Arch. Hist. Exact Sci. (2008) 62:553–600
DOI 10.1007/s00407-008-0027-9

Studies on Babylonian goal-year astronomy I: a comparison between planetary data in Goal-Year Texts, Almanacs and Normal Star Almanacs

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Received: 20 May 2008 / Published online: 1 July 2008

1 Introduction

A large body of astronomical material remains from the Late Babylonian period (c. 750 BC to AD 75) covering observations, calculations and predictions of astronomical events. Astronomical texts from the period are generally divided into two categories: mathematical texts, which include theoretical schemes and calculated predictions; and non-mathematical texts, which include observations and empirical predictions derived from these observations. This paper attempts to catalogue some of the relationships between the various non-mathematical astronomical texts of the Late Babylonian period, particularly the use of Goal-Year Texts in compiling the predictive texts known as Almanacs and Normal Star Almanacs.

Hunger[1] previously examined this problem but concluded that too little material was available for a quantitative study. More data is available now than at the time of Hunger's analysis as more examples of the various texts become identified, dated and accessible for study. Hence, the current investigation is able to draw on records from a larger number of texts and support more firmly some conclusions relating to the questions surrounding this area.

[1] Hunger (1999).

Communicated by A. Jones.

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Generally, the non-mathematical astronomical texts are divided into the following categories, following the classifications first proposed by Sachs:[2]

1. Astronomical Diaries[3]—observational texts containing monthly accounts of astronomical events including: six time intervals of the moon and sun crossing the horizon on certain days during the month, known as the Lunar Six; passages of planets or the moon by stars; dates of planetary synodic phenomena, or "Greek-letter" phenomena (first and last visibilities, stationary points, acronychal risings);[4] dates of solstices, equinoxes and visibility phenomena of the star Sirius; eclipses; summary planetary positions at the end of the month. The Diaries frequently describe the weather, especially on occasions where the conditions made observing impossible; quite often predictions of dates of events or Lunar Six intervals are included instead on days where the weather had prevented observation. Also found in the Diaries are non-astronomical reports of local market prices and news; later Diaries also contain dates on which a planet moves from one zodiacal sign into the next.
2. Goal-Year Texts[5]—texts composed of excerpts from various Diaries relating to Greek-letter phenomena and planetary passages; Lunar Six data; eclipses. On occasion, late Goal-Year Texts will also record a date on which a planet moves into the next zodiacal sign.
   The records for each event come from the Diary for a particular year, using the periodic motion of the moon and planets to create rough predictions for the events of the "goal year":

Mercury	46 years
Venus	8 years
Mars	47 years (passages)
	79 years (phenomena)
Jupiter	83 years (passages)
	71 years (phenomena)
Saturn	59 years
Lunar Six	18 and 19 years[6]
Eclipses	18 years

   The Goal-Year Text for the Babylonian year Y will thus contain Mercury observations from the Diary for year Y-46, Venus observations from the Diary for year Y-8, and so on.
3. Normal Star Almanacs—predictive texts containing predictions of: planetary passages and Greek-letter phenomena; Lunar Six or Lunar Three data (the Lunar Three are the dates of first visibility of the lunar crescent, the first day on which

[2] Sachs (1948).

[3] Translations of all known dated Diaries have been published by Sachs and Hunger (1988, 1989, 1996).

[4] In this paper the planetary synodic phenomena will be collectively referred to as the "Greek-letter phenomena", following Sachs (1948) and Neugebauer (1955).

[5] Translations of all known Goal-Year Texts, dated and undated, have been published by Hunger (2006).

[6] Brack-Bernsen (1999).

the moon set for the first time after sunrise, and the day of last visibility of the moon); solstices, equinoxes and Sirius phenomena; eclipses. Normal Star Almanacs take their name from the fact that they predict passages of the planets by particular stars. The Babylonian astronomers used about 28 reference stars for this purpose, which are nowadays known collectively as the "Normal Stars".

4. Almanacs—another type of predictive text, containing predictions of: the current zodiacal signs of the planets visible at the start of each month; dates on which a planet moves into a new zodiacal sign; Greek-letter phenomena; Lunar Three; solstices, equinoxes and Sirius phenomena; eclipses.
5. Lunar or planetary texts[7]—a broad description covering texts that do not belong to any of the above categories. Texts of this type can contain a range of records relating to a particular planet, to eclipses, or to Lunar Six data over a range of timescales, from one month up to several years. It seems that the data found in these texts was usually extracted from the Astronomical Diaries.

For this investigation, the important question is how were the Almanac and Normal Star Almanac planetary predictions made? Indeed, were the same methods used to create both text types? As Hunger points out, all the predictions found in the Almanacs and Normal Star Almanacs could have been made using Diary observations, and the suggestion has been raised[8] that they were indeed made empirically from Diary observations, via the Goal-Year Texts. However, it is clear that the data in the predictive texts is not simply an exact copy of the Goal-Year Text data, as will be discussed further below.

It seems logical to consider Goal-Year Texts as an intermediate step between Diaries and Almanacs or Normal Star Almanacs. Goal-Year Texts are very easy to compile several years in advance of when they are needed, simply by taking the Diaries from the relevant years and extracting the records relating to the planet in question from each one. However, even though they are easy to produce, as a referral tool during the actual goal year they are somewhat inexact and difficult to use due to the data being written in separate sections for each planet rather than by date. Therefore, it would reasonably follow to make the next step of recopying the data chronologically, making them much more convenient as a tool to refer to during the goal year. At this stage corrections could be applied to some dates of events to take into account the fact that the Goal-Year periods are not necessarily exact to the day; these corrections are indicated in several procedure texts.[9]

This paper compares the planetary observations in the Goal-Year Texts with the planetary predictions in the Almanacs and Normal Star Almanacs to test the theory that the predictions could have been made using the methods described above.

For the purposes of this study only the planetary data will be included; that is, dates and measurements associated with Normal Star passages and dates of Greek-letter phenomena. Not included here is any analysis of eclipse or Lunar Six data prediction (which have been the focus of other studies)[10] or the periodic events for which the

[7] Translations of most of the lunar and planetary texts have been published by Hunger (2001).

[8] Kugler (1924), Sachs (1948).

[9] For example Neugebauer and Sachs (1967), Text E.

[10] For example see Brack-Bernsen (1999), Steele (2000).

Babylonian astronomers had well-established schemes, i.e. dates of solstices, equinoxes and phenomena of Sirius.[11]

2 Theoretical considerations

There are several problems with using Goal-Year periods to predict future events that we must account for. These will be outlined in this section.

2.1 Variation of Babylonian year lengths

The length of the Babylonian year is not constant because the months always began with the first visibility of the new crescent moon, and there are not an exact number of lunar months in a solar year. The Babylonians devised a system of intercalary months to preserve the link between months and seasons. From at latest the fourth century BC, the intercalary scheme took the form of seven extra months inserted into a 19-year period, with one year having an extra Month VI (customarily written as VI_2) and 6 years having an extra Month XII (XII_2).[12]

The fact that Babylonian years could have either 12 or 13 months implies a complication in using Goal-Year periods for predictions: Goal-Year periods consist of a number of complete Babylonian years and so the exact number of months contained in any particular Goal-Year period can differ depending on how many intercalary months the Goal-Year period includes. Table 1 outlines the different numbers of months that Goal-Year periods can contain.

For example, we know that the Babylonian astronomers used an 8-year Goal-Year period for Venus. Referring to this table, we see that an 8-year period would contain either 98 or 99 months, depending on which year within the cycle the observations came from. This means that for most years the Venus observations can be used to predict events which will happen in exactly the same month of the year 8 years later.

However, 1 year in 19 there are only 98 intervening months in the Goal-Year period rather than 99. Following the method of counting forward exactly 8 Babylonian years would lead to predictions of Venus' Greek-letter phenomena for dates one month later than they will actually occur during the goal year itself, so a correction of a month will need to be applied to the data in this case.

There is evidence that the Babylonian astronomers were aware of this problem and accounted for it, which will be discussed more thoroughly in a forthcoming paper.[13]

2.2 Accuracy of the Goal-Year periods in latitude

Roughton has used modern calculations to produce tables of Babylonian planetary events.[14] The tables show calculated dates of every Greek-letter phenomenon and

[11] For details of these schemes see Neugebauer (1948), Sachs (1952).

[12] Parker and Dubberstein (1956), Britton (2007).

[13] See also Brown (2000), p. 175.

[14] Roughton (2002).

Table 1 Number of months in GY period for each year in 19-year cycle

	Months I-VI	Months VI_2-XII																		
Year of cycle	1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Mercury	569	568	569	569	569	569	569	569	569	569	569	569	568	569	569	569	569	569	569	569
Venus	99	98	99	99	99	99	99	99	99	99	99	99	98	99	99	99	99	99	99	99
Mars (47 years)	582	581	581	582	581	581	582	581	581	582	581	581	581	581	582	581	581	582	581	581
Mars (79 years)	978	977	977	977	977	977	977	977	977	978	977	977	977	977	977	977	977	977	977	977
Jupiter (83 years)	1027	1026	1026	1027	1026	1027	1027	1026	1027	1027	1026	1027	1026	1026	1027	1026	1027	1027	1026	1027
Jupiter (71 years)	879	878	878	878	878	878	878	878	878	879	878	878	878	878	878	878	878	879	878	878
Saturn	730	729	730	730	729	730	730	729	730	730	730	730	729	730	730	729	730	730	729	730

passage of a planet past a Normal Star throughout the Late Babylonian Period. The analysis in this section and Sect. 2.3 use data taken from Roughton's tables.

First, we consider the distances between planets and Normal Stars at the time of planetary passages. The observational texts and the Normal Star Almanacs record these distances in terms of cubits and fingers with 1 cubit made up of 24 fingers being a distance of approximately 2°. In the Normal Star Almanacs, the predictions of planets moving past Normal Stars always give a distance that the planet was "above" or "below" the star, which approximately corresponds to a difference in latitude.[15] The data in Roughton's tables assume that planetary passages occur at the time when the planet reaches the star in longitude, so the same assumption is used here.

The question is whether the planet to Normal Star latitude difference will be equivalent for corresponding planetary passages which occur one Goal-Year apart. If this is the case then records in Goal-Year Texts can be easily used to predict measurements of planetary passages by Normal Stars as well as the dates of events. However, if we find that there is no relationship between the latitudes of the two bodies at the moments when they are equal in longitude, then this would show that Goal-Year periods could not have been used in this way.

We can investigate this by considering pairs of corresponding planetary passages, and calculating how the latitude difference changes. For example, consider a particular year in which a planet with latitude α passes a star with latitude β. One Goal-Year period later the planet, now with latitude γ, passes the same star, now with latitude δ. Then the latitude difference $[(\gamma - \delta) - (\alpha - \beta)]$ can be calculated.

We have used Roughton's tables to find the latitudes of the planet and Normal Star involved in every planetary passage which would have been visible from Babylon in a 19-year period, along with the latitudes of the equivalent planetary passages occurring a Goal-Year period later for each planet. Using the above formula the latitude difference was calculated for each case, and these latitude differences for each of the five planets are summarised in Fig. 1. The figure shows the percentage of passages for which the latitude difference calculation falls within 1-finger ranges.

The latitude differences are given in the Babylonian unit of fingers (measurements on the sky are nearly always written using units of cubits and fingers, where 1 cubit is made up of 24 fingers. 1 cubit = approximately 2°, so 1 finger = approximately 5 arcminutes).[16] Therefore, in any case where the latitude difference had changed by less than one finger after one Goal-Year period, the Babylonian astronomers would have recorded the same measurement for each observation. As the figure shows, almost all of the latitude differences are less than one finger and the Babylonian astronomers in these cases would not have noticed a change in the planet-star distance.

