**101) Some new results on a commentary to *Enūma Anu Enlil* Tablet 14** — The fragments BM 42961 (1881-7-1, 725) and BM 42964 (728) join BM 45821+46093+46215 (1881-7-6, 242+399 +565+672 +676), a Late Babylonian commentary on EAE Tablet 14 published by al-Rawi and George (1991/2) (=AG91/2). Apart from presenting an updated edition, a new interpretation is offered here for certain passages that were hitherto badly understood. BM 42964, situated near the left upper corner, preserves an invocation and parts of obv. 1-4. BM 42961 joins BM 45821+ below BM 42964 and partly preserves obv. 5-11. Both are destroyed on the reverse and colored grey, whereas BM 45821+46093+46215 has a brown color. The joined fragments measure 8.7 x 9.6 x 2.4-3.0 cm. At most a few cm remain missing near the bottom of the obverse. The invocation (obv. 0) implies that the tablet was written by scholars connected to the Esagila temple in Babylon. All numbers are expressed in the sexagesimal positional system, which is a relative notation, i.e. the power of 60 corresponding to each digit is not indicated. In order to render the algorithms most faithfully, this notation is maintained in the translation, but absolute values of all numbers, as inferred from the context, are mentioned in the commentary. For the reverse of the tablet see AG91/2.

**Photograph of BM 42961+42964+45821+46093+46215 (obverse).**


 

**Transliteration and translation**

*Obverse*

⸢*ina a-mat*⸣ $^{d}$EN *u* $^{d}$GAŠAN-*ia liš-lim*
[DIŠ] ⸢*sin* U$_4$.1.KAM⸣ 3.45 GUB *ša* E-*u* IGI 3.⸢45⸣ 1⸢6⸣ 1[6 A.RA$_2$]
[4] ⸢IGI⸣.GUB.BA IGI.DU$_8$.A *ša*$_2$ *sin* DU-*ma* 1.4 1.4 A.[RA$_2$ 3]
[EN].⸢NUN⸣ GI$_6$-*ka* ⸢DU-*ma*⸣ 3.12 ⸢: 3⸣.12 A.RA$_2$ 3.45 DU-⸢*ma*⸣ [12]
[12 A].⸢RA$_2$ 1⸣ 12 U$_4$.1.KAM 12 UŠ ⸢NA⸣-*su* *ša*$_2$ 2-*i* IGI 3.45 1[6]
[16] ⸢A⸣.RA$_2$ 12 3.12 : 3.12 A.RA$_2$ 3.45 12 : 12 A.RA$_2$ 1 : 1⸢2⸣
[U$_4$].1.KAM 12 UŠ ⸢GUB⸣-*zu* *ša*$_2$-*niš* 16-*u*$_2$ *ša*$_2$ 3.12 IL$_2$-*ma* 12
[U$_4$].1.KAM 12 UŠ ⸢GUB-*zu* 3.45⸣ 16-*u*$_2$ *šu*-⸢*u*$_2$⸣ *ina* ŠA$_3$ 16-*šu*$_2$ ⸢IL$_2$.A⸣
*ša*$_2$ *šal-šu*$_2$ IGI 3.45 16 16 A.RA$_2$ 15 4 4 ⸢IGI.GUB⸣.BA IGI.DU$_8$.A ⸢*ša*$_2$⸣ *sin*
3 MA.NA EN.NUN GI$_6$ A.RA$_2$ 4 IL$_2$-*ma* ⸢1⸣[2 IGI.D]U$_8$.A *ša*$_2$ *sin tam-mar*
4 A.RA$_2$ 3 : 12 : 12 *man-za-za ša*$_2$ U$_4$ 1 [:] ⸢3⸣.45 A.RA$_2$ 2 7.30
[U$_4$.2].⸢KAM 7.30⸣ GUB : IGI 7.30 : 8 : 8 ⸢A⸣.RA$_2$ 4 : 32
[32 A].⸢RA$_2$ 3⸣ : 1.36 : 1.36 A.RA$_2$ 7.30 : 12 : 12 A.RA$_2$ 2 DU-*ma* 24
[U$_4$.2.KAM 2/3 D]ANNA 4 UŠ *ša*$_2$ 2-*i* IGI 7.30 : 8 : 8 A.RA$_2$ 12 ⸢:⸣ 1.36
[1.36 A.RA$_2$] 7.30 : 12 : 12 A.RA$_2$ 2 24 U$_4$.2.KAM 2/3 DANNA ⸢4 UŠ⸣ GUB
[*ša*$_2$-*niš* 8-*u*$_2$ *š*]*a*$_2$ 1.36 IL$_2$-*ma* 12 *a-na* 12 NA *ša*$_2$ ⸢U$_4$ 1⸣ DAḪ-*ma* [:] 24
[U$_4$.2.KAM] ⸢2/3⸣ DANNA 4 UŠ GUB-*zu* 7.30 8-*u*$_2$ *šu-u*$_2$
[*ina* ŠA$_3$ 8-*šu*$_2$] IL$_2$.A 7.30 ⸢A.RA$_2$⸣ [2] DU-*ma* 15
[U$_4$.3.KAM 15 GUB : IGI 15 4 : 4 A.R]A$_2$ 4 : 16 : 16 A.RA$_2$ 3 48
[48 A.RA$_2$ 15 : 12 : 12 A.RA$_2$ 3 : 3]6 U$_4$.3.KAM «2/3» DANNA 6 UŠ GUB-*zu*
[*ša*$_2$ 2-*i* IGI 15 4 : 4 A.RA$_2$ 12 : 48] : 48 A.RA$_2$ 15 : 12 :
[12 A.RA$_2$ 3 36 : U$_4$.3.KAM DANNA 6 U]Š ⸢GUB-*ma*⸣ *ša*$_2$-*niš* 4-*u*$_2$ *ša*$_2$ 48
[IL$_2$-*ma* 12 : 12 *a-na* 24 NA *ša*$_2$ U$_4$ 2 DAḪ-*ma* 36 : DA]NNA ⸢6 UŠ GUB 15⸣ A.RA$_2$ ⸢2⸣
[DU-*ma* 30 : U$_4$.4.KAM 30 GUB ...]

