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SYNCHRONIZATION OF THE LATE ATHENIAN WITH THE JULIAN CALENDAR

"There is much we shall never know about the ancient Athenian calendar"
W. K. Pritchett [1]

Summary

Progress in our understanding of the Athenian calendar in the past decades has been considerable. If all major problems have not been solved, this is essentially due to the finding that, at least for the period where adequate epigraphical material exists, the system actually used was quite irregular, thus preventing a simple reconstruction of the calendar.

As a result of the recent discovery that from the late second century onwards, and apparently for some 300 years, a Metonic cycle was actually used for inserting intercalary months, the situation has become more transparent for this period. A comparison with the well-known Babylonian calendar allows us to suggest an accurate correlation with the Julian calendar. Checks based on some known equivalences support the proposed relation.

1. The general situation

The calendar of Athens, despite the amount of research devoted to its various problems, remains rather ill known to us. Although some other calendric systems of Antiquity, as for instance the one pertaining to the Roman Republic, confront the modern historian with even greater riddles, there were also contemporary civilisations with a well-ordered calendar for which all the main problems seem long since to have found a satisfactory answer. One system on which we are well informed is the Late-Babylonian calendar [2].

Our knowledge of the Athenian calendar is limited for a number of reasons. One is the relative rarity of useful epigraphical documents — especially if compared with the information provided by the many hundreds of exactly datable cuneiform tablets —, but another lies in the apparent absence of a simple cyclic system which might have been used for steering the intercalation of months. Such intercalations are indispensable in a luni-solar calendar for ensuring that the year follows closely enough the rhythm of the seasons. This absence is the more surprising in that the very accurate and useful Metonic cycle of 19 years, applied in Babylon from as early as about 500 BC till the time of the Parthian kings, was well known to the Greek astronomers who even improved on it. The rather haphazard implementation of intercalary months is one of the main, but also quite disappointing results of the strenuous efforts made by several generations of Agora epigraphers. Excellent accounts of the progress achieved and summaries of the present situation are provided by the reviews of Pritchett [3] and Follet [4]. As a consequence of the difficulties encountered, we are still far from a reliable and detailed reconstruction of the Athenian calendar, in particular for the classical period.

2. The appearance of regularities

For late Hellenistic times, and more precisely for the years from about 120 BC till approximately AD 180, a noteworthy improvement of the situation has resulted from the recent discovery [5] that during these three centuries a regular Metonic system of intercalation was followed also in Athens. Therefore — although only a small number of cycles at the very beginning and towards the end of this poorly documented time period can be based on epigraphical evidence —, the existence of a cyclic periodicity should be considered as a well-established fact. This allows us to reconstruct the calendar with confidence for the period in question, at least as far as the character (ordinary or intercalary) of the years is concerned.

3. Preliminary remarks

To establish effectively the correlation between the Athenian and the Julian calendars, we take advantage of the fact that the Late-Babylonian calendar is very well known for this period and that there exists a tabulation [2] in which the beginning of each Babylonian month is expressed by its equivalent Julian date. This correspondence is based on the calculated first sightings of the lunar crescent after the new moon. The tables, with the month lengths cross-checked by the available contemporary information, can be assumed to be correct in nearly all cases, and probably never to be off by more than one day.

Obviously, these correspondences cannot simply be transferred to Athens, because there are some significant differences between the two calendars, although both are of the luni-solar type and, for the late period under discussion, used the Metonic cycle for intercalations. However, whereas the Babylonian year started in spring (Nisanu 1 was usually in April), in Athens it began in the summer; modern historians agree that Hekatombaion, the first month, corresponds approximately to July or August. Another difference consists in the detection of the surprising fact that the respective Metonic cycles were not coincident: in Babylon they started some six years later than in Athens. Finally, there is also a difference in the way the beginning of a month was chosen: in Babylon by observation of the moon, in Athens according to some agreed rule. This should normally not produce a shift of more than about two days. These remarks concern the civil Athenian calendar "kata theon (or selenen)", the real lunar calendar. The "kat' archonta" calendar, if it was still in existence in the period of interest, with its "cases of tampering ... by the archon" [3], would bring in additional irregularities.

