Saros Cycle Dates and Related Babylonian Astronomical Texts

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Text A: B.M. 36910 (80-6-17,651) + B.M. 36998 (80-6-17,742) + B.M. 37036 (80-6-17,780)

Obv

PLATE 1.

Rev.

Contents: Regnal years and months of lunar eclipse possibilities for (at least) year 31 of Darius I to year 30 of Artaxerses II (-490 to -374) arranged in 18-year groups.

Previous Publications: Mentioned as Nos. *1422, *1423, and *1424 in LBAT.

Transcription: Table 1; *Translation*: Table 2; *Photograph*: Plate 1

Description of Text:

Text A consists of three rejoined fragments and measures 3½" by 3½". While no edges are preserved, traces of line 1 of the obverse appear in columns IV' and V', showing that its vertical extent is nearly complete. Horizontally, the text could have contained one or more columns on either side.

The text gives columns of dates in the form of a regnal year number and a month. No instance of a first regnal year is preserved, so we do not know if the kings' names were given.[2] Within each column, successive dates are either six or five months apart, and each column begins after a five-month interval. Successive dates in the same line differ by 223 months between columns. Each column has 38 dates which begin at line 1 of the obverse and carry over the bottom edge to the reverse. There are 21 or 20 lines on the obverse and 17 or 18 on the reverse.

Though Text A leads into, and partly overlaps, the Saros Canon (Text C), it looks quite different: it is less carefully written; it has no vertical rulings separating the columns of dates, nor horizontal lines indicating five-month intervals; and "5 itu" (= five months) is not written after a five-month interval. The dashed lines in Tables 1 and 2 thus have no counterparts in the text. All in all Text A appears much less carefully prepared than Texts B or C.

The character of an intercalary year is indicated by "dir" if the year contains a second *Addaru* (XII₂), and by 2-kám (short for "kin-2-kám") if it has a second *Ululu* (VI₂).[3] This information is mostly written immediately below the year number, except in Obv. 9',III' and when the intercalated month itself appears in the text (Obv. 6',II' and Rev. 6',IV'). Month XII₂ is twice written "dir" and once "dir-še" (Rev. 6',IV'). In the latter case it is the careful

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[2] Cf. Text C where they are given and Text D where they are omitted.

[3] In translations such years are indicated by * and ** respectively.

TABLE 1

Text A

Obverse

	I′	II′	III′	IV′	V′	VI′	VII′
1′)				] [2]8′[ ]	⌜5⌝ ⌜5⌝ig		
2′)			d][u_6]	dir apin	apin	dir ⌜gan⌝	⌜gan⌝[
3′)	][bar]	14 bar	11 ba[r]	29 gu_4	6 gu_4	5 sig	23[
4′)	]du_6	du_6	du[$_6$]	[di]r apin	apin	dir gan	g[an
5′)	]dir	15 bar	12 bar	[30] bar	7 gu_4	6 gu_4	24 si[g
6′)	3,3, kin	dir du_6	du_6	[du_6,]	dir apin	apin	dir gan[
7′)	]ze	dir	13 bar	31 [bar][	8 bar	7 gu_4	25 gu_4
8′)	]	16 kin	du_6	du_6[	du_6	]apin	ap[in
9′)	]	zíz	dir ze	ze	[ze][	]'	[26][
10′)		17] izi	14 izi	32 kin	9 k[in]	[8 kin	
11′)		] zíz	zíz	dir ze	ze[ ]	[ze	
12′)		18 i]zi	15 izi	33 izi	10 kin	9[kin	
13′)		di]r zíz	zíz	zíz	dir ze	ze[	
14′)		]19 zu	16 izi	34 izi	11 izi	10 kin	2′8′[
15′)		] ab	dir zíz	dir zíz	zíz	dir ze	[
16′)	]	20 zu	17 zu	35 izi	12 izi	11 izi	29[
17′)		] gan	gan	dir ab	ab	ab	[
18′)		s[ig]	18 sig	3,6 sig,[			
19′)			],gan,	[			
20′)				[37			

Reverse

	I′	II′	III′	IV′	V′	VI′	VII′
1′)	?— —	—?		]	[a]ir gan		
2′)				3,9 bar	16 [g]u_4		
3′)				]du_6	2-kam du_6	[	
4′)			]ze]dir	40 bar	17 bar	16 [g]u_4	
5′)		]⌜4⌝ kin	22 kin	du_6	du_6	2-kam du_6[	
6′)		]dir ze	ze	dir ze	i]8 [bar]	17 [bar][	
7′)		]5 kin	23 kin	41 kin[			
8′)		d]ir ze	ze	[3]ze			
9′)	9 3]u^2	6 izi	24 [kin]	], [			
10′)	]ab	ab	d]ir zíz				
11′)	]10 zu	7 [zu	24,5,[				
12′)	dir]ab	[ab]	[				
13′)	11]sig	8 z[u]	[26				
14′)	gan[	[ab][ ]	[				
15′)			[27				
16′)							

TABLE 2

Text A

Obv.

