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Babylonian Lunar Six Tablets

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I. Introduction

In Babylonian astronomy there are a set of six specific time intervals between the rising and setting of the sun and moon observed near new moon and near full moon every month. These intervals were named by Sachs (1948) the 'Lunar Six'. The six time intervals are:

On the first day of the month:

(1) evening: the time between sunset and the setting of the moon after it had become visible for the first time after conjunction. This interval is called NA.

Around the middle of the month, four intervals relating to full moon:

(2) morning: the time between moonset and sunrise when the moon set for the last time before sunrise; this is called ŠÚ.

(3) morning: the time between sunrise and moonset when the moon set for the first time after sunrise; called NA.

(4) evening: the time between moonrise and sunset when the moon rose for the last time before sunset; called ME.

(5) evening: the time between sunset and moonrise when the moon rose for the first time after sunset; called GE_6.

At the end of the month:

(6) morning: the time between moonrise and sunrise when the moon was visible for the last time; called KUR.

The six intervals are recorded in the unit UŠ and its subdivision NINDA where there are 60 NINDA in an UŠ. 1 UŠ equals 4 minutes of time and so it is often convenient to translate UŠ as "time degree".

The sequence in which the four intervals (2) – (5) occur depends on the lunar position relative to the sun, and in particular on whether opposition falls into daytime or nighttime. Theoretically, the following four sequences can be expected:

ŠÚ – ME – NA – GE_6,	on days:	n, n+1, n+1, n+2
ŠÚ – NA – ME – GE_6,		n, n+1, n+2, n+3
ME – ŠÚ – GE_6 – NA,		n, n, n+1, n+1
ME – GE_6 – ŠÚ – NA,		n, n+1, n+1, n+2

Note that (2) and (3) measure the same quantity, namely the time difference between sunrise and moonset: if moonset comes first, it is called ŠÚ, otherwise NA. Similarly, (4) and (5) are basically the same. In the Babylonian calendar, the date changes at sunset. Curiously, the Babylonians dated both evening events (4) and (5) with the date of the night beginning at that sunset, even though, technically, the time interval (4) still falls into the preceding day. The Astronomical Diaries draw attention to this by using an explicit "night of the nth" notation for both intervals, such as GE_6 15 7 ME: "night of the 15th 7° ME", while the entire interval still falls into the daytime of day 14. The same practice is found in early lunar six texts but unlike the Diaries where the practice remained in use down to the latest preserved examples, such reminders of night dates were dropped in later lunar six texts. They are also absent from all published Goal Year Texts and Normal Star Almanacs. Here we would only find 15 7 ME. We shall call the use of this extra GE_6 (in GE_6 15 7 ME) the "GE_6 convention".

Reports of the lunar six time intervals are found in the Astronomical Diaries, the Goal Year Texts and in individual tablets that contain compilations of lunar six data, presumably abstracted from the Diaries. Generally these reports contain measurements of the duration of a particular lunar six time interval, sometimes supplemented by remarks on the adverse weather conditions that may have affected, but not prevented, measurement, and often the term *muš* "measured". Sometimes, however, the interval is denoted as NU PAP "I did not watch", usually accompanying the remark DIR "clouds", and must therefore be a calculated value. Calculated values of the lunar six intervals for a coming year are also found in the Normal Star Almanacs. A method by which the Babylonians could calculate lunar six data based upon past observations, known to modern scholars as the "Goal Year Method", has been rediscovered by Brack-Bernsen in the text TU 11 (Brack-Bernsen 1999, Brack-Bernsen and Hunger 2002).

Fourteen tablets containing compilations of lunar six data have been published by H. Hunger, *Astronomical Diaries and Related Texts from Babylonia. Volume V: Lunar and Planetary Texts* (2001: hereafter ADART V), Nos. 36–51, plus four tablets that contain lunar six data together with planetary or other lunar data (ADART V Nos. 12, 13, 23 and 55). Of the fourteen that contain only lunar six data, six have the date preserved, the earliest containing data from –322 to –318 and the latest data from –187. Earlier lunar six data are found on ADART V No. 55, containing data for Cambyses year 7 (–522) (see Britton 2007 for a detailed discussion and analysis of this text), and in early Astronomical Diaries.

A method for establishing the date of lunar six compilations where the date has been broken away has been developed by Huber. Adapting the computer programs used in Huber (2000) to automatically compare observed and calculated lunar sixes, a robust statistical method (i.e. a method insensitive to occasional gross errors caused by scribal errors and misreadings of damaged sections) was used to score potential fits between the preserved data on a tablet and the calculated lunar six data. The method chosen is to score

by median absolute deviations: median(abs(obs-calc)). Full details of the method and its testing are given in Huber and Britton (2007).

Using Huber's method, Huber and Britton (2007) dated the tablet ADART V No. 49 to the period covering –590 to –579. Six further lunar six tablets published in ADART V have subsequently been dated (some provisionally) by Huber; these will be discussed in section 2 below. In addition, Steele has identified seventeen further lunar six tablets of which Huber has dated seven. These new tablets are edited and dated in section 3 below.

Table 1 lists all of the lunar six tablets known to us. In the second column a reference to the edition of the text is given (here "Text x" refers to tablets published in section 3 of the present paper). The third column gives the date covered by the text. A question mark after the date indicates that the date is uncertain. In parentheses we indicate those texts with a preserved date by "P" and those that have been dated by Huber with an "H". Note that the date ranges given for each tablet are the dates of the years of the first and last preserved records and that intermediate years may be (and often are) lost. In the fourth column we indicate whether the text follows the GE_6 convention (see above). Multi-column lunar six tablets may be set out in one of two formats: either as straightforward lists where the scribe continued onto the next column when he reached the end of one column, or in a grid format where entries in successive column are separated by one year, and so neighbouring entries are for the same month in successive years; this is indicated in column five of table 1. Finally, column six contains any comments to the tablets.