Indeed, if the measured distance was large, for example 4 or 5 cubits, then it is likely that a difference of 2 or 3 fingers would not be noticed either. The Babylonian astronomers customarily recorded distances of 1 finger, 2 finger, 3 fingers etc. but then 3 cubits, 3.5 cubits, 4 cubits, and so on, rather than recording all large measurements

15 Jones (2004).

16 See for example Steele (2003).

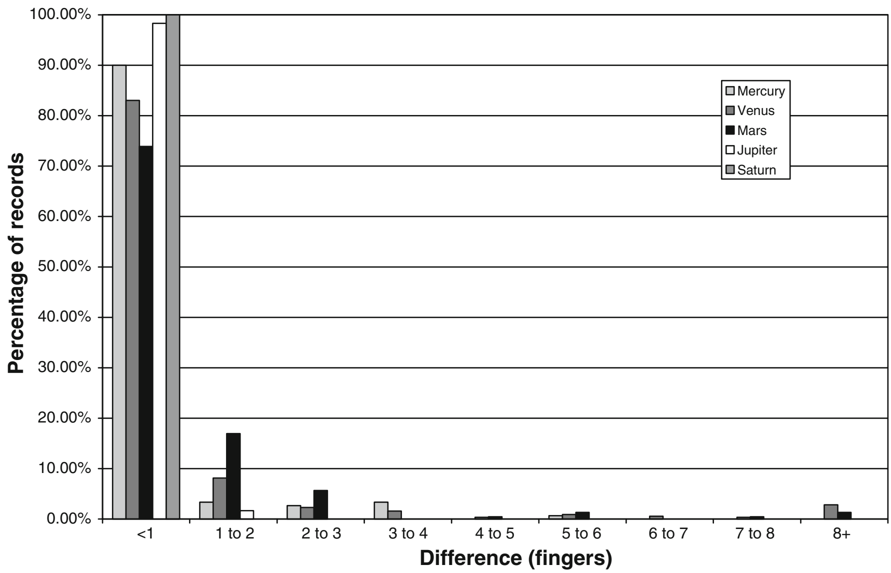

Fig. 1 Differences between expected planet-Normal Star distances for corresponding planetary passages one Goal-Year apart

to an accuracy of 1 finger.[17] Therefore, a distance measurement of 3 cubits could have altered by several fingers by the time of the equivalent planetary passage one Goal-Year period later, but the measurement would still then be recorded as 3 cubits.

Note also in Fig. 1 that a small percentage of the measurements show a significantly large latitude difference. In some cases, particularly those for Venus, the calculated difference is larger than 1 cubit. These large latitude changes always occur around a planet's stationary points; this is discussed further in Sect. 2.4.

2.3 Exact lengths of the Goal-Year periods

As noted in Sect. 1 above, Goal-Year periods are not exact to the day. We can compare the dates of planetary events separated by one Goal-Year period using modern calculations, although it is not possible to calculate precisely the dates of planetary visibilities due to daily variability in atmospheric conditions. Nevertheless, approximate dates may be calculated and used to establish a theoretical understanding of how the date of an event changes after one Goal-Year period.

Figure 2a–e show the difference in dates for pairs of corresponding planetary passages occurring one Goal-Year apart. It uses the same data as for Fig. 1, i.e. every planetary passage occurring within a 19-year period which would have been visible from Babylon, along with the equivalent planetary passages occurring a Goal-Year period later. All the date differences are stated in days.

17 Sachs and Hunger (1988), pp. 22–23.

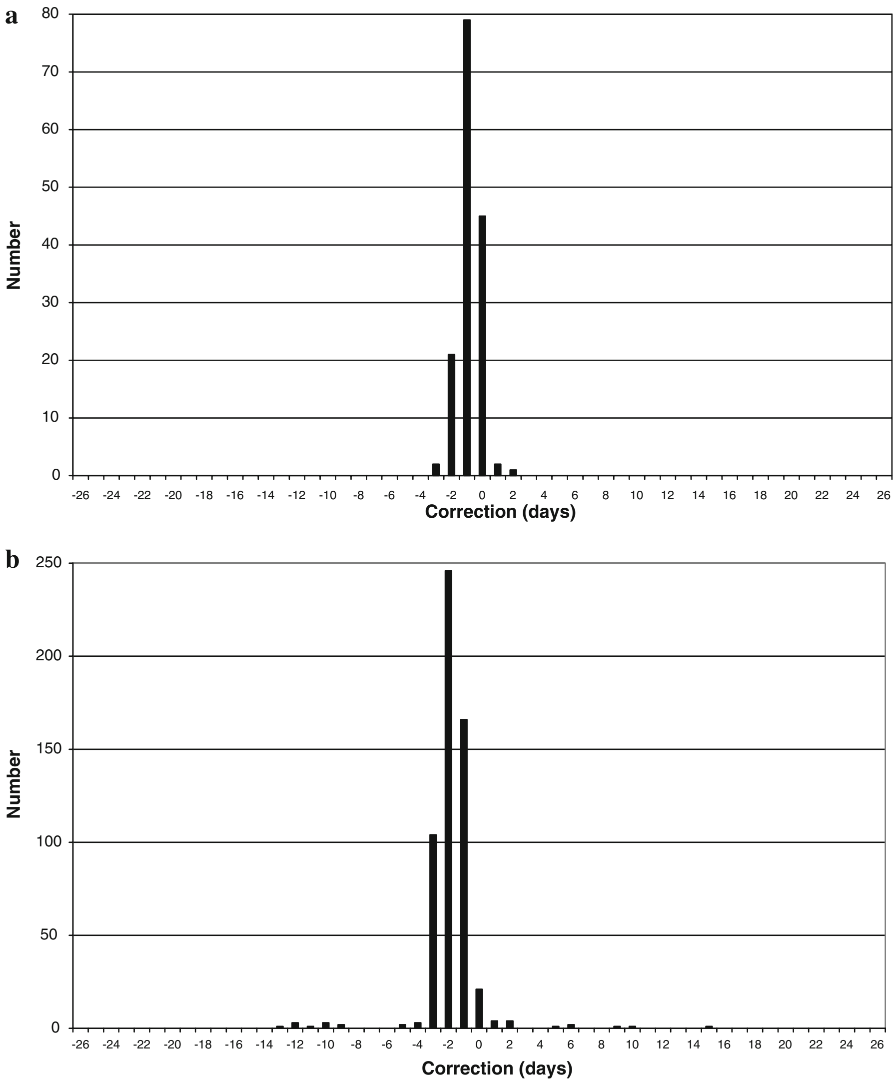

Fig. 2 Difference between expected dates for corresponding passages on Goal-Year apart for (**a**) Mercury, (**b**) Venus, (**c**) Mars, (**d**) Jupiter, (**e**) Saturn

The formula to calculate the date difference is simply $(\alpha - \beta)$, where α is the day of the year on which the planetary passage is recorded in a particular year, and β is the day of the year on which the equivalent planetary passage is recorded one Goal-Year period later. For example, a planetary passage which took place on the 24th of a month in 1 year and the 23rd of the same month one Goal-Year period later would be recorded as a date difference of -1 day.

The figures confirm that the Goal-Year periods used by the Babylonians can be used for predicting planetary passages. As expected, the Goal-Year periods are not an

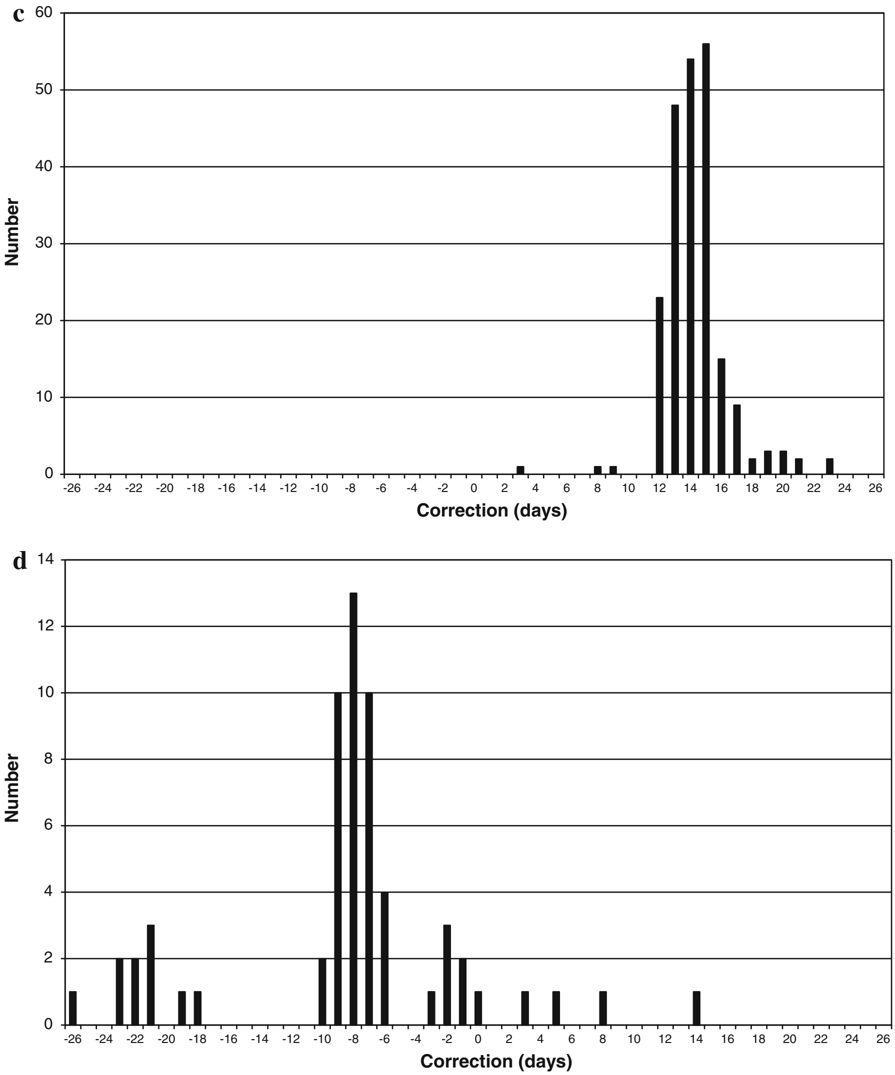

Fig. 2 continued

exact number of years, and the figures show that we would expect the following date corrections to be applied when using Goal-Year Texts to predict planetary passages one Goal-Year period later:

Mercury	−1 day
Venus	−2 days
Mars	+15 days
Jupiter	−8 days
Saturn	−15 days

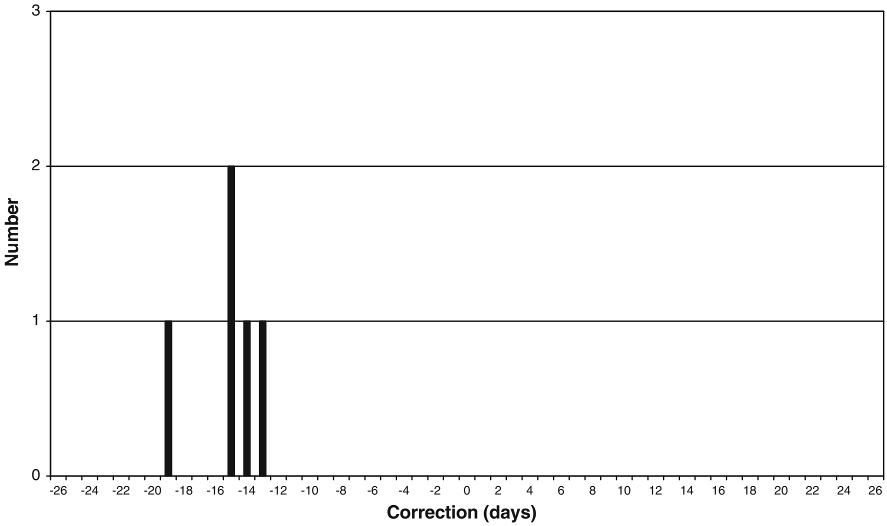

Fig. 2 continued

Most of the time these numbers will produce a good approximation for the expected planetary passage dates. Overall, using the above date corrections would lead to a prediction of the correct date, to within one day either way, 97% (Mercury), 91% (Venus), 68% (Mars), 55% (Jupiter), and 80% (Saturn) of the time. Only around stationary points can the date differences can vary significantly from these numbers.

Finally, Fig. 3a–e show the difference in dates for corresponding pairs of Greek-letter phenomena occurring one Goal-Year apart. The date differences are calculated in the same way as for Fig. 2 and are, again, given in days.