	I'	II'	III'	IV'	V'	VI'	VII'
(Dar.I) 2.	31 I/VII	13 I/VII	10* II/VII	28 II/VIII	5* III/IX	4 III/IX	22 III/IX
	32 I/VII	14 I/VII	11 I/VII	29* II/VII	6 II/VIII	5* III/III	23 III/IX
5.	33 XII$_2$/VI — XII	15* I/VII	12 I/VII	30 I/VII	7* II/VIII	6 X/II	24* III/IX
	34 VI/XI	16 VI/XI — XII₂	13* I/VII — VII	31 I/VII — VII	8 I/VII — VII	7* II/VII — VII	25 II/VIII — VII
10.	35* V/XI	17 V/XI	14 V/XI	32* VI/XII	9 VI/XII	8 XII₂/XI	26* I/VII
	36 IV/X	18* V/XI	15 V/XI	33 V/XI	10* VI/XII	9 VI/XII	27 VI/XII₂
(Xer.) 1	1 IV/X	19 IV/X	16* V/XI	34 V/XI	11 V/XI	10* VI/XII	28 VI/XII
15.	2** IV/VIII	20 IV/IX	17 IV/IX	35* V/X	12 V/X	11 V/X	29* V/XII₂
	3 II/VIII	21*** III/VIII (Art.D)	18 III/IX	36 III/IX	13 IV/X	12 IV/X	30 IV/IV
20.	4* II/VIII	1 II/VII	19* III/IX	37 III/IX	14 III/IX	13* IV/X	Rest destroyed

Rev.

	I'	II'	III'	IV'	V'	VI'	VII'
1.	5 I/VII — XII	2* II/VIII — XII₂	20 II/VIII	38* III/IX	15 III/IX	14 III/IX	
	6 VI/XII	3 VI/XII	21* I/VII	39 I/VII	16** II/VII	15 II/VIII	
5.	7* VI/XII	4 VI/XII	22 VI/XII₂	40* I/VII	17 I/VII	16** II/VII	
	8 V/XI	5* VI/XII	23 VI/XII	41 (Dar.II) VI/XII	18* I/VII	17 I/VII	
10.	9 V/X	6 V/X	24* VI/XI	1 VI/XI	19 (Art.D) VI/XII₂	18* I/VII	
	10* IV/X	7 IV/X	25 V/X	2* V/XI	1 V/IV	19 V/XI	
15.	11 III/IX	8* IV/X	26 IV/X	3 IV/X	2* V/XI	20* V/XI	
	12* III/IX	9 III/IX	27* IV/X	4 IV/X	3 IV/X	21 V/X	

(VII' Rev.: *destroyed*)

alignment of the month name which distinguishes it from the sev-
eral instances of "dir še" (Obv. 9',III'; 11',IV'; 13',V'; and 15',VI' and
Rev. 8',II') where "dir" is written under the year and the meaning
is "XII$_2$ year, month XII."

The text contains three erasures, all of misplaced "dir"s. This,
together with the absence of rulings, suggests that the text was not
a copy of a finished text, and that the scribe had some difficulty
in designating intercalary years. Traces of a "dir" in year 38 of
Artaxerxes I, however, show that actual, rather than calculated,
intercalations are recorded.[4]

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[4] During the reign of Artaxerxes I intercalations occur in the correct sequence required
by the nineteen-year cycle, but only month XII$_2$ is used and VI$_2$ does not appear. Thus
years 19 and 38 have intercalary XII$_2$'s, where we would otherwise expect VI$_2$'s. See PD^3,
6–9.

Text B: B.M. 37044 (80-6-17,788)

Obv.

PLATE 2.

Rev.

10

TEXT B

Contents: Regnal years and months of lunar eclipse possibilities for (at least) year 10 to year 30 of Artaxerses I (-454 to -434).

Previous Publication: Mentioned as No *1425 in LBAT.

Transcription: Table 3; *Photograph*: Plate 2

Description of Text:

Text B is a small, well-written fragment with part of the upper edge preserved. The surface of its reverse, where preserved, is blank. A vertical line separates Columns I' and II'. Text B duplicates the first four or five lines of Columns III' and IV' of the obverse of Text A, but with two differences. First, its columns are separated by a vertical ruling and, second, it has the annotation "5 itu" (= five months) in Col. I', line 1. Thus when complete, Text B probably appeared very much like the Saros Canon (Text C).