Several comments may be made about the Babylonian lunar six tablets based upon table 1. First, we now have ample evidence for the regular observation and recording of lunar six time intervals from the middle of the seventh century down to the period of the latest astronomical texts from Babylonia. As discussed below, Text A, C, D and F appear to have been written by the same scribe. Indeed, we believe that Texts A, C and F were part of a multi-tablet compilation of lunar six data stretching from at least –642 to –511. If each tablet contains six or seven columns (which is quite plausible), around twenty tablets would be required to cover this period; if we postulate bigger tablets, fewer would be needed. The tablets comprising this compilation have a uniform format: each column extends from the obverse to the reverse of the tablet and contains lunar six data arranged into monthly blocks for one year. The entries for the following years are given in the following columns such that lunar six data for a particular month in successive years is found along each row of this matrix. This arrangement is similar to that found in the large, eight-tablet compilation of lunar eclipse observations extending from –746 to –314 of which fragments of three tablets are preserved (Hunger 2001, Nos. 2, 3 and 4; see also Huber and De Meis 2004). The existence of an extensive compilation of early lunar six data is very interesting.

Tablet	Publication	Date	GE_6 Convention	List or Grid
BM 38414	Text A	–642 to –640 (H)	Yes	Grid
N.2349[1]	Text B	–617 (H)	Yes	List
BM 55554[2]	ADART V No. 49	–590 to –579 (H)	Yes	List
BM 50753	ADART V No. 48	–551? (H)	Yes	Grid
BM 38749	Text C	–523 to –521 (H)	Yes	List
BM 38802	Text D	–518 to –516 (H)	Yes	Grid
BM 38856	Text E	–516 to –515? (H)	Yes	Unknown
BM 38472	Text F	–513 to –511 (H)	Yes	Grid
BM 55558	ADART V No. 50	–443? (H)	No	List
BM 34583+35698[3]	ADART V No. 43	–370? (H)	Yes	List
BM 34075	ADART V No. 36	–322 to –318 (P)	No	List
BM 35044	ADART V No. 45	–308? (H)	No	List
BM 34810[4]	ADART V No. 44	–290? (H)	No	Grid
BM 40493[5]	ADART V No. 37	–284 to –283 (P)	No	N/A
BM 36798	ADART V No. 38	–252 to –251 (P)	No	List
BM 35390	ADART V No. 46	–245 to –243 (H)	No	Grid
BM 40091	ADART V No. 40	–242 to –239 (P)	No	List
BM 55509	Text G	–216? (H)	No	List
BM 37050	ADART V No. 41	–207 (P)	No	List
MLC 1883[6]	ADART V No. 42	–187 (P)	No	List
BM 66375	ADART V No. 51		Yes	List
Rm 727	Text H		No	Unknown
BM 37007	Text I		No	Unknown
BM 39193	Text J		Unknown	Unknown
BM 39291	Text K		Unknown	Unknown
BM 39410	Text L		Yes	Unknown
BM 39553	Text M		No	Unknown
BM 40019	Text N		No	Unknown
BM 40277[7]	Text O		N/A	N/A
BM 99646	Text P		No	Unknown
BM 99735	Text Q		Unknown	Unknown

[1] From Nippur

[2] See Huber-Britton (2007)

[3] Also prices

[4] Poor alignment in grid

[5] Month length data only

[6] From Uruk?

[7] NA and KUR only

Table 1. Lunar Six Texts

These early lunar six tables also suggest a timeline for the development of methods for predicting lunar sixes. Our earliest preserved example, Text A containing data from –642 to –640, apparently does not contain any predicted lunar six. Instead we find gaps on days where bad weather presumably prevented observation. However, by the time of ADART V No. 49 (–590 to –579), we find complete runs of lunar six data including cases marked as NU PAP "I did not watch" which must be predictions. This suggests that methods for predicting lunar sixes were developed in the intervening period (unfortunately, the only lunar six tablet from this period, Text B, is small and does not indicate one way or the other whether predictions could be made at that time). We conclude that methods for predicting lunar six data were developed towards the end of the seventh century BC. It is interesting to note that this is about the same period as the development of the Saros scheme for predicting eclipses (Steele 2000).

From table 1 it is evident that the GE_6 convention was regularly used in the early lunar six texts, but disappears sometime between the end of the sixth and the middle of the fourth century BC. The lunar and planetary text ADART V No. 55 (containing data for –522) follows the GE_6 convention, as do both the lunar six and eclipse texts ADART V No. 12 and 13 (–333 to –330 and –328 to –326; these are probably part of the same tablet). As noted, the GE_6 convention is used throughout the Astronomical Diaries, but not in the Goal Year Texts or the Normal Star Almanacs. It would appear that either ADART V No. 12 and 13 follow the tradition of the Diaries or we can place the disappearance of the GE_6 tradition in lunar texts to between –326 and –322; we suspect the former case.

II. Dates of Lunar Six Tablets Published in ADART V.

For details of the procedure followed and the method of presentation, see Huber and Britton (2007). The computer output provides the following information: the file name and the number of (usable) Sixes data, then for each tentative dating, the Julian date of the first (usable) line of the text (in the format yyyy.mmdd e.g. the date –245.0629 corresponding to –245 June 6) and the corresponding score (the median of the absolute deviations between the observed and the calculated values of the Sixes).

ADART No. 46 (BM 35390)

The six columns were treated separately. The first six files represent separate columns, from Obv. I (=h46o1) to Rev. III (=h46r3).

```
file= h46o1.dat,       n= 18          file= h46r1.dat,       n= 15
    -245.0629     .83                     -78.1124    1.30
    -377.0718    1.12                    -245.1111    1.33
    -706.0527    1.21                    -599.1124    1.42
    -270.0704    1.23                    -300.1118    1.53
    -208.0709    1.29                     -60.1105    1.59

 file= h46o2.dat,       n= 16          file= h46r2.dat,       n= 17
    -244.0701     .50                    -244.1226    1.04
    -112.0612     .94                    -430.1213    1.10
    -466.0626    1.43                    -732.1122    1.12
    -482.0623    1.46                     -76.1129    1.18
    -652.0612    1.53                    -243.1215    1.23

 file= h46o3.dat,       n= 9           file= h46r3.dat,       n= 16
    -243.0722     .73                    -243.1215     .71
    -501.0725     .88                    -244.1226    1.02
    -169.0715     .92                    -242.1204    1.46
    -301.0803    1.00                    -112.1207    1.69
    -262.0722    1.03                    -609.1212    1.69
```

Evidently, Hunger's arrangement of the text is correct, and equally evidently, the text covers 3 years, namely from –245 to –243. The consistency of the results for the six individual columns shows that already between 10 and 20 Sixes values may suffice to determine the correct date – or at least, to construct a short list containing it. Now the results for the composite file:

```
 file= h46.dat,         n= 91
    -245.0629     .85
    -467.0623    1.81
    -653.0610    1.98
     -60.0623    2.05
    -431.0715    2.20
```

ADART V No. 43 (BM 34583 + 35698)

```
 file= h43.dat,         n= 15
    -370.0914     .76
    -502.0903    1.25
    -148.0919    1.32
    -369.0903    1.44
```

```
    -555.0919    1.53
    -493.0924    1.54
    -433.0920    1.55
     -34.0919    1.62
    -742.0818    1.63
    -335.0917    1.64
```

In II' 9' (month VII), we emend 15 into 16, since ME and GE_6 cannot happen on the same day, and the expected sequence of days for ŠÚ – ME – NA – GE_6 is n, n+1, n+1, n+2. If we accept the date –370, this would be the latest text using the GE_6 convention.

