The 364 Day Year in Mesopotamia, Again – In *N.A.B.U.* 1996/4 pp. 97-99, no. 111, J. Koch queried my suggestion in *JCS* 46 that Mul-Apin II ii 11-17 and the *zipqu*-star text AO 6478//K. 9794 show knowledge of a 364 day year in Ancient Mesopotamia as early as the Neo-Assyrian period. [1] Below is a response to concerns raised by Mr. Koch.

1. Mul-Apin

Both Mr. Koch and myself are in agreement that Mul-Apin II ii 13-17 provides a mathematical rationale or commentary to lines 11-12, and that the computations in lines 13-17 presuppose an ideal stellar year of 360 days (12 ideal months of 30 days). [2] Yet we differ in our understanding of Mul-Apin II ii 11-12.

In his note, Mr. Koch argues that Mul-Apin II ii 11-12 and the « *Kommentar II* ii 13-17 » both refer to 360 day years. This is true for Mul-Apin II ii 13-17, but Mul-Apin II ii 11-12 *explicitly* refers to a calendar in which a leap year is declared every third year. This must refer to the lunar calendar, or more specifically to the three year (37 month) lunar cycle (two regular years of 12 lunar months each plus one leap year of 13 lunar months) rather than three 360 day years, since the very *raison-d'être* for the 360 day year was that it was not to be intercalated. Thus, as I argued in my previous publications, the total of 10 diri days per 12 months in Mul-Apin II ii 11-12 should be understood as the 10 day difference between a standard lunar year and a mean lunar/stellar year, i.e. in my opinion, the difference between 12 lunar months = 354 days, and an ideal 364 day mean lunar/stellar year consisting of 12 lunar months (354 days), plus 1/3 of a 30 day ideal astronomical month (10 days).

Although it must be admitted that the 354 day length of the lunar year is not explicit in Mul-Apin, [3] this value is implicit in calculations for the years -615 to -587 in the late copy BM 36731 of an « atypical astronomical cuneiform text » which assumes an epact of approximately 11 1/4 days. [4] Here, the true length of the lunar year, 354 days, plus the epact of 11 1/4 days, yields a good approximation of the true stellar/solar year. It is most likely that the slightly earlier 7th and 6th century Assyrian and Babylonian astronomers too would have known the approximation 354 days = 12 lunar months = 1 lunar year. If so, « *The Kommentar Mul-Apin II ii 13-17* » may be best understood as a numerical exegesis on Mul-Apin II ii 11-12 whereby Mul-Apin II ii 13-17 demonstrates that the 10 day difference between the 354 day year and the 364 day year can be extracted mathematically by way of the 360 day year, thereby, in some fashion, perhaps, unifying the calendars.

Although numerical exegeses might be foreign to the modern sciences of Astronomy and Astrophysics, they do find their place in the 7th century Ancient Mesopotamian cultural milieu. For exemple, the *I.NAM.giš.hur.an.ki* tablet K. 2164+ from Assurbanipal's library, [5] preserves exegeses of topics relating to lunar phenomena and nomenclature that might seem to us to be of a most non-scientific nature, as well as parallels to sections of Mul-Apin II. K. 2164+ rev. 1-24 (Livingstone 24-29) preserves a parallel to Mul-Apin II ii 43 - iii 12, while K. 2164+ 25-29 (Livingstone 24) preserves a parallel to the « *Kommentar Mul-Apin II ii 13-17* » that also appears to derive the numeral/number 10 by way of a mathematical exegesis relating to the length of the year : [6]

25. [x x x x] 5,55 GE_6.MEŠ ša 5,58.KAM GE_6 ana UD 3-tum
26. [x x x x] 58 GAR.GAR-ma 11,50 1,40 UD.DA.ZAL-e u_4-mu
27. [50 UD.DA.ZAL]-e[!] ITI 10 UD.DA.ZAL.LÁ-e MU.AN.NA
28. [x x x x 5]0 A.RÁ 12 10,0 10 a-na 11,50 DAH-ma 12,0
29. [x x x x] 6 ŠID.MEŠ GE_6.ME 6 A.RÁ 12

K. 2164 : 25-29 (Livingstone pp. 24-25, Copy : Babyl. 6 pl. 1)

25. [....] 5,55 nights of 5,58 night(s) by a third of a day.
26. [....] 58 add 11,50 - 1,40 is the correction per day.
27. [50 is the correctio]n per month, 10 is the correction per year.
28. [.... 5]0 times 12 = 10,0. 10 you add to 11,50 to reach) 12,0.
29. [....] 6 measures of the night. 6 x 12.