4. Determination of the correlation

For a phenomenon which repeats itself in a cyclic fashion, what actually counts is its internal structure; the starting point is just a matter of convention. Such a formal point of view is too rigid for historical events which happen in time and thus have a beginning, even if we do not know it. This applies also to the Metonic cycle of 19 years. It is customary for the Babylonian calendar to choose the beginning in such a way that the seven years in the cycle numbered 3, 6, 8, 11, 14, 17 and 19 are intercalary, while the twelve others remain ordinary. This will be called the "standard cycle". If this rule is also applied to the Athenian calendar, we arrive, as a consequence of the observed delay of six years mentioned above, at the correspondences listed in Table 1. Clearly, they are applicable only to the period in late Hellenistic times where there were regular intercalations in Athens.

Table 1 — List of the corresponding year numbers (R) in the Metonic cycles as used in the calendars in Babylon and Athens. Note that the two cycles are shifted by six years. This is an empirical fact. Both Metonic cycles are assumed to be of the "standard" type. Intercalary years are denoted by A or U for Babylon and • for Athens, where A and U are abbreviations for the months Addaru II and Ululu II; all the other years are ordinary.

Babylon	Athens	Babylon	Athens
1	7	11 A	17 •
2	8 •	12	18
3 A	9	13	19 •
4	10	14 A	1
5	11 •	15	2
6 A	12	16	3 •
7	13	17 U	4
8 A	14 •	18	5
9	15	19 A	6 •
10	16		

It is obvious that the insertion of an intercalary month in either of two calendars applied in parallel has an influence on their relative starting point in the following year. In principle, such an intercalation always produces a shift of about one month (in the Julian calendar). This effect has already been accounted for in the tables for the Babylonian calendar [2]. Here, however, we are interested in the effect of intercalary months on the beginning of the Athenian year. The four possible cases are listed in Table 2.

Table 2 — Effect of intercalations on the beginning of the Athenian year.

Intercalation in the preceding year		Consequence for the start of the new Athenian year*
in Babylon	in Athens	
no	no	no shift
no	yes	shift of +1 month
yes	no	shift of –1 month
yes	yes	no shift

* with respect to the position of the previous year, in the Babylonian calendar

It is a basic feature of a good intercalation cycle that lunar and solar dates, after this period (or a multiple of it), are again in the same relation to each other. For the Metonic cycle, which has a very high accuracy, this fact can readily be verified by looking at the Julian dates given in the tables of Parker and Dubberstein [2]. For about 300 years, thus an interval which corresponds to the surmised period of regular intercalations in Athens, there is a systematic displacement in the corresponding dates of only about one day. It is therefore sufficient for our purposes to know the beginnings of months for a single Metonic cycle.

We now come to the decisive step in our reasoning. This will allow us to determine the Julian date for Hekatombaion 1, i.e. for the beginning of the Athenian year. For this purpose we first list the beginnings of the Babylonian months to which they may correspond. Due to the later start of the year in Athens, these are Duzu or Abu, the fourth and fifth months in the Babylonian year (Table 3).

Table 3 — Julian dates for the beginning of two Babylonian months, according to the year number in the Babylonian Metonic cycle. They were taken from [2] and averaged over the period of interest for Athens. The dates followed by an asterisk are those which correspond to Hekatombaion 1 in the Attic calendar.

Year in the Babylonian Metonic cycle	Julian dates for the beginning of the Babylonian months	
	Duzu	Abu
1	July 18 *	August 16
2	July 7 *	August 6
3	June 26	July 25 *
4	July 14 *	August 13
5	July 4 *	August 2
6	June 23	July 22 *
7	July 12 *	August 10
8	July 1 *	July 31
9	July 20 *	August 18
10	July 9 *	August 7
11	June 28 *	July 27
12	July 16 *	August 15
13	July 5 *	August 4
14	June 25	July 24 *
15	July 13 *	August 12
16	July 2 *	August 1
17	June 21	July 21 *
18	July 10 *	August 8
19	June 29 *	July 29

If we use the information on the relative positions of the years in the two Metonic cycles (Table 1) and combine it with the rules established in Table 2 for the corresponding shifts in the beginning of the Athenian year, we can easily find the Julian dates for Hekatombaion 1. These dates are marked by an asterisk in Table 3. The apparently irregular choice of one or the other among the two possible Babylonian months is thus recognized as a consequence of the shift of six years between the two Metonic cycles, which were applied at the same time but not synchronized.