The figures confirm that the expected dates of Greek-letter phenomena could have been deduced using Goal-Year periods. We would expect the following date corrections to be applied:

Mercury	−1 day
Venus	−4 days
Mars	+6 days
Jupiter	0 days
Saturn	−6 days

The figures also show that these date corrections are much more precise than the corrections are for the dates of planetary passages. Here the figures suggest that using the above corrections to the dates would result in a prediction of the correct date of a planetary event, to within one day either way, 98% (Mercury), 100% (Venus), 82% (Mars), 91% (Jupiter), and 92% (Saturn) of the time. They also show that when using these date corrections none of the predictions would be more than 3 days away from the calculated date, apart from Mars' results where the differences in date cover an unusually wide range.

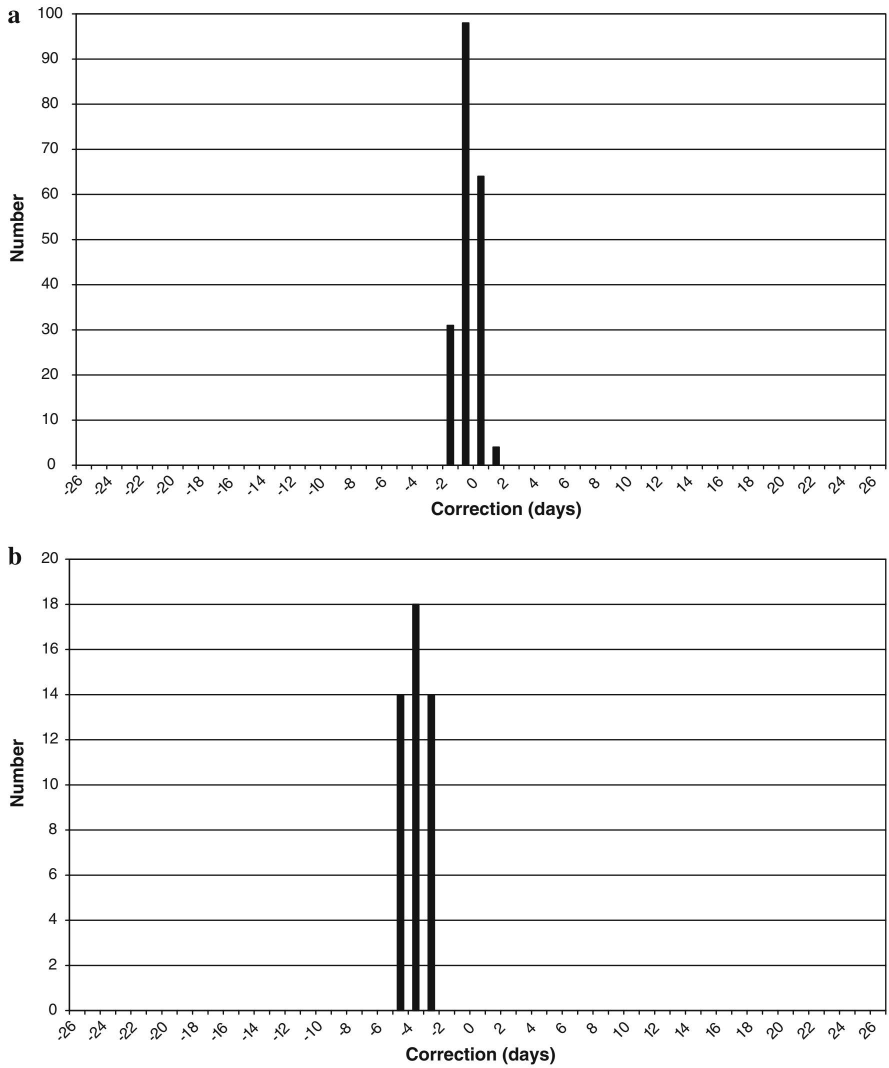

Fig. 3 Difference between expected dates of corresponding planetary phenomena one Goal-Year apart for (**a**) Mercury, (**b**) Venus, (**c**) Mars, (**d**) Jupiter, (**e**) Saturn

2.4 Normal Star passages around stationary points

Goal-Year periods generally provide a good approximation for predicting recurring planetary events. Yet, as mentioned in Sect. 2.2, these patterns of Normal Star passage dates vary greatly as the planet nears a stationary point and its motion becomes less regular. Additionally, small variations in a planet's longitude and latitude path between one year and the same dates a goal-year later mean that occasionally a passage of a planet by a Normal Star will be observed one year that will then not occur a goal

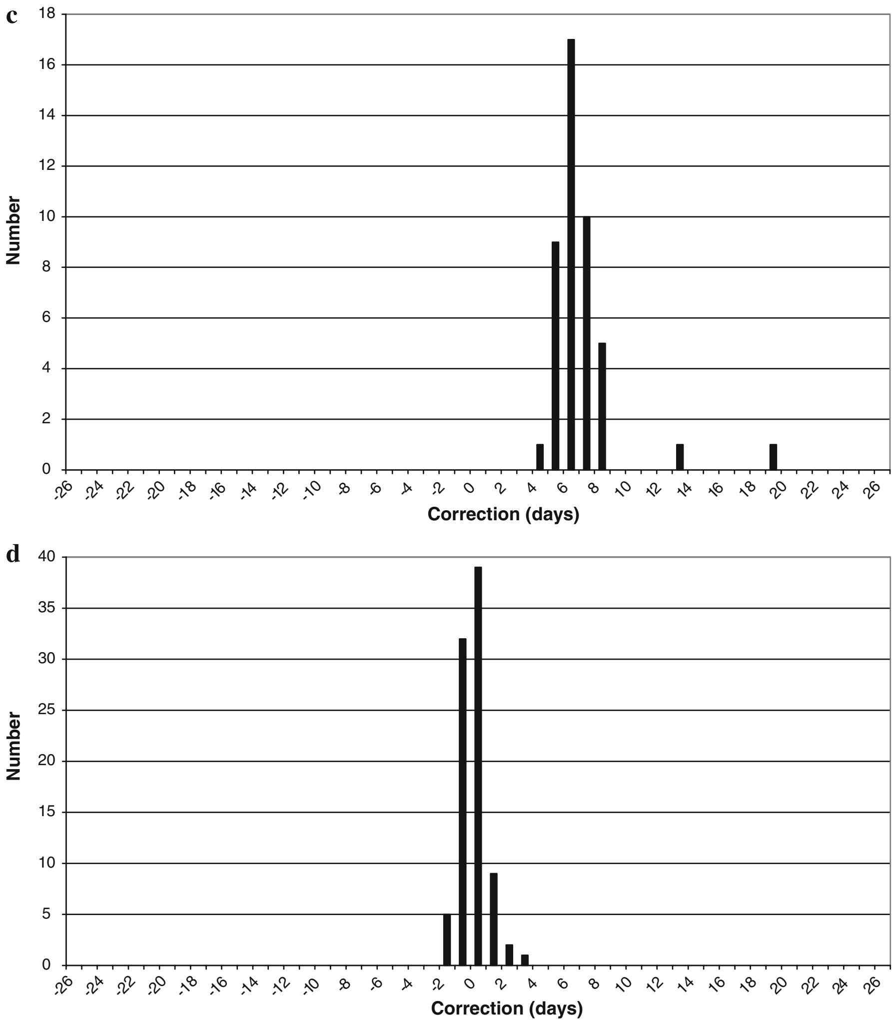

Fig. 3 continued

year later. Equally, a planet could reach a Normal Star in longitude one year where it had not done so a Goal-Year period previously, again due to the longitude at which it became stationary.

An example of this is illustrated in Fig. 4, which shows the longitude of Venus throughout two Babylonian years one Goal-Year period (8 years) apart.

The figure shows Venus' longitude throughout the two years and marks the days on which it reaches each of the commonly used Normal Stars. The stars which Venus passed by during its period of invisibility are shown in italics. The figure demonstrates that, from about day 100 of the years onwards, the Goal-Year period of 8 years is an excellent fit for Venus' motion. Venus consistently reaches each Normal Star in

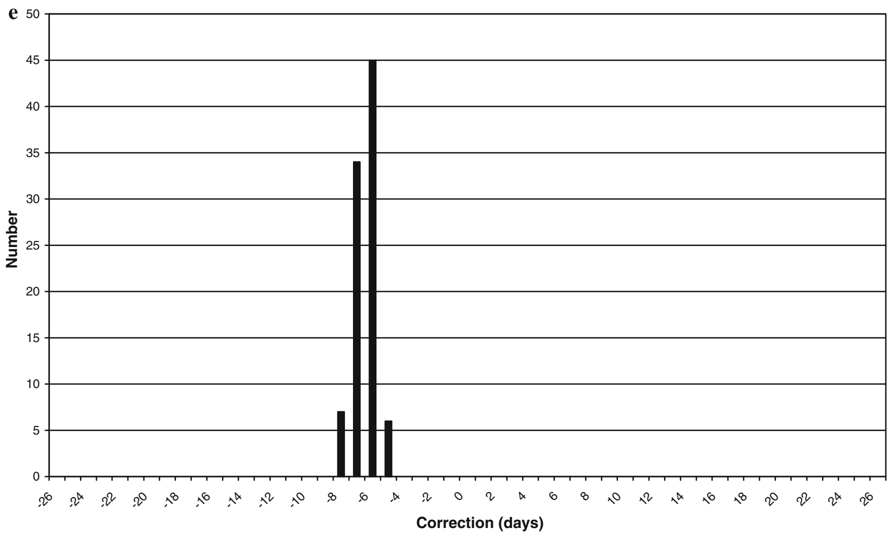

Fig. 3 continued

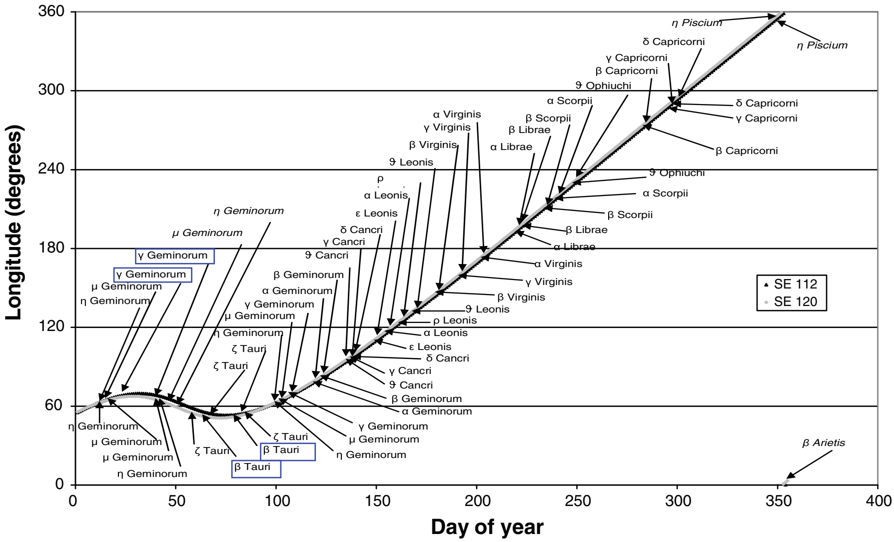

Fig. 4 Venus' longitude during the Babylonian years SE 112 and SE 120, marking the points where the planet passed by each Normal Star. Star names in italics were passed by during Venus' periods of invisibility. The boxes around γ Geminorum and β Tauri highlight stars which the planet passed by in one year but not the other, showing that these planetary passages could not have been predicted using Goal-Year Text methods

longitude one or two days earlier in SE 112 than in SE 120, as we would expect from Sect. 2.3.

However, before day 100 there is much less agreement between the dates when Venus passes by the Normal Stars due to the irregular motion around the stationary points. Indeed, highlighted in the figure are two stars which Venus would have passed in one year but not in the other—γ Geminorum in SE 112 and β Tauri in SE 120.

It is clear that simply using observations from one Goal-Year Text to predict events could lead to planet-Normal Star passages being predicted that could not happen during a particular year, or potential passages not being predicted because they did not occur one Goal-Year period previously. This would not have been a very common event, only happening on the occasions when 2 years a Goal-Year period apart contained stationary points where the difference in longitude differed by just enough to reach the next Normal Star during one of the years. Nevertheless, the question remains unanswered whether the Babylonian astronomers were aware of this and accounted for it.