Here, as in Mul-Apin, the *uddazallû*, « corrections » for the day and month are given as 1,40 and 50 (restored), and the value 50 is then multiplied by the number of months of the year (12) to attain the numeral 10 for the *uddazallû* of the year (50 x 12 = 600 = sexagesimal 10,0). Then, K. 2164+ 28 reuses 10,0 as 10 units - and adds 10 to 11,50 to reach the sum 12.[7] The opening line of the section, K. 2164+ 25, like Mul-Apin II 11-12, does not seem to assume a 360 day year .[8]

2. The *ziqpu*-star Text AO 6478//K. 9794[9]

If one accepts the above arguments as evidence for a 364 day ideal lunar/stellar year in Mul-Apin, there is little reason to argue that the 364 UŠ *ina qaqqari* circuit of ziqpu-stars in AO 6478 is an error for a stellar circle of 360 UŠ, or a year of 365 days.[10] This, however, does not prove that the 364° circuit of *ziqpu*-stars now known from the late exemplar AO 6478 was also known in Neo-Assyrian times since the presumed duplicate K. 9794 from Assurbanipal's library preserves only a small portion of the original fragment.[11] Although this particular difficulty cannot be resolved unless additional Neo-Assyrian exemplars of AO 6478//K. 9794 come to light, there is evidence from AO 6478 itself that indicates that this tablet is a late-copy of a Neo-Assyrian/Babylonian period *ziqpu*-star text, rather than an original late-period compilation, and so that the 364° stellar circuit known from AO 6478 likewise dates back to Neo-Assyrian times.

AO 6478 1'-4', which introduces the *ziqpu*-star list that follows, presents materials that would be at home on Neo-Assyrian/Babylonian period tablets. Lines 2'-4' preserve an almost verbatim parallel to the introductions to the two Mul-Apin *ziqpu*-star sections (Mul-Apin I iv 1-3, 7-9), and AO 6478 1' alludes to a cosmographical model best known from the Neo-Assyrian period work « Babylonian Map of the World » :[12]

7 ⸢*na-gu-ú šá*$^{!}$*-ṭir*$^{!}$⸣*-ma* ⸢*u ma-ṣu-ma ŠÀ*$^{?}$⸣*-š*[*u*$^{?}$] ⸢*là ZU-ma ša*⸣ *A.AB.BA*(*tâmti*) *ina* ⸢*bi-ri-ti*⸣ *x* [. . .],

Inscribed with seven regions (*nagū*), and which are equal, whose$^{?}$ inside$^{?}$ no one knows, and concerning the sea in between [...]

On « The Babylonian Map of the World », *nagû* are inscribed beyond the limits of the cosmic ocean (marratu), and the text on the reverse of the map describes eight such *nagû*.[13] Thus, AO 6478 1' may have been meant to explain that *ziqpu*-stars rose and set into or beyond the cosmic ocean amidst *nagû* according to a model for stellar movement that dates back to the time of the Neo-Assyrian fragment K. 9794.[14]

Thus, it remains my position that a mean lunar/stellar year of 364 days was known to Ancient Mesopotamian astronomers no later than the 7th century, and that this Mesopotamian year is the ultimate source for the 364 day year in later Babylonian and Jewish sources.[15]

1. « Two New Ziqpu-star Texts and Stellar Circles », *JCS* 46 (1994) 94-95. I would like to point out that it was Mr. Koch himself who brought his note in N.A.B.U. to my attention. This response is offered with similar collegial intent. For the 360 and 364 day year in Mesopotamia see now my more recent article « The 360 and 364 Day Year in Ancient Mesopotamia, » *JANES* 24 (1996) 35-41 with discussion of the 364 day year on pp. 40-41. The relevant lines of Mul-Apin are quoted in full in Mr. Koch's note.
2. I do not presume that the computations in Mul-Apin II 13-17 are based on a 354 day year as seems to be assumed in *N.A.B.U.* 1996 p. 98, 2.
3. There are no explicit native Mesopotamian statements as to the number of days in a solar or lunar year until the late period (see O. Neugebauer, *A History of Ancient Mathematical Astronomy*, 528-530, and more recently F. Rochberg-Halton in *The Anchor Bible Dictionary* (1992), vol. I 811-812, « Calendars »). Thus, the fact that Mul-Apin does not explicitly state that the lunar year is 354 days long, or that a mean lunar/stellar year is 364 days long, need not indicate that Neo-Assyrian/Neo-Babylonian period astronomers did not know these values.
4. See O. Neugebauer and A. Sachs, « Some Atypical Cuneiform Astronomical Texts. I, » *JCS* 21 (1967) 189-190. For the date of the calculations in the text see *JCS* 21 185 ; O. Neugebauer, *History of Ancient Mathematical Astronomy*, New York (1975) 542-543.
5. A. Livingstone, *Mystical and Mythological Explanatory Works of Assyrian and Babylonian Scholars* (1986), pp. 23-29 with commentary on pp. 38-44. Previously, E. Weidner, *Babyl.* 6 (1912) 8-28 and further references cited in R. Borger, *HKL* I 616, II 316. For K. 2164+ more recently see F. Al-Rawi and A. George, *AfO* 38-39 (1991-2) 62-65.
6. For these lines see previously Livingstone 42, and earlier, E. Weidner, *Babyl.* 6 21-23, *OLZ* 20 (1917) 264-266. See Livingstone 29-33 for further mathematical-astronomical exegeses.