ADART V No. 44 (BM 34810)

```
file= H44.dat,         n= 9
    -717.0101     .95
    -514.0205    1.01
    -290.0119    1.01
    -133.0124    1.02
      -7.0208    1.06
    -309.0120    1.08
    -158.0129    1.11
    -726.0110    1.26
    -504.0116    1.26
    -389.0203    1.37
```

The non-use of the GE_6 convention suggests a late date, but there is no clear winner.

ADART V No. 45 (BM 35044)

```
file= H45.dat,         n= 11
    -494.1102     .77
    -308.1115     .91
    -368.1118    1.01
    -216.1117    1.17
    -477.1124    1.24
     -87.1102    1.28
    -679.1107    1.32
    -680.1019    1.35
     -70.1124    1.42
    -369.1130    1.44
```

The non-use of the GE_6 convention suggests a late date. The year –308 scores best, but not sufficiently to rule out other dates.

ADART V No. 48 (BM 50753)

```
 file= h48.dat,          n= 18
    -551.0425    1.04
    -605.0324    1.15
     -84.0323    1.19
    -197.0412    1.44
    -438.0406    1.53
    -419.0406    1.56
    -382.0417    1.57
    -625.0305    1.61
     -65.0324    1.77
     -83.0411    1.79
```

The year -551 scores best, but not sufficiently to rule out -605. The later dates (-84 or -197) are unlikely as the text uses the GE_6 convention.

ADART V No. 50 (BM 55558)

```
Col. Rev. I':                          Col. Rev. II':
 file= h50r1.dat, n= 14                 file= h50r2.dat, n= 16
    -443.0811     .64                      -187.1226    1.11
     -35.0830    1.22                        -2.1221    1.14
    -406.0822    1.34                      -426.1129    1.54
    -504.0825    1.43                      -533.1212    1.56
    -219.0824    1.44                       -19.1129    1.71
    -593.0820    1.46                      -335.1213    1.83
    -462.0811    1.56                      -373.1213    1.92
    -221.0817    1.58                      -746.1127    1.93
    -629.0729    1.72                      -585.1217    2.00
    -295.0824    1.76                      -347.1225    2.0
Entire text:
 file= h50.dat,   n= 30
      -2.0825    1.74
     -35.0830    1.92
    -406.0822    1.97
    -221.0817    2.17
    -557.0812    2.22
```

```
    -743.0729    2.22
     -52.0808    2.28
    -335.0817    2.38
    -338.0820    2.42
    -126.0816    2.44
```

An attempt to date the two columns of the text separately, as we had done with No. 46 and No. 49, produced a good fit for Col. I', but no persuasive date supported by both columns. Col. II' contains a large number of predictions (which may explain the poor fit of that column), and therefore we are leaning toward the date –443 obtained from Col. I'. If the date is correct, it would make this the earliest text not using the GE_6 convention.

ADART V No. 51 (BM 66372)

```
file= H51.dat,          n= 10
   -429.1022    1.17
   -561.1110    1.22
   -614.1027    1.25
   -490.1105    1.26
   -445.1019    1.44
   -577.1107    1.67
   -223.1024    1.67
   -225.1115    1.69
   -677.1004    1.77
    -56.1106    1.78
```

The use of the GE_6 convention suggests an early date. The year –429 scores best, but not sufficiently to rule out other dates.

III. Newly Identified Lunar Six Tablets

Seventeen newly identified fragments of lunar six tablets are presented below. The formulaic nature of lunar six tablets makes it unnecessary to provide translations of these tablets. Each group of records of the lunar six measurements (or calculations) for a given month commences with the name of the month using the standard logograms:

BAR	Month I	IZI	Month V	GAN	Month IX
GU_4	Month II	KIN	Month VI	AB	Month X
SIG	Month III	DU_6	Month VII	ZÍZ	Month XI
ŠU	Month IV	APIN	Month VIII	ŠE	Month XII

No intercalary month names are preserved in these fragments. Year numbers are sometimes preserved before the logogram for Month I.

Following the month names are the six entries for the lunar six. Each entry begins with the day number (in some cases preceded by the sign GE_6 – see above for discussion of the "GE_6 convention"), followed by the lunar six interval implicitly given in units of UŠ (the unit UŠ is only explicitly given when the interval is 10 UŠ). These intervals are written sexagesimally, to the nearest 0;10 (= 1/6) of an UŠ. Where the time interval is less than an UŠ, the sign NINDA is usually given to distinguish between, for example, 20 UŠ and 0;20 UŠ (= 20 NINDA). Following its value the lunar six interval in question is named; sometimes the names of the new moon intervals are omitted as the day number prevents any confusion over which interval is meant. After the time interval we sometimes find the term *muš* "measured", or the phrase NU PAP "I did not watch", and a remark on adverse weather conditions. The only weather terms that appear in these texts are DIR "clouds" and GÍR "lightning". In Text G, on the first day of the month, the phrase *ana šamáš* SIG "low to the Sun" is often given after the measured NA value. This phrase appears often in the Diaries. In several texts we find 2 measurements or calculations of the interval KUR on successive days.

Dates for texts A to G are proposed below. The remaining fragments are all too small to date; they are published here in the hope that other scholars may find other fragments to which they join.

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Text A: BM 38414 (1880–11–12, 297)

Photographs: Plates I–II
Contents: Lunar six data arranged in columns for –642 to –640
This tablet was brought to our attention by C. B. F. Walker.