*Obverse*

[0]⸢At the command of⸣ Bēl and Bēltiya may it succeed (or: remain intact).

(*Day 1: i*) [1][¶] ⸢On day 1 the Moon⸣ is present for 3.45. As it was said: the reciprocal of 3.⸢45⸣ is 1⸢6⸣. You multiply 1[6 times] [2][4], the ⸢*igi*⸣*gubbû*-coefficient for the appearance of the Moon, it is 1.4. You multiply 1.4 ti[mes 3], [3][the wat]⸢ch⸣ of your night, it is 3.12 : You multiply ⸢3⸣.12 times 3.45, it is [12]. [4][12] ⸢times 1⸣ is 12. On day 1 its presence is 12 UŠ.

(*ii*) According to a second one: the reciprocal of 3.45 is 1[6]; [5][16] ⸢ti⸣mes 12 is 3.12 : 3.12 times 3.45 is 12 : 12 times 1 is 1⸢2⸣. [6][On day] 1 it is present for 12 UŠ.

(*iii*) Alternatively: you compute a 16th of 3.12, it is 12. [7][On day] 1 it is present for 12 UŠ. ⸢3.45⸣ is a 16th - that is whereby you compute a 16th of it.

(*iv*) [8]According to a third one: the reciprocal of 3.45 is 16. 16 times 15 is 4. 4 is the ⸢*igi*⸣*gubbû*-coefficient for the appearance of the Moon. [9]3 minas, the watch of the night, you multiply ('raise') times 4 and you see ⸢1⸣[2, the appea]rance of the Moon. [10]4 times 3 is 12 : 12 is the presence for day 1 [:]

(*v*) ⸢3⸣.45 times 2 is 7.30.

(*Day 2: i*) [11][On day 2] it is present for ⸢7.30⸣ : the reciprocal of 7.30 is 8 : 8 times 4 is 32. [12][32] ⸢times 3⸣ is 1.36 : 1.36 times 7.30 is 12 : you multiply 12 times 2, it is 24. [13][On day 2 2/3] *bēru* 4 UŠ.