The fact that calendars, used simultaneously at two neighbouring places, suddenly differ by a whole month may seem strange to us, but such situations were already known in the time of the Third Dynasty of Ur. Thanks to Huber [6] the chronology of this period is now well established. It follows that from Amar-Sin, year 1, to Ibbi-Sin, year 3 (i.e. 2094/3 to

2074/3 BC), the local calendars of Drehem and Umma, two cities separated by less than 100 km, both had nine intercalary months. However, since these were not inserted in the same years, the relative positions of these calendars changed by one month eight times in these 21 years. This situation is very similar to what we infer for Athens and Babylon from Table 3.

The Julian dates for the beginnings of the years, both in the Athenian and the Babylonian calendars, are listed in a more convenient way in Table 4. They are all based on [2] and can be expected to be accurate to within one or two days for Babylon and within three days for Athens. The table shows that in Athens the year started three months, occasionally four months, later than in Babylon, the mean delay being about 95 days. Expressed in the Julian calendar, and averaged over a Metonic cycle, the year began around April 8 in Babylon and July 12 in Athens.

Table 4 — Julian dates for the first day of a year. The year is determined by the position R_A or R_B which it has in the corresponding Metonic cycle of the Athenian (A) or the Babylonian (B) calendar.

Year in the Athenian Metonic cycle, with its first day (Hekatombaion 1)			Year in the Babylonian Metonic cycle, with its first day (Nisanu 1)		
R_A =	1	July 24	R_B =	1	April 21
	2	July 13		2	April 10
	3	July 2		3	March 30
	4	July 21		4	April 17
	5	July 10		5	April 7
	6	June 29		6	March 26
	7	July 18		7	April 14
	8	July 7		8	April 3
	9	July 25		9	April 22
	10	July 14		10	April 11
	11	July 4		11	March 31
	12	July 22		12	April 18
	13	July 12		13	April 8
	14	July 1		14	March 28
	15	July 20		15	April 16
	16	July 9		16	April 5
	17	June 28		17	March 25
	18	July 16		18	April 13
	19	July 5		19	April 2

5. Position of a year in the Metonic cycles

The dates assembled in Table 4 are the main result of the present calendric exercise. For their practical use, however, it is necessary to know the position (or rank R) of a given year in the respective Metonic cycle.

This problem can be solved in two quite different ways: either "empirically", by using known "reference values", or mathematically, where we take advantage of a more general method of counting in terms of "residuals". Obviously, the two approaches lead to the same results.

In the first approach, all we need is a list of some specific years with known values of R_A or R_B. From them, the ranks for all the other years can readily be obtained. Thus, if we know, for example, that the years

107/6 BC, 69/8 BC, 31/0 BC, AD 46/7, AD 141/2

all correspond to $R_A = 1$, i.e. to the first year in the Metonic cycle of Athens, then it is not difficult to determine R_A for another year, say 85/4 BC. Since $107 - 85 = 22 = 1 \times 19 + \underline{3}$, there is a difference of one cycle and 3 years with respect to 107/6 BC. Therefore, the year 85/4 BC has the rank $R_A = 1 + 3 = 4$. Similarly, for a year in the Christian era, say AD 90/1, we find, by comparison with AD = 46/7, because the difference is now $90 - 46 = 44 = 2 \times 19 + \underline{6}$, that $R_A = 1 + 6 = 7$ for AD 90/1.

The same simple calculation is applicable to the Babylonian Metonic cycle where, for example, the years

120/19 BC, 82/1 BC, 44/3 BC, AD 14/5, AD 71/2

all correspond to $R_B = 1$. The character of the year (ordinary or intercalary) can be found from Table 1 once the year number (or rank) is known.

