority of their points are below 180°, and although the averages are quite high, for an opposition we would expect an even distribution above and below 180°. For these two sources it would therefore appear that Θ does in fact mean acronycal rising.

Examining the data with respect to which planet is being observed, again there is a definite bias. It is also clear that the range for each planet varies resulting in different averages.

Figure 9. All the data divided into planets.

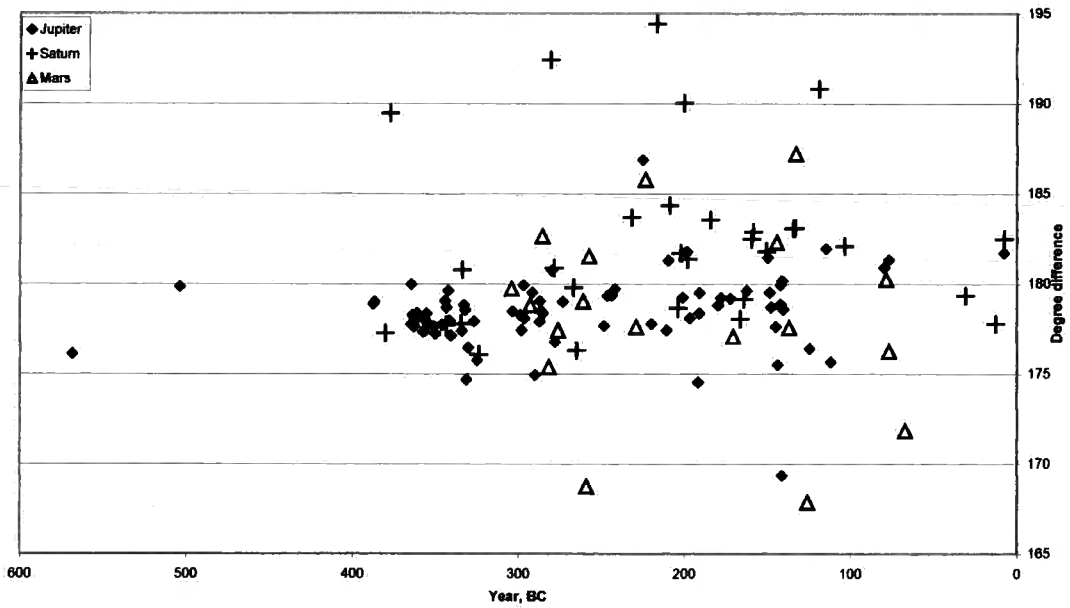
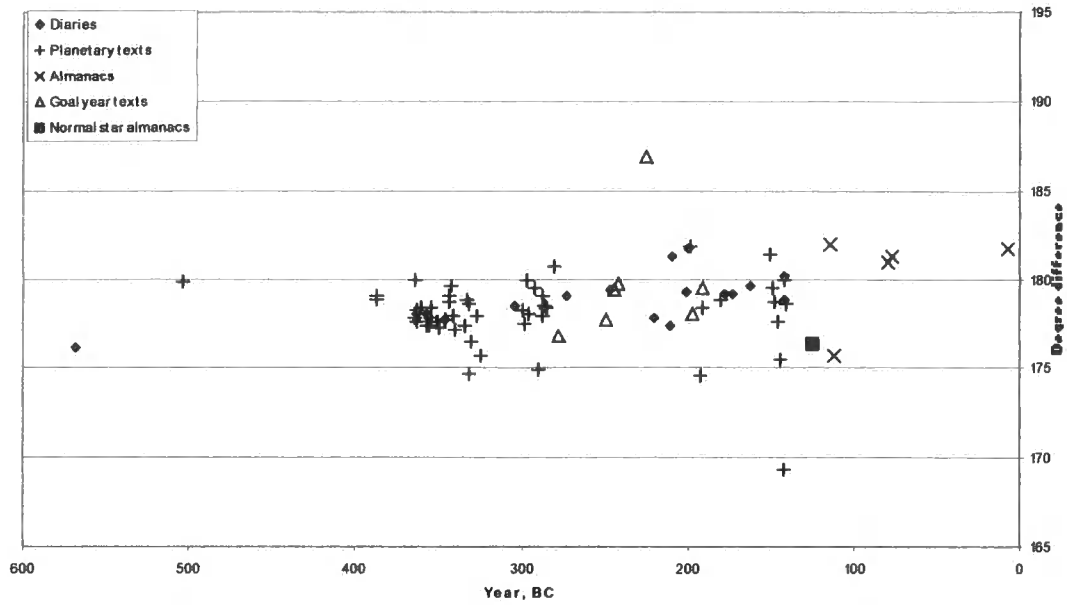


Table 5. Acronycal risings data with respect to planet.

Planet	Average	Standard Deviation	No. observations
Jupiter	178.1	4.2	82
Saturn	182.1	4.8	31
Mars	178.2	5.1	18

Figure 10. Data for Jupiter



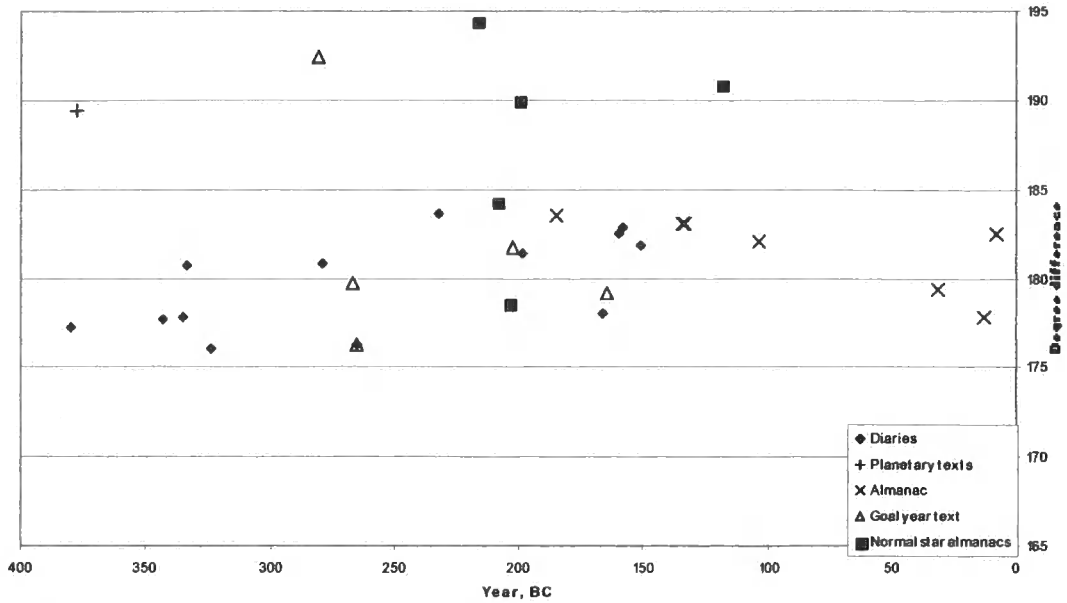
The data for Jupiter ranges mainly from 175-182°, distributed between 580BC to 10BC. As shown in the figure 10 most of the entries - more than 60% in fact - originate from the planetary texts. This is to be expected since the planetary texts were compilations of the astronomical entries from many diaries for each planet - unlike a fragment of a diary, for example, which could also contain remarks relating to the weather or military events. Despite the large amount of data for Jupiter, it is not widely distributed, and with an average of 178.1° it would seem to indicate an acronycal rising.

For Saturn (Figure 11) the data was from 390BC to 10BC and was more widely spread out than for Jupiter. However most of the data is still above 180°, resulting in a large average of 182° which would seem to suggest that the measurement was not for an acronycal rising, where we would expect 175-180°. Whilst it could mean that 'acronycal rising' should be 'opposition', it should be remembered that for each source of datum the values are very different. The data from the diaries is mainly distributed around 180°, whereas the normal star almanacs data are based around 185°.

This is almost certainly a result of how the data was calculated for the normal star almanac. If the correction to the goal year period is too large, i.e. a late prediction, it will give a larger $\lambda_{\odot}$-λ_{p}. According to Hunger (1999), by modern theory the calculation should be the addition of one synodic period less 6 days. When he compared the goal year texts to the normal star almanacs he found a range of differences, from –1 to –13 days. Where the correction is less than 6 days, which he found was often the case, the phenomenon will occur too late and Saturn's elongation will be greater than that expected for an acronycal rising.

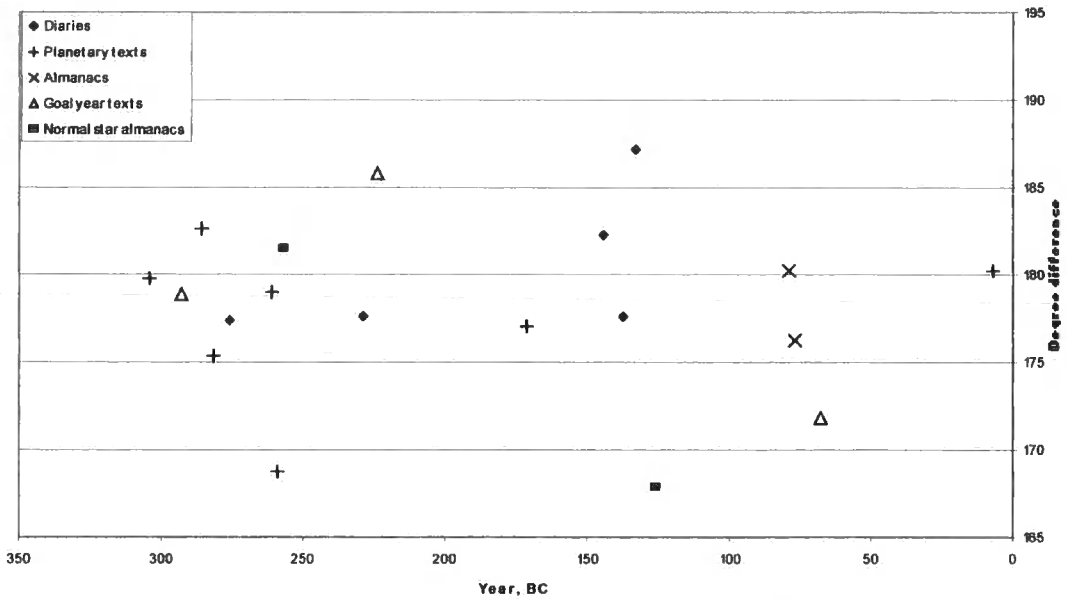
The fact that Saturn's elongation at Θ is greater for the predictions in the normal star almanacs than the observations in the diaries, confirms that too small a correction to the goal year period was often applied. It also indicates that the goal year periods were in actual fact used to compile the normal star almanacs.

Figure 11. Data for Saturn.



For Mars (Figure 12) the data dated mainly from 304BC to 7BC, ranging in elongation 167-187°. The data is very widely distributed, however the diaries cluster around 180°, with the normal star almanacs having the lowest longitude difference. Nevertheless the average is 178.26° which is within the preliminary boundaries we have set, but with such a large variation in the data it can by no means be considered conclusive.

Figure 12. Data for Mars.



For the planets it would at first appear that there is a problem with Saturn, since the average is over 180°, but even though there are numerous datum points they come from various sources, and the values from the normal star almanacs are extreme. Thus for Saturn the results can be explained and still prove the case for ☉ being an acronycal rising. It is also evident that the results for Jupiter will be the most confident since it has by far the most amount of data. It has a reasonable average and a low standard deviation, and indicates an acronycal rising.

SIRIUS

The data for Sirius was obtained from the diaries and the almanacs, with A.Sachs collecting the latter in his 1952 article. In this study it is Sachs' compilation of raw datum that was used.

Since all but one of the Sirius entries was calculated, it is essential to examine them separately from those for the planets. The diaries used schematic dates for the characteristic phenomena of Sirius since around 330BC, with only occasional observations recorded. Likewise the solstices and equinoxes were calculated from this date – unsurprising given that they are needed to calculate Sirius phenomena.

Since Sirius is located a long way from the ecliptic it has quite a large negative latitude, about -37° for the years with the necessary data. This forces the characteristic phenomena of Sirius to occur in an abnormal order. That is with acronycal setting, Θ_2, falling on an earlier date than acronycal rising, Θ_1. Thus the order of phenomena is Ω to Γ to Θ_2 to Θ_1[30]. Since Θ_2 occurs before Θ_1, the elongation for an acronycal rising will in fact occur with an elongation greater than 180°, and acronycal setting less than 180°.

The system for calculation, as established by Sachs (1952) is

Γ = SS + 21 tithis[31]

Ω = SS – 44 tithis

Θ = SS + 191 tithis

This scheme works in conjunction with a scheme for determining solstices discovered by Neugebauer (1947). It must also be remembered that this scheme is made assuming all months contain 30 days, therefore if the previous month has 29 days then the phenomena should occur a day later.

This means that for a nineteen-year cycle the schemes are:

	SS	AE	WS	VE
1	III 18	VI 21	IX 24	XII 27
2	III 29	VII 2	X 5	XII_2 8
3	III10	VI 13	IX 16	XII 19
4	III 21	VI 24	IX 27	XII 30
5	IV 2	VII 5	X 8	XII_2 11
6	III 13	VI 16	IX 19	XII 22
7	III 24	VI 27	IX 30	I 3
8	IV 5	VII 8	X 11	XII_2 14
9	III 16	VI 19	IX 22	XII 25
10	III 27	VI 30	X 3	XII_2 6
11	III 8	VI 11	IX 14	XII 17
12	III 19	VI 22	IX 25	XII 28
13	III 30	VII 3	X 5	XII2 9
14	III 11	VI 14	IX 17	XII 20
15	III 22	VI 25	IX 28	I 1
16	IV 3	VII 6	X 9	XII_2 12
17	III 14	VI 17	IX 20	XII 23
18	III 25	VI 28	X 1	I 4
19	IV 7	VI_2 9	IX 12	XII 15

Table 6. Solstice and equinox dates for the Sirius cycle.

	Γ	Θ	Ω
1	IV 9	IX 29	II 4
2	IV 20	X 10	II 15
3	IV 1	IX 21	I 26
4	IV 12	X 2	II 7
5	IV 23	X 13	II 18
6	IV 4	IX 24	I 29
7	IV 15	X 5	II 10
8	IV 26	X 16	II 21
9	IV 7	IX 27	II 2
10	IV 18	X 8	II 13
11	III 29	IX 19	I 24
12	IV 10	IX 30	II 5
13	IV 21	X 11	II 16
14	IV 2	IX 22	I 27
15	IV 13	X 3	II 8
16	IV 24	X 14	II 19
17	IV 5	IX 25	I 30
18	IV 16	X 6	II 11
19	IV 28	X 18	II 23

Table 7. Sirius cycle.

[30] See HAMA, 1091.

[31] 1 tithi= $^1/_{30}$ month

The Uruk solstice scheme was recently re-examined by Slotsky (1993). In the original scheme reconstructed by Neugebauer he determined that each successive solstice date was found by adding 11;3,10 tithis, but the scheme rounded this to 11 for convenience. This meant that due the accumulation of 0;3,10 tithis 11 days must be added each year, in the form of hollow and full months, except in years with an intercalary Ululu where 12 days were added.

Another inaccuracy, which is due to the difference between the approximation of 1 year to 12;22;6,20 months which is too long by 0;0;10 tithis when compared to the cycle of 19 years to 235 months, was determined by Neugebauer to accumulate to one full day in SE113, thus the scheme would require the solstices to be one day earlier from that date, i.e. SS became IV 6, for years with an intercalary Ululu.

However Slotsky found evidence to the contrary. In BM 36811 which is an undated astronomical text, but is pre SE113, she found that years which contained 2-Ululu the summer solstice continued to be on IV7. Then in a diary from SE 56 which contains month 2-Ululu, the autumnal equinox is on VI** 10, which is consistent with the post SE 113 scheme. Thus there is no divergence at SE 113 and dates before this with a 2-Ululu calculated by the Uruk scheme must be disregarded.

Comparing the Uruk scheme to the 31 entries collected, taking a date for the scheme as SE 56, shows that the data corresponds exactly in all but 2 cases.

One is the oldest entry, from 384BC, which differs by 2 days and is observed according to the diary. This is acceptable since the diaries did not start consistently using the computed values until 330BC.

Another entry, from SE151, was taken from a translation by Sachs of an unpublished tablet. In it he has written the month as [IX] indicating how he had to fill in this data himself. In order to fit with the scheme, however, we require it to be month X, something which is probably attributable to a scribal error either on the tablet or in the translation.

A tablet from Uruk translated by von Weiher (1998)[32] describes an alternate scheme. It does not mention Θ but does have Γ which is one tithi earlier than in Sachs' scheme. This scheme does not fit with our data but it still shows that several schemes were available.

Of our data collected (shown in table 8) shows that $\lambda_{\odot}$-λ_{Sirius} ranges from 203-207°. The data varies only over 4° in 300 years, which could be expected since Sirius does in fact move along the zodiac, although very slowly, less than 3° in 300 years.

These values match with what we would expect for Θ_1 for Sirius.

[32] See also ASM and Britton (2001).

Table 8. Acronycal rising data for Sirius.

Source	No.	Year, SE	Month	Date	Sirius longitude	$\lambda_{\odot}$-λ_{p}	Comments
1	384	ARII 20	X	1	71.19	205.953	
1	281	30	X	1	72.612	207.136	
2	254	57	IX	29	72.981	206.193	
2	247	64	X	16	73.073	205.39	Clouds, I did not watch
2	232	79	X	2	73.276	205.551	
2	221	90	X	3	73.423	204.734	I did not watch, clouds
2	212	99	X	13	73.552	205.415	I did not watch
2	201	110	X	14	73.7	204.595	I did not watch, overcast
2	198	113	IX	18	73.737	205.848	
2	195	116	IX	21	73.774	205.06	
2	193	118	X	13	73.81	205.548	I did not watch
3	180	131	X	6	73.976	205.228	
NSA	MLC 1885	133	IX	29	74.013	205.715	SBA[33]
A	1152	209	X	1	74.087	204.7	Date uncertain, could be end of month
2	173	138	IX	24	74.124	205.663	
2	170	141	IX	27	74.197	203.1	
A	MLC2195	147	X	3	74.197	204.363	SBA
NSA	Sp. 217	146	IX	22	74.253	205.093	SBA
NSA	IU 194	151	IX	18	74.63	204.493	SBA
NSA	AO 8530	156	X	13	74.345	205.309	SBA
NSA	1127	158	X	5	74.35	206.209	
A	Sp. 223	158	X	5	74.529	203.951	SBA
3	140	171	IX	29	74.547	203.682	Around, I did not watch, clouds
NSA	Sp. 173+221	172	X	10	74.566	205.452	SBA
NSA	Sp. 305	173	IX	21	74.566	204.708	SBA
3	137	174	X	2	74.769	205.361	I did not watch
NSA	Sp. 129	189	IX	18	74.842	206.087	SBA
NSA	Sp. II 250+353	194	X	13	74.879	204.3	SBA
A	SH. 81-7-6,123	197	X	16	74.934	205.291	SBA
NSA	Sp. 128	201	X	1	75.045	206.74024	SBA
A	1173	236	IX	27	92.128	189.08827	
A	SH. 81-7-6,103	236	IX	27	75.414	203.284	SBA
A	Sp. 264	282	IX	25	76.058	204.496	SBA
A	1185	282	IX	25	76.06	204.496	

[33] SBA means Sachs (1952).

IDEAL DATES OF PLANETARY PHENOMENA

Amongst observational records there are often comments regarding an unexpected observation or not observing a phenomenon that was expected. Hunger and Pingree[34], mention within a discussion of planetary theory in Enūma Anu Enlil where they refer to a previous publication of Reiner-Pingree (1981):

> Two commentaries on tablets relating to Tablet 50 ... ... refer to the planets passing by their specified times (UD.SUR of adannu) and not rising promptly, or to the planets not completing their days and setting promptly.

Within descriptions of a planet's first or last visibility there is sometimes a remark made about the 'ideal' date when the phenomenon was supposed to occur. This often appears with a measurement of the time from sunrise/set to the observed phenomenon. For example:

> 10 GU_4-UD *ina* ŠÚ *ina* UR-A 3 KÙŠ *ina* IGI *dele-bat ana* ŠÚ IGI 16 [*na-su in* 8 IGI]
>
> The 10th, Mercury's first appearance in the west in Leo, 3 cubits in front of Venus to the west; sunset to setting of Mercury:16°; [(ideal) first appearance on the 8th.][35]

Swerdlow (1998), p. 44 describes this "ideal" or "true" date being corrected according to the timed measurement, but where this measurement is small no correction is necessary:

> As proposed by Hunger, certainly correctly, the ideal date was inferred from the time of visibility between rising and setting of the planet and the sun; if this was over some amount, the true first appearance must have been earlier and last appearance later than the observed by some number of days, although the method of computation, of inference, is not clear, and as would be expected, the times of visibility in the reports without an ideal date seem to be shorter.

In Swerdlow (1999) he claims:

> dates of heliacal risings were used to establish synodic times since, through the use of rising times to determine the 'true' date, they appear to have been the most carefully observed.

Again Hunger and Pingree[36] remark about this, in a chapter concerning the planets:

> Often, if the interval appears to the observer to be too long, he notes that the phenomenon should have been visible on a previous night or that it will be seen on a later night with the words: "(ideal) first (or last) appearance on the nth." For the superior planets we are sometimes given the time degrees between Γ and sunrise or sunset and Ω; ... ... A careful study of such observations might reveal the criteria that the Babylonians used to estimate the "ideal" dates of the phenomena.

It is the aim of this study to go some way towards finding that criterion.

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[34] ASM, 40.
[35] ADT I, 132-133.
[36] ASM, 145.

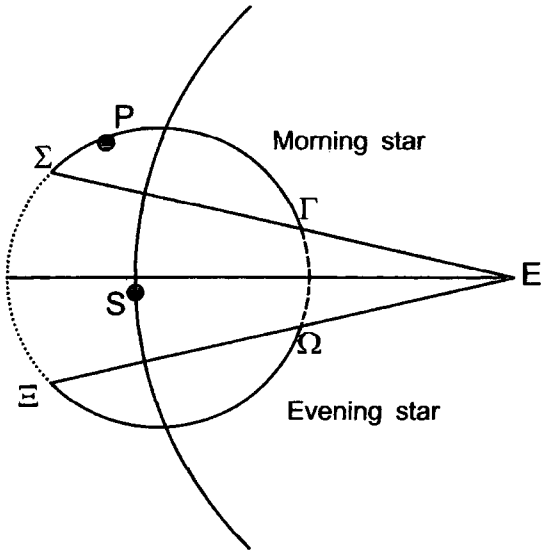


Figure 13. For the inner planets. A planet has a period of invisibility when it is above the horizon the same time as the sun. First visibility is the first day the planet is far enough away from the sun that it rises long enough before sunrise to be seen. Last visibility is the last day before the planet is too close to the sun to be observable.

Γ, Σ, Ξ and Ω are 'Greek letter phenomena' used to describe how a planet moves (see figure 13[37]). There are schemes for predicting these phenomena described in ACT. For each planet there are often several schemes that are used, falling into two main types known as system A and system B. Both are based on variation of velocity and specify that the phenomenon moves through synodic arc $\Delta\lambda$ in synodic time ΔT. System A has the synodic arc as a step function of longitude, the velocity having fast and slow zones. In system B the synodic arc is a zigzag function of the number of times the phenomenon has occurred in the ACT period resulting in a continuously varying velocity.