3 A comparison of the planetary records in Almanacs, Normal Star Almanacs, and Goal-Year Texts

3.1 The database

We have examined all the Goal-Year Texts, Almanacs and Normal Star Almanacs to find cases where a planetary event is mentioned in at least two of these texts covering the same Babylonian year. The records in all three text types can be compared as predictions made for events in the Babylonian year in question, although due to their nature a record from the Goal-Year Texts will of course be an observation of the same event a Goal-Year period earlier.

The full database can be found in Appendices A (Normal Star Almanac vs. Almanac data) and B (Goal-Year Text vs. Normal Star Almanac or Almanac data). Appendix A contains all known examples of matching planetary predictions found both in Normal Star Almanacs and in Almanacs, in order to show whether we need to consider the data from these two sources separately. Specifically we are interested in the predicted dates of the Greek-letter phenomena, as this will show whether the corrections applied to dates of predicted events are the same for each text type.

As always, small data sets are a problem. To illustrate this: while there are Almanacs known for 53 different years and Normal Star Almanacs known for 62 different years, only 15 of these years overlap and in only 6 years do we actually find corresponding examples of the same planetary record. Thus, the total remaining comparison of Normal Star Almanac and Almanac data is 28 pairs of planetary events. They show that there are no significant differences between records found in the two texts: in 23 of these cases the records are identical, at least as far as the text is preserved in each case. Of the remaining cases, three are most likely copying errors on the part of either the original scribe or a modern copyist:

SE 201, Month VII

Normal Star Almanac (LBAT **1059, Rev. 1): 8 AN ina RÍN IGI
The 8th, Mars in Libra first visibility.

Almanac (LBAT 1151, Obv. 14): 8 AN ⌜ina A IGI⌝
The 8th, Mars ⌜in Leo first visibility⌝

The cuneiform signs for Leo and Libra are quite similar. Calculating the longitude of Mars on this date (using Parker and Dubberstein's tables to convert the Babylonian date into a Julian date) we find that it was at a longitude of around 182°, i.e. in the zodiacal sign of Libra.

SE 201, Month XI

Normal Star Almanac (LBAT **1059, Rev. 25): 2 GENNA ina SAG RÍN UŠ
The 2nd, Saturn in the beginning of Libra stationary.

Almanac (LBAT 1151, Rev. 8): 20 GENNA ina SAG RÍN ⌜x⌝
The 20th, Saturn in the beginning of Libra ⌜x⌝

It is very likely that in the record from the Almanac the date should have been the second. The record is found at the beginning of the month and is followed by several records earlier than day 20 of the month, which suggests that the 20th is the wrong date.

SE 201, Month XII

Normal Star Almanac (LBAT **1059, Rev. 35): 29 GU_4-UD ina ŠÚ ina HUN IGI
The 29th, Mercury in the west in Aries first visibility.

Almanac (LBAT 1151, Rev. 12): 29 GU_4-UD ina ⌜ŠÚ ina HUN ŠÚ⌝
The 29th, Mercury in the west in ⌜Aries last (sic) visibility⌝

It is clear from reading the other Mercury records in the Almanac that it contains a scribal error for "first visibility" in this case.

The remaining two records that differ are, in one case, a slightly different use of terminology, and in the one remaining case a disagreement on the date of a planetary event.

SE 92, [Month XII]

Normal Star Almanac (LBAT 1005, Rev. 3'): 21 dele-bat ina NIM ina SAG HUN IGI
The 21st, Venus in the east in the beginning of Aries first visibility

Almanac (LBAT *1118-9, Rev. 11): 21 dele-bat ina NIM ina HUN IGI
The 21st, Venus in the east in Aries first visibility

SE 201, Month IX

Normal Star Almanac (LBAT **1059, Rev. 13): 5 dele-bat ina NIM ina PA IGI
The 5th, Venus in the east in Sagittarius first visibility.

Almanac (LBAT 1151, Rev. 3): 6 dele-bat ina NIM [ina x IGI …]
The 6th, Venus in the east [in x first visibility…]

To write an Almanac or Normal Star Almanac involves copying and recopying records several times (which will then be recopied at least once more during the production of translations), meaning that an occasional copying error is inevitable. 5 differences out of 28 may seem to be more than 'occasional', but one is only a slightly different terminology and the remaining copying errors are all from the same Almanac. Therefore, the number of discrepancies in the dataset does not seem at all significant.

With only one out of the 28 examples showing any disagreement in the predicted *date*of an event, we therefore conclude that any date corrections that were applied to the Normal Star Almanacs were also applied equally to the Almanacs. Consequently, the remainder of this investigation does not examine the Normal Star Almanac data differently from the Almanacs, but the records which they have in common (i.e. dates of Greek-letter phenomena) are considered as being one large dataset.

Appendix B contains all remaining examples of an equivalent record existing in both a Goal-Year Text and an Almanac or Normal Star Almanac. Equivalent record means that the Goal-Year Text for a particular year would be compared with the Almanac and Normal Star Almanac for the same year. That is, even though the Goal-Year Text records would have been written down as observations a Goal-Year period earlier, the records from all three types of text function as predictions for the goal year and can be compared in this way.

The criterion for a record to be included in the database was that the records did not need to be complete and unbroken, but each one of the pair must contain a date for comparison and/or (in the case of Normal Star passages) a measurement of a planet-Normal Star distance.

In the database, the translations have been slightly abbreviated for reasons of space. For example, "first/last part" is written rather than "first/last part of the night"; and remarks in the Goal-Year Texts on a planet's size or brightness at its first visibility or time measurements around a planet's first or last appearance have not been included. However, dates of "ideal" first appearances and "last seen" dates around the times of last appearances have been included; there is further discussion of this later. Below are some examples of record pairs from the database:

[IZI …] ⌜GE$_6$ 10⌝ ina zalág dele-bat e LUGAL 3 SI
"[Month V…] Night of the 10th, last part of the night, Venus was 3 fingers above α Leonis."
- *ADART* vol VI no. 15, Obv. 13, Goal-Year Text for SE 106

[IZI …] GE$_6$ 8 ina zalág dele-bat e LUGAL 3 SI
"[Month V…] Night of the 8th, last part of the night, Venus was 3 fingers above α Leonis."
- LBAT *1013, Obv. 8', Normal Star Almanac for SE 106

This pair of records will give both a date and a measurement for comparison.

APIN GE$_6$ 16$^?$ USAN AN SIG SI MÁŠ 2 KÙŠ
"Month VIII, night of the 16th, first part of the night, Mars was 2 cubits below beta Capricorni."
-*ADART* vol VI no. 69, Rev. 2, Goal-Year Text for SE 194

GAN … ⌜GE$_6$⌝ 2 USAN AN SIG SI MÁŠ […]
"Month IX … ⌜Night of the⌝ 2nd first part of the night, Mars was below beta Capricorni […]"
-LBAT 1057, Rev. 2', Normal Star Almanac for SE 194

Here the date remains for comparison, though the distance measurement has been lost.

⌜AB 20 MÚL$^?$-BABBAR$^?$⌝ [ana ME E-a …]
"Month X, the 20th, Jupiter's [acronychal rising …]"
-*ADART* vol VI no. 17, Obv. 1', Goal-Year Text for SE 107

[AB…] 20 MÚL-BABBAR ⌜ana ME E-a⌝
"[Month X…] The 20th, Jupiter's ⌜acronychal rising.⌝"
-LBAT 1016, Rev. 3', Normal Star Almanac for SE 107

Again, we can compare the dates.

IZI 24 GU$_4$-UD ina NIM ina A IGI KUR NIM-a 16,40 na-su in 21 IGI

"Month V, the 24th, Mercury's first appearance in the east in Leo; it was bright (and) high, rising of Mercury to sunrise: 16°40'; (ideal) first appearance on the 21st."
ADART vol VI no. 86, Obv. 22, Goal-Year Text for SE 236

⌜IZI⌝ … 21 GU_4-UD ina NIM ina A IGI
"⌜Month V⌝ … The 21st, Mercury in the east in Leo first visibility."
-LBAT 1174, Obv. 10, Almanac for SE 236

In this case, we can compare the predicted date from the Almanac with both the observed and ideal dates from the Goal-Year Text. 26 of the Greek-letter phenomena records taken from the Goal-Year Texts include either a second (ideal) date for first visibilities as above, or the phrase "from the xth when I watched I did not see it" in the case of last visibilities.

In some cases found in the database, for example Mars' records for SE 105, one of the two recorded event dates is a month earlier or later than we would expect. This is due to the differing lengths of Goal-Year periods, as shown in Sect. 2.1 and Table 1. The month corrections will be examined in more detail in a forthcoming paper.

All the Goal-Year Text excerpts in the database are taken from Hunger's translations in ADART Volume VI. The Almanac and Normal Star Almanac excerpts are our translations of texts obtained from copies published in LBAT and elsewhere,[18] and tablets viewed in person at the British Museum.

Numbers of database entries:

GYT-NSA overlaps:

NS passages: 84 examples

Mercury 13 Venus 37 Mars 27 Jupiter 4 Saturn 3

Greek letter phenomena: 39 examples

Mercury 20 Venus 3 Mars 2 Jupiter 5 Saturn 9

GYT-Almanac overlaps:

Greek letter phenomena: 42 examples

Mercury 24 Venus 3 Mars 5 Jupiter 3 Saturn 7

This gives us a total of:

64 records which can be used for comparing recorded planet—Normal Star distances.

53 records which can be used for comparing recorded dates of planet—Normal Star passages.

81 records which can be used for comparing dates of Greek-letter phenomena.

Of the Greek-letter phenomenon records in the database, only a few included an ideal or "last seen" date:

[18] Sachs (1955, 1976), Sachs and Walker (1984), Roughton (2002).

Table 2 Comparing records found in both GYT and NSA, of a planet-Normal Star passage with preserved distance measurements

Planet	Number of cases where the distance measurement:		
	Matches	"Nearly" matches	Does not match
Mercury	6	2	1
Venus	23	5	4
Mars	15	1	2
Jupiter	2	1	0
Saturn	2	0	0
All	48	9	7

Number with both observed and ideal or "last seen" date: 18 (14 for Mercury, 2 for Venus, 2 for Saturn)

Number with ideal or "last seen" date only: 7 (4 for Mercury, 1 for Jupiter, 2 for Saturn)

3.2 Results

3.2.1 Predicted distance measurements of planet-Normal Star passages

As shown in Sect. 2.2, we expect that comparing distance measurements of Normal Star passages in Normal Star Almanacs and Goal-Year Texts will show very similar distances recorded in each case. Table 2 summarises the results of this comparison between the texts and shows that in most (75%) of the remaining pairs of records, the distance measurements exactly match each other. This adds strong support to our suggestion that predictions of planet-Normal Star distances in Normal Star Almanacs could have been made by using observational records from one Goal-Year period previously copied from the Goal-Year Texts.

Of the pairs of distances that are not exact matches, 14% are classed as "nearly" matching and only 11% are classed as being notably different from each other. We now examine the non-matching records in more detail:

The 9 cases of measurement pairs which have been classed as "near" matches are shown in Table 3 for comparison. "Nearly" matching records include measurements that differ from each other by $^1/_2$ a cubit or less; or up to a cubit apart where one of the readings is marked as uncertain.

The 7 cases of measurement pairs which are classed as being clearly "different" from each other are shown for comparison in Table 4. "Different" measurements include those where the two texts differ from each other by a cubit or more.

A possible explanation for records which "nearly" match is that the measurements may have been copied from different Astronomical Diaries for the same year. A few examples remain of two Diaries which cover the same month and which have recorded

Table 3 Details of the "nearly" measurements from Table 2

	Year	NSA	vs	GYT
Mercury	SE 96	1 2/3 cubits		1 5/6 cubits
	SE 194	1 ⌜cubit x⌝ fingers		1 cubit 4 fingers
Venus	SE 107	4 cubits		5? cubits
	SE 107	1 cubit 8 fingers		1 cubit 10 fingers
	SE 192	2/3 cubit		1/3? cubit
	SE 194	⌜4?⌝ [...]		5 cubits
	SE 194	3 cubits		2? cubits
Mars	SE 96	3 cubits		2 1/2 cubits
Jupiter	SE 184	2 1/2 cu[bits]		2 cubits

Table 4 Details of the "different" measurements from Table 2

Planet	Year	NSA	vs	GYT	Year	Notes
Mercury	SE 201	4 cubits		1 cubit	SE 201	GYT SE 155: 4 cubits
Venus	SE 96	3 cubits		2 cubits	SE 96	
	SE 96	1 1/3 cubits		2 1/2 cubits	SE 96	
	SE 107	2 cubits		1/2 cubit	SE 107	
	SE 194	3 cubits		5 cubits	SE 194	GYT SE 186: 3 cubits
Mars	SE 107	3 1/2 cubits		2 [cubits]	SE 107	
	SE 194	2 cubits		1 cubit	SE 194	

a measurement slightly differently. Examples of comparing these measurements from duplicate Diaries are shown in Tables 5 and 6.