TABLE 3

Text B

Obverse   I'   II'

1)	]10	gu₄ 5 itu	28	gu₄ ⸢itu
2)	]dir	apin		apin[
3)	i]⸢l	bar	29	gu[₄
4)	]	du₆	dir	ap[in
5)			]30	bar,[

1.	10 II 5 mo.	28 II	1.
	* VIII	VIII
	11 I	29 II
	VII	* VIII
5.		30—I	5.

11

Text C ("Saros Canon"): B.M. 34597[5] (Sp. II,71)

Obv.

Rev.
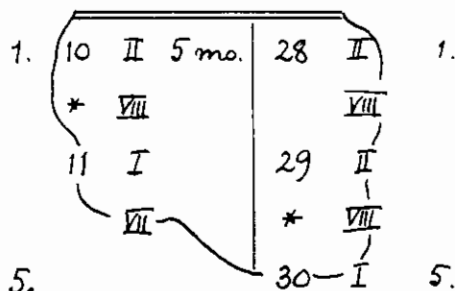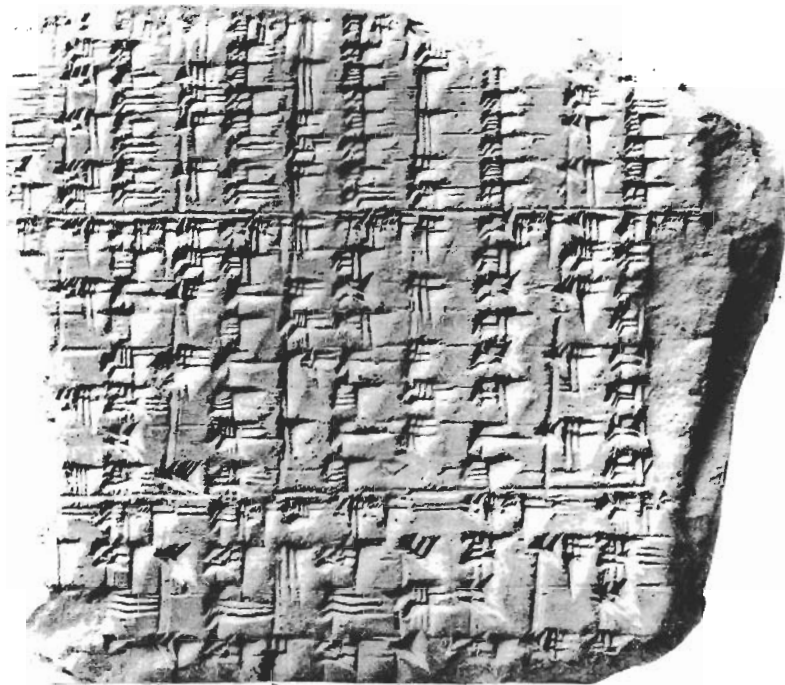
PLATE 3.

[5] Text C Not 34579 as in Neugebauer [1938], 248, 342].

Contents: Regnal years and months of lunar eclipse possibilities for (at least) year 4 of Artaxerxes II to S.E. 40[6] (−400 to −271) arranged in columns of 18 years (223 months).

Previous Publications: Published in hand copy by Strassmaier [1895] and (in Pinches's copy) as No. 1428 in LBAT; and excerpted with revisions in Aaboe [1972]. It has been discussed in, *i.a.*, Epping and Strassmaier [1893], Pannekoek [1917], and Neugebauer [1938].

Translation: Table 4;   *Photograph*: Plate 3

Description of Text:

Text C is a handsome fragment 4¾" wide by 4⅛" high. Vertical rulings separate columns of dates, which include abbreviated king names after year 1 of each reign.[7] Horizontal alignment is observed throughout, so that dates in a given line increase by 223 months from one column to the next. Where the interval from one line to the next increases by five months, the entries are separated by a horizontal line, and the second entry carries the annotation "5-itu" as in Text B. These lines continue across the entire text, dividing each column into groups of seven or eight dates separated by six-month intervals.

As published by Strassmaier and in LBAT, Text C presents elements of seven columns of 38 lines each, beginning and ending in the middle of a group of seven eclipse possibilities. In Strassmaier's copy the columns on obverse and reverse appear in good alignment, whereas Pinches's copy in LBAT shows columns which do not connect cleanly across the tablet's edges, but are somewhat offset. In LBAT the identification of "obverse" and "reverse" was made to minimize this shift.

Subsequently Aaboe [1972] proposed that "obverse" and "reverse" be interchanged, based on the curvature of the tablet. With this identification each column begins just after a five-month interval, and the dates are consistent with those of Text A and Text B

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[6] We use "S.E. *N*" to denote year *N* of the Seleucid Era. Month I of S.E. 1 began on April 3, −310.