Obv.	I	II	III
1'	⌜x⌝ [...]	[...]	[...]
2'	SIG 1 ⌜DIR⌝	[...]	[...]
3'	GE_6 x x x	[...]	[...]
4'	12 6,40 x [ŠÚ]	[...]	[...]
5'	13 12,40 ME	10[+x ...]	[...]
6'	14 2?,20 NA	10[+x ...]	[...]
7'	15 *šá ina* GE_6 DIR ⌜x⌝	15? 10[+x ...]	[...]
8'	ŠU 30 16[+x ...]	ŠU 30 [...]	[...]
9'	13 17 ME	GE_6 x x [...]	[...]
10'	13 3,40 ⌜x⌝	13 x [...]	[...]
11'	14 x x x	14 10+x x [...]	[...]
12'	15 9 NA x	14+x? 7+x [...]	[...]
13'	(blank)	(blank)	27
14'	⌜IZI⌝ 1 x 14	IZI *nu*	IZI 30 12? [...]
15'	12 10[+x ...]	GE_6 13 13,30 ME	GE_6 14 10,30
16'	13 [...] NA	13 13,20 ŠÚ	14 10 ŠÚ GE_6 10[+x
17'	[...] 11,30 *ina* IGI?	GE_6 x 20 NINDA GE_6	16 1,40 GE_6 14
18'	(blank)	14 2,30 NA	6,30 ⌜x⌝
19'	(blank)	(blank)	(blank)
20'	[KIN] 30 13 13	KIN 1 15?	[...]
21'	x ŠÚ	GE_6 12 2,30 x	[...]
22'	x x	x x	[...]

Rev.			
1'	[APIN] 1 10,30 DIR	⌜APIN⌝ 30 13	APIN ⌜1⌝
2'	13 (blank)	12 16,30 ŠÚ	GE_6 12 30 [...]
3'	13 1,20 ŠÚ	13 4,30 ME	12 9 ŠÚ 13 [...]
4'	14 2 GE_6 *muš*	13 3 ŠÚ	13 6 NA 27 ⌜x⌝ [...]
5'	14 13 NA	14 2,40 GE_6	28 AN IZI 28 [...]
6'	(blank)	14 13 NA	(blank)
7'	⌜GAN⌝ 30 16	G[AN ...] 18	GAN 30 GÍR [...]
8'	13 10,20 ŠÚ	10[+x ...]	13 11 ⌜x⌝
9'	13 4 ME DIR	13 6 ⌜40⌝ [...]	[1]3 1 [...]
10'	14 2 NA x ŠÚ	13 1,20 NA	[...] ⌜x⌝ [...]
11'	(blank)	GÍR ŠÚ	⌜x⌝ [...]
12'	[AB] 1 14[+x ...]	AB 30 10[+x ...]	[...]
13'	13 6 ŠÚ	GE_6 13 [...]	[...]
14'	14 7,30 ME	13 4[+x ...]	[...]
15'	14 6 NA	12[+x ...]	[...]
16'	$GE_6$15 6 GE_6	[...]	[...]

Critical Apparatus:

Obv. I, 9: 9 new-style
Rev. III, 3': 9 new-style
Rev. III, 5': IZI$^{?}$ Is there a reading for this sign relating to the weather?
Obv. I 4': the event must be [ŠÚ], because of the sequence.
Obv. III 15': the event must be [ME], because of the sequence.

Comments:

The tablet contains lunar six data arranged in columns for at least three years. The columns continue from the obverse onto the reverse and each column contains one year's worth of data. This tablet was almost certainly written by the same scribe as BM 38472, BM 38749 and BM 38802 (Texts F, C and D below): the script on the four tablets is identical in style and size and the column widths are precisely the same on the four tablets. The latest of these four tablets is dated below to –511. This suggests that the four tablets were compiled around the end of the sixth century BC as part of an attempt to put together a complete dataset of lunar six records stretching back for about 150 years. One caveat must be raised: BM 38749, although almost certainly written by the same scribe has a slightly different layout than the other tablets in this group. Interestingly, the present text does not contain predictions; instead a blank space is left when a measurement could not be made.

Date:

```
file= BM38414.dat,     n= 37
   -642.0524    1.17
    -49.0607    1.85
   -694.0529    2.19
   -623.0524    2.28
   -206.0702    2.28
   -296.0607    2.37
   -234.0612    2.38
   -173.0627    2.38
   -384.0620    2.42
   -732.0528    2.48
```

The GE_6 convention and the lack of predicted data suggest an early date; thus in all probability –642 is correct. This date is further confirmed by the nearby dates of those tablets that have identical scripts and layout.

Text B: N.2349

Photograph: Plate III
Contents: Lunar six data for –617[?]
This tablet was identified by A. Sachs and brought to our attention by E. Robson.

Left column

1' [...] ⌜NA⌝
2' [...] ⌜12⌝,50 : ME
3' [1]4 4,40 ŠÚ
4' [G]E_6 15 17 GE_6
5' [1]5 9,20 NA
6' [2]7 27,30 KUR

7' [...] 30 13,40 NA ⌜GU_4[??]⌝
8' [... G]E_6 15 11,40[?] [...]
9' [...] ⌜x x⌝

Right column

1' ⌜2⌝8 1⌜5⌝ [...]

2' MU–9
3' BAR 30
4' 15,10 NA

(blank)

Comments

This small fragment from the right edge of a tablet was excavated from Nippur and is held in the University Museum, Philadelphia. The text is arranged in a simple list format in columns, rather than horizontally aligned.