First and last visibilities have many factors that cause them to be non-specific phenomena, i.e. there is no exact condition for $\lambda_{\odot} - \lambda_{p}$. Instead, the planet's elongation varies according to latitude, brightness of the planet (the brighter it is the shorter the period of invisibility), inclination of the ecliptic to the horizon (the smaller the inclination the further the sun must be from the star or planet to be visible), and atmospheric conditions. For example, a person observing on the equator would see the sun would rise earlier than someone further north, thus Γ would occur on a different day, even if all other factors were constant.

However, it is expected that the 'ideal' date was not calculated by any known system in ACT, as a time measurement was included within the entries and no system within ACT uses a time measurement. Whenever an entry is found without a time measurement it was often due to a break in the tablet or because the entry was recorded in the summary at the end of the month.

To investigate this issue, 'ideal' information was collected from the diaries, planetary texts and goal year texts. We would not expect to find any from the almanacs or normal star almanacs since they contain theoretical data and the 'ideal' data is obviously an observation of a phenomenon that occurred outside a predictive scheme.

The majority of the data was found for Mercury, with only 63 complete records found for the other planets combined. In analysing the data it is necessary to consider each phenomenon separately since the time measurement for each will be for a different period, for example rising of a planet to sunrise for Γ, but sunset to setting of a planet for Ξ. As a result the analysis mainly focuses on Mercury for whom more dependable deductions could be made.

[37] Adapted from Neugebauer (1952), 120.

Because of the scarcity of data for the other planets, their analysis has been done by combining all of the available data including Mercury. Thus it may only be relevant to the extent of seeing a general trend with relation to the zodiac. No specific results could be gleaned as each planet has several schemes to calculate 'Greek letter' phenomena, and it is to be expected that each planet would again have a different scheme for calculating an 'ideal' date from a time measurement.

Before looking at the observational data obtained from the diaries it is worth considering the theoretical systems. Obviously for there to be a need to correct the observation there was something 'wrong' with it. Initially we could suggest it was either to high in the sky and required a correction, or it did not fit in with the theory.

Theoretical Schemes for Calculating Mercury Phenomena

For Mercury there are three separate methods currently known for calculating ephemerides.[38] For the first system, A_1, first visibilities Γ and Ξ, are computed independently and the period of visibility is added to find last visibilities Σ and Ω. A_2 is the reverse of this, in that the first visibilities are functions of the last visibilities. For system A_3, Γ, Ω and Ξ are all independent phenomena, but the procedure text that describes this system says nothing about Σ. This system only occurs in one procedure text and much has had to be reconstructed so less is known about it.

All three of these systems work on the basic premise that for Mercury, 145 occurrences of the same phenomena occur in 46 years. The systems are all are of type A and so use step functions of the position in the ecliptic. There are variations between each system due to distributions of the zones for each phenomena. However non of the systems use the time difference between the setting of the sun and rising of Mercury within the method.

Each first and last visibility does in fact have slightly different periods to the general one shown above. These are

Γ	2673 appearances in 848 years
Σ	1223 disappearance in 388 years
Ξ	1513 appearances in 480 years
Ω	684 disappearances in 217 years[39]

But these differences would not be noticed unless several centuries of data were examined.

System A_1

For system A_1 the procedures are as follows.

For Γ	From Leo1 to Capricorn 16	w_1 = synodic arc = 1,46°
	From Capricorn 16 to Taurus 30	w_2 = 2,21;20°
	From Gemini 0 to Leo 1	w_3 = 1,34;13,20°

The correction for going between

zones 1 to 2 = 0;20
zones 2 to 3 = -0;20
zones 3 to 1 = 0;7,30

For the date the synodic time is

$\Delta_n\tau = (\Delta_n\lambda + 3;30,39)^\tau$ where τ means the unit of a tithi= $^1/_{30}$ month.

For Ξ	From Cancer 6 to Libra 26	w_1 = 2,40°
	From Libra 26 to Pisces 10	w_2 = 1,46;40°
	From Pisces 10 to Cancer 6	w_3 = 1,36°

Which makes the correction for going between

zones 1 to 2 = -0;20
zones 2 to 3 = -0;6
zones 3 to 1 = 0;40

The synodic time for the date is the same as for Γ.

[38] See ACT II for a full description of these systems.
[39] ACT II, 288.

To show how this works in practice we will take an entry from one of the ephemerides and use this system A_1 on it to obtain a new position which we can then check with the ephemeris.

From ACT no.300[28] line 35 we read a position for Γ of Capricorn 26;20 with date 2,8 XI 3;33,11.

First for the position: We are in zone 2 so we add w_2 to our position to obtain Capricorn 2,46;40 which is in fact Gemini 17;40 as there are 5 lots of 30 so we travel through 5 signs.
Now we need the difference between the end of this zone and our position to multiply by the correction for crossing zone 2 to 3.
This is 17;40 * -0;20 = - 5;53,20.
We now add this to our preliminary position of Gemini 17;40 to obtain a final position of Gemini 11;46,40.
This can now be checked against the next line in the text which reads 11,46,40 Gemini Γ, and shows we have done our workings correctly.

For the date we need the difference between the first position on line 35, and the next position which we have calculated. This difference is the synodic arc and is equal to 2,15;26,40°.
To this we add 3;30,39ᵀ to obtain the synodic time 2,18;57,19ᵀ which is equivalent to 4 months + 18;57,19ᵀ.
We now add synodic time onto our original date and arrive at our final date of 2,9 III 22;30,30ᵀ.
This is in agreement with the text.

In System A_1, for the last visibility positions and dates an amount Δ is added to the first visibility. The amount Δ varies according to its position in the zodiac: In the following table,[40] the values are given for 15° of each sign, i.e. the middle, and to find Δ for positions in between you must simply use linear interpolation.

	Δ = B(Σ) – B(Γ)		Δ = B(Ω) – B(Ξ)	
	For 15°	Interpolation to next sign	For 15°	Interpolation to next sign
Aries	12	+ 0;4	36	+ 0;12
Taurus	14	+ 0;8	42	+ 0;8
Gemini	18	+ 0;8	46	- 0;8
Cancer	22	+ 0;8	42	- 0;12
Leo	26	+ 0;8	36	- 0;28
Virgo	30	+ 0;8	22	- 0;16
Libra	34	+ 0;20	14	0
Scorpio	44	0	14	+ 0;4
Sagittarius	44	- 0;4	16	+ 0;8
Capricorn	42	- 0;16	20	+ 0;4
Aquarius	34	- 0;20	22	0
Pisces	24	- 0;24	22	+ 0;28

[28] ACT III, 156.
[40] ACT II, 293.

	$\Delta = T(\Sigma) - T(\Gamma)$		$\Delta = T(\Omega) - T(\Xi)$	
	For 15°/ᵀ	Interpolation to next sign	For 15°	Interpolation to next sign
Aries	14	+ 0;4	36	+ 0;12
Taurus	16	+ 0;6	42	+ 0;12
Gemini	19	+ 0;10	48	- 0;8
Cancer	24	+ 0;6	44	- 0;12
Leo	27	+ 0;6	38	- 0;36
Virgo	30	+ 0;12	20	- 0;10
Libra	36	+ 0;20	15	0
Scorpio	46	0	15	+ 0;2
Sagittarius	46	- 0;4	16	+ 0;12
Capricorn	44	- 0;20	22	+ 0;4
Aquarius	34	- 0;20	24	0
Pisces	24	- 0;20	24	+ 0;24

An example to find a position for Σ will be the same method to use to find any position of time for Σ or Ω.
On line 27 of no.302 column VI we have the position Virgo 20;45. This is equivalent to Virgo 15 + 5;45.
The correction from the interpolation is now 5;45 * 0;8 = 0;46.
Thus we have B(Σ)- B(Γ) = 30 + 0;46 = 30;46.
So B(Σ) = Virgo 20;45 + 30;46 = Virgo 51;36 = Libra 21;31.
To check this result we have to look at the same line but in column VIII where we see we have the same answer.

The other two systems or Mercury work in a similar fashion and are outlined below.

SYSTEM A_2.

For Σ	From Pisces 0 to Virgo 30	$w_1 = 1,47;46,40°$
	From Libra 0 to Capricorn 6	$w_2 = 2,9;20°$
	From Capricorn 6 to Aries 5	$w_3 = 1,37°$
	From Aries 5 to Gemini 30	$w_4 = 2,9;30°$

Which makes the correction for going between
zones 1 to 2 = 0;12
zones 2 to 3 = -0;15
zones 3 to 4 = 0;20
zones 4 to 1 = -0;10
For the date the synodic interval is
$\Delta\tau = \Delta\lambda + 3;30,39^{\tau}$

For Ω	From Pisces 0 to Sagittarius 30	$w_1 = 1,48;30°$
	From Virgo 0 to Aquarius 30	$w_2 = 2,0;33,20°$
	From Pisces 0 to Aries 30	$w_3 = 1,48;30°$
	From Taurus 0 to Gemini 30	$w_4 = 2,15;37,30°$

The synodic interval for the date is the same as for Σ.

For Ξ there are few tablets with a complete scheme. The following is reconstructed from no.300 and does not cover Aries to Taurus or Leo to Virgo. Nevertheless it is known that B(Ξ) is found by adding an amount to B(Σ) which relies solely on the planets position in the zodiac.

For Pisces $0 \leq \lambda \leq$ Sagittarius 20 $\quad B(\Xi) =$ Sagittarius 18;30 + 0;45*(λ - Pisces 0)
For Sagittarius $20 \leq \lambda \leq$ Aries 20 $\quad B(\Xi) = \lambda + 58;30$
For Gemini $0 \leq \lambda \leq$ Cancer 30 $\quad B(\Xi) =$ Cancer 15 + 1;30*(λ - Gemini 0)

B(Γ) is found by adding "pushes" to B(Ω). For most of the zodiac the pushes are negative as Mercury is in retrograde.

$\delta = B(\Gamma) - B(\Omega)$

For Aries 0 $\quad \delta = 0$
From Aries 0 to Aries 15 $\quad$ increasing 0;24 per °
Aries 15 $\quad \delta = 6$
From Aries 15 to Taurus 15 $\quad$ decreasing 0;4 per °
Taurus 15 $\quad \delta = 4$
From Taurus 15 to Cancer 15 $\quad$ decreasing 0;12 per °
From Cancer 15 to Libra 15 $\quad \delta = -8$
From Libra 15 to Virgo 15 $\quad$ decreasing 0;8 per °
From Virgo 15 to Pisces 15 $\quad \delta = -12$
From Pisces 15 to Aries 0 $\quad$ increasing 0;48 per °

Or for actual computation the following system can be used:

$\lambda = B(\Omega)$	$B(\Gamma)$
Aries $0 \leq \lambda \leq$ Aries 15	Aries 0 + 1;24 λ
Aries $15 \leq \lambda \leq$ Taurus 15	Aries 21 + 0;56 (λ - Aries 15)
Taurus $15 \leq \lambda \leq$ Cancer 15	Taurus 19 + 0;48 (λ - Taurus 15)
Cancer $15 \leq \lambda \leq$ Libra 15	λ - 8
Libra $15 \leq \lambda \leq$ Virgo 15	Libra 7 + 0;52 (λ - Libra 15)
Virgo $15 \leq \lambda \leq$ Pisces 15	λ - 12
Pisces $15 \leq \lambda \leq$ Pisces 30	Pisces 3 + 1;48 (λ - Pisces 15)

T(Ξ) and T(Γ) are found by adding pushes onto T(Σ) and T(Ω). From the damaged tablet only restoration of T(Γ) was possible.

$\lambda = B(\Omega)$	$T(\Gamma) - T(\Omega)$
Aries $15 \leq \lambda \leq$ Taurus 15	38^{τ} - 0;6 (λ - Aries 15)
Taurus $15 \leq \lambda \leq$ Cancer 15	35^{τ} - 0;13 (λ - Taurus 15)
Cancer $15 \leq \lambda \leq$ Libra 15	22^{τ}
Libra $15 \leq \lambda \leq$ Virgo 15	22^{τ} - 0;16 (λ - Libra 15)
Virgo $15 \leq \lambda \leq$ Capricorn 30	14^{τ} - 0;3,12 (λ - Virgo 15)
Aquarius $0 \leq \lambda \leq$ Pisces 15	10^{τ} + 0;12 (λ - Aquarius 15)
Pisces $15 \leq \lambda \leq$ Aries 15	19^{τ} - 0;38 (λ - Pisces 15)

SYSTEM A_3

For Γ and Ω

Aries 30 to Leo 30 $\quad w1 = 0;11,6,40$
Aries 30 to Cancer 20 $\quad w2 = -0;12$
Cancer 20 to Aries 30 $\quad w3 = 0;3,16,52$

For Ξ, the loss in longitude over 1 year or 3 appearances is

From	Aquarius 0 to Gemini 30	-16°
In	Cancer and Leo	-20°
	Virgo	-28°
	Libra	-23°
	Scorpio	-18°
	Sagittarius and Capricorn	-14°

Upon examination of these systems and those for the other planets, found in ACT II, we can see that there is no procedure text which describes a system that uses a time measurement to correct the date.

Our data overlaps the periods that are covered by the preserved ephemerides contained within ACT in 19 cases, table 9. The tablets that relate to the time when our observations were made make no mention of an ideal date and instead simply follow the systems previously laid out.

Table 9. Overlaps between ideal entries and ephemerides.

Planet	Observation date	Observation position	Ideal date	Entry source	ACT date	ACT position	ACT no.
Mercury	7 XII$_2$ 18	Pisces	14	P	11	Pisces	300a
Mercury	140 IV 27	Cancer	25	P	26,9,55	Cancer	300
Mercury	140 IV 27	Cancer	25	P	22	Cancer	301
Mercury	141 III 24	Gemini	22	D V2	22,21,52	Gemini	300
Mercury	141 III 24	Gemini	22	D V2	18	Gemini	301
Mercury	147 VII 22	Libra	20	D V2	14	Libra	301
Mercury	167 VII 29	Libra	27	D V3	28	Libra	302
Mercury	168 VI 28	Virgo	24	D V3	22	Virgo	302
Mercury	176 VI 1	Virgo	V 28	G	V 16	Virgo	302
Mercury	180 XI 22	Aquarius	19	D V3	20	Aquarius	302
Mercury	188 III 19	Gemini	16	D V3	16	Gemini	302
Mercury	189 III 24	Gemini	23	D V3	12	Taurus	302
Mercury	171 XI 14	Pisces	10	D V3	12	Pisces	302
Mercury	174 IX 27	Capricorn	25	D V3	26	Capricorn	302
Mercury	141 I 15	Taurus	13	P	12	Taurus	301
Jupiter	203 V 8	Leo	7	D V3	4	Leo	611
Jupiter	215 V 26	Virgo	24	D V3	21	Leo	611
Venus	225 VII 28	Sagittarius	24	D V3	24	Sagittarius	420
Venus	208 II 16	Taurus	14	D V3	14	Taurus	420

In most cases the date from the ephemerides is earlier than both the observation and the ideal date, and except for Mercury SE 189, the positions all correlate. In four cases, Mercury 141 and 188, and Venus 208 and 225, the ideal date is the same as the date contained in the ephemerides.

For Mercury the same ephemeris covers others dates that do not match, so these two entries could simply coincide by accident with the scheme for predicting the true date. For Venus, the two cases that appear in ACT are the only two with suitable dates that they can be checked. That these dates match with our ideal dates does not necessarily mean that the ideal dates were sourced from the ephemerides as in the other 15 cases the dates do not match.

The ideal data collected does not overlap in the almanacs or NSA and could therefore not be checked.

GOAL YEAR PROCEDURE

Within Babylonian astronomy the only other entry that has a day correction occurs when creating a goal year text. A goal year text is created by collating observational datum for the required year less the period for one characteristic period from the diaries. The almanacs and NSA were made using the goal year text and adding a suitable correction for the fact that the characteristic period relation is not exactly 46 years (for Mercury).

Hunger (1999) compared the Δt correction required when using a period relation of 46 years between modern day calculation and those found in non-mathematical texts. The largest source of information when finding Δt came from comparing goal year texts and almanacs and normal star almanacs. It was found that the correction for observations was between –8 and +5 days, and for calculated data between –3 and +10 days. By modern day calculation the correction should be –1 day.

The ideal data from the texts found a range of correction from –5 days to +3 days, with an average of -2.2 days. This range is much smaller than those shown above and is closer to what the correction should be by modern calculation. But there is no evidence that the almanacs and NSA are calculated by anything but the basic scheme of day correction, i.e. no time measurement was required to determine what the correction would be. Thus we can conclude that the method for determining the ideal date was not the same as for compiling the almanacs and NSA.

IDEAL DATA

Entries concerning ideal dates for Mercury, whilst the most numerous, are unfortunately still few. Fifty-four complete entries were collected which should be examined separately for each phenomenon. This splits the entries so there are 26 for Γ, 25 for Ξ, 2 for Σ and 1 for Ω. The data from the texts found a range of correction from –5 days to +3 days.

It is possible that there are more entries correcting first visibilities as it would be easier to watch for and realise that it had appeared late as you would be watching a specific part of the sky before it had appeared. When watching for a last visibility it is possible that no notice was taken of the planet until the expected date of last visibility, which, when not observed, would only confirm that the phenomenon had occurred on the true date.

As shown in the tables 9 and 10 the data does in general show the expected trend of having a larger time measurement for a larger day correction. However there are several exceptions where this is not the case. These exceptions are not connected to any particular zodiacal signs and there are contradictions within sign too. For example for Γ, Pisces shows 15° being equivalent to a 4 day correction, however whilst it then has 14° for a 2 day correction it also has 16° for a 3 day correction. These contradictions cannot be rectified since the data base is too limited.

Table 10. Ideal data for Mercury's Γ.

Year, SE	Month	Date	Position	Difference in rise times / hours	Time measurement / degrees	Ideal date	Day correction	Source	Page
AR III 12	10	2	Sagittarius	1.286	20	IX 29	-4	D V1	145
AR II 44	6	24	Virgo	-0.818	18	21	-3	P	249
AR II 44	3	10	Gemini	-1.026	19	6	-4	P	249
7	13	18	Pisces	-2.135	15	14	-4	P	283
22	4	7	Cancer	1.774	18.5	5	-2	D V1	279
48	11	10	Aquarius	0.675	17	7	-3	P	297
74	4	23	Cancer	1.604	17	21	-2	D V2	89
79	8	28	Scorpius	-1.590	17	26	-2	D V2	107
94	4	26	Cancer	0.736	15	25	-1	G	1251
102	4	9	Gemini	1.705	18.5	5	-4	D V2	185
110	10	13	Sagittarius	-0.987	20	8	-5	D V2	219
114	11	14	Aquarius	0.716	15	12	-2	D V2	249
114	7	19	Libra	-13.494	16	17	-2	D V2	243
140	4	27	Cancer	0.370	20	25	-2	P	345
141	3	24	Gemini	-0.074	16	22	-2	D V2	453
147	7	22	Libra	0.877	15	20	-2	D V2	495
167	7	29	Libra	-1.403	17	27	-2	D V3	95
168	6	28	Virgo	-0.044	18	24	-4	D V3	109
176	6	1	Virgo	1.218	17	28 of V	-3	G	1294
180	11	22	Aquarius	0.460	17.5	19	-3	D V3	237
188	3	19	Gemini	1.626	16.5	16	-3	D V3	281
189	3	24	Gemini	-0.623	11	23	-1	D V3	295
224	13	17	Pisces	0.028	14	15	-2	D V3	455
225	8	1	Scorpius	-1.180	16	VII 28	-4	D V3	461
234	3	18	Gemini	1.701	16	16	-2	D V3	491
258	11	18	Pisces	-0.512	16	15	-3	P	357

Table 11. Ideal data for Mercury's Ξ.

Year, SE	Month	Date	Position	Difference in rise times / hours	Time measurement / degrees	Ideal date	Day correction	Source	Page
8	2	6	Gemini	1.925	16	4	-2	P	283
38	8	21	Sagittarius	0.455	16	19	-2	D V1	341
45	4	9	Cancer	-1.091	15	7	-2	G	1220
50	9	20	Capricorn	-0.993	15	18	-2	D V1	375
55	10	12	Capricorn	1.591	15	9	-3	P	307
56	12	22	Taurus	0.392	16.5	20	-2	P	309
84	12	4	Aries	0.523	14.5	2	-2	P	321
102	6	5	Virgo	0.760	15	3	-2	D V2	187
116	12	13	Aries	-0.996	15	11	-2	D V2	269
119	2	18	Gemini	-1.858	15	16	-2	D V2	293
125	11	14	Virgo	-1.122	16	12	-2	D V2	343
128	10	15	Capricorn	0.985	15.5	13	-2	G	1285
143	5	27	Virgo	2.007	16	25	-2	D V2	471
171	11	14	Pisces	2.258	16.5	10	-4	D V3	157
174	9	27	Capricorn	1.372	14.5	25	-2	D V3	169
176	4	2	Leo	-1.155	15	1	-1	G	1294
178	6	21	Pisces	-0.879	15	20	-1	D V3	203
179	2	8	Gemini	-1.721	15.5	5	-3	D V3	211
202	9	10	Capricorn	-0.996	12	7	-3	D V3	351
234	5	13	Virgo	0.687	16	12	-1	D V3	495
258	10	15	Aquarius	-0.844	15	13	-2	P	357
259	2	2	Gemini	-0.933	16	1	-1	P	357
A IV 8	6	3	Libra	0.263	14	1	-2	D V1	237
A IV 8	1	19	Taurus	-0.836	20	16	-3	D V1	233
AR II 38	3	10	Leo	1.150	16	8	-2	D V1	133

Table 11 shows that Σ and Ω have a positive day correction. This is to be expected, but due to the lack of data no further inferences can be made.

Table 12. Ideal data for Σ and Ω. (Ω in italics).

Year, SE	Month	Date	Position	Difference in rise times	Time measurement	Ideal date	Day correction	Source	No.
94	12	7	Aquarius	0.885	17	10	3	G	1251
125	6	1	Virgo	0.796	11	2	1	G	1269
94	10	15	Aquarius	-1.173	18	18	3	G	1251

Combining all the data for Mercury as both morning and evening star gives us a larger base with which to attempt to find trends and is shown in table 12.

Table 13. Comparison of measurement to day correction for all ideal entries.

Measurement / degrees	Average correction / days	Range of correction / days	Number of entries
11	1	1	2
12	3	3	1
14	2	2	2
14.5	2	2	2
15	2	$1 \rightarrow 4$	13
15.5	2.5	$2 \rightarrow 3$	2
16	2	$1 \rightarrow 4$	12
16.5	3	$2 \rightarrow 4$	3
17	3	$2 \rightarrow 3$	6
17.5	3	3	1
18	3.3	$3 \rightarrow 4$	3
18.5	3	$2 \rightarrow 4$	2
19	4	4	1
20	4	$2 \rightarrow 5$	4

Examination of table 12 shows the maximum day correction increasing as the measurement increases. There appear to be general blocks for upper limits on the time measurement for each day correction, however for 12°, 15.5° and 18° we see the following measurement having a lower day correction.

For the measurements of 15° and 16°, where we have a large number of entries, we have equal ranges and average day corrections. This could mean that they both reside within the same zone for the theoretical scheme but it is impossible to say for sure.