[7] For the Achaemenid king names see Sachs [1977]. The abbreviations used in the text are: *ú* (Umasu) = Artaxerxes III; *ár* = Arses; *da* = Darius III; *a* = Alexander III (the Great); *pi* = Philip III (Arrhidaeus); and *an* = Antigonus. The entry for 1 Seleucid Era is broken; it probably had *si*.

in the sense that all dates in a given line are separated by a mul-
tiple of 223 months. In this arrangement the text preserves traces
of eight rather than seven columns, which if complete would have
extended from -400 to -257. On the right side the narrowness of
the tablet makes it likely that the last preserved column was in fact
the last column of the original. To the left, however, at least a third
and possibly almost half the tablet appears missing. Thus the com-
plete text probably contained between 13 and 15 columns, ex-
tending at least as far back as Text A (-490) and possibly to -526.

As in Texts A and B intercalary years with a XII_2 are designated
by a "dir" beneath the year number unless the intercalary month
itself appears as an eclipse possibility in that year. An exception
is 12 S.E. where the designation is omitted, although it is clear
from the months that the year contains a XII_2. Years with a VI_2
are designated by "kin-dir," in contrast to Text A.

The text's use of regnal years after Darius III is as follows:

> 1 Alexander III (the Great) follows 5 Darius III;
> 1 Philip IV (Arrhidaeus) follows 7 Alexander III;
> 1 Antigonus follows 6 Philip IV; and
> 1 Seleucid Era follows 6 Antigonus.

As discussed more fully below, this rational, but unconventional
practice differs from that described in PD[3] and also from that
found in Text D. No colophon is preserved, but the text was ob-
viously written after the adoption of the Seleucid Era.[8]

Critical Apparatus:

For our identification of obverse and reverse, see above. All ref-
erences are to the translation given in Table 4.

Rev. 33, Cols. V' and VI' and Rev. 35, Col. VI': Pinches (LBAT) gives
"šu" (month IV) for "du$_6$" (month VII); this implies that he
copied what he saw and not what he thought should be there.

Rev. 37 and 38, Col. I' : The text (and Pinches) has traces of "izi"
(month V) and "zíz" (month XI). Strassmaier restores a "dir" (in-
dicating an intercalary XII_2) in year 20, in agreement with Sp. II
$901 = $ B.M. 35328,[9] which forces the readings "šu" (month IV)

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[8] While 1 Seleucid Era begins in -310, Seleucus did not become king until 7 S.E.
(-304) (Sachs and Wiseman [1954], 205), and the earliest attested date is 8 S.E. (PD[3], 20).
As late as 10 S.E., however, we find the date "year 4" (of Seleucus) in a Diary for $-302/301$
(Sachs-Hunger [1988], 251). Thus the convention of counting years from 1 S.E. regardless
of who was king, must have become general practice between -300 and -280 (31 S.E.),
when Antiochus I became sole king.

[9] Published as No. 1394 in LBAT. Translated and discussed by Kugler SSBI, 80–81. The
text is a Jupiter observation text, which is explicitly as well as astronomically dated. Obv.
26' has "dir-še 30" in a section beginning "year 20." This appears to be confirmed by sub-
sequent month names, although poorly preserved.

TABLE 4

Text C

| | I | II | III | IV | V | VI | VII |

Obv.

Rev.

Marginal row numbers (Obv.): 1, 5, 10, 15, 20, 25, 30, 35

Notations appearing within the table: 5 mo., 1 Sel., 1 Phil., 1 Art. III, 1 Arses, 1 Dar. III, 1 Antig. II, 1 Alex.

and "ab" (month X). The text (with Pinches) implies that the intercalation occurred in year 21*, which agrees with Text L (below). This removes the only meaningful anomaly in the nineteen-year intercalation cycle after −497, and moves the introduction of a consistent nineteen-year intercalation scheme back to the beginning of the fifth century B.C.[10]

Commentary:

Texts A, B and C − despite differences in orthography − all derive from a single, consistent scheme. Each has columns of 38 dates (years and month names), which begin after a five-month interval and run from obverse to reverse. Furthermore, two dates in a given line (counting from 1 to 38) always differ by a multiple of 223 months, whether in the same text or not. As a result the five-month intervals always occur after the same lines, dividing each column into groups of 8-8-7-8-7 dates, where five months separate the groups, while consecutive dates within each group are six months apart.

This arrangement of dates can be derived from the assumptions that: (1) sun, moon and node move uniformly; and (2) the sun returns to its position relative to a node in 223 months.[11] The second assumption corresponds to an eclipse cycle, now generally known as the "Saros," in which 38 eclipse possibilities occur in 223 months.[12] Our texts thus give the months of lunar eclipse possibilities based on this cycle.