Date

The apparent catch-line to Year 9, month I, has plenty space and is distributed over three lines. The left-hand column unfortunately does not preserve month-names; most likely, it contains data belonging to year 8. There is not enough space at the beginning of line 7'

for a change of year, but there are no other indications that might allow us to infer month names. An attempt was made to date the left-hand column to any month of a year 6, 7, or 8 of some king, with a search believed to be exhaustive. Among the eight best scorers, the value 17 of GE_6 – while clear in the text – was grossly deviant in all cases, and in five of them, the calculated value even had the wrong sign (i.e. it corresponded to the opposite order of sunset and moonrise). The surviving three cases all corresponded to a year 8. They were:

Nabonassar 8A IX = –739,	score: 0.85	(0.85)
Nabopolassar 8 III = –617,	score: 1.41	(0.74)
Artaxerxes I 8A VIII = –456,	score: 1.75	(1.75)

(In parentheses, the scores are those obtained if the value of GE_6 would be emended from 17 to 7.) Among these three dates, the second gives an excellent agreement also for the right hand column (also the shift of –1 day in KUR matches the marginal visibility of the preceding lunar crescent). The size of the gap at the beginning of line 2' and the GE_6 in line 4' suggest that the GE_6 convention was used, indicating a relatively early date. On the other hand, the text appears to contain predictions (large time intervals given to a precision of 1/6 UŠ almost invariably are, cf. Huber (2000), Table 2). This suggests a date later than that of BM 38414 (i.e. –642). Thus, a date –739 without doubt is too early. We are hesitantly leaning toward the Nabopolassar date. But there are simply too few data for reliable dating – while we found an excellent fit, the correct date may nevertheless have slipped through the dragnet. Note that the advantage of knowing the king's year is counterbalanced by the disadvantage of not knowing the month names in the left-hand column.

Text C: BM 38749 (1880–11–12, 633)

Photograph: Plate I
Contents: Lunar Six data for –523 to –521 from the top edge of a tablet.

	I	II	III	IV
u.e.	[...]	MU-7	[...]	[...]
O.1	[...] ⌈x⌉	BAR 1 32 NA	[...]	[...]
2	[...] ⌈x⌉	GE_6 13 8,40 ME NU PAP	13 ⌈x⌉ [...]	[...]
3	[...]	13 2,30 ŠÚ	GE_6 14 8 [...]	[...]
4	[...]	GE_6 14 8 GE_6	14 11,30 ⌈NA⌉	[...]
5	[...]	14 10 NA NU PAP	GE_6 15 2,30 [...]	[...]
6	[...]	[2]6 22 27 13,20 NU PAP	26 18 [...]	27 [...]
7	[...]	⌈GU_4⌉ 30 23	APIN 30 12,40	GU_4 1 20[+x$^{?}$ ...]
8	[...]	[...] 18,20 ŠÚ NU PAP	13 *ina* 15 ŠÚ NU PAP	*ina ina* 10[+x ...]
9	[...]	[...] NU PAP	14 4 NA	12 10[+x ...]
10	[...]	[...] NU PAP	GE_6 15 1 ME	GE_6[...]
11	[...]	[...]	GE_6 16 13,30 GE_6	⌈x⌉ [...]
12	[...]	[...]	[2]5+x 14+x [...]	[...]

Date:

```
file= BM38749.dat,     n= 17
    -522.0406     .98
    -613.0324    1.07
    -469.0420    1.08
    -488.0419    1.27
    -115.0406    1.35
    -186.0411    1.40
    -337.0401    1.42
    -377.0423    1.69
    -610.0320    1.81
     -20.0405    1.84
```

The date –522 is certain, since it is the only "year 7" in the above list. The most interesting aspect of this text is that it overlaps with ADART V No. 55. Table 2 compares the data in the present text with ADART V No. 55.

There is good, but not exact, agreement between Text C and ADART V No. 55. In some cases, such as the GE_6 interval in Month I, it may be that the 8;20 UŠ in ADART V No. 55 has been rounded to 8 UŠ in Text C, and vice versa in some other cases. Another possibility is that the two sets of lunar six data come from different observer's measurements of the same intervals (similar discrepancies are found in some overlapping Diaries). Britton (2007) has shown that at least some of the lunar six data in ADART V No. 55 are calculated, so discrepancies may be between measured intervals in Text C and calculated intervals in ADART V No. 55.

Month	Text C	ADART V No. 55
I	1 32 NA	1 DIR *sin* IGI *ina* 1 KASKAL NA
	GE_6 13 8,40 ME NU PAP	GE_6 13 DIR *ina* 9 ME
	13 2,30 ŠÚ	13 2,30 ŠÚ
	GE_6 14 8 GE_6	GE_6 14 DIR 8,20 GE_6
	26 22 27 13,20 NU PAP	27 DIR *ina* 16
II	30 23	30 23
	[…] 18,20 ŠÚ NU PAP	13 8,20 ŠÚ
VII	GE_6 14 8 [ME]	GE_6 14 7,30 ME
	13 11,30 NA	14 12 NA
	GE_6 15 2,30	GE_6 15 3 GE_6
	26 18 […]	26 22
VIII	30 12,40	30 12,40
	13 *ina* 15 ŠÚ NU PAP	13 15 ŠÚ
	14 4 NA	14 5 NA
	GE_6 15 1 ME	GE_6 15 1 ME
	GE_6 16 13,30 GE_6	GE_6 16 14 GE_6

Table 2. A comparison between overlapping data on Text C and ADART V No. 55.

Text D: BM 38802 (1880–11–12, 686)

Photograph: Plate II
Contents: Lunar six data arranged in columns for –518 to –516?

Obv.	I'	II'	III'
1'	[...]	23[+x ...]	[...]
2'	[...] NU PAP	KIN 1 21 ⌜NA⌝	[...]
3'	[...] ⌜ME?⌝ *muš*	11 16,20 ŠÚ	10[+x ...]
4'	[...]	GE_6 12 12 ME	14 [...]
5'	[...]	12 1 NA	GE_6 15 [...]
6'	[...]	GE_6 13 1 GE_6	15 9 [...]
7'	[...]	26 22?	24[+x ...]

Comments:

BM 38802 and BM 38472 could very well be from the same tablet.

Date:

```
file= BM38802.dat,     n= 6
   -110.0906     .56
   -369.0821     .69
   -517.0906     .77
   -427.0901     .88
   -198.0820     .91
   -163.0823     .98
   -554.0826    1.01
   -245.0830    1.04
    -33.0826    1.10
    -91.0906    1.13
```

Although a unique dating is not given by the statistical method, a date of –517 is preferred as it is close to that of BM 38472 (Text F below), and the two fragments are probably from the same tablet, although they do not join.

Text E: BM 38856 (1880–11–12, 741).

Photographs: Plate III
Contents: Lunar six data arranged in columns for –516 to –515 from the bottom right corner of a tablet.