7. The full significance of lines 28-29 are obscure to me.

8. Note the numerals 355 and 358.

9. K. 9794 is copied on CT 26 50. AO 6478 = *TCL* 6 21, earlier copy, *RA* 10 pp. 216-217. For bibliography see *JCS* 46 93 n. 10 and *JANES* 24 41 n. 23.

10. Cf. N.A.B.U 1994 p. 98, 1. For the rule 1 day = 1° of stellar movement see Mul-Apin I iii 49-50, *JCS* 46 93 : 25-28. For the term UŠ ina qaqqari see *JCS* 46 94.

11. K. 9794 at present does not even preserve the term UŠ *ina qaqqari*. This, of course, does not prove that K. 9794, when complete, did not preserve the full circuit of 364 UŠ *ina qaqqari*, particularly since there are only a few minor differences between AO 6478 and the surviving parallel portion of K. 9794 (for example, the writing 30 LIM 6 LIM for 36,000 in K. 9794 as opposed to 36 LIM in AO 6478). Furthermore, K. 9794 seems to be lacking at least one full column of text to the left of the present fragment where measurements in UŠ *ina qaqqari* could have been presented. At K. 9794 11'//AO 6478 20', the signs TA *ku-ma-ri šá* mulUD.KA.D]UH.A are crowded into AO 6478 col. ii although the scribe of K. 9794 is able to leave what appears to be the right half of his col. i' 11' vacant suggesting that [TA *ku-ma-ri šá* mulUD.KA.DUH.A here began in a now missing column to the left of the surviving tablet.

12. An updated edition of « The Babylonian Map of The World » will appear in the author's book « Mesopotamian Cosmic Geography ». For now, see W. Horowitz, *Iraq* 50 (1988) 147-165 and « The Great Wall of Sargon of Akkad, » [N.A.B.U. in press]. For the Neo-Assyrian date of the text see *Iraq* 50 153.

13. Compare also AO 6478 1' *qerebšu*? la idû with World Map obv. 11 rev. 27.

14. Of course, K. 9794 when complete, could have preserved the same introductory material as AO 6478 1'-4'.

15. In addition to AO 6478, a 364 day year is also known in late period Babylonia from the astronomical procedure text BM 36712 where one finds reference to year lengths of both 365 1/6 days and 364 1/2 days (see O. Neugebauer and A. Sachs, « A Procedure Text Concerning Solar and Lunar Motion : BM 36712, » *JCS* 10 131- 134, Section 1 and Commentary Section 1 ; O. Neugebauer, *A History of Ancient Mathematical Astronomy*, 529). This total of 364 1/2 days is derived by assuming that 81 days (1,21) = 80 degrees of solar motion ; i.e. 4 1/2 intervals of 81 days (364 1/2 days) = an annual solar circuit of 360° (see *JCS* 10 132, 134, Section 3). The use of the reciprocals 1,21 and 44,26,40 in the procedure (see

JCS 10 132 : 6') may be compared to the use of this same pair of reciprocals in « The Hilprecht Text, » which purports to measure distances between stars (see W. Horowitz, *Grazer Morgenländische Studien* 3 (1993) 149-159). This issue will be explored further in the author's upcoming study of « The Hilprecht Text » in *Astrolabes and Related Texts*. For BM 36712 see previously *JCS* 46 94 n. 13, *JANES* 24 41, and note that this tablet belongs to the same collection of tablets as the « atypical astronomical text » BM 36731 discussed above [BM 36712 = 80-6-17, 445+820+919 ; BM 36731 = 80,6,17, 464].

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