By "eclipse possibility" we mean a syzygy at which the sun is within half a month's progress in elongation from a lunar node. At such times solar eclipse possibilities occur at conjunctions and lunar eclipse possibilities at oppositions. By this definition, assuming uniform motion, there will be exactly one solar and one lunar eclipse possibility associated with each passage of the sun by a node.[13] This agrees with the observational fact that for a given location solar eclipses rarely, if ever, occur only one month apart, and lunar eclipses never do.

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[10] The only divergence from the standard nineteen-year intercalation scheme after −497 is the previously noted (Note 3) replacement of VI2s with XII2s during the reign of Artaxerxes I. This obviously has no effect on the distribution of intercalary years.

[11] For this derivation from simple arithmetical considerations see Aaboe [1972] and Britton [1989].

[12] See Neugebauer [1957], 141–143, and HAMA, 497 n.2 for the history of the modern use of "Saros" for the 223-month eclipse cycle, beginning with Halley in 1691. In Babylonian texts this cycle was called "18 years." We have used "Saros cycle" to mean 223 months, and "Saros Cycle" to mean 223 months which are also consistent with the arrangement in Texts A–C (i.e., the first month is a multiple of 223 months distant from those in line 1 of Texts A–C).

[13] For a full discussion of the theory presented in System A, where the motion of the sun and moon at syzygy is not uniform, see Aaboe and Henderson [1975].

Lunar EP	Lunar DATE	Solar EP	Solar DATE	Months
		1	ALEX XI	S = L-1
		2	1 V	"
		3	• XI	"
1	2 IV	4	2 IV	S = L
2	X	5	X	"
3	3 IV	6	3 IV	"
4	X	7	X	"
5	4 IV	8	4 III	S = L-1
6	• X	9	• IX	"
7	5 III	10	5 II	"
8	X	11	VIII	"
9	6 II	12	6 II	S = L
10	VIII	13	VIII	"
11	7 II	14	7 II	"
12	• VIII	15	• VIII	"
13	8 I	16	XII2	S = L-1

(SC 24)

FIGURE 1

There is a simple relationship between lunar and solar eclipse possibilities which, for the Saros cycle, is shown in Figure 1. If lunar eclipse possibilities are associated with a distribution of dates into groups of 8-8-7-8-7 EP,[14] then solar eclipse possibilities will be distributed into groups of 7-8-7-8-8 EP, and the cycle will begin 3 EP earlier than the corresponding lunar cycle.[15]

For solar eclipse possibilities, therefore, the five-month intervals fall in the middle of the (six-month) groups for lunar eclipse possibilities (and vice versa). Consequently, half of all solar eclipse possibilities occur in (i.e., at the end of) the same month as the corresponding lunar eclipse possibility, while the other half occur in the preceding month. This fact, together with the location of the five-month intervals allows us to establish with certainty

[14] For convenience we use the abbreviation "EP" for "eclipse possibility" when referring to some number of them or to a specific one, and use the written-out expression when referring to the general phenomenon.
[15] See Britton [1989], 21-24, for the derivation of these relationships.

that Texts A, B, and C concern lunar, rather than solar, eclipse possibilities.

It is natural to ask how well this simple scheme agrees with the actual record of historical eclipses. Table 5 shows the Julian years of all lunar eclipses visible in Babylon from the beginning of Nabonassar's reign in −746 through −238. The dates are arranged to be consistent with our texts where they overlap, and the Cycles are numbered so that Saros Cycle 1 (SC 1) is the first complete Cycle after the beginning of Nabonassar's reign. Horizontal lines indicate the boundaries between groups of eclipses separated by a multiple of six months, and thus correspond to five-month intervals in our texts.

For 16 complete Saros Cycles, beginning with SC 13 in −526 and extending through SC 27 (−257), the scheme works perfectly in the sense that all lunar eclipses visible in Babylon occurred in the given months.[16] In SC 12 and earlier Cycles, however, eclipses at EP 16 occur one month earlier than in our scheme, which shifts the boundary between Groups II and III one EP earlier. Similar shifts occur in the boundaries between Groups I and II and Groups IV and V in SC7 and between Groups III and IV in SC 4. Thus before SC 5, which began in −670, only the boundary of the Cycles themselves−i.e., the five-month interval between Group V of one Cycle and Group I of the next−is consistent with our scheme. This boundary persists from sometime before Nabonassar (−746) through SC 27. In SC 28 the eclipse of −238:Oct 23 extends Group V, so that subsequent cycles begin 1 EP later.