Obv.	I	II
1'	[...]	[...] ⌜x⌝ [...]
2'	[...]	⌜x x⌝ [...]
3'	[...]	⌜x x x⌝
4'	[...]	GE_6 15 ⌜x x⌝
5'	[...]	15 12 NA
6'	[...]	GE_6 16 12 GE_6
7'	[...]	27 12 28 24
8'	[...]	⌜KIN⌝ 30 16
9'	[...]ŠÚ	13 15 ŠÚ
10'	[... x+]7 ME	GE_6 14 4 ME
11'	[...] x,30 NA	14 15 NA
12'	[... x+]3 5,30	GE_6 15 $8^?$ GE_6
13'	[...] 17,20	27 19,30

Rev.

1	[...]	DU_6 30 21
2	[...]	GE_6 13 7 ME
3	[...] x x	13 3,40 ⌈x⌉
4	14 x GE_6	GE_6 14 6 GE_6
5	[...] 19 NA	14 16 NA
6	[...] 28	27 27
7	[...]	APIN 1 15
8	[...]	[G]E_6 13 13 ME
9	[...]	[1]3 10 NA *muš*
10	[...]	[1]4 7 NA GE_6 NU PAP
11	[...]	[2]$6^{?}$ 14,30

Critical Apparatus:

Obv. 13': 19 written using old-style 9.
Rev. 5: 19 written using old-style 9.

Comments:

Obv. 7' gives two observations of KUR, for day 27 and day 28, but they cannot both be correct, since KUR decreases with increasing date. The text uses the GE_6 convention.

Date:

```
file= BM38856.dat,     n= 20
   -515.0828    2.18
   -161.0815    2.37
   -583.0731    2.38
   -453.0902    2.41
   -434.0902    2.54
    -27.0804    2.69
    -99.0819    2.81
   -311.0823    2.88
   -568.0814    2.92
   -285.0806    2.94
```

Text F: BM 38472 (1880–11–12, 356)

Photographs: Plate IV
Contents: Lunar six data arranged in columns for –513 to –511.

Obv	I'	II'	III'
1	[...] ⌜8⌝ BAR 1,28 *ina šamáš* IGI	MU-9 BAR 1 27 NU PAP	MU-10 BAR 1,20 ⌜x⌝
2	[...] 20 NINDA ŠÚ	11 6 ŠÚ DIR *muš*	12 4 ŠÚ DIR NU [PAP]
3	⌜13⌝ 7 ME	12 2 NA	GE 13 14 ME *muš*
4	[...] 10 NA	GE_6 13 2 ME DIR *muš*	13 5,40 NA [...]
5	[1]4 $30^{?}$ GE_6	GE 1⌜4⌝ 1⌜2⌝,30 GE_6	G[E_6] 14[+x] ⌜$5^{?}$⌝ GE_6
6	traces only	traces only	traces only

Rev.

1'	[...] ŠÚ	[...]	
2'	[...] 14 ME	⌜x⌝ [...]	This column lost.
3'	[...] $5^{?}$,30 NA	(blank)	
4'	[...] 4,30 GE_6	(blank)	
5'	[...] 21,20	(blank)	

Critical Apparatus:

Obv II', 1: 9 written old-style.

Date:

```
file= BM38472.dat,     n= 14
   -513.0328      .86
    -87.0328      .87
   -460.0410      .95
   -494.0328     1.20
   -441.0411     1.23
   -549.0405     1.38
   -161.0405     1.45
   -328.0421     1.47
   -106.0328     1.50
   -680.0314     1.52
```

The date –513 is certain, since it is the only "year 8" in the above list. In addition, Darius I, year 8 is intercalary, with a month XII_2, in agreement with the fact that Col. I' contains more text than Col. II'.

Comments:

BM 38472 and BM 38802 could very well be from the same tablet.

Text G: BM 55509 (1882–7–4, 86)

Photographs: Plates V–VI
Contents: Lunar six data possibly for –216.

Obv. left column
1' [...] ⌜x⌝
2' [...] 40 ŠÚ
3' [...] x ME *muš*
4' [...] 14$^{?}$ NA *muš*
5' [...] 30 GE_6 *muš*
6' [...] 50 *muš*
6a' [...] *ana šamáš* SIG
7' [...] ⌜x x x x⌝

Obv. right column
1' [...] ⌜*muš*⌝
2' ⌜13 1,30⌝ ŠÚ *muš*
3' 14 4 GE_6 *muš*
4' 14 15,30 NA *muš*
5' 26 16 (erasure)
5a' *ana šamáš* SIG
6' KIN 1 18 DIR$^{?}$ *muš ina* AB$^{??}$ IGI 2 UD
7' 12 9$^{??}$ ME *muš*
8' 12 8 ŠÚ *muš*
9' 13 1,20 GE_6 *muš*
10' [...] 8,30 NA *muš*
11' [...] 4,30 *muš*
12' [...] 30 *muš*
13' [...] x *muš*
14' [...] x

Rev. left column: traces only

Rev. right column
1' [...] ⌜x⌝
2' [...] 2,20 GE_6

3' [...] 6 NA *muš*
4' [...] 17 KUR *muš*
5' ⌜GAN?⌝ 30 17 DIR *muš*
(about 5 lines blank)
6' AB 30 10,30 DIR NU PAP
7' 13 13 ŠÚ DIR *muš*
8' 14 9 ME DIR *muš*
9' 14 20 NINDA NA DIR *muš*
10' [1]5 3,30 GE_6 DIR *muš*
11' [x] 10,50 DIR x NU PAP
11a' *ana šamáš* SIG
12' [...] ⌜x⌝ *muš ina* AB IGI 2 UD
13' [...] x+20 ŠÚ
14' [...] *muš*
15' [...] x NU PAP
16' [...] x NU PAP

Critical Apparatus

Obv. right column 6': The end of the line seems to comment on the moon being seen on 2 days. The same comment appears at Rev. right column 12'.
Obv. right column 7': the 9 is uncertain.
Rev. right column 2': 2,20 is possibly [x+]2,20.

Comments:

This is a large tablet with large script and lots of empty space. We suspect that columns continue from one side to another, and contain lunar six for each year: thus the lunar six data in Obv. and Rev. right column are for the same year. Interestingly, the lunar six intervals around conjunction are given without the designation NA/KUR. Presumably the scribe did not have available all the data for the month on GAN (Rev right column) as a blank space is left on the tablet. This suggests that the tablet is set out as a table with 1 year to a column (there is not room for more than one year to a column). The phrase *ana šamáš* SIG ("low to the sun") is added in small superscript at the end of the entry for most months – designated here as lines 6a' etc.