This result is not conclusive but it does allow us to place upper limits on the day corrections. Up to 11°, 1 day correction,; 12-16° 2 days correction; 16.5-18.5° 3 days correction; and 19-20° 4 days correction.

Combining the data for Mercury with data taken for other planets (table 13) we see we have a very general trend of a larger measurement with large day correction. It is much more varied than for Mercury, but this was to be expected since each planet will have a different system for calculating each phenomena.

Table 14. Ideal data for all the planets combined.

Measurement / degrees	Average correction / days	Range of correction / days	Number of entries
8.33	1	1	1
8.5	3	2 → 4	2
9	3.2	3 → 4	5
9.5	2	2	2
10	2.25	1 → 4	4
10.5	1	1	1
11	1.86	1 → 5	7
11.5	1.67	2	3
11.67	1	1	1
12	2.5	2 → 3	4
12.5	2.67	2 → 4	3
13	1.75	1 → 3	4
14	1.83	2	6
14.5	2	2	4
15	2.13	4 → 6	31
15.5	3.2	3 → 6	5
16	2.07	3 → 4	27
16.5	3	2 → 4	6
17	2.69	3 → 5	16
17.5	4	3 → 10	5
18	3	3 → 4	7
18.5	3	2 → 4	4
19	5.67	4 → 9	3
20	5.3	5 → 20	10
20.5	4	4	1
21	3	3	1
22	13	13	1
30	5.33	4 → 7	3

NORMAL STARS

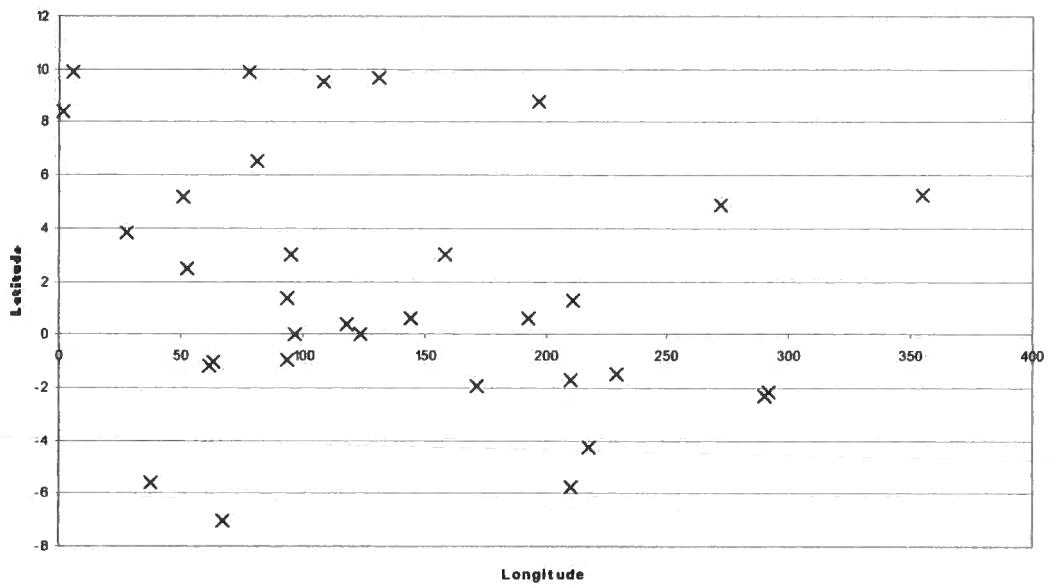
When sourcing the data to investigate acronycal risings and ideal dates it was necessary to translate the planetary texts, which could later be checked against Hermann Hunger's translations[41], almanacs and normal star almanacs.

During the translation of these it was necessary to compile a 'star catalogue'. This has been done before but not with a cuneiform description as well. The ultimate number of stars the Babylonians used is for debate, with Sachs (1974) listing 31 and Hunger and Pingree[42] 32, to name but a couple.

During my reading I needed 33 star names to fully translate all the entries I required. These were obtained using an initial list by Hunger[43] and then examining his translations for a diary containing the appropriate star so that the cuneiform could be obtained from examination of the relevant plate. It is by no means a complete listing of all the stars in the Babylonian zodiac but merely the ones I found useful to obtain and use.

Figure 14 is a plot of these 33 stars. It shows their distribution across the sky and zodiac (by longitude). It is apparent that they are not evenly distributed and there are gaps of up to 50° by longitude.

Figure 14. A plot of the 33 normal stars.



The cuneiform and Akkadian descriptions of the stars are given in their fullest form. However upon examination of the tablets it is seen that they are often shortened. For example in the entry[44]

> SAG GE_6 sin ina IGI ŠUR SI 2 K[ÚŠ...]
> beginning of the night, the moon was 2 cu[bits] in front of β Tauri

The description for β Tauri uses ŠUR SI as opposed to the full ŠUR GIGIR šá SI .

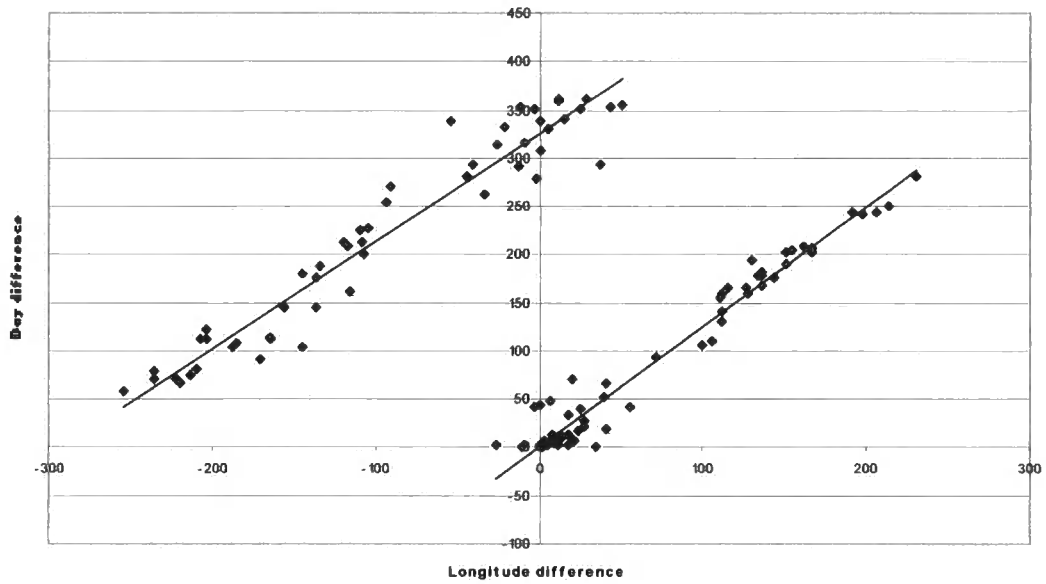
[41] ADT V5.
[42] ASM.
[43] ADT V1, 17-19.
[44] ADT V3, 53.

Also for each of the Akkadian signs there are often variations. The ones listed here are simply the most common.

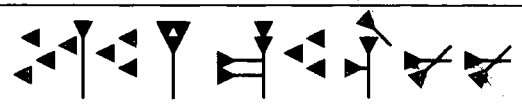
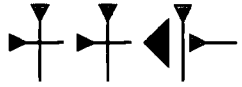
These star names, and the entries recording conjunctions with them can be used to follow the path of a planet over several cycles much more accurately than if it were identified only by zodiacal sign.

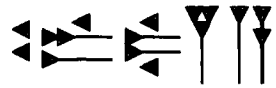
Figure 15 is a plot using entries[45] recording Mercury's position by a specific star. The lines plotted through the points, whilst being a trendline, can be used as the ecliptic, this being the path the sun takes. The data fluctuates around this line in the same way we would expect for a graph displaying the daily motion of Mercury. It shows that this format of recording a planetary position is very accurate.

Figure 15. Plot to show Mercury's daily motion using entries noting passings by the normal stars.



[45] See Appendix.

Identification	λ at 300BC	β at 300BC	Name	Akkadian	Cuneiform
η Piscium	354;52°	5;14°	Bright star of ribbon of fishes	MÚL KUR šá DUR nu-nu	
β Areitis	2;1°	8;24°	Front star of head of hired man	MÚL IGI šá SAG HUN	
α Arietis	5;40°	9;54°	Rear star of head of hired man	MÚL ár SAG HUN	
η Tauri	28;2°	3;48°	Bristle	MÚL-MÚL	
α Tauri	37;48°	-5;37°	Jaw of bull	is le_{10}	
β Tauri	50;36°	5;11°	Northern rein of chariot	ŠUR GIGIR šá SI	
ξ Tauri	52;49°	2;29°	Southern rein of chariot	ŠUR GIGIR šá ULÚ	
η Geminorum	61;31°	-1;10°	Front star of twins' feet	MÚL IGI šá še-pit MAŠ MAŠ	
μ Geminorum	63;18°	-1;3°	Rear star of twins' feet	MÚL ár šá še-pit MAŠ MAŠ	
γ Geminorum	67;7°	-7;1°	Twins star near shepherd	MAŠ MAŠ šá SIPA	
α Geminorum	78;22°	9;53°	Front twin star	MAŠ MAŠ IGI	
β Geminorum	81;38°	6;30°	Rear twin star	MAŠ MAŠ ár	

Identification	λ at 300BC	β at 300BC	Name	Akkadian	Cuneiform
η Cancri	93;27°	1;21°	Front star of crab to north	MÚL IGI šá ALLA šá SI	
θ Cancri	93;48°	-0;58°	Front star of crab to south	MÚL IGI šá ALLA šá ULÚ	
γ Cancri	95;37°	2;59°	Rear star of crab to north	MÚL ár šá ALLA šá SI	
δ Cancri	96;44°	-0;1°	Rear star of crab to south	MÚL ár šá ALLA šá ULÚ	
ε Leonis	108;43°	9;32°	Head of lion	SAG A	
α Leonis	118;1°	0;22°	King	LUGAL	
ρ Leonis	124;26°	0;1°	Small star 4 cubits behind king	MÚL TUR šá 4 KÙŠ ár LUGAL	
θ Leonis	131;25°	9;39°	Rump of lion	GIŠ KUN A	
β Virginis	144;42°	0;39°	Rear foot of lion	DELE šá IGI ABSIN	
γ Virginis	158;30°	2;59°	Single star in front of furrow	SA_4 šá ABSIN	
α Virginis	171;54°	-1;54°	Bright star of furrow	GIR ár šá A	
α Librae	193;10°	0;37°	Southern part of scales	RÍN šá ULÚ	

Identification	λ at 300BC	β at 300BC	Name	Akkadian	Cuneiform
β Librae	197;26°	8;45°	Northern part of scales	RÍN šá SI	
π Scorpii	210;11°	-5;46°	Star below head of scorpion	MÚL SIG šá SAG GIR-TAB	
δ Scorpii	210;37°	-1;41°	Middle star of head of scorpion	MÚL MURUB$_4$ šá SAG GIR-TAB	
β Scorpii	211;13°	1;18°	Upper star of head of scorpion	MÚL e šá SAG GIR-TAB	
α Scorpii	217;49°	-4;16°	Lisi	SI$_4$	
θ Ophiuchi	229;26°	-1;31°	Bright star on tip of Pabilsags arrow	MÚL KUR šá KIR4 šil PA	
β Capricorni	272;4°	4;51°	Horn of the goat-fish	SI MÁŠ	
γ Capricorni	289;43°	-2;19°	Front star of the goat-fish	MÚL IGI šá SUHUR MÁŠ	
δ Capricorni	291;28°	-2;11°	Rear star of the goat-fish	MÚL ár šá SUHUR MÁŠ	

SUMMARY

The main findings of this thesis are therefore as follows.

For determining the true meaning of Θ, one of the Greek letter phenomena, after following the presumption throughout literature since 1889 we have proved through examination of the texts of Babylonian astronomy that it relates to acronycal rising.

Evidence in the texts of mathematical astronomy show that for examples for Mars and Jupiter Θ occurs closer to closer to Φ than to Ψ which means that Θ has an elongation from the sun of less than 180° and is therefore an acronycal rising.

Evidence from the texts of non mathematical astronomy was examined for the outer planets by source then by planet, and then for Sirius. Due to the lack of data in other sources, conclusions can only be drawn for the diaries and planetary texts. The majority of their points are below 180° and for an opposition we would expect an even distribution above and below 180°. For these two sources it would therefore appear that Θ does in fact mean acronycal rising.

The results for Jupiter will be the most confident since it has by far the most amount of data. It indicates that Θ should be read as acronycal rising and is confirmed by the Mars data. Whilst it would at first appear that there is a problem with Saturn, since the average is over 180°, the values from the normal star almanacs are extreme. The fact that Saturn's elongation at Θ is greater for the predictions in the normal star almanacs than the observations in the diaries, confirms that too small a correction to the goal year period was often applied. It also indicates that the goal year periods were in actual fact used to compile the normal star almanacs. Thus for Saturn the results can be explained and still prove the case for Θ being an acronycal rising.

Data collated for Sirius shows that $\lambda_{\odot}$-λ_{Sirius} ranges from 203-207°. The data varies only over 4° in 300 years, which could be expected since Sirius does in fact move along the zodiac, although very slowly, less than 3° in 300 years. Since Sirius is located a long way from the ecliptic it has quite a large negative latitude, about -37° for the years with the necessary data. This forces the characteristic phenomena of Sirius to occur in an abnormal order. Since Θ_2 occurs before Θ_1, the elongation for an acronycal rising will in fact occur with an elongation greater than 180°, and acronycal setting less than 180°. Thus the collected data matches with what we would expect for Θ_1 for Sirius.

The other main part of this thesis investigates the ideal dates of planetary phenomena. Amongst observational records there are often comments regarding an unexpected observation or not observing a phenomenon that was expected. Unexpected observations contain a time measurement between the unexpectedly observed phenomenon and the rising/setting of the sun, accompanied with a date when the phenomenon should have occurred. Of all the information collected the greatest portion was for Mercury, thus Mercury was examined and then all the planets together.

Theoretical systems for Mercury work on the basic premise that 145 occurrences of the same phenomenon occur in 46 years. The systems are all are of type A and so use step functions of the position in the ecliptic. There are variations between each system due to distributions of the zones for each phenomena. However none of the systems use the time difference between the setting of the sun and rising of Mercury within the method. Upon examination of these systems for the other planets, found in ACT II, we can see that there is again no procedure text which describes a system that uses a time measurement to correct the date.

Examples of ideal data from the texts found a range of correction from –5 days to +3 days, with an average of -2.2 days. This range is much smaller than those for goal year texts created using almanacs and normal star almanacs and is closer to what the correction should be by modern calculation. But there is no evidence that the almanacs and NSA are calculated by anything but the basic scheme of day correction, i.e. no time measurement was required to determine what the correction would be. Thus we can conclude that the method for determining the ideal date was not the same as for compiling the almanacs and NSA.

Entries concerning ideal dates for Mercury were collected and examined separately for each phenomenon. There are 26 for Γ, 25 for Ξ, 2 for Σ and 1 for Ω. The data from the texts found a range of correction from –5 days to +3 days. This result is not conclusive but it does allow us to place upper limits on the day corrections. Up to 11°, 1 day correction; 12-16° 2 days correction; 16.5-18.5° 3 days correction; and 19-20° 4 days correction.

Combining the data for Mercury with data taken for other planets there is very general trend of a larger measurement with large day correction. It is much more varied than for Mercury, but this was to be expected since each planet will have a different system for calculating each phenomena. Due to the lack of data however, no specific limits could be placed.

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APPENDICES.

REFERENCES TO ACRONYCAL RISINGS IN DATED NORMAL STAR ALMANACS, ALMANACS AND GOAL YEAR TEXTS

NORMAL STAR ALMANACS

998 – SE 55
II. 8 AN ana ME-E A
The 8th, Mars' acronycal rising.

1008 – SE 96
V. 10 GENNA ana ME-E A
The 10th, Saturn's acronycal rising.

1010 – SE 104
[IX][46]. 3 GENNA ana ME-E A
The 3rd, Saturn's acronycal rising.

1016+1017+1018 – SE 107
X. 13 GENNA ana ME-E A
The 13th, Saturn's acronycal rising.

IX. 22 MÚL kak-ban ana ME-E A
The 22nd, Sirius' acronycal rising.

1020 – SE 111
XII. 2 GENNA ana [ME]-E A
The 2nd, Saturn's acronycal rising.

1021 – SE 116
IX 21 MÚL kak-ban ana ME-E A
The 21st, Sirius' acronycal rising.

1034+1035 – SE 157-8
VII. 22 AN ana ME-E
The 22nd, Mars' acronycal rising.

1050 – SE 187
VII. 27 AN ana ME-E A
The 27th, Mars' acronycal rising.

1052 – SE 188
VIII. 11 MÚL-BABBAR ana ME-E A
The 11th, Jupiter's acronycal rising.

1056 – SE 192
VI. 6 GENNA ana ME-E A
The 6th, Saturn's acronycal rising.

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[46] Restoration from SSB.

1057 – SE 194
X. 6 GENNA ana ME-E A
The 6th, Saturn's acronycal rising.

ALMANACS

1122 – SE 128
[VI].[47] 10 GENNA ana ME-E A
The 10th, Saturn's acronycal rising.

1127 – SE 158
X. 5 MÚL KAK BAN ana ME-E A
The 5th, Sirius' acronycal rising.

1134 – SE 178
III. 1 GENNA ana ME-E A
The 1st, Saturn's acronycal rising.

1135 – SE179
II. 23 GENNA ana ME-E-A
The 23rd, Saturn's acronycal rising.

1148+1149 – SE 198
V. 28 MÚL-BABBAR ana ME-E A
The 28th, Jupiter's acronycal rising.

1151 – SE 201
IX. 11 MÚL-BABBAR ana ME-E A
The 11th, Jupiter's acronycal rising.

X. 1 MÚL KAK BAN ana ME-E [A]
The 1st, Sirius' acronycal rising.

1152 – SE 209
[III]. 1 GENNA ana ME-E [A]
The 1st, Saturn's acronycal rising.

1160 – SE 233
V. 3 MÚL-BABBAR ana ME-E-A
The 3rd, Jupiter's acronycal rising.

1164+1165 – SE 234
IX. 8 AN ana ME-E A
The 8th, Mars' acronycal rising.

1174 – SE 236
VIII. 24 MÚL-BABBAR ana ME-E A
The 24th, Jupiter's acronycal rising.

IX. 6 AN ana ME-E A

[47] Restoration from SSB.

The 6th, Mars' acronycal rising.
IX. 27 MÚL KAK BAN ana ME-E A
The 27th, Sirius' acronycal rising.

1185 – SE 282
IX. 4 GENNA ana ME-E A
The 4th, Saturn's acronycal rising.

IX. 25 MÚL KAK BAN ana ME-E A
The 25th, Sirius' acronycal rising.

1188+1199 – SE 300
IV. 16 GENNA ME-E A
The 16th, Saturn's acronycal rising.

1195 – SE 305
VI. 21 MÚL-BABBAR ana ME-E-A
The 21st, Jupiter's acronycal rising.

VI. 21 GENNA ana ME-E-A
The 21st, Saturn's acronycal rising.

GOAL YEAR TEXTS

1228 – SE 97. Mars data for SE 18.
Line 8. [...] ... 16 AN ana ME-E ...
(Month X), the 16th, Mars' acronycal rising.

1229 – SE 105. Saturn data for SE 46.
Line 2. [...] ... APIN 30 GENNA ana ME-A ...[...]
Month VIII, the 30th, Saturn's acronycal rising.

1233 – SE 106. Jupiter data for SE 35.
Line 3. GAN 8 MÚL-BABBAR ana ME-E [A]
Month IX, the 8th, Jupiter's acronycal rising.

1236 – SE 107. Saturn data for SE 48.
Line 5. [...] ... APIN in 18 GENNA ana ME-E A ... [...]
Month IX, the 18th, Saturn's ideal acronycal rising.

1246 – SE 131. Mars data for SE 52.
Line 11. [...] ... 12 AN ana ME-E A
The 12th, Mars' acronycal rising.

1249 – SE 135. Jupiter data for SE 64.
Line 1. ... GU4 3 MÚL-BABBAR ana ME-E-A
Month II, the 3rd, Jupiter's acronycal rising.

1251 – SE 140. Jupiter data for SE 69.
Line 2. ... APIN 3 MÚL-BABBAR ana ME-E A ...
Month VIII, the 3rd, Jupiter's acronycal rising.

1253 – SE 142. Jupiter data for SE 71.

Line 4. AB 2 MÚL-BABBAR ana ME-E A [...]
Month IX, the 2nd, Jupiter's acronycal rising.

1261 – SE 158. Jupiter data for SE 87.
Line 4. [...] ... BAR in 3 MÚL-BABBAR ana ME-E [A ...]
Month I, the 3rd, Jupiter's ideal acronycal rising.

1263 – SE 160. Jupiter data for SE 43.
Line 1. ... GU4 in 26 MÚL-BABBAR ana ME-E A ...
Month II, the 26th, Jupiter's ideal acronycal rising.

1265 – SE 168. Saturn data for SE 109. Mars data for SE 89.
Line 12. ... ZÍZ in 6 [GENNA ana ME]-E A
Month XI, the 6th, Saturn's ideal acronycal rising.

Line 13. ... IZI 1 AN ana ME-E A ...
Month V, the 1st, Mars' acronycal rising.

1266 – SE 168. Mars data for SE 89.
Line 19. ... KIN in 1 AN ana ME-E A nu pap ...
Month VI, the 1st, Mars' ideal acronycal rising.

1280 – SE 187. Jupiter data for SE 116.
Obv Line 2. ... KIN in 27 MÚL-BABBAR ana ME-E A ...
Month VI, the 27th, Jupiter's ideal acronycal rising.

1283 – SE 191. Jupiter data for SE 120.
Obv Line 2. ... ZÍZ in 22 MÚL-BABBAR ana ME-E A
Month XI, the 22nd, Jupiter's ideal acronycal rising.

1291 – SE 207. Saturn data for SE 148.
Line 21. ... in 19 GENNA ana ME-E A
(Month II) The 19th, Saturn's ideal acronycal rising.

1300 – SE 245. Mars data for SE 166.
Line 19. ... GU_4 in 21 ana ME-E A ...
Month II, the 21st, Mars' ideal acronycal rising.

References to Mercury in Dated Normal Star Almanacs, Almanacs and Goal Year Texts

The format for the following translations will be
LBAT number – Year, SE
Month. Akkadian
English translation

These translations were only used to extract data from the tablets. There will undoubtedly be errors and omissions but it should be considered a working progress.

Normal Star Almanacs

998 – SE 55

II. USAN GU4-UD SIG MAŠ MAŠ ár 2 2/3 KÙŠ
...first part of the night Mercury was 2 2/3 cubits[36] below β Geminorum.

XI. 4 GU4-UD ina ŠÚ ina GU ŠÚ
The 4th, Mercury's last appearance in the west in Aquarius.

XI. 16GU4-UD ina NIM ina GU IGI.
The 13th, Mercury's first appearance in the east in Aquarius.

1008 – SE 96

V. GE6 18 USAN GU4-UD SIG DELE šá IGI ABSIN [...]
Night of the 18th, first part of the night, Mercury was below γ Virginis [...]