The last preserved column in the Saros Canon corresponds to the last cycle (SC 27) which is fully consistent with preceding cycles. As we shall see below, a similar list of solar eclipse possibilities also ends with SC 27, although in this case an additional column was ruled off but not filled in. Whether the scheme was continued past the discontinuity at SC 28 remains unknown. Nor is it clear how far the scheme in our texts was extended to earlier periods, especially before −526 (SC 13) when the five-month intervals between groups of actual eclipses are no longer consistent with those in our texts. That some such scheme was used for earlier dates is suggested by the use of the term "5-itu" in several early eclipse reports, since the term can only refer to the interval

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[16] Lunar eclipses did in fact occur in −274 and −256 (EP 1; SC 27 and SC 28), one month after the indicated date, but neither was visible at Babylon. In the following cycle the corresponding eclipse (−238:Oct 23) was visible at Babylon, thus violating the scheme.

TABLE 5. Lunar Eclipses Visible at Babylon: −746 to −238

Headings (read along the rotated axes): S.E. → | Saros Canon | Solar Saros | Text A | Saros Cycle (beginning year)

LP	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Grp
1	−745	−743	−724	−707	−689	−670	−652	−634	−616	−598	−580	?	−544	−526	−508	−490	−472	−454	−436	−418	−400	−382	−364	−346	−328	−310	−292	−274	−256	
2	−742	−724		−705	−688	−670	−652	−634	−616	−598	−579	−562	−544	−526	−508	−490	−472	−454	−436	−418	−400		−363	−345		−309	−291			I
3	−742	−724		−683	−670		−633	−615		−579	−561				−507	−489	−471	−453	−435			−381	−363	−344		−307	−290	−272	−254	
4	−741	−723	−705	−687	−669	−670	−633	−614		−579	−560		−525	−524	−506	−489		−452	−434	−417			−362	−344	−326		?		−253	
5	−741	−723		−687	−669	−669	−632	−614	−614	−578	−560	−560	?	−524	−506	−488	−471	−452		−416	−398	−380	−362	−325	−325	−308	?	−271	−253	
6									−613			−560	−538	−520	−506		−470	−452			−397	−379	−344	−325		−307		−271	−253	
7			−720	−703	−685		−649	−631		−595	−559	−540	−538	−522	−504	−486	−468	−450	−432		−396		−359	−339		−305	−285	−269	−251	
8	−739		−720	−703		−666	−648	?		−595	−576	−540	−521	−521	?	−486	−467	−450	−431	−413		−377	−359			−305			−251	II
9	−739		−720	−702	−685	−666	−648		−609	−594	−576	−540	−521	?		−485	−467	−449	−431	−413	−396		−359	−341	−323	−305	−287			
10	−738	−719		−684	−666	−647	−626		−608	−594	−575	−559	−521	−502	?	−485	−466	−448	−412	−413	−395		−358	−340		−304	−286	−268	−250	
11	−738	−719	−701	−684	−665	−647	−626	?	−607	−593	−575	−557	−538	−521	−502	−484	−466		−412		−394	−358	−358		−322	−304	−286		−250	
12	−719	−719	−701		−665	−661	−625	−611	−607				−538	−520		−484	−466			−412	?			−339	?	−303	−285	−268	−249	
13																													−249	
14		−717	−699		−663	−645			−609	−591		−555	−537	?	−501		?	−447				−375		−339		−285			−249	
15	−735	−717	−698	−680	−663	−644	−626		−609		−572	−536	−518	?	−500	?	−464	−446		−410	−392		−356	−338			−283	−265		III
16	−735	−716	−698	−680	−663	−644	−626		−605	−590	−572	−536	−518	−518	−500	−482	−464			−409	−392	?	−355	−337		−301	−283	−265	−247	
17	−735	−716		−680	−662		−625	−607	−605		−572		−536		−499	−482	?			−391	−391	−373	−354			−300		−265	−264	−246	
18	−734	−716	−698		−661	−643	−625		−605	−586		−554	−536	−514	−499	−478			−427		−391	−372	−351	−336	−318			−264		
19	−734			−679	−680					−586	−571				−499	−478	−463	−445	−427	−408	−390				−318		−282	−264	−245	
20				−679	−679								−517												−318					
21		−732		−696	−678		−660	−642		−605	−587	−551	−533	?	−497	−479		−443	−424	−407	−389	−370	−353	−335	−316		?			
22	−731		−696	−677		−659	−642	−623	?	−605	−586	−551	−533	−514	−497		?	−443	−424		?	−370	−352			−298				IV
23	−731		−695	−695	?	−659	−641	?		−586	−550	−532	−532	−514	−496	−478	−460	−442	−424	−406		−370	−351	−333		−298	?	−261	−243	
24	−713	−695	−694		−658	−640	−626	−605	−586	−567	−550	−532		−513	−495	−478	−459	−441	−423	−405	−387	−369	−351	?		−297	−279	−261	−242	
25	−712	−712	−676	?	?	−640	−622	−604	−602	−584		−549	−531	−513	−495	−477			−423	?	−386	?	?	−315	−314		−278	−260	−242	
26		−710	−692	?	−638			−602		−584	−566	−548	−529	−511	−493		−457	−439		−403	−385	−349	?	−332		−298	−276		−240	V
27	−746	−710	−691	−673	−656	−637	−619			−583	−565	−529	−511	−510	−492	−473	−457	+438	−420	−402	−384	−366	−348	−330	−312	−294	−276	?	−239	
28	−745	−709	−691	−637	−600	−546		−618		−583	−565	−529	−510	−510	−492	−474	−456	−420	−420	−401	−384	−366	−347		−311	−293	−275	−257		
29	−727		−691	−672	−654				−564	−582	−565	−546	−528	−510	−492	−474	−456	−419	−419	−401		−365	−347	−330		−293	−276	−260	−239	
30	−726	−708	−690	−676	−636	?		−600	?	−582	−564	−527	−527	−510	−492	−473	?	−419				−365	−347	−332	−311	−293	−275	?	−238	