Date:

On the assumption that the data in Obv. and Rev. right column are for the same year, one obtains the following scores:

```
file= BM55509.dat,     n= 15
   -216.0821     .58
   -570.0904     .81
   -624.0802    1.16
   -509.0821    1.33
   -217.0803    1.35
   -278.0817    1.37
   -605.0803    1.72
   -312.0803    1.72
   -269.0808    1.76
   -135.0826    1.80
```

The best results are obtained for –216 and –570. We are leaning towards –216, but doubt that a reliable unique date can be extracted from this meager data set.

Text H: Rm 727

Photograph: Plate VI
Contents: Upper left corner of a lunar six tablet. Obverse blank.

Rev.
1' 13 [...]
2' 14 [...]
3' 14 10,⌜40⌝ [...]
4' 15 7,20 G[E_6 ...]
5' 27 18,40 [...]

Text I: BM 37007 (1880–6–17, 751)

Photographs: Plate V
Contents: Fragment from the left edge of a lunar six tablet.

Side A

1' 15 1,30 GE_6 *muš* [...]
2' 15 2 NA *muš* [...]
3' 28 17 KUR *m*[*uš* ...]
4' SIG 1 16 30 [...]
5' 14 2[+x ...]
6' 14 10[+x ...]
7' 14[+x ...]

Side B

1' [...] x x x [...]
2' 14 11,10[+x ...]
3' [2]8? [...]

Text J: BM 39193 (1880–11–12, 1079)

Photograph: Plate VI
Contents: Small fragment from a lunar six tablet arranged in columns. Reverse blank.

Obv.

1'	[...]	15 50?	[...]	[...]
2'	[...]	16 GE_6 14 [...]	[...]	[...]
3'	[...]	[...] x DIR NU PAP	[...] 2,30	[...]
4'	[...]	10 [...]	[...] 8 x NA	x [...]
5'	[...]	[...] x	x x [...]	[...]

Text K: BM 39291 (1880–11–12, 1177)

Photograph: Plate IV
Contents: Small fragment of a lunar six tablet.

1' [...] x 10[+ ...]
2' [...] 16 8 [...]
3' [...] 27 19 x [...]
4' [...] AB 1 22,30 [...]
5' [...] 13 x ŠÚ [...]
6' [...] 13[+x] 14? ME [...]
7' [...] x [...]

Text L: BM 39410 (1880–11–12, 1296)

Photograph: Plate VIII
Contents: Small fragment from upper or lower edge of a lunar six tablet.

Flake

1'	[...] 12 2 x [...]	[...]
2'	[...] GE_6 13 1 GE_6	GE_6 [...]
3'	[... x+]4[+x] 22	26 10[+x ...]
4'		ŠE [...]

Edge

Text M: BM 39553 (1880–11–12, 1439)

Photograph: Plate VIII
Contents: Flake from a multi-column lunar six tablet or Goal Year Text.

1'	[...]	x [...]
2'	[...] x	13 [...]
3'	[...] x	13 [...]
4'	[...] ME NU PAP	14 [...]
5'	[...] ŠÚ NU PAP	14 [...]
6'	[... G]E_6	27 [...]
7'	[...] x *muš*	KIN 30 [...]
8'	[...] *muš*	14 20[+x ...]
9'	[...] *muš*	15 x [...]
10'	[...] x	x [...]

Text N: BM 40019 (1880–11–12, 2148)

Photograph: Plate VIII
Contents: Flake from a multi-column lunar six tablet or Goal Year Text.

1'	[...]	[...]	[...] x x [...]
2'	[...]	13 5 [...] x	12 21$^{?}$ [...]
3'	[...]	13 3,20 ŠÚ	13 1,40 [...]
4'	[...]	14 10 UŠ GE_6	14 30 NINDA ME A[
5'	[...]	14 12 NA *muš*	15 10 UŠ [...]
6'	[...]	[2]6 x KUR$^{?}$	26 21,30 [...]

Text O: BM 40277 (1881–3–24, 144)

Photographs: Plates VII
Contents: Month lengths and NA and KUR values for twelve months of an unknown year.

Obv.	I	II
1'	GU_4 1 23 x	x [...]
2'	19,20	15,20
3'	SIG 1 15,40	GAN 30 12,10
4'	25,20	22,40
5'	ŠU 1 22,30	AB 1 14,30
Lower edge	24,30	24,20[+x ...]
Rev.		
1	IZI 1 21,30	ZÍZ 1 19

2	25	x 18
3	(erasure) 12	ŠE 30 26
	x	[...]
Left edge	[…] 10 11 12 13 14 15 16	
	[…] x 1 2 3 4 5 6 7	

Text P: BM 99646 (1883–1–21, 2008)

Photograph: Plate IV
Contents: Flake from the left edge of a lunar six tablet or a Normal Star Almanac.

1’ SIG 30 12 [...]
2’ 13 6,30 ŠÚ [...]
3’ 14 12,40 ME [...]
4’ 14 1[?],20 NA [...]
5’ 15 1,20 GE_6 [...]
6’ 28 18,10 KUR [...]
7’ ŠU 1 24,20[+x ...]
8’ [...] x x [...]

Text Q: BM 99735 (1883–1–21, 2097)

Photograph: Plate IV
Contents: Small fragment from the upper(?) right corner of a lunar six tablet.

1 [...] 2,40 [...] x [...]
2 [...] 16 ŠÚ *muš* [...]
3 [...] 11 ME [...]
4 [...] 16 ⌜x⌝ [...]
5 [...] ⌜x⌝ [...]