(*ii*) According to a second one: the reciprocal of 7.30 is 8 : 8 times 12 ⸢is⸣ 1.36. [14][1.36 times] 7.30 is 12. 12 times 2 is 24. On day 2 it is present for 2/3 *bēru* ⸢4 UŠ⸣.

(*iii*) [15][Alternatively: you compute an 8th] of 1.36, it is 12. You append it to 12, the presence for ⸢day 1⸣, it is 24. [16][On day 2] it is present for ⸢2/3⸣ *bēru* ⸢4 UŠ⸣. 7.30 is an 8th - [17]that is whereby you compute [an 8th of it].

(*v*) You multiply 7.30 ⸢times⸣ [2], it is 15.

(*Day 3: i*) [18][On day 3 it is present for 15 : the reciprocal of 15 is 4 : 4 ti]mes 4 is 16 : 16 times 3 is 48, [19][48 times 15 is 12, 12 times 3 is 3]6. On day 3 it is present for a «2/3» *bēru* 6 UŠ.

(*ii*) [20][According to a second one: the reciprocal of 15 is 4 : 4 times 12 is 48] : 48 times 15 is 12 : [21][12 times 3 is 36 : On day 3] it is present for [a *bēru* 6 U]Š.

(*iii*) Alternatively: [you compute] a 4th of 48, [22][it is 12 : you append 12 to 24, the presence for day 2, it is 36 : it is present for a *bē*]*ru* ⸢6 UŠ.

(*v*) You multiply 15⸣ times ⸢2⸣, [23][it is 30. ...]

(*Day 4: i*) [On day 3 it is present for 15 ...]

[*unknown number of lines missing*]

**2** [4] *igigubbû*(⸢IGI⸣.GUB.BA) *tāmarti*(IGI.DU$_8$.A) *ša$_2$ sin*: '[4], the *igigubbû*-coefficient for the appearance of the Moon': this confirms a suggestion by Steele & Brack-Bernsen (2008).

**3** *maṣṣarti*(EN.NUN) *mūši*(GI$_6$)*-ka*, 'watch of your night': this denotes the duration of the entire night (AG91/2, 59-60).

**4** *manzāssu*(NA-*su*), 'its presence': *manzāzu*, literally 'station', cognate noun of *izuzzu*(GUB), 'to stand; be present', is a technical term for the visibility of a celestial body, here the time from sunset to moonset. The emendation to GUB-*zu* suggested by AG91/2 is unnecessary, because NA-*su* is also found in the duplicate BM 45900 (Steele & Brack-Bernsen 2008). Furthermore, *manzāzu* appears with the same meaning at least two more times on the present tablet (obv. 10, 15). The Akkadian reading of UŠ, 'time degree', is unclear.

**6** ⸢GUB-*zu*⸣: this reading, suggested by AG91/2, is now confirmed; NA-*su* can be excluded.

**7** ⸢3.45⸣ 16-*u$_2$ šu-*⸢*u$_2$*⸣ *ina libbi*(ŠA$_3$) 16-*šu$_2$* ⸢*tanašši*(IL$_2$.A)⸣: unlike AG91/2, I understand this to be a glosse explaining the usage of the reciprocal number 3.45 and similarly in obv. 16-17.

*našû*, literally 'to raise', here 'to compute'. This meaning, usually with a fraction 1/*n* or a named quantity as the object, is not mentioned in the dictionaries but well attested in LB astronomical and mathematical texts (Ossendrijver 2012, 597).

*ina libbi*(ŠA$_3$) 'whereby': this instrumental meaning is not mentioned in the dictionaries, but attested in LB texts (Ossendrijver 2010). For other adverbial meanings of *ina libbi* see *CAD* L *libbu* 5.

16-*šu$_2$* : 'its 16th' and not '16-fold' (AG91/2); the latter would require the preposition A.RA$_2$ or *adi*, 'until', before 16-*šu$_2$*.

**12** [32 A].⸢RA$_2$ 3⸣: there is sufficient room for restoring 32; it was not necessarily omitted by mistake as suggested by AG91/2.