footnote: − { } : eclipse belonging to previous group, but not visible at Babylon

between eclipse possibilities.[17] The term is found in the following list of eclipse reports, where "EP-1" indicates that the five-month interval occurred 1 EP earlier than in our texts. In each case it correctly denotes the boundary between groups as evidenced in Table 5, whether an eclipse was visible or not. This suggests the existence of some scheme similar to that of our texts, but reflecting the actual distribution of eclipses in the earlier period.

Lunar Eclipse Reports with "5-itu"

Date	SC:EP	Visible?	"5-itu"	Reference
−746:Feb 6	0:31	Yes	EP-1	LBAT 1413
−685:Apr 22	4: 8	Yes	EP-1	LBAT 1416
−667:May 2	5: 8	No	EP-1	LBAT 1416
−649:May 13	6: 8	Yes?	EP-1	LBAT 1416
−631:Jun 4	7: 8	Yes	EP-1	LBAT 1416
−598:Feb 19	9: 1	Yes	EP	LBAT 1420*
−591:Apr 2	9:16	Yes	EP-1	LBAT 1420*
−588:Jul –	9:23	No	EP-1	LBAT 1420*
−577:Jun –	10: 8	No	EP-1	LBAT 1420*
−526:Apr –	13: 1	No	EP	B.M. 37276*
−422:Aug –	18:31	No	EP-1	LBAT 1426

* = unpublished

The (unpublished) text B.M. 37276 contains brief observational reports at consecutive eclipse possibilities, beginning with EP 1; SC 13 (3** Cambyses = −526). Only the top of the first column is preserved, so it is impossible to tell the structure and full extent of the text. Nevertheless, it begins with the earliest Saros Cycle for which the five-month intervals in our texts agree with the eclipse record.

The earliest use of the term "5-itu" to designate the beginning of a new group of eclipse possibilities occurs in the report of the eclipse of −746:Feb 6. This eclipse was the first in Nabonassar's reign and is the earliest detailed eclipse report which we have from Babylon.[18]

The scheme underlying our texts is consistent with the histor-

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[17] While theoretically possible, eclipses separated by five months are seldom, if ever, observed and eclipses separated by eleven months are rare. In the 500 odd years covered by Table 5 there is only one instance of two eclipses separated by five months which might have been visible in Babylon (EP 16 & 17; SC 21). The first of these had a magnitude of only 0.1^d, while the second was only marginally visible, if at all, before sunrise.

[18] The eclipse occurred in month XII of the accession year of Nabonassar (i.e., at EP 31; SC 0) and begins a series of consecutive eclipse reports covering at least Group V of SC 0.

TABLE 6. Saros Cycle Dates–Lunar Eclipse Possibilities

<---I'------II'------III'------ Text A ------V'------VI'------VII'------VIII'->
<---I------II------III------Saros Canon------V------VI------VII------VIII->