The tables contain pairs of records taken from either two Diaries covering the same date, or a Diary and a text from ADART Volume V (which contains texts compiled directly from Diaries) covering the same date. Table 5 shows records which measure distances, and Table 6 shows records which measure timings of Lunar Six events.

From Table 5 we see that different people observing the same event at the same time do not always agree. The table shows that differences of opinion up to half a cubit are possible regarding a measurement of a distance. Half a cubit therefore is confirmed as marking the difference between "nearly" matching and "different" measurements. It seems likely that a situation where the Goal-Year Text had been copied from one Diary, and the Normal Star Almanac had been created using a different Goal-Year Text copied from an alternate Diary, could explain a pair of records which "nearly" match.

Another explanation for records in either the "nearly" agreeing or the "different" categories is that they may be due to copying errors. To make a prediction of a planetary event means that any one record needs to be copied repeatedly from Diaries into Goal-Year Texts and then into Normal Star Almanacs, and there are therefore several stages

Table 5 Details of cases where Diaries report different distance measurements for same event

	Year	Measurement 1	Measurement 2
Moon	SE 120	1 1/2 cubits	2 1/2 cubits
	SE 133	4 cubits	5 cubits
	SE 148	1 cubit 4 fingers	1 cubit
	SE 179	1 1/2 cubits	2 cubits
	SE 179	1 1/2 cubits	2 cubits
	SE 179	2 cubits 6 fingers	1 1/2 cubits
	SE 192	1 1/2 cubits	2? cubits
	SE 192	2 5/6 cubits	2 2/3 cubits
	SE 206	1 cubit	1 cubit 6 fingers
	SE 206	3 1/2 cubits	4 cubits
Mercury	−384	2 cubits 4 fingers	2 cubits 8 fingers
	SE 56	1 1/2 (sic) cubits	4 1/2 cubits
	SE 102	1 cubit 8? fingers	1 1/2 cubits
Venus	SE 102	1 cubit	1 cubit 4 fingers
	SE 179	1/2 cubit	2/3 cubit
	SE 179	1 1/2 cubits	1 cubit
	SE 206	3 cubits	3 1/2 cubits
Jupiter	SE 143	6 fingers	8 fingers

at which copying errors could be introduced. Also shown in Table 4 are the two cases where the comparison seemed to be "different" or not agree in the two texts for the same year, but when the Goal-Year Text from one Goal-Year further back was examined it *did* agree with the Normal Star Almanac. This strongly suggests that, for these two Goal-Year Text records at least, the "different" classification comes from a copying error of the number.

3.2.2 Predicted dates of planet-Normal Star passages

Table 7 summarises the date differences for the data relating to NS passages. For each corresponding pair of records taken from a Goal-Year Text and a Normal Star Almanac the table shows the calculated differences between the given dates, and the number of records which show each correction. A correction of "−2" means that the date of the NSA record is 2 days earlier in the month than the date of the GYT record of the same event.

A problem with analysing these records is that there only remains a small amount of data. For Mercury, Venus and Mars we can infer date corrections from the comparisons, analogous to those produced in Sect. 2.2 from the theoretical data. However, there is only one remaining pair of records for Jupiter or Saturn and so we cannot draw any conclusions for the date corrections applied to these planets.

Table 6 Details of cases where Diaries report different Lunar Six measurements for same event

Year	Month	Phenomenon	Measurement	
−321	VI	SS-MR	Diary:	7°
			Lunar Text 36:	4°
SE 71	IX	SS-MR	Diary:	11° 50′
			Lunar Text 40:	11° 40′
SE 124	VII	MS-SR	Diary:	15° 40′
			Lunar Text 42:	15° 30′
SE 124	VII	SR-MS	Diary:	4° 10 + [x'…]
			Lunar Text 42:	2° 50′
SE 124	XI	MR-SS	Diary:	7° 30′
			Lunar Text 42:	6° 40′
SE 124	XI	MS-SR	Diary:	1° 30′
			Lunar Text 42:	1°
SE 124	XI	SS-MR	Diary:	6° 30
			Lunar Text 42:	6° 20
SE 124	XII	MR-SS	Diary:	2°
			Lunar Text 42:	1° 40′
SE 124	XII	SS-MR	Diary:	11°
			Lunar Text 42:	13° 50′
SE 224	XII	SS-MS	Diary:	20° 20′
			Lunar Text 23:	20°

Table 7 Corrections applied to dates of NS passages, comparing GYT and NSA records

Mercury	Correction applied, in days	−1	0	1	
	Number of records	8	2	1	
Venus	Correction applied, in days	−3	−2	−1	1
	Number of records	2	11	10	1
Mars	Correction applied, in days	15	16	17	
	Number of records	2	12	2	
Jupiter	Correction applied, in days	−7			
	Number of records	1			
Saturn	Correction applied, in days	−22			
	Number of records	1			

Table 8 Summary comparing expected numbers from Roughton's data with numbers coming from comparing Babylonian records, for dates of planetary passages

	Numbers using calculations from Roughton's tables			Numbers using records from Babylonian texts		
	Peak difference in date (days)	Total no of records	Percentage within ± 1 day of peak	Peak difference in date (days)	Total no of records	Percentage within ± 1 day of peak
Mercury	−1	150	97%	−1	11	91%
Venus	−2	566	91%	−2	24	96%
Mars	15	220	68%	16	16	100%
Jupiter	−8	60	55%	−7	1	100%
Saturn	−15	5	80%	−22	1	100%

Table 8 summarises the peak date corrections which the records indicate that the Babylonian astronomers were using for planetary passages. The peak corrections suggested by the theoretical data in Sect. 2.2 are also shown, along with the percentage of the records which fall within ± one day of the peak value.

The table demonstrates that, for Mercury and Venus, the Babylonian records imply corrections to the dates which are very close to those the theoretical data shows. We showed that using a date correction of −1 day (for Mercury) and −2 days (for Venus) would predict the correct date of a planetary passage over 90% of the time, and the Babylonian records show that corrections of −1 and −2 days were indeed used for each planet over 90% of the time.

For Mars, the Babylonian astronomers very consistently used a correction of 16 days. This does not completely agree with the theoretical data, which suggested peak values of 14 and 15 days and had relatively few cases with an expected correction of 16 days. This means that a lot of the time the Babylonian astronomers would have been expecting to view the planetary passage a day or two after the passage actually took place. Calculations show that over the course of one day Mars' longitude changes by an average of 0.51°, with a standard deviation of 0.32°. This suggests that some of the time the passage would have already taken place on their expected date, but that quite a lot of the time Mars' longitude would have changed so little that it could still have been viewed as passing by the same star on the expected date.

Again, no firm conclusions can be drawn from the small amount of data remaining for Jupiter and Saturn.

The corrected periods used for predicting planetary passages should also be applicable, to dates where a planet changes zodiacal sign. However, these dates are recorded in very few Goal-Year Texts (*ADART* vol. VI nos. 77, 86, 90 and 91) suggesting that they were not explicitly predicted in the same way as dates of Greek-letter phenomena were, but perhaps deduced using dates of passing nearby Normal Stars.[19]

Observations and predictions of sign entry dates can be found in the Diaries and the Almanacs respectively. By comparing dates when a planet is observed moving into

[19] Huber (1958), Jones (2004), Steele and Gray (2007).

Table 9 Mentions of planets changing zodiacal signs in Diaries versus Almanacs

Diary					Almanac					
Year	Month	Day	Planet	Zodiacal sign reached	Year	Month	Day	Planet	Zodiacal sign reached	Date difference (days)
133	XII	4	Mercury	Pisces	179	XII	8	Mercury	Pisces	4
175	VI	30	Saturn	Scorpio	234	V	30	Saturn	Scorpio	−30
189	II	7	Mars	Aries	236	I	26	Mars	Aries	−11
189	VI2	8	Mars	Cancer	236	VI	29	Mars	Cancer	−9
193	VII	3	Venus	Sagittarius	201	VII	1	Venus	Sagittarius	−2
228	III	23	Venus	Leo	236	III	21	Venus	Leo	−2

Table 10 Corrections applied to dates of Greek-letter phenomenon dates (date combined for NSAs and Almanacs)

Mercury	Correction applied, in days	−7	−5	−4	−3	−2	−1	0	1	4	7	10
	Number of records	1	3	1	3	7	4	11	2	1	1	2
Venus	Correction applied, in days	−7	−6	−5	−4							
	Number of records	1	1	1	3							
Mars	Correction applied, in days	−6	0	4	8	9	17					
	Number of records	1	2	1	1	1	1					
Jupiter	Correction applied, in days	−2	−1	0	1							
	Number of records	1	2	3	1							
Saturn	Correction applied, in days	−13	−12	−7	−6	−5	18	22	24	28		
	Number of records	1	1	3	1	2	1	1	2	1		

a particular zodiacal sign in one year, with predicted dates of the planet moving into the same sign exactly a Goal Year period later, should show the same date differences as in Table 8. Very few such comparisons are available from the remaining data; for completeness these have been included in Table 9.

3.2.3 Predicted dates of Greek-letter phenomena

Table 10 summarises the date differences for the data relating to Greek-letter phenomena. As in Table 7, the table shows the calculated differences between the given dates of each corresponding pair of records taken from a Goal-Year Text and an Almanac or Normal Star Almanac, and the number of records which show each correction.

Table 11 shows data from the same planetary records as Table 10, and also includes comparisons of ideal first visibility or "last seen" last visibility dates when they have

Table 11 Corrections applied to dates of Greek-letter phenomenon dates, including “ideal” dates and “last seen” dates when available

Mercury	Correction applied, in days	−7	−4	−3	−2	−1	0	1	3	4	7	10
	Number of records	1	1	3	3	4	22	3	1	1	1	2
Venus	Correction applied, in days	−5	−4									
	Number of records	1	5									
Mars	Correction applied, in days	−6	0	4	8	9	17					
	Number of records	1	2	1	1	1	1					
Jupiter	Correction applied, in days	−2	−1	0	1							
	Number of records	1	2	3	2							
Saturn	Correction applied, in days	−17	−10	−9	−7	−6	−5	18	22	24	28	
	Number of records	2	1	1	3	1	2	1	1	2	1	

been recorded. Huber[20] showed that if only one date is given in the Diaries for a visibility, then it is probably the ideal date.[21] However, in the case of the records shown in Appendix B, it is usually clear from context whether an observed date or an ideal date is meant in the instances where only one date remains.

This means that planetary visibility phenomena for which only an ideal or “last seen” date remained in the Goal-Year Text will only appear in Table 11, and phenomena for which only an observed date remained will appear in both Tables 10 and 11. For phenomena where the Goal-Year text had both an observed and an ideal or “last seen” date, the difference involving the observed date is shown in Table 10, and the difference involving the ideal or “last seen” date in Table 11.

As we saw for the planetary passage data, small amounts of data mean it is not easy to draw firm conclusions from the results. This is particularly apparent for Mars and Saturn, where the data shows no clear peak. The date corrections for Greek-letter phenomena show a much wider spread than Table 7 showed for planetary passages, even in the case of Mercury where the data demonstrates a very clear peak correction. For Mercury, we have a lot more data than for any of the other planets and it has a clear peak but a very wide spread of data, while Venus and Jupiter demonstrate a much more consistent correction but only using a few points.

Contrasting Tables 10 and 11 also gives us an idea of how the ideal dates found in the Goal-Year Texts could have been used in practice. Again, there is only really enough data for this to become apparent in the case of Mercury. In both tables, the peak correction is at 0 days, but the number of records showing this correction is significantly higher when we take into account the ideal dates. This leads to the conclusion that ideal dates were taken into account when compiling the predictive texts.