X. 8 GU4-UD ina ŠÚ ina MÁŠ ŠÚ
The 8th, Mercury's last appearance in the west in Capricorn.

1010 – SE 104

[IX]. 22 GU4-UD ina NIM ina PA IGI
The 22nd, Mercury's first appearance in the east in Sagittarius.

1016+1017+1018 – SE 107

III. 29 GU4-UD ina ŠÚ ina ALLA ŠÚ
The 29th, Mercury's last appearance in the west in Cancer.

X. [2]5 GU4-UD ina ŠÚ ina GU IGI
The [2]5th, Mercury's last appearance in the east in Aquarius.

XI. 18 GU4-UD ina ŠÚ ina zib ŠÚ
The 18th, Mercury's last appearance in the west in Pisces.

1019 – SE 108

IV. 10 GU4-UD ina NIM ina ALLA ŠÚ
The 10th, Mercury's last appearance in the east in Cancer.

IX. 20 GU4-UD ina ŠÚ ina MÁŠ IGI

[36] 1 cubit = 2.5°.

The 20th, Mercury's first appearance in the west in Capricorn.

1020 – SE 111

II. 7 GU4-UD ina NIM is le10 IGI DIB
The 7th, Mercury's first appearance in the east by α Tauri, passed by.

II. 26 GU4-UD ina NIM is le10 ŠÚ-šú DIB
The 26th, Mercury's last appearance in the east by α Tauri, passed by.

III. 13 GU4-UD ina ŠÚ ina ALLA IGI
The 13th, Mercury's first appearance in the west in Cancer.

IV. 24 GU_4-UD ina ŠÚ [...]
The 24th, Mercury's [last appearance] in the west in

V. 19 GU4-UD ina NIM ina A IGI
The 19th, Mercury's first appearance in the east in Leo.

VI. 12 GU4-UD ina NIM ina ABSIN ŠÚ
The 12th, Mercury's last appearance in the east in Virgo.

XI. 20 GU4-UD ina ŠÚ ina zib.ME IGI
The 20th, Mercury's first appearance in the west in Pisces.

XII. GE6 5 USAN GU4-UD SIG MÚL IGI
Night of the 5th, first part of the night, Mercury was ... below β Arietis?

XII. GE6 8 USAN GU4-UD SIG MÚL ár šá SAG HUN 2 ½ KÙS
Night of the 8th, first part of the night, Mercury was 2 ½ cubits below α Arietis.

XII. 16 GU4-UD ina ŠÚ ina HUN ŠÚ
The 16th, Mercury's last appearance in the west in Aries.

1021 – SE 116

IV. 14 GU4-UD ina ŠÚ ina A IGI
The 14th, Mercury's first appearance in the west in Leo.

IX 27 GU4-UD ina NIM ina MÁŠ IGI
The 27th, Mercury's first appearance in the east in Capricorn.

1022 – SE 120

II. 23 USAN GU4-UD SIG MAŠ MAŠ ár 2 ½ KÙŠ
The 23rd, first part of the night, Mercury was 2 ½ cubits below β Geminorum.

X. 30 GU4-UD ina NIM ina zib ŠÚ
The 30th, Mercury's last appearance in the east in Pisces.

1029+1030 – SE 146

V. 2 GU4-UD ina NIM ina A ŠÚ
The 2nd, Mercury's last appearance in the east in Leo.

VIII. 6 GU4-UD ina NIM ina PA ŠÚ
The 6th, Mercury's last appearance in the east in Sagittarius.

1034+1035 – SE 157-8

VIII. 10 GU4-UD ina ŠÚ ina PA IGI
The 10th, Mercury's first appearance in the west in Sagittarius.

IX. 2 GU4-UD ina NIM ina PA IGI
The 2nd, Mercury's first appearance in the east in Sagittarius.

IV. 5 GU4-UD ina NIM dele-bat A ŠÚ
The 5th, Mercury's last appearance in the east in Leo.

1038 – SE 172

III. GE6 1 USAN GU4-UD SIG MAŠ MAŠ IGI 3 KÙŠ
Night of the 1st, first part of the night, Mercury's first appearance 3 cubits below α Geminorum.

III. GE6 4 USAN GU4-UD SIG MAŠ MAŠ ár 2 [...]
Night of the 4th, first part of the night, Mercury was 2 [cubits] below β Geminorum.

III. GE6 13 USAN GU4-UD E MÚL ár šá ALLA šá ULU 2 SI
Night of the 13th, first part of the night, Mercury was 2 fingers above δ Cancri.

V. 2 GU4-UD ina NIM ina ALLA IGI
The 2nd, Mercury's first appearance in the east in Cancer.

X. 1 GU4-UD ina NIM ina PA IGI
The 1st, Mercury's first appearance in the east in Sagittarius.

1039 – SE 173

VIII. [...] ina ZALAG GU4-UD SIG MÚL E á SAG GÍR-TAB 2
[...] Last part of the night, Mercury was 2 cubits below β Scorpii.

VIII. 2[X] GU4-UD u AN ina SAG PA ŠÚ
The 2[x], Mercury and Mars' last appearance in the beginning of Sagittarius.

X. GU4-UD ina ŠÚ ina TIL GU ŠÚ
Mercury's last appearance in the west in the end of Aquarius.

XI. 11 GU4-UD ina NIM ina GU IGI
The 11th, Mercury's first appearance in the east in Aquarius.

XI. GE6 29 GU4-UD dele-bat SIG MÚL IGI šá SAG
Night of the 29the, Mercury was ... below β Arietis.

XII. 12 GU4-UD ina NIM ina zib ME IGI
The 12th, Mercury's first appearance in the east in Pisces.

1047 – SE 184

X. 5 GU4-UD ina NIM ina MÁŠ ŠÚ
The 5th, Mercury's last appearance in the east in Capricorn.

XI. 7 GU4-UD ina ŠÚ ina zib.ME IGI
The 7th, Mercury's first appearance in the west in Pisces.

1048 – SE 184

XII. 3 GU4-UD ina ŠÚ ina HUN ŠÚ
The 3rd, Mercury's last appearance in the west in Aries.

1051 – SE 188

I. 7 GU4-UD ina ŠÚ ... MÚL IGI
The 7th, Mercury's first appearance in the west in Taurus.

I. GE6 13 USAN GU4-UD E is le10 4 KÙŠ
Night of the 13th, first part of the night, Mercury was 4 cubits above α Tauri.

I. GE6 21 USAN GU4-UD SIG SUR GIGIR šá SI 1 KÙŠ
Night of the 21st, first part of the night, Mercury was 1 cubit below β Tauri.

I. GE6 23 USAN GU4-UD E SUR GIGIR šá ULÚ 1 2/3 KÙŠ
Night of the 23rd, first part of the night, Mercury was 1 2/3 cubits above ξ Tauri.

II. 13 GU4-UD ina ŠÚ ina MAŠ MAŠ ŠÚ
The 13th, Mercury's last appearance in the west in Gemini.

III. 17 GU4-UD ina NIM ina MAŠ MAŠ IGI
The 17th, Mercury's first appearance in the east in Gemini.

X. 8 GU4-UD ina ŠÚ ina SAG GU [ŠÚ]
The 8th, Mercury's [last] appearance in the west in the beginning of Aquarius.

X. 20 GU4-UD ina NIM ina MÁŠ IGI
The 20th, Mercury's first appearance in the east in Capricorn.

XI. 28 GU4-UD ina NIM ina GU ŠÚ
The 28th, Mercury's last appearance in the east in Aquarius.

1052 – SE 188

VII. GE6 11 ina ZALAG GU4-UD E SA4 šá [ABSIN] 2 KÙŠ
Night of the 11th, last part of the night, Mercury was 2 cubits above α Virginis.

VII. 30 GU4-UD ina NIM ina RÍN ŠÚ
The 30th, Mercury's last appearance in the east in Libra.

1056 – SE 192

VI. 24 GU4-UD ina NIM ina GÍR-TAB [...]
The 24rd, Mercury's ... in the east in Scorpius.

1057 – SE 194

II. GE6 1 USAN GU4-UD SIG ŠUR GIGIR šá [...]
Night of the 1st, first part of the night, Mercury was [...] below [ξ/β] Tauri.

II. GE6 3 USAN GU4-UD e MÚL IGI šá ULU 1 ½ [...]
Night of the 3rd, first part of the night, Mercury was 1 ½ [cubits] above ξ Tauri.

II. GE6 9 USAN GU4-UD e MÚL IGI šá še-pit MAŠ MAŠ 1 KÙŠ
Night of the 9th, first part of the night, Mercury was 1 cubit above η Geminorum.

II. GE6 11 USAN GU4-UD e MÚL ár šá še-pit MAŠ MAŠ 1 KÙŠ 4 SI
Night of the 11th, first part of the night, Mercury was 1 cubit, 4 fingers above μ Geminorum.

IV. GE6 15 ina ZALAG GU4-UD SIG MAŠ MAŠ ár 3 KÙŠ
Night of the 15th, last part of the night, Mercury was 3 cubits below β Geminorum.

IV. [2]3 GU4-UD ina NIM ina ALLA ŠÚ
The 23rd, Mercury's last appearance in the east in Cancer.

X. 3 GU4-UD ina ŠÚ ina MÀŠ IGI
The 3rd, Mercury's first appearance in the west in Capricorn.

X. 20 GU4-UD ina ŠÚ ina GU [...]
The 20th, Mercury's [last appearance] in the west in Aquarius.

XI. 8 GU4-UD ina NIM ina MÁŠ IGI
The 8th, Mercury's first appearance in the east in Capricorn.

XI. GE6 24 ina ZALAG GU4-UD e MÚL [...] MÀŠ ½ KÙŠ
Night of the 24th, last part of the night, Mercury was ½ cubit above [γ/δ] Capricorni.

XI. GE6 26 ina ZALAG GU4-UD e MÚL ár šá [...]
Night of the 26th, last part of the night, Mercury was [...] above δ Capricorni.

XII. [1]4 GU4-UD ina NIM ina TIL dele-bat GU ŠÚ
The 14th, Mercury's last appearance in the east in the end of Aquarius.

1061 – SE 210

X. 18 GU4-UD MÁŠ KUR GIR
The 18th, Mercury reached Capricorn.

1062+1063 – SE 212

III. 21 GU4-UD ina ŠÚ ina ALLA ŠÚ
The 21st, Mercury's last appearance in the west in Cancer.

IV. 19 GU4-UD ina NIM ina ALLA IGI
The 19th, Mercury's first appearance in the east in Cancer.

ALMANACS

Summaries occur at the beginning of the month, thus the date can be assumed to be the first.

1127 – SE 158

III. 23 GU4-UD A KUR-ád
The 23rd, Mercury reached Leo.

IV. dele-bat GU4-UD u AN ina RÍN
(summary) Venus, Mercury and Mars in Libra.

X. 12 GU4-UD ina NIM ina MÁŠ ŠÚ
The 12th, Mercury's last appearance in the east in Capricorn.

XI. 13 GU4-UD ina ŠÚ ina zib.ME IGI
The 13th, Mercury's first appearance in the west in Pisces.

1130 – SE 162

V. GU4-UD ina ŠÚ ina A IGI
Mercury's first appearance in the west in Leo.

VI. GU_4-UD ina ABSIN
(summary) Mercury in Virgo.

VI. 6 GU4-UD ina ŠÚ ina ABSIN ŠÚ
The 6th, Mercury's last appearance in the west in Virgo.

1134 – SE 178

II. 21 GU4-UD ina NIM is le10 ŠÚ ŠÚ-šú
The 21st, Mercury's last appearance in the east by α Tauri.

III. 13 GU4-UD ALLA KUR-ád
The 13th, Mercury reached Cancer.

IV. GU4-UD ina ALLA ... 4 GU4-UD A KUR-ád
(summary) Mercury in Cancer .... The 4th, Mercury reached Leo.

V. 20 GU4-UD ina NIM ina A IGI
The 20th, Mercury's first appearance in the east in Leo.

VI. dele-bat U GU4-UD ina A
(summary) Venus and Mercury in Leo.

VI. 12 GU4-UD ina NIM ina A ŠÚ
The 12th, Mercury's last appearance in the east in Leo.

VIII. 6 GU4-UD ina ŠÚ ina GÍR-TAB IGI
The 6th, Mercury's first appearance in the west in Scorpius.

1135 – SE179

XI. 11 GU4-UD ina ŠÚ ina zib.ME ŠÚ
The 11th, Mercury's last appearance in the west in Pisces.

1136 – SE 179

V. IZI 1 dele-bat U GU4-UD ina ALLA
Month V, the 1st, Venus and Mercury in Cancer.

V. 10 GU4-UD ina NIM ina A ŠÚ
The 10th, Mercury's last appearance in the east in Leo.

IX. 3 GU4-UD PA KUR
The 3rd, Mercury reached Sagittarius.

X. 16 GU4-UD ina ŠÚ ina GU IGI
The 16th, Mercury's first appearance in the west in Aquarius.

1137 – SE 183

III. 3 GU4-UD ina NIM is le10 IGI

The 3rd, Mercury's first appearance in the east by α Tauri.

III. 13 GU4-UD ina e? is le10 ŠÚ
The 13th, Mercury's last appearance above α Tauri.

IV. 8 GU4-UD A KUR-ád
The 8th, Mercury reached Leo.

V. 20 GU4-UD ina ŠÚ ina [...] ŠÚ-šú
The 20th, Mercury's last appearance in the west in

VIII. 29 GU4-UD ina ŠÚ ina PA IGI
The 29th, Mercury's first appearance in the west in Sagittarius.

IX. 10 GU4-UD MÁŠ KUR 14 GU4-UD ina ŠÚ ina SAG A ŠÚ
The 10th, Mercury reached Capricorn. The 14th Mercury's last appearance in the west in the beginning of Leo.

IX. 27 GU4-UD ina NIM ina RÍN IGI
The 27th, Mercury's first appearance in the east in Libra.

X. AB 1 MÚL-BABBAR u GU4-UD ina PA
Month X, the 1st, Jupiter and Mercury in Sagittarius.

XI. GU4-UD ina MÁŠ
(summary) Mercury in Capricorn.

XII. 10 GU4-UD ina ŠÚ ina zib IGI
The 10th, Mercury's first appearance in the west in Pisces.

XII. 14 GU4-UD HUN KUR
The 14th, Mercury reached Aries.

1141+1142 – SE 189

II. 12 GU4-UD ina NIM dele-bat MÚL MÚL IGI ina TIL not delebat
The 12th, Mercury's first appearance in the east in the end of Taurus.

V. 30 GU4-UD ina ŠÚ ina ABSIN ŠÚ
The 30th, Mercury's last appearance in the west in Virgo.

1148+1149 – SE 198

VII. GU4-UD ina ŠÚ dele-bat GÍR-TAB ŠÚ
Mercury's last appearance in the west in Scorpius.

VIII. 11 GU4-UD ina NIM ina GÍR-TAB IGI
The 11th, Mercury's first appearance in the east in Scorpius.

IX. [1]6 GU4-UD ina NIM ina TIL PA ŠÚ
The [1]6th, Mercury's last appearance in the east in the end of Sagittarius.

1151 – SE 201

I. 18 GU4-UD MAŠ MAŠ KUR-ád
The 18th, Mercury reached Gemini.

III. 29 GU4-UD ina ALLA [...]

The 29th, Mercury in Cancer [...]

V. 27 GU4-UD ina ŠÚ ina ABSIN ŠÚ
The 27th, Mercury's last appearance in the west in Virgo.

VII. GU4-UD u GENNA ina ABSIN
(summary) Mercury and Saturn in Virgo.

VII. 26 GU4-UD ina NIM ina TIL RÍN ŠÚ
The 26th, Mercury's last appearance in the east in the end of Libra.

IX. 13 GU4-UD ina ŠÚ ina MÁŠ IGI
The 13th, Mercury's first appearance in the wets in Capricorn.

IX. 25 GU4-UD GU KUR-ád
The 25th, Mercury reached Aquarius.

X. GU4-UD ina GU
(summary) Mercury in Aquarius.

XI. dele-bat u GU4-UD ina MÁŠ
(summary) Venus and Mercury in Capricron.

XII. 29 GU4-UD ina ŠÚ ina HUN ŠÚ
The 29th, Mercury's last appearance in the west in Aries.

1152 – SE 209

[XI].[48] 9 GU4-UD MÁŠ KUR-ád
The 9th, Mercury reached Capricorn.

[XII]. 2 GU4-UD ina NIM ina SAG ABSIN [...]
The 2nd, Mercury's [...] appearance in the east in the head of Virgo.

1153 – SE 209

II. 19 GU4-UD ina NIM ina MÚL MÚL IGI
The 19th, Mercury's first appearance in the east in Taurus.

II. 30 GU4-UD MAŠ MAŠ KUR
The 30th, Mercury reached Gemini.

III. GU4-UD ina MAŠ MAŠ
(summary) Mercury in Gemini.

III. 5 GU4-UD ina NIM ina MAŠ MAŠ ŠÚ
The 5th, Mercury's last appearance in the east in Gemini.

III. 29 GU4-UD ina ŠÚ ina [...] A IGI
The 29th, Mercury's first appearance in the west in [...] Leo.

V. 3 GU4-UD ina ŠÚ ina ABSIN ŠÚ
The 3rd, Mercury's last appearance in the west in Virgo.

IX. 12 GU4-UD ina NIM ina PA IGI

[48] Restored From SSB.

The 12th, Mercury's first appearance in the east in Sagittarius.

XI. GU4-UD GU 2 GU4-UD ina NIM ina SAG GU ŠÚ
(summary) Mercury was in Aquarius. The 2nd, Mercury's last appearance in the east in the head of Aquarius.

XII. 4 GU4-UD ina ŠÚ ina TIL zib.ME IGI 5 GU4-UD HUN KUR
The 4th, Mercury's first appearance in the west in the end of Pisces. The 5th, Mercury reached Aries.

1154+1155 – SE 209

I. dele-bat u GU4-UD ina MÚL MÚL
(summary) Venus and Mercury in Taurus.

I. 16 GU4-UD ina ŠÚ ina MÚL MÚL ŠÚ
The 16th, Mercury's last appearance in the west in Taurus.

II. 19 GU4-UD ina NIM ina MÚL MÚL IGI
The 19th, Mercury's first appearance in the east in Taurus.

II. 30 GU4-UD MAŠ MAŠ KUR
The 30th, Mercury reached Gemini.

III GU4-UD ina MA[Š-MAŠ]
(summary) Mercury in Gemini.

III. 5 GU4-UD ina NIM ina MAŠ MAŠ ŠÚ
The 5th, Mercury's last appearance in the east in Gemini.

III. GU4-UD ina ŠÚ ina SAG A IGI
Mercury's first appearance in the west by ε Leonis.

1159 – SE 226

XI. GU4-UD ina NIM ina GU IGI
Mercury's first appearance in the east in Aquarius.

XII. 15 GU4-UD zib.ME KUR-ád 22 GU4-UD ina NIM ina zib.ME ŠÚ
The 15th, Mercury reached Pisces. The 22nd, Mercury's last appearance in the east in Pisces.

1160 – SE 233[49].

II. dele-bat u GU4-UD ina MAŠ MAŠ
(summary) Venus and Mercury in Gemini.

II. 22 GU4-UD ina ŠÚ ina SAG ALLA ŠÚ
The 22nd, Mercury's last appearance in the west in the beginning of Cancer.

III. 22 GU4-UD ina NIM ina TIL MAŠ MAŠ IGI
The 22nd, Mercury's first appearance in the east in the end of Gemini.

IV. GU4-UD ina ALLA
(summary) Mercury in Cancer.

[49] Examined at British Museum.

VI. 1 GU4-UD ina ŠÚ is le10 IGI
The 1st, Mercury's first appearance in the west by α Tauri.

VII. 5 GU4-UD ina NIM ina RÍN IGI
The 5th, Mercury's first appearance in the east in Libra.

VII. 28 GU4-UD GÍR-TAB KUR
The 28th, Mercury reached Scorpius.

VIII. GU4-UD ina GÍR-TAB
(summary) Mercury in Scorpius.

IX. 21 GU4-UD ina ŠÚ ina MÁŠ IGI
The 21st, Mercury's first appearance in the west in Capricorn.

X. MÚL-BABBAR u GU4-UD ina GU
(summary) Jupiter and Mercury in Aquarius.

X. 28 GU4-UD ina NIM ina SAG GU IGI
The 28th, Mercury's first appearance in the east in the beginning of Aquarius.

XI. GU4-UD ina GU
(summary) Mercury in Aquarius.

XII. 1 GU4-UD zib KUR 5 GU4-UD ina [...]
The 1st, Mercury reached Pisces. The 5th, Mercury

1164+1165 – SE 234

VII. GU4-UD ina ABSIN
(summary) Mercury in Virgo.

VIII. GU4-UD ina ABSIN
(summary) Mercury in Virgo.

XI. 28 GU4-UD ina NIM ina GU ŠÚ
The 28th, Mercury's last appearance in the east in Aquarius.

1169 – SE 236

II. 12? GU4-UD ina NIM is le10 ŠÚ ½ SI
The 12th?, Mercury's last appearance in the east ½ finger from α Tauri.

III. 22 GU4-UD A KUR-ád
The 22nd, Mercury reached Leo.

X. 23 GU4-UD ina NIM ina MÁŠ ŠÚ
The 23rd, Mercury's last appearance in the east in Capricorn.

XI. 6 GU4-UD ina ŠÚ ina GU ŠÚ
The 6th, Mercury's last appearance in the west in Aquarius.

XI. 23 GU4-UD ina ŠÚ ina zib.ME IGI
The 23rd, Mercury's first visibility in the west (error for east) in Pisces.

XI. 28 GU4-UD HUN KUR-ád

The 28th, Mercury reached Aries.

