A Seleucid Table of Daily Solar Positions(?)

Asger Aaboe (1964)[1]

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B. M. 37089 (80.6.17,837) (see figure 1) is a fragment, measuring at most some 2" in any direction, with numbers in columns separated, by vertical rulings, preserved on both of its sides. It turns out that it must have belonged to the lower right hand corner of the obverse of a text, which, when unbroken, was probably 8" wide and 9" tall. Though there are traces of the last line of the obverse, no edge is preserved.

The side which I shall show to be the reverse is just sufficiently preserved to make plausible the assumption that the columns have a constant second difference of 1,43,42,13,20. This assumption is affirmed, for it makes it possible to join the two sides of the fragment, and so to identify obverse and reverse, and to join the two columns on each side, accounting for all beginnings and spaces. My restoration is given in Tables 1 and 2, which also contain columns giving last differences.

The connections between Columns I and II of the obverse is tight, for not only does it reproduce the quite considerable endings prevserved in Col. I, as well as the blank spaces in I.4, but it also makes I.2 the first value in a zodiacal sign, and a *pa* is preserved, though partly erased, in the text. This implies that the length of Col. II of the obverse is 45 lines. The connexion between Columns I and II of the reverse is less secure, and it makes Col. I of the reverse only 39 lines long. Incidentally, the fragment employs both writings of 9, in Obv. I.3 and Rev. I.5. 9 is written with the three wedge sign, and in Obv. I.6 and Rev I.8 with the older nine-wedge sign.

What we have is clearly a list of longitudes without dates, and the nature of the differences suggests strongly that they are solar positions on successive days. In ACT we have already evidence for table of daily solar positions; in Nos. 185, 186 and possibly 187, we find lists of consecutive dates and corresponding solar longitudes computed under the simple assumption that the sun's daily progress is 0;59,9°.

From No. 200, sect. 8, Neugebauer restores a scheme (see Table 3) which assigns to each zodiacal sign a constant daily solar progress. The mean is here the better value of 0;59;8°, and the other values are derived by making the difference 0;1,12° from sign to sign.

Further, in his commentary to No. 200d, sect 1. Neugebauer interprets the text's 1,1,45 as the maximal solar progress in degrees per tithi (1 tithi = 1/30 mean synodic month), for 1;1,45 degrees per tithi is very nearly 1;2,44 degrees per day which is the value from No. 200, sect. 8.

If our text is indeed a list of solar longtitudes on successive days, it seems reasonable to assume that the sun's daily progress follows a scheme of System B type, i.e., that it is represented as zig-zag function. Unfortunately, all that is preserved belongs to the descending branch, so it is impossible to say with certainty what the function's characteristic parameters are, excepting the difference of 0;0,1,43,42,13,20 degrees per day.

However, some guesses can be made. The period of such a function must clearly be one year; we have attested Babylonian values of 6,5;14,44,51 days and 6,5;15,36, ... days (the latter from 12;22,8 mean synodic months per year). The amplitude D of a zig-zag function, *i.e.,* the difference between its maximum *M* and its minimum *m* is half its period times its difference d; thus we find, using the two values for the year:

$$\Delta = M - m = \begin{cases} 0;5,15,38, \ldots \\ 0;5,15,46, \ldots \end{cases}$$

$$u \pm \frac{\Delta}{2}$$

Now, attested Babylonian mean values *u* for daily solar progress 0;59,9 and 0;59,8. The extrema *M* and *m* are:

Thus we get

$$M \sim \begin{cases} 1;1,45, \ldots^{o} \\ 1;1,46, \ldots^{o} \end{cases}$$

and

$$m \sim \begin{cases} 0;56,30, \ldots^{o} \\ 0;56,31, \ldots^{o} \end{cases}$$

Daily Solar Progress (*ACT No. 200, 8*)	
♊	m = 0;55,32°
♉ ♋	0;56,44
♈ ♌	0;57,56
♎ ♍	u = 0;59,8
♐ ♒	1;0,20
♑ ♏	1;1,32
♓	M = 1;2,44° (*Table 3*)

These extrema do not agree with those from ACT No. 200 (Table 3), yet, from a modern point of view, they are perhaps better. Further, they make the maximum value from ACT No. 200d, *i.e.*, 1;1,145, appear reasonable, even if taken as degrees per day, and not per tithi. It is, however, clearly too small to serve exactly as *M* for the zig-zag function, for this would imply a year of 363 days. (I may add that assuming that our text employs tithis does not help matters, for though not changing D much, it would lower *u* so much that 1;1,45 is quite out of the question).

It is a plausible consequence of the assumption of a System B scheme for daily solar progress that the table contained longitudes for a full year; it would require 4-5 columns to a side, for we have seen that the length of Col. I, Obv. is 45 lines. To restore the text much further than I have done, would, however, require more hypotheses than I can comfortably make.

There is one obstacle to the assumption that our text gives solar positions computed according to System B, and it is that the text's one preserved zodiacal sign is a *pa* (Sagittararius) in line 2 of Col. I, Obv. This would make the mean daily progress roughly in the middle of Capricorn (see Col. II. Obv.) and hence the maximum in the middle of Libra which is two signs too soon, both from a modern point of view, and compared with other Babylonian evidence (see, e.g., Table 3). If one believes the *pa* to be correct, it is therefore barely possible that the texts describes daily progress of Venus. Our fragment would then preserve part of the stretch where Venus is near its greatest elongation as a morning star, for in this situation Venus mimics the behaviour of the Sun some 45° farther on in the ecliptic for a period of 2-3 months.

However, as already mentioned, the *pa* is partially erased, and the scribe's intent can only be learnt if we find more of the tablet.

Thus my interpretation of the text is of necessity inconclusive and unsatisfactory, yet it makes it plausible that we may have here a piece of a more refined scheme for daily solar progress than hitherto attested and that the text further belongs to a growing class of texts exhibiting longitudes, but no dates, for a whole period.

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[1.] Aaboe, Asger. "A Seleucid Table of Daily Solar (?) Positions," *Journal of Cuneiform Studies,* Volume 18,1964:31-34. (condensed; photograph of B.M.37089, Aaboe's restored Tables 1 and 2 omitted, formulas and Table 3 repositioned)