Table 12 summarises the peak date corrections which the records indicate that the Babylonian astronomers were using for Greek-letter phenomena. In the same way as

[20] Huber (1977).

[21] See also Swerdlow (1998) pp. 41–50, Steele and Gray (2007).

Table 12 Summary comparing expected numbers from Roughton's data with numbers coming from comparing Babylonian records, for dates of planetary events

	Numbers using calculations from Roughton's tables			Numbers using records from Babylonian texts		
	Peak difference in date (days)	Total no of records	Percentage within ± 1 day of peak	Peak difference in date (days)	Total no of records	Percentage within ± 1 day of peak
Mercury	−1	197	98%	0	36	47%
					42	(69% using ideal dates)
Venus	−4	46	100%	−4	6	67%
					6	(100% using ideal dates)
Mars	6	44	82%	0	7	29%
Jupiter	0	88	91%	0	7	86%
					8	(88% using ideal dates)
Saturn	−6	92	92%	−7	13	31%
					15	(27% using ideal dates)

Table 8, the peak corrections suggested by the theoretical data in Sect. 2.2 are again shown, along with the percentage of the records which fall within ±1 day of the peak value.

Examining the percentages of results which fall close to the peak value provides an interesting contrast between Tables 8 and 12. Table 8 showed that, for any particular planet's Normal Star passages, the date corrections applied were nearly always the same, to a higher degree of consistency in dates than the theoretical calculations suggest they would observe. However, we see that there is a much wider spread of the data for Greek-letter phenomena which means that, even though the peak corrections for dates of Greek-letter phenomena generally match the expected, calculated values, the data show a much lower consistency in the date corrections than the theoretical calculations suggest would have been observed.

From Table 12, the Babylonian astronomers applied a correction 1 day different from that which the theoretical data suggests for Mercury (i.e. expecting to observe its phenomena on the same date of the year 46 years later, rather than 1 day previously to this). This might help to account for the number of records in the Diaries which mention ideal dates, implying that quite often the Babylonian astronomers would be expecting to observe Mercury for the first time the day *after* its true first visibility, and watching out for it a day too late. This could lead to the "it was bright, high" etc reports that the Diaries contain when a planet was first observed too high up in the sky for it to be the actual day of first visibility.

4 Conclusions

Analysis of planetary records from Goal-Year Texts, Almanacs and Normal Star Almanacs allows us to draw several conclusions about the composition of these texts. Firstly, the dates of Greek-letter phenomena records in the Almanacs and Normal Star Almanacs consistently agree with each other, implying that the same methods were used in the creation of each.

Secondly, there is a high level of agreement between the planetary records in the Goal-Year Texts and Almanacs or Normal Star Almanacs, suggesting that the records found in the Goal-Year Texts could have been used in creation of the Almanacs and Normal Star Almanacs. Statistical analysis of the records shows that, if this were the case, the Babylonian astronomers consistently applied small corrections of a few days to the dates of events from Goal-Year records, and that records of planet-Normal Star distances at the time of a planetary passage remain unchanged between the various texts.

Analysis of theoretical planetary data across Goal-Year periods confirmed that it would be possible to use Goal-Year data in this way. The theoretical analysis, agreeing with the analysis of records from the texts, showed that small corrections would indeed need to be applied to dates, and that no correction would generally be necessary for planet-Normal Star distances.

Forthcoming investigations following on from this study will include examining the relationship between Goal-Year Texts and procedure texts (for example Atypical Text E), and exploring in greater detail how the Babylonian astronomers corrected for Goal-Year periods of different lengths due to intercalary months.

Acknowledgments We thank N. A. Roughton for allowing the use of his tables of calculations, and for supplying transliterations of unpublished texts, Hermann Hunger for also supplying transliterations of unpublished texts, and A. Jones for comments on a draft of this paper. Jennifer Gray's work was supported by a STFC studentship and John Steele's work was supported by the Royal Society.

Appendix A

Table 13

Appendix B

Table 14

Table 13 Overlapping records from the Almanacs and Normal Star Almanacs

Year	Month	NSA text no	Observation	Almanac text no	Observation
SE 92	[Month XII]	LBAT 1005	The 21st, Venus in the morning in the beginning of Aries first visibility	LBAT *1118, *1119	The 21st, Venus in the morning in Aries first visibility?
SE 158	Month IV	LBAT 1034–35	[… Saturn] in the end of Pisces stationary.	LBAT 1127	[… Saturn] in the end of Pisces stationary.
SE 179	Month IV	LBAT 1043–44	The 14th, Venus in the morning […]	LBAT 1135–36	The 14th, Venus in the morning in Cancer first visibility
SE 179	Month IV	LBAT 1043–44	[…x+]1 (end of month) Saturn in Sagittarius stationary.	LBAT 1135–36	(end of month) Saturn in Sagittarius stationary
SE 179	Month V	LBAT 1043–44	The 10th Mercury in the morning […]	LBAT 1135–36	The 10th, Mercury in the morning in Leo last visibility.
SE 189	Month III	LBAT **1055	The 12th, Mercury in the morning in the end of Taurus first visibility	LBAT 1141–42	The 12th, Mercury in the morning in the end of Taurus first visibility
SE 189	Month III	LBAT **1055	The 22nd Jupiter in Gemini first visibility.	LBAT 1141–42	The 22nd Jupiter in Gemini first visibility.
SE 189	Month V	LBAT **1055	The 30th, Mercury in the evening in Virgo last visibility.	LBAT 1141–42	The 30th, Mercury in the evening in Virgo last visibility.
SE 201	Month II	LBAT **1059	The 11th, Mercury in the evening in Gemini last visibility.	LBAT 1151	⌜The xth⌝(7th-11th), Mercury in the evening in Gemini […]
SE 201	Month III	LBAT **1059	The 12th, Jupiter in Gemini first visibility.	LBAT 1151	The 12th, Jupiter in Gemini first visibility.
SE 201	Month III	LBAT **1059	The 22nd, Mars in Cancer last visibility.	LBAT 1151	The 22nd, Mars in Cancer last visibility.

Table 13 continued

Year	Month	NSA text no	Observation	Almanac text no	Observation
SE 201	Month IV	LBAT **1059	The 1st, Mercury in the morning in Cancer last visibility.	LBAT 1151	The 1st, Mercury in the morning […]
SE 201	Month V	LBAT **1059	The 27th, Mercury in the evening in Virgo last visibility.	LBAT 1151	The 27th, Mercury in the evening in Virgo last visibility.
SE 201	Month VI	LBAT **1059	The 24th, Saturn in Virgo first visibility	LBAT 1151	The 24th, Saturn in Virgo first visibility
SE 201	Month VI	LBAT **1059	The 26th, Mercury in the morning in Virgo first visibility.	LBAT 1151	[…(end of month) Mercu]ry in the morning in Virgo ⌜first visibility⌝
SE 201	Month VII	LBAT **1059	The 8th, Mars in Libra first visibility.	LBAT 1151	The 8th, Mars ⌜in Leo first visibility?⌝ […]
SE 201	Month VII	LBAT **1059	The 11th, Jupiter in Cancer stationary.	LBAT 1151	The 11th, Jupiter in Cancer stationary.
SE 201	Month VII	LBAT **1059	The 26th, Mercury in the morning in the end of Libra last visibility.	LBAT 1151	The 26th, Mercury in the morning in the end of Libra last visibility.
SE 201	Month IX	LBAT **1059	The 3rd, Venus in the evening in Sagittarius last visibility	LBAT 1151	The 3rd, Venus in the evening in Sagittarius last visibility
SE 201	Month IX	LBAT **1059	The 5th, Venus in the morning in Sagittarius first visibility.	LBAT 1151	The 6th, Venus in the morning [in x first visibility…]
SE 201	Month IX	LBAT **1059	The 11th, Jupiter's acronychal rising	LBAT 1151	The 11th, Jupiter's acronychal rising
SE 201	Month IX	LBAT **1059	The 13th, Mercury in the evening in Capricorn first visibility	LBAT 1151	The 13th, Mercury in the evening in Capricorn first visibility

Table 13 continued

Year	Month	NSA text no	Observation	Almanac text no	Observation
SE 201	Month X	LBAT **1059	The 4th, Mercury in the evening in the beginning of Aquarius(?) last visibility.	LBAT 1151	The 4th, Mercury in the evening in the beginning of ⌜x⌝ last visibility
SE 201	Month X	LBAT **1059	The 14th, Mercury in the morning in Capricorn(?) first visibility.	LBAT 1151	The 14th, [Mercu]ry in the morning in Capricorn first visibility
SE 201	Month XI	LBAT **1059	The 2nd, Saturn in the beginning of Libra stationary.	LBAT 1151	‘The 20th, Saturn in the beginning of Libra ⌜x⌝
SE 201	Month XI	LBAT **1059	The 11th, Jupiter in Gemini stationary	LBAT 1151	The 11th, Jupiter in Gemini stationary
SE 201	Month XII	LBAT **1059	The 29th, Mercury in the evening in Aries first visibility.	LBAT 1151	The 29th, Mercury in the evening in ⌜Aries? last?? visibility⌝
SE 234	Month XII	BM 32247	The 10th, Saturn in Scorpio stationary.	LBAT **1161, 1162-6, **1167-8	The 10th, Saturn in Scorpio stationary.

Table 14 Overlapping records from the Goal-Year Texts and Normal Star Almanacs or Almanacs

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
SE 96	10	Month I	The 7th, Mercury's first appearance in the west in the beginning of Taurus	NSA	LBAT **1007, 1008	Month I	⌜The 14th⌝, Mercury in the evening in the beginning of […]
		Month I	Night of the 17th first part Venus 4 1/2 cubits above gamma Geminorum			Month I	Night of the 16th first part Venus? above gamma Geminorum 4 [cubits x…]
		Month I	Night of the 5th first part Mars, while moving back to the east, 2 1/2 cubits below epsilon Leonis			Month I	⌜Night of the⌝ 21st first part Mars below? epsilon Leonis 3 cubits
		Month I	Night of the 25th first part Mercury 1 cubit 4 fingers below beta Tauri			Month I	Night of the 24th first [part] Mercury below beta Tauri […]
		Month I	Night of the 25th first part Mars 14 fingers above alpha Leonis			Month II	Night of the 11th first part Mars above alpha Leonis 14 fingers
		Month II	The 13th, Mercury's last appearance in the west in the beginning of Gemini			Month II	The 13th, Mercury in the evening in Gemini last visibility.
		Month II	Night of the 9th first part Mars 1/2 cubit above rho Leonis			Month II	Night of the 25th first part Mars above rho [Leonis …]
		Month III	The 3rd, Venus' last appearance in the west in Gemini			Month II	The 29th, Venus in the evening in Gemini ⌜last visibility?⌝
		Month II	Night of the 28th first part Mars 4 cubits below theta Leonis			Month III	Night of the 14th first part ⌜Mars⌝ below the[ta] Leonis 4 ⌜cubits⌝
		Month III	[…] first part Mars 1 finger above beta Virginis, it came close			Month IV	x first part Mars above beta Virginis 1 finger

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month IV	Night of the 10+[xth last part] Venus 1 1/2 cubits […] mu Gem			Month IV	Night of the 11th last part Venus below mu Geminorum 1 1/2 cubits.
		Month V	[…] last part of the night Venus 5 1/2 cubits below alpha Geminorum			Month V	Night of the 1st last part Venus below alpha Geminorum 5 1/2 cubits.
		Month IV	Night of the 29th first part Mars 1 cubit above alpha Virginis			Month V	Night of the 15th first part Mars above alpha Virgin[is …]
		Month V	Night of the 30th, 8 fingers [… alpha Lib]rae			Month VI	Night of the 16th first part Mars below alpha Librae 8 fingers.
		Month VI	Night of the 30th last part Venus 4 cubits below theta Leonis			Month VI	Night of the 29th last part Venus […] 4 cubits
		Month IX	Night of the 4th last part Venus 2 fingers above beta Scorpii			Month IX	Night of the 2nd last part Venus above beta Scorpii 2 ⌜fingers⌝
		Month IX	[…] Venus 2 cubits above alpha Scorpii			Month IX	[…]⌜last part Venus⌝ above alpha Scorpii 3 cubits.
		Month IX	Night of the 21st last part Venus 1 cubit 4 fingers above theta Ophiuchi			Month IX	Night of the ⌜19th Venus⌝ above theta Ophiuchi 1 cubit 4 fingers.
		Month X	[…] Venus 2 1/2 cubits below beta Capricorni; I watched, but I did not see beta			Month X	Night of the ⌜23rd⌝ last part Venus below beta Capricorni 1 1/3 cubits
SE 105	14	Month I	Night of the 19th first part Mars […] above eta Gem	NSA	LBAT *1011, 1012,	Month I	Night of the 5th first part Mars above eta Gem 20 fingers