1174 – SE 236

II. 14? GU4-UD NIM is le10 IGI
The 14th?, Mercury's first appearance in the east by α Tauri.

II. 20 GU4-UD ina NIM is le10 ŠÚ-šú DIB
The 20th, Mercury's last appearance in the east by α Tauri, ommited.

III. 15 GU4-UD ina ŠÚ ina ALLA IGI
The 15th, Mercury's first appearance in the west in Cancer.

III. 22 GU4-UD A KUR-ád
The 22nd, Mercury reached Leo.

IV. dele-bat u GU4-UD ina A
(summary) Venus and Mercury in Leo.

IV. 23 GU4-UD ina ŠÚ ina TIL A ŠÚ
The 23rd, Mercury's last appearance in the west in the end of Leo.

V. 21 GU4-UD ina NIM ina A IGI
The 21st, Mercury's first appearance in the east in Leo.

VI. GU4-UD ina A
(summary) Mercury in Leo.

VI. 3 GU4-UD ABSIN KUR-ád
The 3rd, Mercury reached Virgo.

VI. 12 GU4-UD ina NIM ina ABSIN ŠÚ
The 12th, Mercury's last appearance in the east in Virgo.

VIII. 8 GU4-UD ina NIM(error for ŠÚ) ina PA IGI
The 8th, Mercury's first appearance in the west in Sagittairus.

VIII. 23 GU4-UD ina ŠÚ ina PA ŠÚ
The 23rd, Mercury's last appearance in the west in Sagittarius.

IX. 7 GU4-UD ina NIM ina PA IGI
The 7th, Mercury's first appearance in the east in Sagittarius.

X. GU4-UD u GENNA ina PA
(summary) Mercury and Saturn in Sagittarius.

X. 8 GU4-UD MÁŠ KUR-ád
The 8th, Mercury reached Capricorn.

X. 23 GU4-UD ina NIM ina MÁŠ ŠÚ
The 23rd, Mercury's last appearance in the east in Capricorn.

XI. 23 GU4-UD ina ŠÚ ina zib.ME [...]
The 23rd, Merucury's [...] appearance in the west in Pisces.

XI. 28 GU4-UD HUN KUR-ád
The 28th, Mercury reached Aries.

XII. GU4-UD ina HUN
(summary) Mercury in Aries.

XII. 27 GU4-UD ina ŠÚ ina HUN ŠÚ
The 27th, Mercury's last appearance in the west in Aries.

1176 – SE 241

IV. 18 GU4-UD ABSIN KUR-ád
The 18th, Mercury reached Virgo.

V. GU4-UD ina ABSIN
(summary) Mercury in Virgo.

1182 – SE 247

II. GU4-UD ina MAŠ MAŠ
(summary) Mercury in Gemini.

III. 12 GU4-UD ina NIM ina MAŠ MAŠ IGI
The 12th, Mercury's first appearance in the east in Gemini.

III. 28 GU4-UD ina NIM ina MAŠ MAŠ ŠÚ
The 28th, Mercury's last appearance in the east in Gemini.

IV. 6 GU4-UD ALLA KUR
The 6th, Mercury reached Cancer.

VII. [...] GU4-UD GU KUR
[...] Mercury reached Aquarius.

IX. 3 GU4-UD ina ŠÚ ina MÁŠ IGI
The 3rd, Mercury's first appearance in the west in Capricorn.

1183 – SE 248

I. 11? GU4-UD MÚL MÚL KUR
The 11th?, Mercury reached Taurus.

I. 29 GU4-UD ALLA KUR
The 29th, Mercury reached Cancer.

VII. GU4-UD ina ABSIN
(summary) Mercury in Virgo.

IX. 7 GU4-UD ina ŠÚ ina dele-bat PA IGI
The 7th, Mercury's first appearance in the west in Sagittarius.

IX. 26 GU4-UD ina ŠÚ ina MÁŠ ŠÚ
The 26th, Mercury's last appearance in the west in Capricorn.

X. 24 GU4-UD ABSIN [...]
The 24th, Mercury [reached] Virgo.

XII_2. 24 GU4-UD ina ŠÚ ina MÚL MÚL ŠÚ
The 24th, Mercury's last appearance in the west in Taurus.

1184 – SE 254

XII2. 18 GU4-UD MÚL MÚL KUR-ád
The 18th, Mercury reached Taurus.

1185 – SE 282

VIII. 10 GU4-UD ina ŠÚ ina PA IGI
The 10th, Mercury's first appearance in the west in Sagittarius.

X. 6 GU4-UD MÁŠ KUR
The 6th, Mercury reached Capricorn.

1187 – SE 297

III. 4 GU4-UD ina NIM x [...]
The 4th, Mercury's [...] appearance in the east in Cancer.

IV. 26 GU4-UD ina NIM A KUR
The 26th, Mercury in the morning reached Leo.

VIII. 8 GU4-UD ina NIM ina TIL GÍR-TAB [...]
The 8th, Mercury's [...] appearance in the east in the end of Scorpius.

1188+1199 – SE 300

II. 17 GU4-UD ina ŠÚ ina MAŠ ŠÚ
The 17th, Mercury's last appearance in the west in Gemini.

III. 23 GU4-UD ina NIM ina MAŠ IGI
The 23rd, Mercury's first appearance in the east in Gemini.

IV. [1] GU4-UD ina ŠÚ zib [...]
The 1st, Mercury's [...] appearance in the west in Pisces.

VI. GU4-UD ina ABSIN
(summary) Mercury in Virgo.

VII. 20 GU4-UD RÍN KUR
The 20th, Mercury reached Libra.

XII?. 8 GU4-UD ina NIM ina ALLA ŠÚ
The 8th, Mercury's last appearance in the east in Cancer.

1194 – SE 305

X. 12 GU4-UD ina ŠÚ ina SAG GU IGI
The 12th, Mercury's first appearance in the west in the beginning of Aquarius.

1195 – SE 305

II. 3 GU4-UD ina ŠÚ ina SAG MAŠ MAŠ IGI
The 3rd, Mercury's first appearance in the west in the beginning of Gemini.

II. 26 GU4-UD ALLA
The 26th, Mercury (reached) Cancer.

III. dele-bat u GU4 ina ALLA
(summary) Venus and Mercury in Cancer.

III. 12 GU4-UD ina ALLA KUR
The 12th, Mercury reached Cancer.

V. GU4-UD ina ALLA
(summary) Mercury in Cancer.

V. 2 GU4-UD ina NIM ina ALLA ŠÚ
The 2nd, Mercury's last appearance in the east in Cancer.

VI. 21 GU4-UD ina NIM is le10 šá DIB
The 21st, Mercury's [...] appearance in the east near α Tauri, omitted.

VII. 5 GU4-UD ina ŠÚ is le10 šá DIB
The 5th, Mercury's [...] appearance in the west near α Tauri.

VII. 18 GU4-UD ina ŠÚ ina RÍN ŠÚ
The 18th, Mercury's last appearance in the west in Libra.

VIII. GU4-UD ina HUN
(summary) Mercury in Aries.

VIII. 15 GU4-UD GÍR-TAB KUR
The 15th, Mercury reached Scorpius.

IX. 3 GU4-UD ina ŠÚ GÍR-TAB ŠÚ
The 3rd, Mercury's last appearance in the west in Scorpius.

X. 12 GU4-UD ina ŠÚ ina SAG GÍR-TAB IGI
The 12th, Mercury's first appearance in the west in the beginning of Scorpius.

GOAL YEAR TEXTS

1220 – SE 91. Mercury data for SE 45.

Obv. Line 12. [...] X-meš BAR 21 ŠÚ šá GU_4-UD ina ŠÚ TA 17 ki pap nu IGI ina 18 ki 19 GU_4-UD ina ŠÚ ina MÚL MÚL ŠÚ

[...] Month 1, the 21st, Last visibility of Mercury in the west. From the 17th, watched for but not seen. On the 18th or 19th Mercury's last visibility in the west in Taurus.

Line 13. [...] 13? ina NIM ŠÚ-šú DIB ŠU 9 ina ŠÚ ina ALLA IGI 15 na ina 7 IGI IZI 20 ina ŠÚ ina SAG ABSIN ŠÚ nu pap

The 13th?, last appearance in the east, which passed. Month IV, the 9th, First appearance in the west in Cancer; sunset to setting of Mercury 15°. The 7th, (ideal) First appearance. Month V, the 20th, last appearance in the west in the beginning of Virgo, not seen.

Line 14. [...] IGI DU_6 17 na muš IGI x [... 1]6 ina NIM ina ABSIN ŠÚ APIN 29 ina ŠÚ ina PA IGI GAN 14 ina ŠÚ ina PA ŠÚ

[...] First appearance [...]. Month VII, 17° measured. [...]. The 16th, last appearance in the east in Virgo. Month VIII, the 29th, first appearance in the west in Sagittarius. Month IX, the 14th, last appearance in the west in Sagittarius.

Line 15. [...] ZÍZ 10 ina NIM ina MÁŠ ŠÚ 20 [...] ŠÚ ina zib.ME IGI GE_6 23 USAN GU_4-UD SIG MÚL IGI

Month XI, the 10th, last appearance in the east in Capricorn. The 20th [...] first appearance in the west in Pisces. Night of the 23rd, first part of the night, Mercury's first appearance below Taurus.

Line 16. [...] 25 USAN GU_4-UD SIG MÚL ár [...] DIR ina 10 GU_4-UD ina ŠÚ ina HUN ŠÚ ŠE DIRI

The 25th, first part of the night, Mercury below ... clouds. The 10th, Mercury's last appearance in the west in Aries. Month XII_2.

1223+1224 – SE 95. Mercury data for SE 49.

Line 10. [...] šá SI 1 ½ KÙŠ GE_6 26 USAN GU_4-UD [...] še-pit MAŠ MAŠ 1 ½ KÙŠ GE_6 2[X]

[...] 1 ½ cubits ... β Tauri. Night of the 26th, first part of the night, Mercury was 1 ½ cubits ... η/μ Geminorum. Night of the 2[x]

Line 11. [...] šá še-pit MAŠ MAŠ 1 KÙŠ 5 SI ITU GU_4 [...] USAN GU_4-UD SIG MAŠ MAŠ IGI 4 KÙŠ GE_6 16 [...]

1 cubit 5 fingers ... η/μ Geminorum. Month II [...] first part of the night Mercury was 4 cubits below α Geminorum. Night of the 16th [...]

Line 12. [...] 3 KÙŠ 27 GU_4-UD ina ŠÚ ina ALLA ŠÚ [...] šá SIG in 20 GU_4-UD ina NIM ina TIL MAŠ MAŠ IGI GE_6 2[X]

3 cubits ... The 27th, Mercury's last appearance in the west in Cancer [...] below? ? The 20th, ideal first appearance in the east in the beginning of Gemini. Night of the 2[x]

Line 13. [...] MAŠ MAŠ ár 2 ½ KÙŠ ITU ŠU [...] 1 GU_4-UD ina NIM SI?(error for HUN?) ŠÚ ITU IZI 30 GU_4-UD ina ŠÚ [...]

2 ½ cubits ... η/μ Geminorum. Month IV [...] The [x]1st, Mercury's last appearance in the east in Aries. Month V, the 30th, Mercury's [...] appearance in the west

Line 14. [...] ABSIN 10 GU_4-UD ina ŠÚ ina RÍN ŠÚ [...]ki in 7 ina NIM ina RÍN IGI GE_6 29 ina ZALAG GU_4-UD

In Virgo. The 10th, Mercury's last appearance in the west in Libra. [...] in Virgo. The 7th, ideal first appearance in the east in Libra. Night of the 29th, last part of the night, Mercury

Line 15. [...] ITU APIN 11 GU_4-UD ina NI[M ina] GÍR-TAB ŠÚ ITU GAN 22 GU_4-UD ina ŠÚ ina MÁŠ IGI 14 [...]

[...] Month VIII, the 11th, Mercury's last appearance in the east in Scorpius. Month IX, the 22nd,

Mercury's first appearance in the west in Capricorn. The 14th, [...]

Line 16. [...] ŠÚ ITU ZÍZ 2 [GU_4-]UD ina NIM ina MÁŠ ki IGI NIM A 22 na-su in

[...] Last appearance in [...] Month XI, the 2nd, Mercury's first appearance in the east in Capricorn?; it was bright; rising of Mercury to sunrise: 22°, ideal first appearance

Line 17. [..x]2 ina ZALAG GU_4-UD SI[G] MÚL ár šá SUHUR MÁŠ 2 ½ KÙŠ ITU ŠE 10 GU_4-UD [...]

[Night of the x]2nd, last part of the night, Mercury was 2 ½ cubits below δ Capricorni. Month XII, the 10th, Mercury [...]

1225 – SE 96. Mercury data for SE 50.

Obv. Line 22. [...] ... ITU BAR 7 GU_4-UD ina ŠÚ ina SAG MÚL MÚL ŠÚ IGI nu pap

[...] ... Month I, the 7th, Mercury's first appearance in the west in the beginning of Taurus, not seen.

Line 23. [...] GU_4-UD SI PA ŠÚ 1 KÙŠ GE_6 25 USAN GU_4-UD SIG ŠUR GIGIR šá SI 1 KÙŠ 4 SI
[...] Mercury was 1 cubit north of Sagittarius. Night of the 25th, first part of the night, Mercury was 1 cubit 4 fingers below β Tauri.

Line 24. [...] e ŠUR GIGIR á ULU 1 1/3 KÙŠ ITU GU_4 17 ŠÚ šá GU_4-UD ina ŠÚ
1 1/3 cubits above ξ Tauri. Month II, the 17th, Mercury's last appearance in the west.

Line 25. [...] ... pap nu IGI 13 GU_4-UD ina ŠÚ ina SAG MAŠ MAŠ ŠÚ [...]
[... watched] for by not seen The 13th, Mercury's last appearance in the west in the beginning of Gemini.

Line 26. [...] 30 na su ITU ŠU in 7 GU_4-UD ina NIM [...]
[...] Rising of Mercury to sunrise: 30°. Month IV, the 7th, Mercury's ideal [...] appearance in the east. [...]

Line 27. [...] GE_6 28 USAN GU_4-UD SIG [...]
[...] Night of the 28th, first part of the night, Mercury was ... below [...]

Line 28. [...] ITU DU_6 [...]
[...] Month VIII [...]

1232 – SE 106. Mercury data for SE 60.
Line 17. [...] ... BAR 2 GU_4-UD ina NIM [...]
[...] Month I, the 2nd, Mercury's [...] appearance in the east [...]

Line 18. [...] 27 USAN GU_4-UD SIG MAŠ MAŠ ár 2 ½ KÙŠ SIG GE_6 6 [...]
[... Night of the] 27th, first part of the night, Mercury was 2 ½ cubits below β Geminorum. Month III, night of the 6th [...]

Line 19. 3 USAN GU_4-UD SIG LUGAL ½ KÙŠ ŠU 4 GU_4-UD ina ŠÚ
[Night of the] 3rd, first part of the night, Mercury was ½ cubit below α Leonis. Month IV, the 4th, Mercury's [...] appearance in the west [...]

Line 20. A ŠÚ DU_6 11 GU_4-UD ina ŠÚ is le10 IGI DIB 26 GU_4-UD [...]
[...] Last appearance in the [...] in Leo. Month VII, the 11th, Mercury's first appearance in the west near α Tauri, passed by. The 26th, Mercury [...]

Line 21. [...] 10 KÙŠ GAN 27 GU_4-UD ina NIM ina PA ŠÚ AB 29 GU_4-UD [...]
[...] 10 cubits [...]. Month IX, the 27th, Mercury's last appearance in the east in Sagittarius. Month X, the 29th, Mercury [...]

1238 – SE 122. Mercury data for SE 76.
Line 13. [...] ... BAR 2 GU_4-UD ina ŠÚ ina MÚL MÚL IGI GE_6 6 [...]
[...] ... Month I, the 2nd, Mercury's first appearance in the west in Taurus. Night of the 6th [...]

Line 14. [...] KÙŠ GU_4-UD SIG ŠUR SI 1 ½ KÙŠ GE_6 16 USAN GU_4-UD e ŠUR ULU 1½ [...]
[...] cubits [...] Mercury was 1 ½ cubits below β Tauri. Night of the 16th, first part of the night, Mercury was 1 ½ [cubits?] above ξ Tauri. [...]

Line 15. [...] ina MAŠ MAŠ IGI GE_6 21 ina ZALAG GU_4-UD [ina ...above/below] MAŠ MAŠ IGI 5 KÙŠ 27 GU_4-UD [...]
[...] First appearance in the ... in Gemini. Night of the 21st, last part of the night, Mercury 5 cubits [above/below] alpha Gemini. The 27th, Mercury [...]

Line 16. [...] IGI 21 GU_4-UD ina ŠÚ ina ABSIN ŠÚ KIN [X]4 GU_4-UD ina NIM ina ABSIN [...]
[...] First appearance [...]. The 21st, Mercury's last appearance in the west in Virgo. Month VI, the [x]4th, Mercury's [first] appearance in the east in Virgo. [...]

Line 17. [...] 2 KÙŠ in 25 GU_4-UD ina NIM ina RÍN [...] 10 GU_4-UD ina ŠÚ ina ABSIN? IGI [...]
[...] 2 cubits [...]. The 25th, Mercury's ideal [last] appearance in the east in Libra. The 10th, Mercury's first appearance in the west in Virgo.

Line 18. [...] MÁŠ 2 KÙŠ ZÍZ 24 GU_4-UD ina NIM ina GU [...2]6 GU_4-UD [...] HUN IGI [...]
[...] 2 cubits [...]. Capricorn. Month XI the 24th, Mercury's [last] appearance in the east in Aquarius. The [2]6th Mercury's first appearance [in the west] in Aries. [...]

1243 – SE 129. Mercury data for SE 83.
Line 3. [...] ŠÚ? GU_4-UD ina ŠÚ ina TIL A IGI TUR 15 [...]
[...] ... Mercury's first appearance in the west in the beginning of Leo. The 15th [...]

Line 4. [...] GU_4-UD ina NIM ina ABSIN IGI TUR 14 30 na-su [...]
Mercury's first appearance in the east in Virgo; rising of Mercury to sunrise 14°30'. [...]

Line 5. [...] 3 [...] SUHUR GU_4-UD(error for MÁŠ) in 4 GU_4-UD ina NIM ina RÍN ŠÚ [...]
[...] 3 [...] γ/δ Capricorni. The 4th, Mercury's ideal last visibility in the east in Libra. [...]

Line 6. [...] GU_4-UD ina [...] 24 GU_4-UD ina NIM ina MÁŠ [...]
[...] Mercury in [...] 24th Mercury's [...] appearance in the east in Capricorn. [...]

Line 7. [...] MÁŠ 2 [...] 24 na GU_4-UD in 7 GU_4-UD [...]
Capricorn. 2 [...] rising of Mercury to sunset 24°; the 7th, Mercury's ideal [...]

Line 8. [...] nu pap GE_6 2[X...] GU_4-UD SIG MÚL MÚL 14 SI GE_6 27 [...]
not seen. Night of the 2[x ...] Mercury was 14 fingers below η Tauri. Night of the 27th

Line 9. [...] ina TIL MÁŠ GE_6 7 ina ZALAG HUN in 24 IGI mu 1,10 kam 1 SI LUGAL ŠÚ [...]
[...] in the beginning of Capricorn. Night of the 7th, last part of the night, Mercury was in Aries ideal first appearance on the 24th. Year 1,10 (=70) of King ....

1246 – SE 131. Mercury data for SE 85.
Line 2. [...] 13 GU4-UD ina NIM [...]
[...] The 13th, Mercury's [...] appearance in the east [...]

Line 3. [...]ŠU GE6 4 USAN GU4-UD E [...]
[...] Month IV, night of the 4th, first part of the night, Mercury was [...] above [...]

Line 4. [...] su 24 IGI KIN 18 GU4-UD ina NIM ina ABSIN [...] 17 [...]

[... rising of Mercury] to sunrise:[...°, ideal?] first appearance on the 24th. Month VI, the 18th, Mercury's [...] appearance in the east in Virgo [...]. The 17th [...]

Line 5. [...] ina PA ŠÚ nu pap GAN 12 GU4-UD ina NIM [...]
[...] Last appearance in Sagittarius, not seen. Month IX, the 12th, Mercury's [...] appearance in the east

Line 6. [...] zib.ME IGI nu pap ŠE GE6 17 USAN GU4-UD [...]
[...] First appearance in the [...] in Pisces, not seen. Month XII, night of the 17th, first part of the night, Mercury [...]

Line 7. [...] HUN ŠÚ nu pap ŠE DIRI
[...] Last appearance in the [...] in Aries, not seen. Month XII_2.

1251 – SE 140. Mercury data for SE 94.
Line 12. ... BAR 16 GU4-UD ina NIM ina HUN ŠÚ DIR nu pap GU4 19 GU4-UD ina [...]
... Month I, the 16th, Mercury's last appearance in the east in Aries, clouds, I did not watch. Month II, the 19th, Mercury (first appearance in the west[50]) in [...]

Line 13. 16 na su in 17 IGI SIG GE6 1 USAN GU4-UD SIG MAŠ MAŠ IGI 3 ½ KÙS GE6 [...]
Sunset to setting of Mercury: 17°; ideal first appearance on the 17th. Month III, night of the 1st, first part of the night, Mercury was 3 ½ cubits below α Geminorum. Night of the [...]

Line 14. SIG MAŠ MAŠ ár 2 ½ KÙS GE6 17 USAN GU4-UD E MÚL ár šá ALLA šá ULÚ 2 SI ŠU 2 [...]
2 ½ cubits below β Geminorum. Night of the 17th, first part of the night, Mercury was 2 fingers above δ Cancri. Month IV, the 2nd, [...]

Line 15. 26 GU4-UD ina NIM ina ALLA IGI 15 na su in 25 IGI IZI 12 16 na GU4-UD in [...]
The 26th, Mercury's first appearance in the east in Cancer, rising of Mercury to sunrise: 15°; ideal first appearance on the 25th. Month V, the 12th, rising of Mercury to sunrise: 16°; Mercury's ideal [...]

Line 16. ina NIM ina SAG A ŠÚ KIN 2 KAM 9 GU4-UD ina ŠÚ is le10 IGI DIB 23 GU4-UD ina ŠÚ is [...]
Last appearance in the east in the beginning of Leo. Month VI_2, the 9th, Mercury's first appearance in the west by α Tauri, passed by.

Line 17. DU6 12 GU4-UD ina NIM ina RÍN 1 ½ KÙS ár RÍN šá ULÚ 1 NIM IGI 17 MÚL(error for na) su in 10 IGI [...]
Month VII, the 12th, Mercury's first appearance in the east in Libra, 11/2 cubits behind α Librae, rising of Mercury to sunrise: 17°; ideal first appearance on the 10th. [...]

Line 18. GU4-UD SIG RÍN šá SI 2 2/3 KÚŠ APIN GE6 1 ina ZALAG GU4-UD E MÚL E šá SAG GÍR-TAB ina SI [...]
Mercury was 2 2/3 cubits below β Librae. Month VIII, night of the 1st, last part of the night, Merucry was (10 fingers[51]) above β Scorpii. [...]

[50] From Hunger (1999), 89.
[51] From Hunger (1999), 89.

Line 19. GU4-UD E SI_4 3 ½ KÚŠ 21 GU4-UD ina NIM ina PA ŠÚ nu pap GAN 27 GU4-UD ina ŠÚ ina GU IGI [...]

Mercury was 3 ½ cubits above α Scorpii. The 21st, Mercury's last appearance in the east in Sagittarius, not seen. Month IX, the 27th, Mercury's first appearance in the west in Aquarius. [...]

Line 20. AB 15 18 na GU4-UD in 18 GU4-UD ina ŠÚ ina GU ŠÚ ZÍZ 7 GU4-UD ina NIM ina GU 2(error for IGI) [...]

Month X, the 15th, rising of Mercury to sunset: 18°; the 18th, ideal last appearance in the west in Aquarius. Month XI, the 7th, Mercury's (first) appearance in the east in Aquarius. [...]

Line 21. 2/3 KÚŠ 1 NIM DIR IGI 14 30 na su ŠE 7 14 na GU4-UD in 10 GU4-UD ina NIM ina zib.ME [...]

2/3 cubit ... The 1st, first appearance in the east, passed by, rising of Mercury to sunrise: 14°30'. Month XII, the 7th, rising of Mercury to sunset: 14°; the 10th, Mercury's ideal ... appearance in the east in Pisces.

1253 – SE 142. Mercury data for SE 96.

Rev. Line 1. [...] ... BAR 7 GU4-UD ina MÚL MÚL IGI nu pap GE_6 15 USAN GU_4-UD [...]

Month I, The 7th, Mercury's first appearance in Taurus, not seen. Night of the 15th. First part of the night [...]

1260 – SE 155. Mercury data for SE 109.