EP#	SC = 13 3 CAMBS -526: 4/4		SC = 14 13 DARII -508: 4/14		SC = 15 31 DARII -490: 4/25		SC = 16 13 XERXS -472: 5/6		SC = 17 10 ARTX1 -454: 5/17		SC = 18 28 ARTX1 -436: 5/26		SC = 19 5 DARI2 -418: 6/8		SC = 20 4 ARTX2 -400: 6/18		SC = 21 22 ARTX2 -382: 6/29		SC = 22 40 ARTX2 -364: 7/9		SC = 23 12 ARTX3 -346: 7/21		SC = 24 2 ALEX -328: 7/31		SC = 25 1 S.E. -310: 8/11		SC = 26 19 S.E. -292: 8/22		SC = 27 37 S.E. -274: 9/2	
	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo	Yr	Mo
1	3**	I	13*	_	31	_	13	_	10*	_	28	II	5*	III	4	III	22	III	40*	IV	12	IV	2	IV	1*	V	19	V	37**	V
2		VI2		VII	32*	VII	14	VII		VIII	29*	VIII	6	IX	5*	IX	23	IX	41	X	13*	X	3	X	2	XI	20*	XI	38	XI
3	4	XII		XII2		VII	15*	VII	12	VII	30	XII		VIII	6	IX	24*	IX	42	IX	14	X	4*	X	3	X	21	XI	39*	XI
4		VI		VI	33	VI		XII2		VII	31	VII	7*	II	6	IX	25	IX	43*	III	15	III	5	IV	4*	IV	22	IV	40	IV
5	5*	XII	14	XII		XII	16	VI	13**	VII		VII		VIII	7*	VIII		VIII		III	16*	III	6	IX	5	IX	23*	IX	41	IX
6		XII		VI	34	VI		XII2		V12	32*	XII	8	VII	8	VI	26*	VI	44	VI	16*	VI	7*	VII	6	VII	24	II	42*	II
7		V	15	XII		V	17	VII	14	VII	33	XII	9	II	9	XII	27	XII	45*	VII	17	VII	PHILA 1	VIII	7*	II	25	II	43	IX
8			16*	VI		V	18*	VII	15	VII	34*	V	10*	_	10*	VI	28	VI	46	XII2	18*	V12	2*	V12	8	II	26*	VIII	44	II
9	6	X	17	_	35*	X	19	XII2	16*	XII	35*	XII	11	VII	11	VIII	29*	XII	ARTX3 1	VI	19	XII2		VII		_		VIII	45*	_
10	7	II	18	IX	36	IX	20	VI	17	V	36	IX	12	X	12	X	30	XI	2*	XI	20	XI	3	XI	9*	XII	27	XII		VII
11	8*	_	19**	X	XERX 1	IV	21**	IX	18	III	37	IX	13*	IV	13*	V	31	IV	3	IV	21*	V	4	V	10	V	28*	V	46	XII
12	DARII 1	VII		IX	2**	X	ARTX1 1	VIII	19*	IX	38*	IX	14	IX	14	XII	32*	V	4	V	ARSES 1	IV	5*	XI	11	XI	29	XI	47*	VI
13		III	20	III	3	III		III	20	III	39	III	15	IX		IX		X	5*	X	2	IX	6	XI		VII		III	48	XII
14	2	IX	21	II	4*	IX	2*	VI	21*	V	40*	III	16**	V	15	VIII	33	XI	6	XII	DARI3 1	IX	ANTG 1	IX	12*	IX	30	IX	49	X
15			22**	II		II	3	XII	22	VI		IX	17	_	16*	II	34	II	7	VIII	2	IX	2*	IX	13	III	31*	III	50*	IV
16			23	_	5	VIII	4	VI	23	XII	41	VII	18*	VII	17	_	35**	VII	8*	II	3	VIII	3	IX	14	IX	32	IX	51	III
17	3**	VIII		VII	6	XII	5*	VI	24*	XII2	DARI2 1	XII2	19	VI	18*	VII	36	VI		XI	4**	XI	4	XII	15*	V	33	V	52	II
18		II	24*	VI	7*	VI	6	XII		VI	2*	VI	ARTX2 1	XII	19	VI		VII	9	VI		VI2	5**	VI2	16	V	34*	VIII	53*	VIII
19	4	_	25	XII	8	XII	7	IV	25	IV	3	V	2*	X	20(?)	XI	37*	VII	10*	XI	5	XII	ALEX3 1	XI	17	VII	35	VII	54	_
20	5*	VII	26	XII	9	XI	8*	IV	26	X	4	IV	3	IV	21*(?)	XI	38	VI	11	X	ALEX3 1	XII	6	XII	18**	_	36	_		VII
21			27*	II	10*	IV		X	27*	IV		IV		X		IV	39	V		X		VI		VI		VII		XII2		XII2

ical eclipse record for fifteen Saros Cycles beginning with SC 13 and extending through SC 27. Table 6 gives the dates of all lunar eclipse possibilities for this period, arranged as in our texts. Rather tidily, the table begins with an eclipse possibility in month I of 3** Cambyses (−526) and ends with one in month XII$_2$ of 54 S.E. (−256). It is not impossible that the Saros Canon originally covered this same period.