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month I	[…] Mars 20 fingers above mu Gem		BM132283	Month I	Night of the 9th first part Mars above mu Gem 20 fingers
		Month II	Night of the 1st first part Mars […] above gamma Gem			Month I	Night of the 18th first part Mars above gamma Gem 3 cubits.
		Month II	[Night of the xth first] part Mars 3 1/2 cubits below alpha Gem			Month II	[Night of the 1st] first part Mars below alpha Gem 3 1/2 cubits
		Month II	Night of the 23rd first part Mars 2 1/2 cubits below beta Gem			Month II	Night of the 9th first part Mars below beta Gem […]
		Month III	The 23rd, Mars' last appearance in Cancer			Month II	The 23rd, Mars in Cancer last visibility
SE 106	15	Month V	Night of the 10th last part Venus 3 fingers above alpha Leonis	NSA	LBAT *1013, 1015	Month V	Night of the 8th last part Venus above alpha Leonis 3 fingers.
		Month X	The 29th, Mercury's [first visibility …]			Month X	29th, Mercury [first visibility …]
		Month XII	[… Venus] 3 cubits [above alpha Tau]ri			Month XII	[…] first part Venus above alpha Tauri 3 cubits
SE 107	16, 17, 18	Month I	Night of the 17th first part Mars 2 [cubits] below alpha Gem	NSA	LBAT 1016, 1017, 1018	Month II	3rd first part Mars below alpha Geminorum 3 1/2 cubits.
		Month II	Night of the 22nd first part Venus […] below delta Cancri			Month II	Night of the 19th first part Venus above [gamma/delta] Cancri? […]
		Month III	The 30th, [Mercury's] last appearance [in the west in] Cancer			Month III	The 29th, Mercury in the evening in Cancer last visibility.

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month IV	Night of the 7th first part Venus 5? cubits below theta Leonis			Month IV	⌜Night of the⌝ 6th first part Venus below theta Leonis 4 cubits.
		Month IV	The 24th, Mercury's [first appearance] in [the east in …]			Month IV	The 24th, ⌜Mercury x first visibility?⌝
		Month IX	Around the 18th, Saturn's acronychal rising			Month X	The 13th, Saturn's acronychal rising
		Month X	The 20th, Jupiter's acronychal rising			Month X	The 20th, Jupiter's acronychal rising
		Month XI	Night of the 11th [last part Venus] 1/2 cubit below beta Capricorni			Month XI	Night of the 9th […]⌜x⌝ Venus below beta [Cap]ricorni 2 cubits.
		Month XI	Night of the 25th last part Venus 1 cubit 8 fingers above gamma Capricorni			Month XI	Night of the 22nd las[t part] Venus ⌜x⌝ […] gamma Capricorni 1 cubit 8 fingers.
		Month XI	Night of the 26th last part Venus 1 cubit 10 fingers above delta Capricorni			Month XI	Night of the 24th last part […] […] [delta Caprico]rni? 1 cubit 8 fingers.
		Month XII	Night of the 26th first part Saturn 2 finger above delta Cancri			Month XII	⌜x⌝ Saturn above delta Cancri 2 fingers
SE 120	21	Month II	The 21st, Venus' [last appearance] in the west in Leo	NSA	LBAT 1022	Month II	The 17th Venus in the evening in Gemini last visibility
SE 129	26, 27	Month I	The 11th, Mercury's first appearance in the west in Taurus?	Almanac	LBAT **1123	Month I	The 12th, Mercury in the evening in Taurus first visibility

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month III	The 26th?, Mercury's [first appearance] in the east …			Month III	The 24th, Mercury in the morning in Gemini first visibility.
		[Mon]th V	The 11th, Mercury's first appearance in the west in the end of Leo			Month V	The 11th, Mercury in the evening in the end of Leo first visibility.
		[Month VII]	The 6th, Mercury's first appearance in the east in Virgo			[Month VII]	The 5th, Mercury ⌜xxx⌝ […]
		Month XII_2	The 6th, Mer[cury's first appearance in the west in Aries]			Month XII_2	The 7th, Mercury in the evening in Aries first visibility.
		Month XI	The 20th?, Mars' acronychal rising			Month XI	The 14th, Mars' acronychal rising.
SE 135	30, 31, 32	Month IX	Night of the 3rd first part Venus 4 fingers above gamma Capricorni	NSA	LBAT 1026	Month IX	[…gamma] Capricorni 4 fingers
		Month IX	Night of the 5th first part Venus 4 fingers above delta Capricorni			Month IX	[…]⌜Venus⌝ above delta Capricorni 4 fingers.
SE 175	54, 55	Month VI	Night of the 12th last part Jupiter, while moving back to the west, 4 cubits below alpha Arietis	NSA	LBAT 1041, 1042	Month VI	[…]⌜x⌝ Jupiter below alpha Arietis 4 ⌜x⌝
		Month VI	The 17th, Venus' [first appearance in the west in …] (ideal) first appearance on the 15th?			Month VI	The 11th, Venus in Virgo first visibility.

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
SE 184	60	Month VIII	Night of the 27th last part Venus [..]. above theta Ophiuchi	NSA	LBAT 1047, 1048	Month VIII	Night of the 25th last part Venus above [theta Ophiuchi …]
		Month IX	Night […] 2 cubits [below] beta Capricorni			Month IX	[… first] part? Jupiter below beta Capricorni 2 1/2 cu[bits …]
		Month IX	Around the 12th, Jupiter's last appearance in Capricorn			Month IX	12th Jupiter in Capricorn last visibility.
SE 187	63	?	[…] Venus was 1 cubit 4 fingers below alpha Leonis	NSA	LBAT 1049, 1050	?	Night of the 2nd last part Venus below alpha Leonis 1 cubit 4 fingers
SE 192	68	Month VI	Night of the 7th last part Venus 5 cubits below theta Leonis	NSA	LBAT 1056	Month VI	Night of the 5th last part Venus ⌜x⌝ theta [Leonis?] 5 cubits
		Month VI	[Ni]ght of the 20 + [xth last part] Venus 2/3? cubit below gamma Virginis			Month VI	[…] last part Venus below gamma ⌜Vir⌝ginis 1/3 cubit
		Month VII	[… Saturn] 6 fingers above zeta Tauri			Month VII	[…] 21st last part Saturn above [zeta] Tauri? 6 fingers
		Month VII	The 29th, Mercury's first appearance in the east in the beginning of Scorpio […] ideal first appearance on the 27th?			Month VII	The 24th, Mercury in the morning in Scor[Pio…]
		Month VII	Night of the 29th last part Venus 2 1/2 cubits below beta Librae			Month VII	[Night] of the 27th last part Venus below beta Librae 2 1/2 cubits.

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month VIII	The 11th, Saturn's acronychal rising			Month VIII	The 6th, Saturn's acronychal rising.
		Month VIII	Night of the 10th last part Venus 8 fingers above beta Scorpii			Month VIII	Night of the 8th last part Venus ⌜above⌝ beta [Scorpii? …]
SE 194	69	Month I	Around the 15th, Jupiter's acronychal [rising …]	NSA	LBAT 1057	Month I	The 16th, Jupiter's acronychal [rising …]
		Month II	Night of the 2nd first part Mercury 1 1/2 cubits below beta Tauri			Month II	Night of the 1st first part Mercury below [beta] Tauri ⌜xxx⌝
		Month II	Night of the 4th last part Venus 4 cubits below eta Piscium			Month II	Night of the 2nd last part Venus below [eta] Piscium 4 cubits
		Month II	Night of the 9th last part Venus 5 cubits below beta Arietis			Month II	Night of the 8th last part Venus below beta Arietis ⌜4?⌝ […]
		Month II	Night of the 9th first part Mercury 1 cubit 4 fingers above eta Geminorum			Month II	Night of the 9th first part Mercury above [eta] Geminorum 1 ⌜cubit x⌝ fingers?
		Month II	Night of the 11th first part Mercury 1 cubit 4 fingers above mu Geminorum			Month II	Night of the 11th first part Mercury above mu Geminorum 1 cubit 4 fingers?
		Month II	Night of the 13th last part Venus 6? [cubits] below alpha Arietis			Month II	Night of the 12th last part ⌜Venus⌝ below alpha Arietis 6 cubits.
		[Month II?]	Jupiter, while moving back to the east, was 3 cubits below beta Librae			Month II	Night of the 13th first part Jupiter below beta? Librae 3 cubits

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month III	Night of the 10th last part Venus 2 cubits above alpha Tauri			Month III	Night of the 9th last part Venus above alpha Tauri 2 cubits.
		Month III	Night of the 20th last part Venus 2 1/2 cubits below beta Tauri			Month III	Night of the 19th? last part Venus below beta Tauri 2 1/2 cubits
		[Month III?]	The 19th, Jupiter became stationary to the west, [nn] cubits behind beta Librae, 3 cubits low to the south			Month III	The 19th, Jupiter in Libra stationary.
		Month IV	Night of the 1st [last part Ve]nus 8 fingers above eta Geminorum			Month III	Night of the 30th last part Venus above eta Geminorum 8 fingers.
		Month II	The 17th, Saturn's last appearance in Gemini			Month III	The 5th, Saturn ⌜xx⌝ […last visibility?]
		Month II	Night of the 20th first part Mars while moving back to the east 1 cubit below Gamma Virginis			Month III	[5th-9th… Mars] below gamma Virginis 1 cubit
		Month III	Night of the 15th [first] part Mars 1 cubit above alpha Virginis			Month IV	Night of the 2nd first part Mars above alpha Virginis 2 cubits
		Month IV	The 7th, Mercury's first appearance in the east in Gemini … [(ideal) first appearance] on the 4th			Month IV	The 4th, Mercury in the morning ⌜xx⌝ first visibility
		Month IV	Night of the 6th last part Venus 2? cubits above gamma Geminorum			Month IV	Night of the 5th last part Venus above gamma Geminorum 3 cubits.

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month IV	Night of the 15th? [last part Venus] 4 cubits [below] alpha Geminorum			Month IV	Night of the 13th last part Venus below alpha Geminorum 4 cubits
		Month III	The 21st, Saturn's first appearance in Gemini			Month IV	The 13th, Saturn in Gemini first visibility.
		Month IV	Night of the 18th last part Venus 5 cubits below beta Geminorum			Month IV	Night of the 17th? last part Venus below beta Geminorum 3 cubits.
		Month IV	The 23rd, Mercury's last appearance in the east in Cancer, I did not watch			Month IV	[. . . x +]3rd Mercury in the morning in Cancer last visibility.
		Month VIII	Night of the 16th first part Mars 2 cubits below beta Capricorni			Month IX	Night of the? 2nd first part Mars below beta Capricorni [. . .]
		Month X	The 5th, Mercury's first appearance in the west in Capricorn, ... (ideal) first appearance on the 4th			Month X	The 3rd, Mercury in the evening in Capricorn first visibility.
		Month X?	Around the 11th, Saturn's acronychal rising; I did not [watch]			Month X	The 6th, Saturn's acronychal rising
		Month IX	Night of the 24th last [part Jupiter] 1 cubit [above theta] Ophiuchi			Month X	Night of the 17th last part Jupiter above theta [Ophiuchi?] ⌜x⌝ cubits.
		Month X	[. . .Mercury's last appearance in the west] in Aquarius: from the 20th, when I watched I did not see it			Month X	The 20th, Mercury in the evening in Aquarius ⌜x⌝ [. . .]