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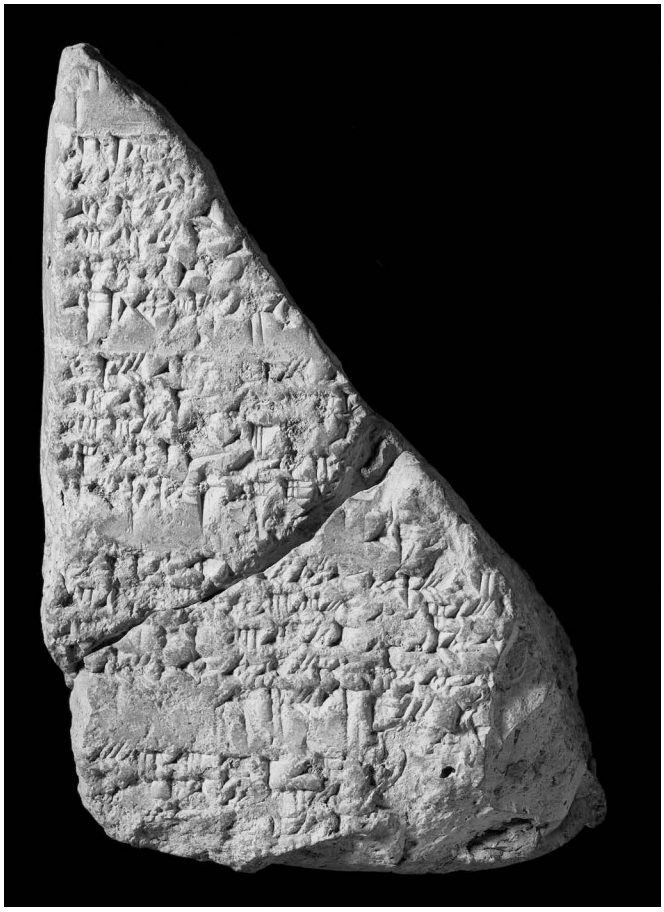
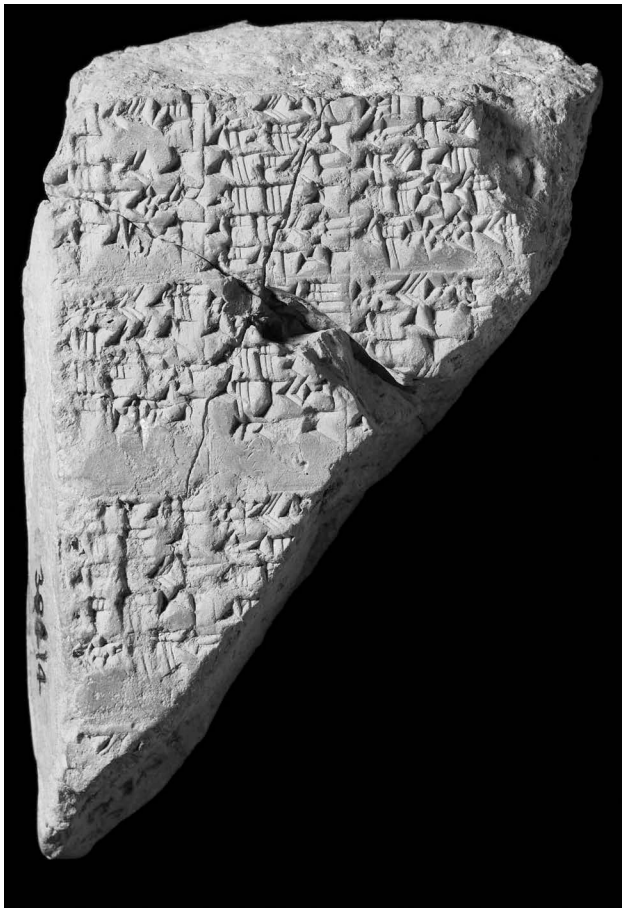
PLATE I



BM 38414 Obv.

BM 38749

PLATE II



BM 38414 Rev.

BM 38802

PLATE III

N.2349

BM 39291

BM 38856 Obv.

BM 38856 Rev.

BM 38856 right edge

PLATE IV

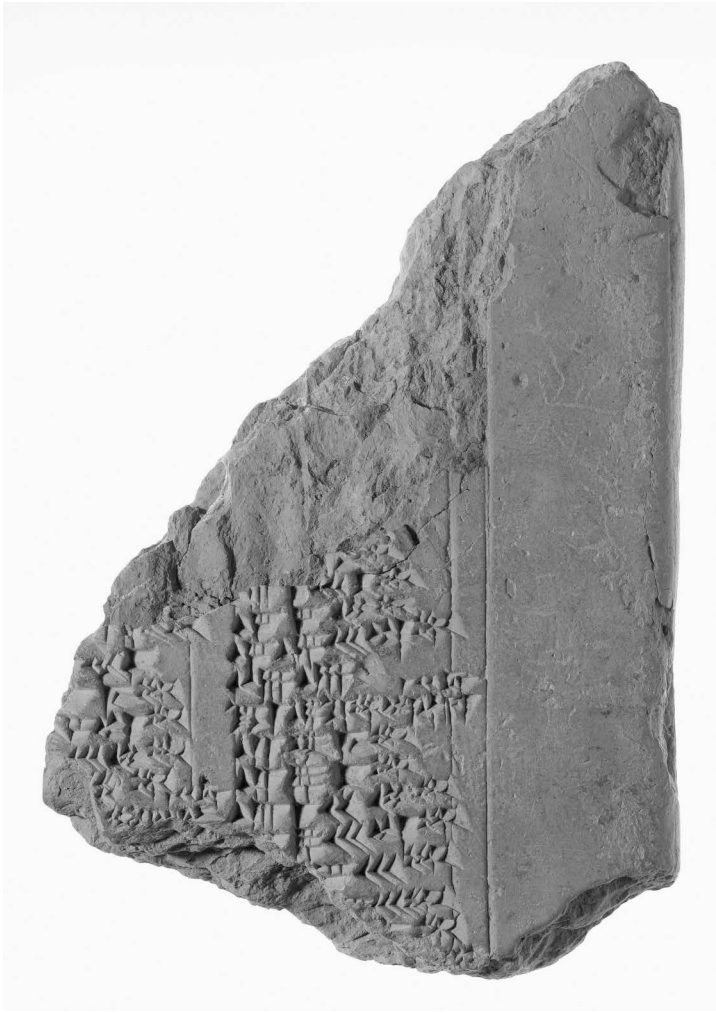
BM 38472 Obv.

BM 38472 Rev.

BM 99646

BM 99735

PLATE V



BM 55509 Obv.

BM 37007 Side A

BM 37007 Side B

PLATE VI

BM 55509 Rev.

Rm 727

BM 39193

PLATE VII

BM 40277 Obv.

BM 40277 Rev.

BM 40207 lower edge

BM 40277 left edge

PLATE VIII

BM 39410

BM 39553

BM 40019