**13** *bēru*(DANNA): literally 'mile': 'double hour', interval corresponding to 1/12 of a day = 30 UŠ.

**15** 12 *a-na* 12 ... *tuṣṣab*(DAḪ), '(it is) 12, you append it to 12, ...': there is no need to assume that a second instance of 12 was erroneously omitted before *a-na* as suggested in AG91/2.

**19** «2/3»: as pointed out by AG91/2 one expects nothing here.

**20** GUB-*ma*: the traces suggest *ma*, but one expects *zu.*

In the colophon, the tablet is labeled as 'lemmata and oral explanations' (*ṣâtu u šūt pî*) of EAE Tablet 14. For this type of commentary cf. Frahm (2011), 48-55. EAE Tablet 14, also edited in AG91/2, contains four numerical tables, A-D. The commentary is mainly concerned with Tables A and B, the first 15 entries of which describe the Moon's 'presence', *manzāzu*(NA), the time from sunset to moonset, for days 1-15 of an ideal equinoctial month. In the commentary and in Table A NA is expressed in UŠ ('time degrees'), where 1 UŠ = 4 modern minutes, but in Table B in minas and sheqels, units of the water clock. Since 1 sheqel (=1/60 mina) corresponds to 1 UŠ, Table B can be trivially converted into UŠ. For days 5-15 Table A coincides with the converted Table B, but for days 1 to 4 the values are different, say $a$ and $b$. What the commentary does is to present several algorithms, here labeled i-v, that establish or suggest links between: 1) values of $a$ and $b$ for the same day; 2) values of $a$ or $b$ for successive days; 3) values of $a$ or $b$ for different calendar dates. All links of type 1 which are established in algorithms i-iv effectively employ the same sequence of operations $a \rightarrow \bar{a}\cdot b\cdot a=b$, where $\bar{a}$ denotes $1/a$, the reciprocal of $a$. Links of type 2 are provided by algorithms iii-v. As will be argued, it was hitherto not fully understood that links of type 3 are clearly suggested, though not spelled out, in algorithms i and iv.

*Algorithm i (AG91/2: steps a-f)*

Day 1: $a=3;45 \rightarrow \bar{a}=0;16 \rightarrow 0;16\cdot4=1;4 \rightarrow 1;4\cdot3=3;12\cdot\rightarrow 3;12\cdot3;45=\bar{a}\cdot12\cdot a=12 \rightarrow 12\cdot1=12=b$.

Day 2: $a=7;30 \rightarrow \bar{a}=0;8 \rightarrow 0;8\cdot4=0;32 \rightarrow 0;32\cdot3=1;36 \rightarrow 1;36\cdot7;30=\bar{a}\cdot12\cdot a=12 \rightarrow 12\cdot2=24=b$.

Day 3: $a=15 \rightarrow \bar{a}=0;4 \rightarrow 0;4\cdot4=0;16 \rightarrow 0;16\cdot3=0;48\cdot\rightarrow 0;48\cdot15=\bar{a}\cdot12\cdot a=12 \rightarrow 12\cdot3=36=b$.

With the new reading of obv. 2, first suggested by Steele & Brack-Bernsen (2008), it is clear that 12=4·3 is construed as the product of '4, the *igigubbû*-coefficient for the appearance of the Moon' and '3 minas, the watch of your night'. The latter coincides with the entries in Table C for 15 VI and 15 XII, ideal dates of the equinoxes. Its mention can therefore be interpreted as a link with Table C, which provides the length of the night for 24 dates of the ideal year. The former term, the coefficient 4, is known from Mul.Apin II.iii.13-14 and well understood (Hunger & Pingree 1989; AG91/2). It links Table C to Table D, which includes 12 values of the time between sunset and moonset (NA) for day 1 of each month of the ideal year. To be precise, 4 is the ratio between any value in Table D and the corresponding value in Table C. While AG91/2 (p. 66) do hint at the implications of these links, they were not fully explored. In particular, it now seems clear that Tables A and B were viewed by the commentator as examples of a general algorithm whereby NA can be computed for arbitrary dates. That 3 minas is construed as an exemplary value of an underlying table and not as an isolated number is implied by the qualifying phrase 'watch of your night'. Note that days 2-14 are not represented in Tables C and D, nor can $b$ for days 2-14 be obtained by straightforward interpolation between the entries in Table D. It is therefore highly significant that the references to Tables C and D appear only for day 1. All of this suggests that the value of $b$ for day 1 of a non-equinoctial month is meant to be computed by replacing 3 minas by the appropriate value from Table C. A slight complication arises from the fact that Tables C and D assign 3 minas and NA=12 UŠ to day 15 of the equinoctial months and not to day 1. Hence for a non-equinoctial month, $b=12$ must be replaced by the value in Table D for day 15 of that month. The value of $a$ for day 1 can then, in principle, be computed by multiplying $b$ by the ratio $a/b$ for the equinoctial month, 3;12 (days 1, 2) and 2;24 (day 3), if one assumes that this ratio is the same for all months. Setting out from day 1, $a$ and $b$ can then be computed for days 2-4, etc., in analogy to the method for the equinoctial month. Algorithm i is therefore not merely a numerological exercise, since it incorporates astronomically meaningful explanations. By reinterpreting $b$ in terms of exemplary values of named astronomical quantities of which the monthly variation is known, a method is suggested for generalizing Tables B and A to arbitrary dates.