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month XI	The 10th, Mercury's first appearance in the east in Capricorn, ... (ideal) first appearance on the 8th			Month XI	The 8th, Mercury in the morning in Capricorn first visibility
		Month XI	Night of the 25th last part Mercury 1/2 cubit above gamma Capricorni			Month XI	Night of the 24th last part Mercury above ⌜x⌝ [...] Capricorni 1/2 cubit
		Month XI	Night of the 27th last part Mercury 1/2 cubit above delta Capricorni			Month XI	Night of the 26th last part Mercury above delta [Capricorni ...]
		Month XI	Night of the xth first part Venus 2 1/2 cubits below eta Piscium			Month XI	Night of the 28th first part Venus below eta Piscium 2 1/2 cubits.
		Month XII	[... Venus] 3 1/2 cubits [below] beta Arietis			Month XII	Night of the 5th first part Venus below [beta] Arietis 3 1/2 cubits.
		Month XII	Around the 8th, Mars' last appearance in the end of Pisces			Month XII	The 8th, Mars in the end of Pisces last visibility.
		Month XII	Ni[ght of the xth first part] Venus 4 1/2 cubits below alpha Arietis			Month XII	Night of the 9th first part Venus below alpha Ari[etis] 4 1/2 cubits
		Month XI	Around the 11th, Saturn became stationary to the west 6 fingers in front of alpha Geminorum			Month XII	The 10th, Saturn in Gemini stationary
		Month XII	The 17th, Mercury's last appearance in the east in Pisces, from the 14th in the end of Aquarius, when I watched I did not see it			Month XII	[x+]5th Mercury in the morning in the end of Aquarius last visibility.

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month XII	Night of the 10 + [xth first part Venus] 1? 1/2 cubits [below eta Tau]ri			Month XII	[… x +]5th first part Venus below eta Tauri 1 1/2 cubits
		Month XII_2	Night of the 14th? first part Venus […] below [beta] Tauri			Month XII_2	Night of the 15th first part Venus below [beta] Tauri […]
SE 201	73	Month I	Night of the 9th first part Mercury 1 cubit above alpha Tauri	NSA	LBAT **1059	Month I	Night of the 8th first part Mercury above alpha Tauri 4 cubits.
		Month I	[…Mars] 4 cubits [above] gamma Geminorum			Month I	Night of the 9th first part Mars above gamma Geminorum 4 cubits
		Month I	Night of the 17th? first part [Mercury …] below beta Tauri			Month I	Night of the 16th first part Mercury below beta Tauri 1 1/2 cubits
		Month I	[Night of the 1]9th first part Mercury 1 1/2 cubits above zeta Tauri			Month I	Night of the 18th first part Mercury above zeta Tauri 1 1/2 cubits.
		Month I	Night of the 10 + [xth first part Mercury] 1 cubit 4 fingers [above eta Geminorum]			Month I	Night of the 25th first part Mercury above eta Geminorum 1 cubit 4 fingers
		Month I	Night of the 28th first part Mercury […] above mu Ge[minorum]			Month I	Night of the 27th first part Mercury above mu Geminorum 1 cubit 4 fingers
		Month I	[…] Mars 3 1/2 cubits below alpha Geminorum			Month I	Night of the 28th first part Mars below alpha Geminorum 3 1/2 cubits.
		Month II	[Night of the xth first part Mercury] 4 cubits above gamma Geminorum			Month II	Night of the 2nd first part Mercury above gamma Geminorum 4 cubits

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month I	Night of the 21st first part Mars […]			Month II	Night of the 8th first part Mars below beta Geminorum 2 1/2 cubits
		Month II	[…] Mars 1/2 cubit above delta Cancri			Month III	Night of the 2nd first part Mars above delta Cancri 1/2 cubit.
		Month III	The 13th, Jupiter's first appearance in Gemini			Month III	The 12th, Jupiter in Gemini first visibility
		Month III	[The xth, Mercury's first appearance in the east in Gemini], ... (ideal) first appearance on the 14th			Month III	The 14th Mercury in the evening in Gemini first visibility.
		Month IV	Night of the 12th first part Saturn while moving back to the west […] fingers [below gamma Virginis]			Month III	Night of the 20th first part Saturn below gamma Virginis 6 fingers.
		Month V	Around the the 5th, Mercury's first appearance in the west in Vir[go?], I did not watch			Month V	The 5th, Mercury in the evening in Virgo first visibility.
		Month V	The 27th, Saturn's last appearance in Virgo, from the 23rd, when I watched I did not see it			Month V	The 14th, Saturn in Virgo last visibility.

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month V	Around the 27th, [Mercury's last appearance in the west in …]			Month V	The 27th, Mercury in the evening in Virgo last visibility.
		Month VII	[The xth, Saturn's] first appearance [in Virgo…behind Mercu]ry to the east; ... (ideal) first appearance on the 12th			Month VI	The 24th, Saturn in Virgo first visibility.
		Month VI	The 28th, Mercury's [first appearance] in the east in Virgo …			Month VI	The 26th, Mercury in the morning in Virgo first visibility.
		Month VII	[Night of the 6th?, last part Mercury] 2 cubits [above] alpha Virginis			Month VII	Night of the 7th last part Mercury above alpha Virginis 2 cubits
		Month VII	[night of the xth] last part Mars 8 fingers below alpha Librae			Month VIII	Night of the 2nd last part Mars below alpha Librae 8 fingers
		Month VII	Night of the 23rd last part Mars [below beta Librae]			Month VIII	Night of the 9th last part Mars below beta Librae 3 1/2 cubits.
		Month VIII	[Night of the xth last part Mars] 8 fingers below beta Scorpii			Month VIII	Night of the 29th last part of the night Mars below beta Scorpii 8 fingers.
		Month VIII	Night of the 23rd last part Mars […] above alpha Scorpii			Month IX	Night of the 9th last part Mars above alpha Scorpii 2 1/2 cubits.
		Month IX	The 9th? Mercury's [first appearance] in the west in [Capricorn …]			Month IX	The 13th, Mercury in the evening in Capricorn first visibility

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month IX	[Night of the xth last part Mars] 1/2 cubit [above theta] Ophiuchi			Month IX	Night of the 25th last part Mars above theta Ophiuchi 1/2 cubit.
		Month X	[The xth, Mercury's first appearance] in the east in Capricorn,... (ideal) first appearance on the 14th			Month X	The 14th, Mercury in the morning in Capricorn(?) first visibility.
		Month IX	Around until the 7th? Saturn became stationary to the east … [behind alpha Virginis]			Month XI	The 2nd, Saturn in the beginning of Libra stationary.
		Month XI	Night of the 6th last part Mars 2 1/2 cubits below beta Capricorni			Month XI	Night of the 22nd last part Mars below beta Capricorni 2 1/2 cubits
		Month XI	The 28th, Mercury's last appearance in the east in Aquarius, from the 26th, when I watched I did not see it			Month XI	The 26th, Mercury in the morning in Capricorn last visibility.
		Month XII	[Night of the x] + 1st last part Mars 1/2 cubit above delta Capricorni			Month XII	Night of the 17th last part Mars above delta Capricorni 1/2 cubit
		Month I	The 1st, Mercury's first appearance in the west in Aries, ..., (ideal) first appearance on the 30th of Month XII			Month XII	The 29th, Mercury in the evening in Aries first visibility.
SE 201	73	Month III	The 13th, Jupiter's first appearance in Gemini	Almanac	LBAT 1151	Month III	The 12th, Jupiter in Gemini first visibility.

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month VII	Saturn's first appearance [in Virgo]; (ideal) first appearance on the 12th			Month VI	The 24th, Saturn in Virgo first visibility.
		Month IX	Around until the 7th?, when Saturn became stationary to the east …			Month IX	The 20th, ⌜Saturn⌝ […stationary?]
		Month X	[Mercury's] (ideal) first appearance on the 14th			Month X	The 14th, [Mercu]ry in the morning in Capricorn first visibility.
SE 236	85, 86	Month II	Around the 4th, Saturn's acronychal rising	Almanac	LBAT 1169-71, **1172, 1173-4	Month I	The 27th, Saturn's ⌜acronychal rising⌝
		Month II	Around the 11th, Venus' first appearance in the west in Gemini			Month II	The 6th, Venus in the evening in Gemini ⌜first visibility⌝
		Month II?	[Jupiter's] first appearance […] (ideal) first appearance on the 19th			Month II	The 20th, Jupiter in the end of ⌜Taurus?⌝ first visibility.
		Month II	Around the 20th, Mercury's last appearance in the east, omitted			Month II	The 20th, Mercury in the morning last visibility omitted
		Month III	The 19th, Mercury's first appearance in the west in Cancer … (ideal) first appearance on the 17th			Month III	The 15th, Mercury in the evening in Cancer first visibility
		Month IV	Until the 8th, when Saturn became stationary to the west…			Month IV	The 1st, Saturn in Scorpio stationary.
		Month IV	Around the 23rd, Mercury's last appearance in the west in Leo			Month IV	The 23rd, Mercury in the evening in the end of Leo last visibility

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month V	The 24th, Mercury's first appearance in the east in Leo … (ideal) first appearance on the 21st			Month V	The 21st, Mercury in the morning in Leo first visibility.
		Month VI	[last] appearance of Mercury in Virgo, when I watched from the 12th I did not see it			Month VI	The 12th, Mercury in the morning in Virgo last visibility
		Month VIII	Around the 8th, Mercury's first appearance in the west in Sagittarius, I did not watch			Month VIII	The 8th, Mercury in the morning in Sagittarius first visibility
		Month VIII	The 4th, Saturn's last visibility in Scorpio, from the 2nd when I watched I did not see it			Month VII	The 21st, Saturn in Scorpio last visibility
		Month VIII	Around the 23rd, Mercury's last appearance in the west in Sagittarius, I did not watch			Month VIII	The 23rd, Mercury in the evening in Sagittarius last visibility.
		[Month IX]	Around the 2nd, Mars' acronychal rising			Month IX	The 6th, ⌜Mars acronychal rising⌝
		Month IX	Around the 7th, Mercury's first appearance in the east in Sagittarius, I did not watch			Month IX	The 7th, Mercury in the morning in Sagittarius first visibility.
		Month X	Around the 13th, Mercury's last appearance in the east in Capricorn, I did not watch			Month X	The 23rd, Mercury in the morning in Capricorn last visibility.

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
		Month XI	Around the 10th, Venus' last appearance in the west in the end of Aquarius			Month XI	The 6th, Venus in the evening in Aquarius last visibility
		Month XI	The 15th, Venus' first appearance in the east in Aquarius			Month XI	The 8th, Venus in the morning in Aquarius first visibility.
SE 245	88, 89	Month I	Around until the 10th, Mars became stationary to the east	Almanac	LBAT *1179, *1180	Month I	[2]7th Mars in Sagittarius ⌜stationary⌝
		Month II	Around the 20th, Mars' acronychal rising.			Month II	The 29th, Mars' acronychal rising.
		Month III	The 29th, Mercury's last appearance in the west in …			Month III	The 22nd, Mercury [in x in] Cancer last visibility.
		Month III	Until the 25th, Mars became stationary to the west			Month IV	The 3rd, Mars in the beginning of Sagittarius stationary.
		Month IV	Around until the 14th, Saturn became stationary to the east in Pisces			Month IV	The 7th, Saturn [in] P[isce]s ⌜stationary⌝
		Month IV	(ideal) first appearance in the east on the 22nd			Month IV	The 22nd, Mercury in the morning in Cancer first visibility.
		Month VII	Around the 18th, [Mercury's last appearance] in the west … [omitted]			Month VII	The 15th, Mercury in the evening last visibility omitted
		Month VIII	The 8th, Mercury's [first appearance] in the east in … (ideal) first appearance on the 5th			Month VIII	⌜The 8th⌝ Mercu]ry in the morning in the end of Libra first visibility

Table 14 continued

Year	Vol VI no	Month	Observation	Text type	Text nos	Month	Observation
SE 246	90, 91	Month I?	Around the 6th, Jupiter's first appearance in the end of Pisces	Almanac	LBAT *1181	Month I	The 4th, Jupiter in Pisces first visibility.
SE 247	92, 93	Month I	The 4th, Mer[cury's] first appearance […] (ideal) first appearance on the 3rd?	Almanac	LBAT 1182	Month I	The 2nd, ⌜Mercury?⌝ in the evening in Taurus first visibility
		Month IV	[The x] + 1st, Mercury's last appearance in the east in the beginning of Gemini; from the 28th of Month III when I watched [I did not see it…]			Month III	°The 25th, Mercury in the morning in Gemini last visibility

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