Line 16. [...] ... BAR 6 GU4-UD ina ŠÚ ina MÚL MÚL 3 KÚŠ ina IGI

Month I, the 6th, Mercury's first appearance in the west 3 cubits into Taurus.

1263 – SE 160. Mercury data for SE 114.

Line 17. ... BAR 28 GU4-UD

Month I, the 28th, Mercury

Line 18. [...] GU4-UD SIG MAŠ MAŠ IGI 4 KÚŠ GE6 15 [USAN?] GU4-UD [...]

[...] Mercury was 4 cubits below α Geminorum. Night of the 15th, first part of the night, Mercury

Line 19. 10 GU4-UD ina NIM ina ALLA IGI KUR NIM A 18 [...]

The 10th, Mercury's first appearance in the east in Cancer, it was bright and high, 18 [...]

Line 20. ina ŠÚ is le10 ŠÚ ŠÚ DIB

Last appearance in the west by α Tauri, passed by.

1265 – SE 168. Mercury data for SE 122.

Line 1. [...] GE6 25 USAN [...]

[...] Night of the 25th, first part of the night [...]

Line 2. [...] GU4-UD ina NIM ina MAŠ MAŠ IGI KUR NIM 2(error for A) 19 na-su in 10 IGI

[...] First appearance in the east in Gemini, it was bright and high, rising of Mercury to sunrise: 19°; ideal first appearance on the 10th.

Line 3. [...] GU4-UD SIG MAŠ MAŠ ár 4 SI KUR 7 GU4-UD ina NIM ina ALLA ŠÚ nu pap

Mercury was 4 fingers below β Geminorum. The 7th, Mercury's last appearance in the east in Cancer, not seen.

Line 4. [...] 16 13 na GU4-UD [...1]7? GU4-UD ina ŠÚ ina ABSIN ŠÚ DIB [...] ina ABSIN RÍN(should be a date?) 15 30 na-su

The 16th, rising of Mercury to sunset: 13° [... 1]7th, Mercury's last appearance in the west in Virgo, passed by. [...] in Virgo. Libra? Rising of Mercury to sunrise: 15°30'.

Line 5. [...] GE6 20 ina ZALAG GU4-UD E SA4 šá ABSIN 1 ½ [...] 23 11 na GU4 [-UD...] GU4-UD ina NIM ina RÍN ŠÚ [...]

Night of the 20th, last part of the night, Mercury was 1 ½ [cubits] above α Virginis. [...] The 23rd, rising of Mercury to sunset, 21° [...] Mercury's last appearance in the east in Libra.

Line 6. [...] GU4-UD ina ŠÚ ina MÁŠ 1 KÚS ár dele-bat 1 NIM(error for SI?) IGI [...]ŠÚ 5 MÚL(error for GU4-UD?) ina ŠÚ

Mercury's first appearance in the west in Capricorn, 1 finger below Venus. [...] last appearance in the ... The 5th, Mercury's [first] appearance in the west

Line 7. [...] šá GÍR ABSIN nu pap IGI 15 GU4-UD ina NIM ina M[ÁŠ ... MÁŠ] 2 KÚŠ

ULÙ SIG E GENNA 1 KÚŠ ... IGI

First appearance in ? Virgo, not seen. The 15th, Mercury's [last] appearance in the east in Capri[corn ...] 2 cubits south below [...Capri]corn, 1 cubit above Saturn. [...] first appearance

Line 8. [...] 17 na-su in [...]ŠÚ GE6 20 ina ZALAG GU4-UD [...] nun ŠÚ 14 17 KUR(na?) GU4-UD in 17 GU4-UD ina ZALAG(NIM?) ina ALLA [...] 23

Rising of Mercury to sunrise: 17°; ideal last appearance [...] Night of the 20th, last part of the night, Mercury's last appearance, ... the 14th, rising of Mercury to sunset: 17°; the 17th, ideal ... appearance in the east in Cancer. [...] 23

1266 – SE 168. . Mercury data for SE 122.

Line 5. [...] ... BAR 2 GU4-UD ina ŠÚ ina MÚL [...]

Month I, the 2nd, Mercury's ... appearance in the west in Taurus

Line 6. [...] GU4-UD SIG ŠUR-GIGIR šá SI 1 ½ KÚŠ GE6 15 ina ZALAG [...]

[...] Mercury was 1 ½ cubits below β Tauri. Night of the 15th, last part of the night

Line 7. [...] šá se-pit MAŠ MAŠ 1 ½ KÚŠ GE6 23 USAN [...]

[...] 1 ½ cubits [...] η/μ Geminorum. Night of the 23rd, first part of the night [...]

Line 8. [...] 4 KÚŠ GU4 8 GU4-UD ina ŠÚ ina MAŠ [...]

[...] 4 cubits [...] Month II, the 8th, Mercury's ... appearance in the west in Gemini.

Line 9. [... GU4]-UD SIG MAŠ MAŠ IGI 5 KÚŠ [...] ina ZALAG GU4-UD SIG MAŠ MAŠ [...]

[...]Mercury was 5 cubits below α Geminorum. [...] last part of the night, Mercury was below α/β Geminorum. [...]

Line 10. [...] ABSIN IGI nu pap [...] GU4-UD in 18 GU4-UD ina ŠÚ [...]

[...] First appearance [...] in Virgo, not seen. [...] Mercury was [...] the 18th, Mercury's ideal ... appearance in the west [...]

Line 11. [...] SA4 šá ABSIN 1 ½ KÚŠ DU6 23 11 [...]
[...] 1 ½ cubits [...] α Virginis. Night of the 23rd, 11 [...]

Line 12. [...] 11 NIM IGI KUR NIM A 15 na su in 1[...]
[...] The 11th, first appearance in the east, it was bright and high, rising of Mercury to sunrise: 15°; ideal [first appearance] on the [1..]

Line 13. [...] 1 KÚŠ GU4-UD ina NIM ina MÁŠ 1 KÚŠ ár SI MÁŠ [...]
[...] 1 cubit [...] Mercury was I cubit in the east of Capricorn, below β Capricorni. [...]

Line 14. [...] A 16 na-su in 12 IGI GE6 20 ina ZALAG GU4-UD [...]
[it was h]igh, rising of Mercury to sunrise: 16°; ideal first appearance on the 12th. Night of the 20th, last part of the night, Mercury [...]

Line 15. [...] 23 USAN GU4-UD ina ŠÚ ina TIL HUN 1 ½ KÚŠ ina IGI MÚL ...
[...]
[night of] the 23rd, first part of the night, Mercury's first appearance in the west, 1 ½ cubits in the beginning of Aries.

1267 – SE 168. Mercury data for SE 122.
Line 13. [...] ina HUN IGI ? 8 na-su in 28 IGI ...
[...] First appearance in .. in Aries, (weather?), rising of Mercury to sunrise: 8°; ideal first appearance on the 28th.

Line 14. [...] GU4-UD E is le10 3 ½ KÚŠ GE6 11
[...] Mercury was 3 ½ cubits above α Tauri. Night of the 11th

Line 15. [...] šá ULÚ 1 ½ KÚŠ GE6 21 USAN GU4-UD
1 ½ cubits ... θ/δ Cancri. Night of the 21st, first part of the night, Mercury

Line 16. [...] pit MAŠ MAŠ 1 ½ KÚŠ GE6 27 USAN GU4-UD
1 ½ cubits ... η/μ Geminorum. Night of the 27th, first part of the night, Mercury

1269+1270 – SE 171. Mercury data for SE 125.
Line 14. ... BAR 25 GU_4-UD ina NIM is le10 IGI DIB GU_4 9 GU_4-UD
Month I, the 25th, Mercury's first appearance in the east by α Tauri, passed by. Month II, the 9th, Mercury's

Line 15. [...] ŠÚ ina ALLA IGI KUR 15 na-su in 2 IGI GE_6 16 USAN GU_4-UD SIG SAG A 4 KÚŠ GE_6 21 [...]
first appearance in the west in Cancer, it was bright, rising of Mercury to sunrise: 15°; the 2nd, ideal first appearance. Night of the 16th, first part of the night, Mercury was 4 cubits below ε Leonis. Night of the 21st [...]

Line 16. [...] 14 ŠÚ šá GU_4-UD ina ŠÚ ina A TA 12 DIR nu pap IGI IZI 14 GU_4-UD ina NIM ina A 3 KÚŠ ár LUGAL 1 NIM(SI?)
The 14th, setting of Mercury in the west in Leo. From the 12th, clouds, first appearance not seen. Month V, the 14th, Mercury 3 cubits in the east of Leo, 1 finger below α Leonis.

Line 17. [...] 18 na-su in 9 IGI KIN 1 11 na GU_4-UD in 2 GU_4-UD ina NIM ina RÍN SA_4 ABSIN ŠÚ APIN 1 GU_4-[UD...]
[...] Rising of Mercury to sunrise: 18°, ideal first appearance on the 9th. Month VI, the 1st, rising of Mercury to sunset: 11°; the 2nd, Mercury's ideal last appearance in the east by α Virginis. Month VIII, the 1st, Mercury's [...]

Line 18. [...] GÍR-TAB ina IGI šamáš aná ŠÚ-ú ana ŠÚ DU IGI KUR NIM A 15 na-su in 28 šá DU_6? IGI 14 ŠÚ šá GU_4-UD ina ŠÚ ina PA [...]
[...] First appearance in Scorpius ... it was bright and high, rising of Mercury to sunrise: 15°; the 28th of Month VII, ideal first appearance in Sagittarius. The 14th, Mercury's last appearance in the west in Sagittarius. [...]

Line 19. [...] GU_4-UD ina NIM ina GÍR-TAB IGI KUR NIM A 16 na-su in 24 IGI GAN GE_6 8 ina ZALAG GU_4-UD E MÚL MÚL [...]
[...[Mercury's first appearance in the east in Scorpius, it was bright and high, rising of Mercury to sunrise: 16°; the 24th, ideal first appearance. Month IX, night of the 8th, last part of the night, Mercury was [...] above η Tauri [...].

Line 20. [...] KÚŠ AB 8 GU_4-UD ina NIM ina MÁŠ ŠÚ nu pap ZÍZ 14 GU_4-UD ŠÚ ŠÚ ina zib.ME 2 ½ KÚŠ ár dele-bat 1 [...]
[...] cubits ... Month X, the 8th, Mercury's last appearance in the east in Capricorn, not seen. Month XI, the 14th, Mercury was 2 ½ cubits in the west of Pisces, 1 [...] below Venus.[...]

Line 21. [...] NIM A 16 na-su in 12 IGI ŠE in 1 GU_4-UD ina ŠÚ ina TIL ABSIN ina ŠÚ nu pap
[...] it was high, rising of Mercury to sunset: 16°; the 12th, ideal first appearance. Month XII, the 1st, Mercury's ideal last appearance in the west in the end of Virgo, not seen.

1277 – SE 186. Mercury data for SE 140.
Line 14. [...] 6 GU_4-UD ina NIM ina HUN ŠÚ nu pap GU_4 2 GU_4-UD ina ŠÚ ina MAŠ MAŠ IGI [...]
[...] The 6th, Mercury's last appearance in the east in Aries, not seen. Month II, the 2nd, Mercury's (first) appearance in the west in Gemini. [...]

Line 15. [...] USAN GU_4-UD SIG MAŠ MAŠ ár 2 ½ KÙŠ GE_6 16 USAN [...]
[...] First part of the night, Mercury was 2 ½ cubits below β Geminorum. Night of the 16th, first part of the night [...]

Line 16. [...] TA 28 aná SIG zib nu pap IGI 26 GU_4-UD ina NIM [...]
From the 28th to month III, first appearance in Pisces, not seen. The 26th Mercury's ... appearance in the east

Line 17. [...] 17 GU_4-UD ina NIM ina SAG A ŠÚ ŠU 9 GU_4[-UD ...]
The 17th, Mercury's last appearance in the east in the beginning of Leo. Month IV, the 9th, Mer(cury) [...]

Line 18. [...] ina RÍN IGI KUR 14 na-su in 8 IGI GE_6 17 [...]
[...] First appearance in Libra, rising of Mercury to sunrise: 14°; ideal first appearance on the 8th. Night of the 17th [...]

Line 19. [...] GE_6 5 ina ZALAG GU_4-UD e SI_4 3 ½ KÚŠ [...]
[...] Night of the 5th, last part of the night, Mercury was 3 ½ cubits above α Scorpii. [...]

Line 20. [...] IGI ZÍZ 18 GU_4-UD ina ŠÚ ina TIL MÁŠ [...]
[...] First appearance [...] Month XI, the 18th, Mercury's [...] in the west in the beginning of Capricorn. [...]

1285 – SE 194. Mercury data for SE 148.

Line 20. ... BAR 26 GU_4-UD [...] šá 20 NIM A 16 na-su in [...]

Month I, the 26th, Mercury ... 20th, in east Leo, rising of Mercury to sunrise:16°; ideal [...]

Line 21. GU_4 GE_6 2 USAN GU_4-UD SIG SUR GIGIR šá SI 1 ½ KÚŠ [...] (ina ZAL)AG GU_4-UD e SUR GIGIR šá ULÚ [...]

Month II, night of the 2nd, first part of the night, Mercury was 1 ½ cubits below β Tauri [... last] part of the night, Mercury was [...] above ξ Tauri.

Line 22. GE_6 9 USAN GU_4-UD e MÚL IGI šá še-pit MAŠ MAŠ 1 KÚŠ 4 SI [...] 4 [...] GE_6 11 USAN [...]

Night of the 9th, first part of the night, Mercury was 1 cubit, 4 fingers above η Geminorum [...] 4 [...] night of the 11th, first part of the night [...]

Line 23. e MÚL ár šá še-pít MAŠ MAŠ 1 KÙŠ 4 SI GE_6 15 USAN GU_4-UD [...] šá SIPA 4 ½ KÙŠ [...]

1 cubit 4 fingers above μ Geminorum. Night of the 15th, first part of the night, Mercury [...] 4 ½ cubits [...] γ Geminorum.

Line 24. [...] ina MAŠ MAŠ TA 1 ki pap nu IGI ŠU 7 GU_4-UD ina e ina MAŠ MAŠ IGI [...] in 4 [...]

Stationary in Gemini. From the 1st, watched for but not seen. Month IV, the 7th, Mercury above α Geminorum [...] ideal on the 4th [...]

Line 25. 23 GU_4-UD ina NIM ina ALLA ŠÚ nu pap KIN 4 GU_4-UD ina ŠÚ ina ABSIN IGI ... 11 [...]

The 23rd, Mercury's last appearance in the east in Cancer not seen. Month VI, the 4th, Mercury's first appearance in the west in Virgo. ... 11 [...]

Line 26. ina ŠÚ ina SAG RÍN TA 16 ki nu pap IGI DU_6 18 GU_4-UD ina NIM ina SAG A RIN 1 ½ (error for ŠÚ?)

in the west in the start of Libra, from the 16th, watched for but not seen. Month VII, the 18th, Mercury's last appearance in the east in the start of Libra ...[

Line 27. 1 KÙŠ 1 SI NIM IGI KUR NIM A 17 na-su in 14 IGI APIN 16 12 na [...]

1 cubit 1 finger [...] it was bright and high, rising of Mercury to sunrise: 17° ... ideal first appearance on the 14th. Month VIII, the 16th, rising of Mercury to sunrise: 12° [...]

Line 28. ina NIM ina GÍR-TAB ŠÚ AB 5 GU_4-UD ina ŠÚ ina MÁŠ IGI KUR 15 30 na-su in 13 IGI [...]

last appearance in the east in Scorpius. Month X, the 5th(error for 15?), Mercury's first appearance in the west in Capricorn, it was bright, rising of Mercury to sunrise: 15°30'; ideal first appearance on the 13th. [...]

Line 29. ina GU TA 20 ki nu pap IGI ZÍZ 10 GU_4-UD ina NIM ina MÁŠ 3 KÙŠ ár SI MÁŠ 1 ½ KÙŠ [...]

in Aquarius, from the 20th, watched for but not seen. Month XI, the 10th, Mercury was 3 cubits east in Capricorn, 1 ½ cubits below β Capricorni.

Line 30. 1 KÙŠ IGI KUR 17 na-su in 8 IGI GE_6 25 ina ZALAG GU_4-UD e MÚL IGI šá SUHUR MÁŠ ½ [...]

first appearance 1 cubit [...], it was bright, rising of Mercury to sunrise: 17°; ideal first appearance on the 8th. Night of the 25th, last part of the night, Mercury was ½ [...] above γ Capricorni.

Line 31. GE_6 27 ina ZALAG GU_4-UD SIG E MÚL ár šá SUHUR MÁŠ ½ KÙŠ GU_4-UD 2/3 KÙŠ [...] 17 ŠÚ šá GU_4

Night of the 27th, last part of the night, Mercury was ½ cubit above δ Capricorni, Mercury being 2/3 cubit [...] 17th, last appearance of Mercury [...].

Line 32. zib TA 14 ina TIL GU ki nu pap IGI DIRI ŠE 23 GU_4-[UD ...] MÚL MÚL IGI KUR SAG [...]

in Pisces, from the 14th, watched for in the beginning of Aquarius but not seen. Month XII_2, the 23rd, Mercury [...] first appearance [...] Taurus, it was bright

Line 33. 7 na-su in 20 ina TIL HUN IGI GE_6 29 USAN [...] 4 KÙŠ

Rising of Mercury to sunrise: 7; the 20th, ideal first appearance in the end of Aries. Night of the 29th, first part of the night [...] 4 cubits.

1287 – SE 198. Mercury data for SE 152.

Line 15. ... BAR in 2 GU_4-UD ina NIM is le10 IGI DIB [...] 20 GU_4-UD ina NIM [...]

Month I, the 2nd, Mercury's ideal first appearance in the east by α Tauri, passed by. ... The 20th, Mercury in the east [...]

Line 16. [...] ina ŠÚ ina MAŠ MAŠ IGI nu pap GE_6 24 USAN GU_4-UD SIG MAŠ MAŠ ár 2 ½ KÙŠ SIG GE_6 [...]

[...] first appearance in the west in Gemini, not seen. Night of the 24th, first part of the night, Mercury was 2 ½ cubits below β Geminorum. Month III, night of the [...]

Line 17. [...] 2/3 KÙŠ GE_6 12 USAN GU_4-UD SIG SAG A 4 KÙŠ ŠU 2 ŠÚ šá GU_4-UD [...]

[...] 2/3 cubit [...] Night of the 12th, first part of the night, Mercury was 4 cubits below ε Leonis. Month IV, the 2nd, Last appearance of Mercury [...]

Line 18. [...] 27 GU_4-UD ina NIM ina TIL ALLA 1 KÙŠ ina IGI sin aná ŠÚ IGI KUR NIM A IGI

The 27th, Mercury's first appearance in the east in the end of Cancer. 1 cubit in front of the moon ... it was bright and high.

Line 19. [...] 4 SI in 17 (or 27?) GU_4-UD [...] šá ŠÚ nu pap ki in 13 [...]

[...] 4 fingers [...] ideal on the 17th, Mercury [...] in the west, not seen, ideal on the 13th.[...]

Line 20. ŠÚ-šú DIB APIN 14 GU_4-UD ina NIM ina GÍR-TAB IGI KUR NIM A 17 30 na [...]

[...] last appearance, passed by. Month VIII, the 14th, Mercury's first appearance in the east in Scorpius, it was bright and high, rising of Mercury to sunset: 17 °30' [...]

Line 21. [...] KÙŠ GAN GE_6 4 ina ZALAG GU_4-UD e MÚL KUR šá KIR_4 šil PA [...]

[...] cubits [...] Month IX, night of the 4th, last part of the night, Mercury was above θ Ophiuchi. [...]

Line 22. [...] 1 GU_4-UD ina ŠÚ ina SAG zib.ME IGI KUR NIM A 14 [...]

[...] The 1st, Mercury's first appearance in the west in the start of Pisces, it was bright and high, [rising of Mercury to sunset]: 14° [...]

Line 23. [...] ŠÚ nu pap [...] GU_4-UD ina NIM ina zib.ME IGI KUR NIM A [...]

Last appearance (in the west) [...] not seen. [...] Mercury's first appearance in the east in Pisces, it was bright and high. [...]

1291 – SE 207. Mercury data for SE 161.

Line 10. ... BAR 21 GU_4-UD ina ŠÚ ina MÚL MÚL 1 KÙŠ ár [...] 11 NIM DU 8 SI 1 SI NIM IGI

... Month I, the 21st, Mercury was 1 cubit west of η Tauri, below [...] ...

Line 11. [... n]a-su in 19 IGI GE_6 26 USAN GU_4-UD SIG SUR GIGIR šá SI 1 KÙŠ 4 SI GE_6 28 USAN GU_4-UD E

[... Ris]ing of Mercury to sunrise [...] ideal first appearance on the 19th. Night of the 26th, first part of the night, Mercury was 1 cubit, 4 fingers below β Tauri. Night of the 28th, first part of the night, Mercury was above

Line 12. [...] KÙŠ GU_4 20(30?) GE_6 5 USAN GU_4-UD E MÚL IGI šá še-pít MAŠ MAŠ 2 KÙŠ GE_6 7 USAN GU_4-UD MÚL ár

[...] Cubits [...] Month II. Night of the 5th, first part of the night, Mercury was 2 cubits above η Geminorum. Night of the 7th, first part of the night, Mercury was [...] μ (Geminorum)

Line 13. [...] GE_6 10 USAN GU_4-UD E MAŠ MAŠ šá SIPA 4 ½ KÙŠ GE_6 20 [...] GU_4-UD SIG MAŠ MAŠ IGI 4 KÙŠ GE_6 23

[...] Night of the 10th, first part of the night, Mercury was 4 ½ cubits above γ Geminorum. Night of the 20th, [...] Mercury was 4 cubits below α Geminorum. Night of the 23rd

Line 14. [...] ár 4 KÙŠ SIG 2 ½ šá(4?) GU_4-UD ina ŠÚ ina TIL MAŠ MAŠ TA 20 [...] IGI ŠU 1 GU_4-UD ina NIM ina MAŠ MAŠ [...]

4 cubits ... 2 ½ cubits below. The 4th, Mercury in the west in the end of Gemini, from the 20th, (watched for but) not seen. Month IV, the 1st, Mercury's [...] appearance in the east in Gemini.

Line 15. KÙŠ 1 ULÚ SIG IGI KUR 16 na-su in 27 šá SIG [...] MÚL SIG MAŠ MAŠ IGI 5 ½ KÙŠ

First appearance [...] cubit [...], 1 finger below, it was bright, rising of Mercury to sunrise: 16°; the 27th of Month III, ideal (first appearance) [...] 5 ½ cubits below α Geminorum.

Line 16. [...] MAŠ MAŠ ár 4 KÙŠ 13 14 na šá GU_4-UD in 16 GU_4[-UD ...] 26 GU_4-UD ina ŠÚ

[...] 4 cubits [...] β Geminorum. The 13th, rising of Mercury to sunset: 14°; ideal on the 16th, Mercury's [...] the 26th, Mercury in the west

Line 17. [...] 22 GU_4-UD ina ŠÚ is le10 ŠÚ ŠÚ DIB DU_6 14 GU4-UD ina NIM [...] su in 13 IGI

[...] The 22nd, Mercury's last appearance in the west by α Tauri, passed by. Month VII, the 14th, Mercury in the east [... rising of Mercury to sunset ...] ideal first appearance on the 13th.