*Algorithm ii (AG91/2: steps g-l)*

Day 1: $a=3;45 \rightarrow \bar{a}=0;16 \rightarrow 0;16\cdot12=3;12 \rightarrow 3;12\cdot3;45=\bar{a}\cdot12\cdot a=12 \rightarrow 12\cdot1=12=b$.

Day 2: $a=7;30 \rightarrow \bar{a}=0;8 \rightarrow 0;8\cdot12=1;36 \rightarrow 1;36\cdot7;30=\bar{a}\cdot12\cdot a=12 \rightarrow 12\cdot2=24=b$.

Day 3: $a=15 \rightarrow \bar{a}=0;4 \rightarrow 0;4\cdot12=0;48 \rightarrow 0;48\cdot15=\bar{a}\cdot12\cdot a=12 \rightarrow 12\cdot3=36=b$.

In this variant, the algorithm is formulated entirely in terms of mathematical operations, i.e. the factor 12 is not construed as the product of two named astronomical quantities as in algorithm i.

*Algorithm iii (AG91/2: steps m-r)*

Day 1: $\bar{a}$=0;16 → 3;12/0;16=12=*b*, where 1/0;16=3;45=*a*.

Day 2: $\bar{a}$=0;8 → 1;36/0;8=12 → 12+12=24=*b*, where 1/0;8=7;30=*a*.

Day 3: $\bar{a}$=0;4 → 0;48/0;4=12 → 24+12=36=*b*, [where 1/0;4=15=*a*.]

Compared to algorithm ii the operations are presented in a different order. For days 2 and 3 the final multiplication is replaced by an addition to the value of *b* for the previous day, i.e. a link of type 2, with the same result. The phrase '*a* is an $\bar{a}$th (part) - that is whereby you compute an $\bar{a}$th (part) of it' is here interpreted as a glosse explaining the function of the reciprocal numbers. It appears to be omitted for day 3.

*Algorithm iv (AG91/2: steps s-u)*

Day 1: *a*=3;45 → $\bar{a}$=0;16 → 0;16·15=$\bar{a}$·4·*a*=4 → 4·3=12=*b*.

This algorithm is labeled the 'third one' (obv. 8). For days 2 and 3 it appears to be omitted. No explanation is given for the number 15, but it can be interpreted as 4·3;45=4·*a*, i.e. 0;16·15 = $\bar{a}$·4·*a*=4. Hence the rules for days 2 and 3 could be obtained by replacing 15 by 30=4·7;30 and 1,0=4·15, respectively, after which *b* could be computed as in algorithms i-ii or iii. For the term '4, *igigubbû*-coefficient for the appearance of the Moon' see the arguments presented above (algorithm i).

*Algorithm v (AG91/2: step v)*

Day 1: 3;45·2=*a*(day 1)·2=7;30=*a*(day 2).

Day 2: 7;30·2=*a*(day 2)·2=15=*a*(day 3).

Day 3: 15·2=*a*(day 3)·2=30=*a*(day 4).

This algorithm links the value of *b* for the present day to that for the next day.

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