Line 18. [...] ina NIM ina GÍR-TAB ŠÚ DIR nu pap AB 1 GU_4-UD ina ŠÚ ina GU šá 1 2/3 KÙŠ ár [...] su in 28

[...] last appearance in the east in Scorpius, clouds, not seen. Month X, the 1st, Mercury was 1 2/3 cubit in the west of Aquarius, [...] below [... rising of Mercury to sunrise ...] ideal on the 28th.

Line 19. [...] ina ŠÚ GU ŠÚ DIR nu pap ZÍZ 4 GU_4-UD ina NIM ina MÁŠ IGI DIR nu pap GE_6 18 [...] E MÚL IGI

[...] last appearance in the west in Aquarius, clouds, not seen. Month XI, the 4th, Mercury's first appearance in the east in Capricorn, clouds, not seen. Night of the 18th [...] above δ [Capricorni]

Line 20. [...] ina ZALAG GU_4-UD E MÚL ár šá SUHUR MÁŠ 1 KÙŠ 27 16 na GU_4-UD [...]
[...] Last part of the night, Mercury was 1 cubit above δ Capricorni. The 27th, rising of Mercury to sunset: 16°, Mercury [...]

1294 – SE 222. Mercury data for SE 176.
Line 9. ... BAR in 11 GU_4-UD ina ŠÚ ina MÚL MÚL ŠÚ DIR nu pap GU_4 23 GU_4-UD ina NIM ina TIL ina MÚL MÚL IGI [...]

Month I, the 11th, Mercury's ideal last appearance in the west in Taurus, clouds, not seen. Month II, the 23rd, Mercury's first appearance in the east in the end of Taurus. [...]

Line 10. [...] 29 GU_4-UD ina NIM ina MAŠ MAŠ ŠÚ nu pap ŠU 2 GU_4-UD ina ŠÚ ina A IGI 15 na-su in 1 IGI IZI [...]
The 29th, Mercury's last appearance in the east in Gemini, not seen. Month IV, the 2nd, Mercury's first appearance in the west in Leo, rising of Mercury to sunrise: 15°; ideal first appearance on the 1st. Month V

Line 11. [...] KIN 1 GU_4-UD u AN ina ABSIN 2 KÙŠ 8 SI ár GÍR ár šá A IGI KUR NIM 2(A) 17 na-su in 28 [...]
[...] Month VI, the 1st, Mercury and Mars first appearance 2 cubits, 8 fingers in Virgo, below β Virginis, it was bright and high, rising of Mercury to sunrise:17°, ideal on the 28th (of month V).

Line 12. [...] GU_4-UD ina NIM ina SAG A ŠÚ APIN 19 GU_4-UD ina ŠÚ ina PA IGI 16 na-su in 18 IGI [...]
[...] Mercury's last appearance in the east in the start of Leo. Month VIII, the 19th, Mercury's first appearance in the west in Sagittarius, rising of Mercury to sunrise: 16°; ideal first appearance on the 18th.

Line 13. [...] GU_4-UD ina NIM [...] IGI dele-bat 1 ½ IGI [...] na-su in 15 IGI NIM GE6 16 [...]
Mercury in the east [...] visible 1 1/2 (cubits) in front of Venus [...] rising of Mercury to sunrise: ...; ideal first appearance on the 15th. Night of the 16th [...]

Line 14. [...] GU_4-UD ina ŠÚ ina HUN 2 KÙŠ SIG MÚL IGI šá SAG HUN ŠÚ [...]
[...] Mercury's last appearance in the west in Aries, 2 cubits below β Arietis. [...]

Line 15. [...] 3 KÙŠ GE6 9 USAN GU_4-UD SIG MÚL [...] šá [...]
[...] 3 cubits [...] night of the 9th, first part of the night, Mercury was below [...]

1300 – SE 245. Mercury data for SE 199.
Line 14. [...] ... še in 5 GU_4-UD ina NIM ina GU IGI
... Month XII, the 5th, Mercury's ideal first appearance in the east in Aquarius.

Line 15. [...] 24 16 30 na GU_4-UD in 28 GU_4-UD ina [...] ... ŠÚ
... the 24th, 16° 30' na Mercury. Ideally on the 28th.

REFERENCES TO IDEAL DATES OF PLANETARY PHENOMENA, EXCLUDING MERCURY, IN DATED GOAL YEAR TEXTS

1249 – SE 135. Jupiter data for SE 64.
Line 2. ... APIN dele-bat 14 na MÚL-BABBAR in 12 MÚL-BABBAR ina GÍR-TAB ŠÚ
Month VIII, rising of Jupiter to sunset: 14°; the 12th, Jupiter's ideal last appearance in Scorpius.

Line 3. GAN 14 MÚL-BABBAR ina TIL GÍR-TAB IGI 13 na su in 12 IGI
Month IX, the 14th, Jupiter's first appearance in the beginning of Scorpius, rising of Jupiter to sunrise 13°; the 12th, ideal first appearance.

Line 10. SIG 20 7 30 na dele-bat in 22 dele-bat [...] ina ALLA ŠÚ
Month III, the 20th, rising of Venus to sunset: 7°30'; the 22nd, Venus' ideal last appearance in the ... in Cancer.

1251 – SE 140. Venus data for SE 132.
Line 11. ... 30 dele-bat ina zib.ME IGI KUR NIM A 8 na su in 29 IGI
The 30th, Venus' first appearance (in the east[52]) in Pisces, it was bright and high, rising of Venus to sunrise: 8°; ideal first appearance on the 29th.

1263 – SE 160. Venus data for SE 152.
Line 5. ... GU4 1 8 20 na dele-bat in 3 ina nu ina ŠÚ dele-bat MÚL MÚL ŠÚ
Month II, the 1st, rising of Venus to sunset: 8°20'; the 3rd, ideal last appearance in the west in the beginning of Taurus.

Line 6. ... KUR? dele-bat 30 na su in 13 IGI ...
Rising of Venus to sunset: 30°; ideal first appearance on the 13th.

Line 16. ... AB 2[X] 8 na dele-bat in 26 dele-bat ina NIM ina SAG GU ŠÚ
Month IX, the 2[x]th, rising of Venus to sunset: 8°; the 26th, Venus' ideal last appearance in the east in the beginning of Aquarius.

1265 – SE 168. Saturn data for SE 109.
Line 9. ... 30 [...] A 17 na-su in 26 šá KUR HUN IGI
The 30th, Saturn's [...] ..., rising of Saturn to sunrise: 17°; the 26th, ideal first appearance in ? Aries.

Line 11. ... 15 30 na-su in 11 IGI ...
The 15th, rising of Saturn to sunrise: 30°, ideal first appearance on the 11th.

1266 – SE 168. Saturn data for SE 109.
Line 17. ... IZI 1 NIM IGI 15 30 na-su in 11 IGI ...
Month V, the 1st, (Saturn's) first appearance in the east, rising of Saturn to sunrise: 15°30'; ideal first appearance on the 11th.

1269+1270 – SE 171. Venus data for SE 163. Mars data for SE 92.
Line 6. ... ŠU 1 12 na dele-bat in 6 dele-bat ina ŠÚ ina SAG A ŠÚ [...]

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[52] From Hunger (1999), 89.

Month II, the 1st, rising of Venus to sunset: 12°; the 6th, Venus' ideal last appearance in the west in the start of Leo.

Line 13. ... ŠE 16 9 na dele-bat in 20 dele-bat ina NIM zib.ME ŠÚ
Month XII, the 16th, rising of Venus to sunset: 9°; the 20th, Venus' ideal last appearance in the east in Pisces.

Line 25. ... ŠU 8 16 na šá AN in 30 ina NIM? ina A ŠÚ
Month IV, the 8th, rising of Mars to sunset: 16°; the 30th, ideal last appearance in the east in Leo.

1287 – SE 198. Venus data for SE 190.
Line 10. ... KIN 1 5 na su dele-bat in 3 dele-bat ina ŠÚ ina SAG RÍN ŠÚ...
Month VI, the 1st, rising of Venus to sunrise: 5°; the 3rd, Venus' ideal last appearance in the west in the start of Libra.

1291 – SE 207. Mars data for SE 128.
Line 25. ... [1]5 18 na AN in 11 AN GÍR-TAB ŠÚ ...
(Month VII) The 15th, rising of Mars to sunset:18°; the 11th, Mars' ideal last appearance in Scorpius.

ACRONYCAL RISING ENTRIES FOR JUPITER.

KEY AIII = Alexander III. ARII = Artaxerxes II. ARIII = Artaxerxes III. DI = Darius I. DIII = Darius III. NEII = Nebuchadnezzar II.

Source	Page	Year, SE	Month	Date	Date, BC	Jupiter longitude	Sun longitude	$\lvert\lambda_{\odot}-\lambda_{J}\rvert$	Comments
D V1	249	9	VII	4	303.75	5.319	183.8	178.481	Previous entry 7th, next 16th
D V1	343	38	XII	16	273.216	175.954	354.957	179.003	Around
D V1	141	ARIII-1	XI	15	357.1244	145.54	323.627	178.087	
D V1	147	ARIII-12	X	20	346.0548	119.479	297.215	177.736	
D V1	47	NII-37	I	11,12	568.3388	219.649	35.755	176.106	Says [11th] or 12th in diary
D V2	71	66	IV	8	246.5219	282.356	101.7	179.344	
D V2	151	93	VIII	7	219.8416	41.015	218.803	177.788	
D V2	185	102	V	1	210.5603	298	115.434	177.434	Date 1/2, before is broken away, next entry 3rd.
D V2	189	103	V	22	209.6667	333.848	155.153	181.305	I did not watch
D V2	221	110	XIII	30	201.2884	202.379	21.631	179.252	Says 30?
D V2	235	113	IV	4	199.4824	267.167	88.908	181.741	Around
D V2	413	133	XII	21	178.2297	180.594	359.811	179.217	Around
D V2	441	140	VIII	2	172.8048	25.992919	205.17482	179.181	Around
D V3	37	150	V	15	162.6217	318.476	138.103	179.627	Around
D V3	115	170	I	12	142.2637	193.834	12.688	178.854	Around
D V3	117	170	I	12	142.2637	193.834	12.688	178.854	Around
D V3	135	171	I	27	141.3553	224.898	45.067	180.169	Around
P	289	12	X	18	299.0192	106.419	284.695	178.276	Says J[upiter's acronycal rising]
P	291	13	X	28	298.0998	137.178	314.614	177.436	I did not watch
P	291	14	XII	13	297.1941	167.057	346.974	179.917	
P	291	15	XIII	25	296.2747	197.765	15.843	178.078	I did not watch
P	293	21	VI	23	291.7664	10.401	189.916	179.515	
P	301	23	IX	19	289.9386	79.565	254.499	174.934	Says acronycal [rising]
P	293	24	X	4	287.0301	110.924	288.825	177.901	Says acronycal ris[ing]
P	301	24	X	5	287.0329	110.792	289.836	179.044	
P	301	25	XI	16	286.1135	141.21412	319.69692	178.482	

Source	Page	Year, SE	Month	Date	Date, BC	Jupiter longitude	Sun longitude	$\lvert\lambda_{\odot}-\lambda_{J}\rvert$	Comments
P	301	26	XII	27	285.2023	171.628	349.989	178.361	Says acro[nycal rising]
P	303	33	VII	10	279.7829	15.311	196.061	180.75	Says acro[nycal rising]
P	329	114	IV	22	198.5833	302.425	124.219	181.794	Around
P	331	119	X	6	192.0329	116.229	290.782	174.553	Around
P	331	120	XI	21	191.1244	146.241	324.609	178.368	Around
P	341	131	X	26	180.0548	120.132	298.939	178.807	Until around
P	349	163	VI	22	149.7379	359.992	181.44	181.448	
P	351	164	VIII	8	148.8322	35.994	215.507	179.513	Says acro[nycal rising]
P	351	165	VIII	22	147.9221	70.199	248.899	178.700	
P	351	166	X	5	145.0055	102.619	280.238	177.619	
P	351	167	XI	15	144.0822	133.748	309.249	175.501	
P	353	170	I	13	142.2664	193.707	13.653	179.946	
P	353	171	I	17	141.3267	226.157	35.513	169.356	
P	353	172	III	12	140.5274	257.7404	76.314992	178.575	
P	211	ARII-18	V	28	387.6518	328.526	147.398	178.872	
P	211	ARII-19	VI	16	386.7527	4.92	183.934	179.014	Says [VI]
P	215	ARII-41	IV	15	364.5767	302.736	120.509	177.773	
P	241	ARII-41	IV	17	364.5822	302.472	122.445	179.973	Aquarius
P	241	ARII-42	VI	5	363.6776	339.166	157.44	178.274	
P	215	ARII-43	VII	21	362.7774	15.543	193.17	177.627	Says 21?
P	217	ARII-44	VIII	8	361.8689	50.445	228.464	178.019	
P	217	ARII-45	IX	22	360.9605	83.509	261.898	178.389	
P	277	ARIII-1	XI	15	357.1244	145.54	322.874	177.334	
P	265	ARIII-10	VIII	24	349.8799	55.398	232.632	177.234	
P	265	ARIII-12	X	20	346.0548	119.479	297.215	177.736	
P	267	ARIII-14	XII	16	344.2297	179.968	359.028	179.060	
P	267	ARIII-16	I	30	343.3158	210.953	29.629	178.676	Says acro[nycal rising]
P	267	ARIII-17	II	16	342.4128	243.156	62.772	179.616	
P	269	ariii-18	IV	2	341.5027	277.08075	95.043469	177.963	
P	269	ARIII-19	IV	20	340.6025	313.274	130.399	177.125	Says ac[ronycal rising]

Source	Page	Year, SE	Month	Date	Date, BC	Jupiter longitude	Sun longitude	$\lvert\lambda_{\odot}-\lambda_{J}\rvert$	Comments
P	263	ARIII-2	XII	27	356.2132	175.735	353.113	177.378	
P	219	ARIII-4	I	12	355.3021	206.4	24.753	178.353	Says [1]2
P	277	ARIII-5	II	27	354.3963	238.227	56.02	177.793	Text says month i, editor corrected
P	265	ARIII-9	VII	9	350.7911	20.671	198.316	177.645	Says [acronycal ris]ing
P	163	DI-19	VIII	9	503.9018	59.332	239.188	179.856	
P	269	DIII-1	XI	8	334.0658	123.942	301.336	177.394	
P	273	DIII-11	VII	15	326.8185	30.687	208.615	177.928	
P	275	DIII-13	X	11	324.9906	97.594	273.355	175.761	Around
P	271	DIII-2	XI	21	333.1518	154.12	332.946	178.826	Says [XI]
P	271	DIII-4	I	4	332.2406	184.462	3.013	178.551	
P	271	DIII-5	I	14	331.3185	215.989	30.685	174.696	
P	271	DIII-7	III	1	330.4167	248.306	64.773	176.467	
A	1148	198	V	28	114.6831	339.114	161.062	181.948	
A	1151	201	IX	11	111.9523	84.73	260.388	175.658	
A	1160	233	V	3	79.62169	318.076	138.991	180.915	
A	1174	236	VIII	24	76.91279	65.271	246.607	181.336	
A	1195	305	VI	21	7.707763	349.317	171.031	181.714	
G	1233	35	IX	8	277.955	83.951	260.721	176.770	
G	1249	64	II	3	248.324	215.803	33.487	177.684	
G	1249	64	I	3	248.2434	219.14	4.622	145.482	Scribal error on tablet states month II
G	1251	69	VIII	3	243.8212	30.853	210.203	179.35	
G	1253	71	X	2	241.9989	97.554	277.265	179.711	
G	1261	87	I	3	225.2829	192.657	19.527	186.870	
G	1280	116	VI	27	196.7747	15.788	193.888	178.100	Ideal
G	1283	120	XI	22	191.1272	146.112	325.602	179.490	Ideal
NSA	1052	188	VIII	11	124.8498	46.39	222.794	176.404	

ACRONYCAL RISING ENTRIES FOR SATURN.

KEY AIII = Alexander III. ARII = Artaxerxes II. ARIII = Artaxerxes III. DI = Darius I. DIII = Darius III. NEII = Nebuchadnezzar II.

Source	Page	Year, SE	Month	Date	Date, BC	Saturn longitude	Sun longitude	$\lvert\lambda_{\odot}-\lambda_{p}\rvert$	Comments
D V1	323	34	IV	6	278.4961187	271.962	92.836	180.874	
D V1	365	48	IX	18	264.9988584	100.543	276.845	176.302	
D V1	87	ARII-24	X	26	380.030137	111.147	288.398	177.251	Around
D V1	159	ARIII-16	I	21	343.2910959	203.278	20.998	177.720	Clouds, I did not watch
D V1	167	DIII-2	IV	19	334.5860731	306.35	124.139	177.789	No date, previous entry 18, next 20
D V1	171	DIII-3	V	16	333.6271689	318.716	139.479	180.763	
D V1	211	PA-1	IX	23	323.9961187	99.079	275.142	176.063	Clouds crossed the sky
D V2	111	79	X	27	232.0712329	120.905	304.584	183.679	I did not watch
D V2	239	113	XII	10	198.2296804	178.3	359.666	181.366	Says [acronycal rising]
D V2	487	146	I	1/2	166.3020548	207.938	25.985	178.047	Entry broken away before, next 3rd.
D V3	47	153	IV	18	159.5410959	286.851	109.328	182.477	Around, i did not watch
D V3	57	154	IV	11	158.5767123	298.761	121.63	182.869	
D V3	87	162	VII	28	150.86621	46.413	228.213	181.800	Around
P	239	ARII-26	XI	20	377.1721461	149.046	338.522	189.476	
A	1122	128	VI	10	184.6968037	342.46951	166.00306	183.534	
A	1134	178	III	1	134.3990868	236.59	59.659	183.069	
A	1135	179	II	23	133.4276256	247.77	70.85	187.080	
A	1152	209	III	1	103.4440639	254.2777	76.365	182.088	
A	1185	282	IX	4	30.94680365	79.334	258.671	179.337	
A	1188/9	300	IV	16	12.52191781	286.225	104.002	177.777	
A	1195	305	VI	21	7.707762557	348.542	171.031	182.489	
G	1220	32	II	29	280.4605023	248.447	80.889	192.442	
G	1229	46	VIII	30	266.933105	72.098	251.869	179.771	
G	1236	48	IX	18	264.9988584	100.543	276.845	176.302	Ideal
G	1265	109	XI	6	202.0860731	128.616	310.328	181.712	Ideal
G	1291	148	II	19	164.3689498	230.278	49.419	179.141	

Source	Page	Year, SE	Month	Date	Date, BC	Saturn longitude	Sun longitude	$\lvert\lambda_{\odot}-\lambda_{p}\rvert$	Comments
NSA	1008	96	V	10	216.5997717	296.19	130.621	194.431	
NSA	1010	104	IX	3	208.9073059	59.241794	243.58818	184.346	
NSA	1016	107	X	13	204.0054795	101.926	280.574	178.648	
NSA	1020	111	XII	2	200.183105	153.511	343.544	190.033	
NSA	1057	194	X	6	118.9878995	82.488	273.326	190.838	

ACRONYCAL RISING ENTRIES FOR MARS.

KEY AIII = Alexander III. ARII = Artaxerxes II. ARIII = Artaxerxes III. DI = Darius I. DIII = Darius III. NEII = Nebuchadnezzar II.

Source	Page	Year, SE	Month	Date	Date, BC	Mars' longitude	Sun longitude	$\lvert\lambda_\odot-\lambda_\mathcal{D}\rvert$	Comments
D V1	335	35	XI	15	276.1353881	150.775	328.19	177.415	
D V2	125	82	XI	19	229.1216895	145.226	322.83	177.604	Says 19?
D V3	105	168	V	5	144.6244292	317.398	139.707	182.309	Around, i did not watch
D V3	171	174	X	1	137	100.685	278.258	177.573	All day overcast
D V3	207	178	XII	28	133.2159817	168.817	356.03	187.213	Around
P	281	8	II	6	304.3826484	233.364	53.085	179.721	
P	285	27	VI	12	285.7187215	350.801	173.428	182.627	Says Ma[rs' acronycal rising]
P	285	31	IX	20	281.9468037	82.242	257.626	175.384	Says [Year 31] .... Month [IX]
P	323	50	XI	19	261.1025114	136.621	315.634	179.013	Around, i did not watch
P	323	52	XII	12	259.1913242	177.049	345.796	168.747	I did not watch
P	339	142	IX	25	170.9714612	89.730022	266.81244	177.082	
A	1164/5	234	VIII	8	78.84977169	42.36695	222.58759	180.220	From translation in SSBII
A	1174	236	IX	6	76.94406393	81.584	257.839	176.255	
G	1228	18	X	16	293.0821918	128.59	307.397	178.807	Date broken away before, could be 26
G	1265	89	V	1	223.6216895	312.1	137.882	185.782	
G	1300	245	II	21	67.39634703	247.645	59.467	171.822	Ideal
NSA	998	55	II	8	257.3634703	225.55093	47.076833	185.526	
NSA	1050	187	VII	27	125.8415525	52.127	219.989	167.862	

IDEAL ENTRIES FOR MERCURY

Year, SE	Month	Date	Position	Difference in rise times	Time measurement	Ideal date	day correction	Source	Page	Comments
AR III 12	10	2	Sagittarius	1.286	20	IX 29	-4	D V1	145	Date 1-4, measurement for rising of Mercury to sunrise=first appearance in east.
AR II 44	6	24	Virgo	-0.818	18	21	-3	P	249	First appearance in east, it was bright.
AR II 44	3	10	Gemini	-1.026	19	6	-4	P	249	First appearance in east, it was bright.
7	13	18	Pisces	-2.135	15	14	-4	P	283	First appearance in east.
22	4	7	Cancer	1.774	18.5	5	-2	D V1	279	First appearance in east.
48	11	10	Aquarius	0.675	17	7	-3	P	297	First appearance in east.
74	4	23	Cancer	1.604	17	21	-2	D V2	89	First appearance in east, it was high.
79	8	28	Scorpius	-1.590	17	26	-2	D V2	107	First appearance in east.
94	4	26	Cancer	0.736	15	25	-1	G	1251	First appearance in east.
102	4	9	Gemini	1.705	18.5	5	-4	D V2	185	First appearance in east, it was bright and high.
110	10	13	Sagittarius	-0.987	20	8	-5	D V2	219	First appearance in east, it was bright and high.
114	11	14	Aquarius	0.716	15	12	-2	D V2	249	First appearance in east, it was bright.
114	7	19	Libra	-13.494	16	17	-2	D V2	243	First appearance in east, it was bright.
140	4	27	Cancer	0.370	20	25	-2	P	345	First appearance in east, it was bright and high.
141	3	24	Gemini	-0.074	16	22	-2	D V2	453	First appearance in east, it was bright and high.
147	7	22	Libra	0.877	15	20	-2	D V2	495	First appearance in east, it was bright and high.
167	7	29	Libra	-1.403	17	27	-2	D V3	95	First appearance in east, date after 26th.

Year, SE	Month	Date	Position	Difference in rise times	Time measurement	Ideal date	day correction	Source	Page	Comments
168	6	28	Virgo	-0.044	18	24	-4	D V3	109	First appearance in east, date after 26, it was bright and high.
176	6	1	Virgo	1.218	17	28 of V	-3	G	1294	First appearance in east, 2 cubits 8 fingers in Virgo.
180	11	22	Aquarius	0.460	17.5	19	-3	D V3	237	First appearance in east, it was bright.
188	3	19	Gemini	1.626	16.5	16	-3	D V3	281	First appearance in east, it was bright and high.
189	3	24	Gemini	-0.623	11	23	-1	D V3	295	Probably Gemini, time for rising of Mercury to sunrise=first appearance in east.
224	13	17	Pisces	0.028	14	15	-2	D V3	455	First appearance in east in end of Pisces, date 16-17, it was small.
225	8	1	Scorpius	-1.180	16	VII 28	-4	D V3	461	First appearance in east, it was bright.
234	3	18	Gemini	1.701	16	16	-2	D V3	491	First appearance in east, it was small.
258	11	18	Pisces	-0.512	16	15	-3	P	357	First appearance in east in beginning of Pisces, date uncertain, in translation [x]+18.
8	2	6	Gemini	1.925	16	4	-2	P	283	First appearance in west.
38	8	21	Sagittarius	0.455	16	19	-2	D V1	341	First appearance in west.
45	4	9	Cancer	-1.091	15	7	-2	G	1220	First appearance in west.
50	9	20	Capricorn	-0.993	15	18	-2	D V1	375	First appearance in west, bright and high, ideal on 19th or 18th.
55	10	12	Capricorn	1.591	15	9	-3	P	307	First appearance in west in end of Capricorn, it was bright and high.
56	12	22	Taurus	0.392	16.5	20	-2	P	309	First appearance in west in beginning of Taurus, it was bright.
84	12	4	Aries	0.523	14.5	2	-2	P	321	First appearance in west in beginning of Aries, it was bright.

Year, SE	Month	Date	Position	Difference in rise times	Time measurement	Ideal date	day correction	Source	Page	Comments
102	6	5	Virgo	0.760	15	3	-2	D V2	187	First appearance in west.
116	12	13	Aries	-0.996	15	11	-2	D V2	269	First appearance in west, it was bright and high.
119	2	18	Gemini	-1.858	15	16	-2	D V2	293	First appearance in west, it was bright and high.
125	11	14	Virgo	-1.122	16	12	-2	D V2	343	First appearance in west, it was bright and high.
128	10	15	Capricorn	0.985	15.5	13	-2	G	1285	First appearance in west.
143	5	27	Virgo	2.007	16	25	-2	D V2	471	First appearance in west sic, time for rising of Mercury to sunrise.
171	11	14	Pisces	2.258	16.5	10	-4	D V3	157	First appearance in west, it was bright and high.
174	9	27	Capricorn	1.372	14.5	25	-2	D V3	169	First appearance in west, it was bright and high.
176	4	2	Leo	-1.155	15	1	-1	G	1294	First appearance in west.
178	6	21	Pisces	-0.879	15	20	-1	D V3	203	First appearance in west in beginning of Pisces, it was bright.
179	2	8	Gemini	-1.721	15.5	5	-3	D V3	211	First appearance in west, date 8-9, it was bright.
202	9	10	Capricorn	-0.996	12	7	-3	D V3	351	First appearance in west, date 9-12 , ideal in Sagittarius, it was bright.
234	5	13	Virgo	0.687	16	12	-1	D V3	495	First appearance in west, it was small.
258	10	15	Aquarius	-0.844	15	13	-2	P	357	First appearance in west in beginning of Aquarius.
259	2	2	Gemini	-0.933	16	1	-1	P	357	First appearance in west.
A IV 8	6	3	Libra	0.263	14	1	-2	D V1	237	First appearance in west.
A IV 8	1	19	Taurus	-0.836	20	16	-3	D V1	233	First appearance in west.
AR II 38	3	10	Leo	1.150	16	8	-2	D V1	133	First appearance in west.

Year, SE	Month	Date	Position	Difference in rise times	Time measurement	Ideal date	day correction	Source	Page	Comments
94	12	7	Aquarius	0.885	17	10	3	G	1251	In east, ideal in Pisces, positive day correction so last appearance in east.
125	6	1	Virgo	0.796	11	2	1	G	1269	Last appearance in east, by alpha Virginis.
94	10	15	Aquarius	-1.173	18	18	3	G	1251	Last appearance in west, ideal in Aquarius.
152	11	1	Pisces		14			G	1287	First appearance in west in start of Pisces.
138	8	17	Scorpius		14			P	343	First appearance in east, it was bright, date uncertain.
56	6	2	Virgo		14.5			D V2	25	First appearance in west.
AR II 44	9	6	Capricorn		17			P	249	First appearance in west, it was bright.
152	8	14	Scorpius		17.5			G	1287	First appearance in east
120	8	7	Libra		21			D V2	301	First appearance in east in end Libra, date 6-8, it was bright and high.
49	11	2	Capricorn		22			G	1223	First appearance in east.
9	2	2	Gemini			-2	-4	P	283	First appearance in west in beginning of Gemini.
AR II 29	8	7	Libra			6	-1	P	207	First appearance in east, it was high
200	1	10	Taurus			8	-2	D V3	337	First appearance in west.
AR II 41	8	10	Scorpius			8	-2	P	241	First appearance in east, it was high.
226	10	11	Aquarius			9	-2	D V3	465	First appearance in west, ideal in beginning of Aquarius.
AR II 25	12	12	Aries			11	-1	P	205	First appearance in west, it was bright.
23	13	16	Aries			13	-3	D V1	283	First appearance in west.
161	7	14				13	-1	G	1291	First appearance in the east.
141	1	15	Taurus			13	-2	P	345	First appearance in west, it was bright.

Year, SE	Month	Date	Position	Difference in rise times	Time measurement	Ideal date	day correction	Source	Page	Comments
AR II 43	11	20	Aquarius			16	-4	P	247	First appearance in east, it was bright and high.
157	11	21	Aquarius			18	-3	D V3	79	First appearance in west in end of Aquarius, measurement 10+x.
AR II 32	4	26	Leo			19	-7	D V1	113	First appearance in west, no measurement.
AR II 31	7	25	Scorpius			20	-5	D V1	105	Last part of night, ideal around 20th.
AR III 15	1	23	Pisces			21	-2	D V1	157	First appearance in west, date 22-24.
175	10	25				21	-4	D V3	187	First appearance, date 25-26.
AR II 41	4	27	Leo			21	-6	P	241	First appearance in east, it was small.
122	6	26	Virgo			24	-2	D V2	319	First appearance in east.
193	1	30	Gemini			27	-3	D V3	321	First appearance in west in beginning of Gemini, ideal in end of Taurus, it was bright and high.
85	11	29	Pisces			27	-2	P	321	First appearance in west.
128	4	1	Gemini			III 26	-5	D V2	363	First appearance in east, date 1-2.
AR II 44	5	2	Virgo			IV 27	-7	P	249	First appearance in west.
AR II 25	10	1	Sagittarius			IX 27	-4	P	205	First appearance in west, in end of Sagittarius, it was high.
84	6	3	Virgo			x		P	321	First appearance in east, it was bright and high, didn't watch the time interval.
AR II 44	1	2	Taurus			XII2 25	-7	P	247	First appearance in west in front of Alpha Tauri, it was bright and high.

IDEAL ENTRIES FOR JUPITER.

KEY ARII = Artaxerxes II. ARIII = Artaxerxes III. PA = Phillip Arrhidaeous.

Source	Page	Year, SE	Month	Date	Planet	Zodiac	Measurement	Ideal	Comments
D V2	343	125	11	9	Jupiter	Aquarius	15	3	First appearance in east
D V3	359	203	5	8	Jupiter	Leo	11	7	First appearance in east
D V1	369	50	5	20	Jupiter	Leo	11.666666	19	First appearance in east
P	331	120	5	21	Jupiter	Leo	12.5	19	First appearance in east
P	289	13	5	1	Jupiter	Leo	15.5	-5	First appearance in east
P	291	15	7	22	Jupiter	Libra	12	20	First appearance in east
P	263	AR III 3	7	9	Jupiter	Libra	13	8	First appearance, it was bright
D V2	53	63	8	4	Jupiter	Libra		-2	First appearance, date 1-6
D V2	431	138	12	12	Jupiter	Pisces	10.5	11	First appearance, ideal in Pisces
D V3	127	170	7	22	Jupiter	Scorpius	11.5	21	First appearance in east, it was small
D V2	119	81	1	21	Jupiter	Taurus	11	18	
D V2	447	141	2	20	Jupiter	Taurus	12.5	18	First appearance, ideal in Taurus
D V1	227	PA 2	6	8	Jupiter	Virgo	11.5	6	First appearance in east
D V3	107	168	6	1	Jupiter	Virgo	12.5	-3	First appearance in east
P	291	14	6	12	Jupiter	Virgo	13	9	First appearance in east
P	263	AR III 2	6	29	Jupiter	Virgo	14	27	First appearance in east
D V3	413	215	5	26	Jupiter	Virgo	15	24	First appearance, date 26-30
D V2	351	126	12	22	Jupiter		10	21	First appearance in east, around 22nd
D V2	202	109	6	11	Jupiter		11.5	13	Date 10-12
P	277	AR III 1	8	22	Jupiter		15	19	First appearance in east, it was bright

IDEAL ENTRIES FOR SATURN.

KEY ARII = Artaxerxes II. ARIII = Artaxerxes III. PA = Phillip Arrhidaeous.

Source	Page	Year, SE	Month	Date	Planet	Zodiac	Measurement	Ideal	Comments
D V1	225	PA 2	5	5	Saturn	Cancer	16	2	First appearance in east
D V2	47	62	9	27	Saturn	Capricorn	15	26	Ideal in beginning of Capricorn
D V2	243	114	7	12	Saturn	Libra	15	10	First appearance in east
D V2	351	126	12	22	Saturn	Pisces	14	21	First appearance in west, ideal in beginning of Pisces
D V1	345	38	12	21	Saturn	Pisces	17	19	First appearance in east
D V2	287	118	9	14	Saturn	Scorpius	17	10	Ideal in end of Scorpius
D V3	183	175	8	21	Saturn	Scorpius	21	18	First appearance, date 20-25, it was bright and high
D V2	87	74	3	6	Saturn	Taurus	20	1	
G	1251	140	4	16	Saturn		16	18	
D V1	295	27	7	23	Saturn		17	21	First appearance in east
D V2	195	104	3	15	Saturn		17.5	12	
G	1265	168	5?	15	Saturn		30	11	First appearance
G	1251	140	16	30	Saturn		30	23	First appearance

IDEAL ENTRIES FOR MARS.

Source	Page	Year, SE	Month	Date	Planet	Zodiac	Measurement	Ideal	Comments
D V2	61	65	1	22	Mars	Aries	20.5	18	First appearance in east in Aries, date 20-24
P	323	52	3	20	Mars	Gemini	17.5	10	First appearance in east
D V1	133	AR II 38	4	28	Mars	Leo	22	15	First appearance in east 1.5 cubits behind Alpha Leonis
D V1	305	28	7	30	Mars	Libra	19	21	First appearance, ideal in Libra
D V1	263	18	2	25	Mars	Taurus	20	5	First appearance, ideal in beginning of Taurus
D V3	401	208	2	28	Mars		16	27	First appearance in east

IDEAL ENTRIES FOR VENUS.

KEY ARII = Artaxerxes II. ARIII = Artaxerxes III. PA = Phillip Arrhidaeous.

Source	Page	Year, SE	Month	Date	Planet	Zodiac	Measurement	Ideal	Comments
D V2	341	125	10	29	Venus	Aquarius	18	28	First appearance in west, date 29/30
D V1	151	AR III 12	12	20	Venus	Aries	9	16	First appearance in west
D V2	41	60	12	28	Venus	Aries	9	-1	cuneiform=in, translated as "to be expected"
D V3	137	171	4	19	Venus	Cancer	8.5	15	First appearance in east
G	1249	135	3	27	Venus	Cancer	30	22	Last appearance
D V1	375	50	9	22	Venus	Capricorn	10	20	First appearance in west
D V1	331	34	10	2	Venus	Capricorn	11	-3	First appearance in west
D V2	279	118	8	2	Venus	Libra	17.5	1	First appearance in east
G	1270	171	12	16	Venus	Pisces	9	20	Last appearance in east
D V2	245	114	8	25	Venus	Sagittarius	9	22	First appearance in east
D V3	461	225	8	28	Venus	Sagittarius	10	24	First appearance in east in east, it was bright and high
D V1	339	38	8	13	Venus	Scorpius	10	11	First appearance in east
G	1263	160	2	1	Venus	Taurus	8.333333333	2	Last appearance in west
D V2	481	144	2	18	Venus	Taurus	9.5	16	First appearance in east, ideal in end Taurus
D V2	61	65	1	17	Venus	Taurus	9.5	15	First appearance in west
D V3	399	208	2	16	Venus	Taurus	13	14	First appearance in east, date 15-16
D V2	469	143	5	24	Venus	Virgo	8.5	22	First appearance in west at end Virgo
D V1	237	3	6	12	Venus	Virgo	9	11	First appearance in east

Entries for Mercury passing by normal stars.

Source	Page	Year, SE	Month	Date	Position	Longitude	Comments
D V3	459	56	2	10	μ Geminorum	66.8	
D V3	431	56	2	14	γ Geminorum	70.6	First appearance in east around
P	74	57	10	22	β Capricorni	276	Last appearance in east
D V2	7	63	1	24	ξ Tauri	56.3	Around
D V3	203	63	1	27	η Tauri	30.1	First appearance in west
D V1	377	78	1	30	Above μ Geminorum	66.8	First part of night, date 22-26
D V2	357	86	2	16	Below α Geminorum	81.8	First part of night
D V1	223	87	2	25	Above δ Cancri	100	First part of night
D V1	223	87	8	11	Above β Scorpii	215	
D V3	61	96	1	10	Below η Tauri	30.1	First part of night
P	65	97	1	9	Above α Tauri	41.3	
P	81	106	2	13	Below β Geminorum	85.1	
D V2	51	106	7	23	Above α Librae	197	Date 27ish
D V2	473	106	7	27	Below β Librae	201	Last appearance in east, I did not watch
P	68	112	1	18	Above η Geminorum	65	First appearance in west
P	68	112	1	19	Above η Geminorum	65	Last appearance in west I did not watch
P	68	112	1	21	Above γ Geminorum	70.6	Last appearance in east
D V2	349	112	1	28	Below α Geminorum	81.8	Last part of night
P	81	112	2	3	Below β Geminorum	85.1	Last appearance in west around
P	65	119	7	30	Above α Librae	197	
D V2	333	125	2	6	Below α Geminorum	81.8	First part of night
P	81	125	2	13	Below β Geminorum	85.1	First part of night
D V2	347	125	3	25	Below α Geminorum	81.8	Last appearance in west, I did not watch
D V1	207	133	8	13	Above β Scorpii	215	Date 12 or earlier
D V2	307	135	12	15	Below α Arietis	7.74	First part of night
D V1	201	137	7	17	Above α Virginis	175	Date 14-15
P	65	137	13	25	Above α Tauri	41.3	
D V2	325	138	2	14	Below α Geminorum	81.8	First appearance in west

Source	Page	Year, SE	Month	Date	Position	Longitude	Comments
D V1	371	141	9	9	Above θ Ophiuchi	233	First part of night
D V3	61	142	1	11	Below η Tauri	30.1	First part of night
D V2	369	142	11	25	Below β Arietis	4.09	First part of night
P	81	146	8	11	Below β Librae	201	First part of night
P	73	158	1	19	Above ξ Tauri	56.3	First part of night
P	68	158	1	26	Above η Geminorum	65	First part of night
D V1	223	158	1	27	Above δ Cancri	100	
D V3	7	164	2	1	Below β Tauri	45.1	First part of night
P	84	164	2	3	Above ξ Tauri	56.3	First appearance in east
P	68	164	2	9	Above η Geminorum	65	First part of night
D V1	343	164	2	11	Above μ Geminorum	66.8	First part of night, date 12-13
P	68	164	2	15	Above γ Geminorum	70.6	First part of night
P	65	164	8	1	Above α Librae	197	Last appearance in east I did not watch
P	65	165	11	10	3 cubits behind β Capricorni	268.5	First appearance in west
D V3	73	168	6	11	Below γ Virginis	162	First appearance in west
D V3	7	170	1	15	Below β Tauri	45.1	First part of night
P	84	170	1	19	Above ξ Tauri	56.3	Last appearance in west
P	68	170	1	26	Above η Geminorum	65	Last appearance in east
D V2	459	170	7	25	Below β Librae	201	Last part of night
D V2	319	171	2	29	Below α Geminorum	81.8	date 26-29
P	81	171	3	3	Below β Geminorum	85.1	First part of night
D V3	461	172	8	17	i cubit behind β Scorpii	213	First appearance in east
P	65	172	9	1	Above α Scorpii	221	
P	84	176	1	9	Above ξ Tauri	56.3	First appearance in west
D V3	7	182	1	28	Below β Tauri	45.1	First part of night
D V2	427	182	11	9	Below β Capricorni	276	First appearance in west
D V1	331	183	2	1	Above μ Geminorum	66.8	Last part of night, date 4-8
P	68	183	2	3	Above γ Geminorum	70.6	First appearance in west
P	65	185	9	5	Above α Scorpii	221	First appearance in east
D V2	307	187	12	1	Below α Arietis	7.74	First part of night
D V1	197	189	6	29	Above α Virginis	175	First part of night

Source	Page	Year, SE	Month	Date	Position	Longitude	Comments
P	68	190	2	17	Above γ Geminorum	70.6	First part of night
D V2	305	190	2	27	Below α Geminorum	81.8	First appearance in west, date 6-7
D V2	439	190	3	2	Below β Geminorum	85.1	Last appearance in east
P	65	191	8	24	Above α Scorpii	221	
P	81	192	2	20	Below β Geminorum	85.1	Last appearance in east
P	65	197	7	25	Above α Librae	197	First appearance in west
P	81	197	7	29	Below β Librae	201	First part of night
D V3	117	197	8	11	β Scorpii	215	
P	65	197	8	16	Above α Scorpii	221	
D V3	7	198	4	2	Below ε Leonis	112	First part of night
D V3	487	202	1	29	μ Geminorum	66.8	
D V2	497	209	2	2	Below β Tauri	45.1	Last part of night
D V1	235	209	2	9	Above η Geminorum	65	
D V1	233	209	2	10	Above η Geminorum	65	First part of night
P	68	209	2	14	Above γ Geminorum	70.6	Last part of night
P	68	209	2	16	Above γ Geminorum	70.6	Last appearance in east around
D V2	379	225	4	26	Below α Leonis	121	Last part of night
P	65	226	4	4	Above α Leonis	121	
D V2	421	228	11	9	Below β Capricorni	276	First part of night
P	65	228	13	28	Above α Tauri	41.3	
D V1	133	230	1	29	3.5 cubits above γ Geminorum	70.6	
D V1	371	232	9	9	Above θ Ophiuchi	233	
D V3	61	234	13	11	Below η Tauri	30.1	First part of night
D V1	55	240	9	2	1 1/2 cub behind β Capricorni	273	Last appearance in east around 12 or 13
D V3	455	242	11	23	γ Capricorni	293	First appearance in east date 16-17
D V3	181	242	11	25	δ Capricorni	295	Last part of night
D V3	449	254	10	29	γ Capricorni	293	Last appearance in east around
D V3	185	254	11	1	δ Capricorni	295	First part of night
P	74	254	12	29	α Tauri	41.3	First appearance in west
D V3	479	255	2	10	μ Geminorum	66.8	
D V3	461	255	2	14	γ Geminorum	70.6	Last part of night

Source	Page	Year, SE	Month	Date	Position	Longitude	Comments
P	73	256	2	16	α Geminorum	81.8	First part of night
D V3	97	256	2	20	β Geminorum	85.1	Last part of night
P	74	256	8	22	α Scorpii	221	Last appearance in east
P	101	261	2	8	Above η Geminorum	65	Last appearance in east
D V1	197	261	7	13	Above α Virginis	175	First part of night
D V3	33	261	13	14	Below η Tauri	30.1	First appearance in east around
D V1	147	261	13	24	Above α Tauri	41.3	Last part of night
D V2	309	273	12	12	Below α Arietis	7.74	Last appearance in west
P	65	277	9	7	Above α Scorpii	221	Last appearance in east
P	65	284	8	14	Above α Scorpii	221	
D V1	375	294	1	24	Above ξ Tauri	56.3	First part of night
P	73	302	2	20	α Geminorum	81.8	First part of night
D V3	91	302	2	23	β Geminorum	85.1	First appearance in west
P	73	303	2	14	α Geminorum	81.8	First appearance in west
D V3	129	303	8	12	β Scorpii	215	First part of night
D V2	21	304	9	21	θ Ophiuchi	233	First part of night
D V3	21	308	1	20	Below β Tauri	45.1	First appearance in east
D V1	297	308	1	28	Above μ Geminorum	66.8	First appearance in west, date 14-15
D V3	175	321	1	20	Bull of heaven	54.1	First appearance in east I did not watch
D V2	471	321	1	24	Below β Tauri	45.1	Last part of night
D V1	223	321	2	3	Above η Geminorum	65	First appearance in west
D V1	259	321	2	4	Above μ Geminorum	66.8	First part of night
P	81	322	2	12	Below β Geminorum	85.1	First appearance in east
D V3	7	324	3	19	Below ε Leonis	112	First part of night
D V2	357	324	3	25	Below α Leonis	121	First part of night
D V2	21	324	5	14	ρ Leonis	128	
P	73	342	1	28	α Geminorum	81.8	First part of night
P	73	343	3	25	α Leonis	121	First appearance in west
P	73	343	5	10	α Leonis	121	First part of night
P	74	343	8	26	α Scorpii	221	First appearance in east
D V1	117	346	10	23	2 cubits 8 fingers below β Capricorni	276	Date 2-7

Source	Page	Year, SE	Month	Date	Position	Longitude	Comments
D V3	159	347	1	4	β Tauri	54.1	
D V3	463	347	1	16	μ Geminorum	66.8	First part of night
P	73	348	8	5	α Librae	197	Last part of night
P	65	348	8	19	6 fingers behind β Scorpii	215	Last appearance in east
P	73	349	5	4	α Leonis	121	First part of night
D V3	421	351	3	26	ε Leonis	112	First appearance in east
P	65	351	4	1	8 fingers behind α Leonis	121	Last appearance in west
D V3	459	352	6	13	γ Virginis	162	First part of night
D V3	143	354	1	21	β Tauri	54.1	Last part of night
P	73	354	2	13	α Geminorum	81.8	Last part of night
P	74	360	1	2	α Tauri	41.3	Last appearance in west
D V3	419	360	1	20	η Geminorum	65	Around
D V1	63	366	1	15	1 cubits 20 fingers in front η Geminorum	70.8	Last appearance in west
D V1	73	366	5	6	½ cubit front α Virginis	176	Date between 6th an 8th
P	81	368	2	11	Below β Geminorum	85.1	Last part of night
D V2	413	372	11	5	Below β Capricorni	276	Last appearance in east, I did not watch
P	65	373	1	15	Above α Tauri	41.3	
P	62	372	13	15	½ cubit front η Tauri	31.3	First appearance in west
P	65	373	7	11	Above α Virginis	175	
D V1	119	384	12	7	2 cubits 4 fingers below β Arietis	4.09	Date 14-17
D V1	65	418	13	13	$1^{2}/_{3}$ cubits front η Tauri	33.8	Beginning of night