For the second, somewhat more mathematical, approach we refer to the Appendix.

6. Attempts to verify the correlation

A relation which has been established by theoretical arguments gains in credibility when it can be shown to agree with empirical facts. This is why we are interested in historical events for which data are available in both calendric systems. For the few cases that could be found the verifications seem to be positive, although the agreement is not always perfect. Let us consider some of them in what follows.

a) Appian, in his "Civil War" (II, 149), states about Caesar that "he died at the Ides of March, approximately (μάλιστα) in the middle of Anthesterion", which is normally the eighth month in the Attic calendar. For converting this into the Julian calendar on the basis of Table 4, we can start from the first day of the following year and calculate backwards. Since 45/4 BC (with $R_A = 6$) was intercalary, probably with Poseideon (the 6th month) doubled, we can thereby simplify and shorten the extrapolation. For an assumed exact day number 15 we have to go back from July 18 by 4.5 months (of 29.5 d on the average), i.e. by some 133 days, which brings us to March 7, 44 BC. This differs from the known date March 15 by about one week. It is possible (but not sure) that this deviation, or part of it, is due to the lack of precision in the expression "approximately in the middle" of the month.

b) A parapegma fragment from Miletus has been discussed by van der Waerden [7]. It gives as date for a summer solstice the equivalence "Skirophorion 14 = Payni 11", where Skirophorion is the last month in the Attic and Payni the tenth month in the Ptolemaic calendar. Astronomically, the event is dated to June 26 and since the stated equivalence was only exactly valid for 106 BC, this is expected to be the corresponding year. The beginning of the following Athenian year (Hekatombaion 1) is 16 (or 17) days after Skirophorion 14, depending on the length of the month (29 or 30 d). According to Table 4 the Athenian year 106/5 BC (with $R_A = 2$) began on July 13. Therefore, the summer solstice fell indeed on June 26 (or 25), as expected. In this example we thus find excellent agreement.

However, this correspondence implies that the archon (Pol)ykleitos, who is mentioned on the fragment, be assigned to the year 107/6 BC. If one prefers his traditional attribution to 110/9 BC, then the beginning of the following Athenian year (with $R_A = 18$) is July 16 and Skirophorion 14 thus corresponds to June 29 (or 28). This would still be reasonably close to the known date of the summer solstice. The problem is also discussed in [8].

c) It is unfortunate that a possible third correspondence can only be used with caution as the text seems to require a correction, as has been noted before (see e.g. [9]). It concerns a passage in Plutarch's biography of Sulla (XIV, 10). In connection with the occupation of Athens, which happened on March 1 of 86 BC, the author gives the equivalence of March 1 with Anthesterion 1.

In an ordinary year, as was the case in 87/6 BC, Anthesterion 1 precedes the beginning of the next year by 5 months, i.e. by 147 or 148 days. Since 86/5 BC (with $R_A = 3$) starts in Athens on July 2 (Table 4), Anthesterion 1 would correspond to February 4 or 5. This is so far away from March 1 that one must assume an error. A rather common slip consists in retaining, at the beginning of a new month, the name of the preceding one. If this is what happened, Anthesterion should be replaced by Elaphebolion and the capture of Athens occurred 118 days before July 2, thus on March 6, 86 BC. There still remains a difference of 5 days from the known exact date. It is possible that this is due to the approximation of equating the beginning of the Athenian with the Roman month; the reason may be negligence or ignorance. However, historians seem to prefer another solution. They start from the fact that Plutarch says also that at the same time ceremonies took place in memory of the deluge, but they do not agree on the day (in Anthesterion), assuming that the statement does not just mean in the same month. At any rate, the difficulty cannot be eliminated by such considerations.

We may conclude from these examples that the suggested calendric correlation is at least reasonably good, and certainly not grossly in error. Other comparisons are clearly desirable.

7. Some final remarks

As the insertion of intercalary months serves the purpose of keeping the lunar year in a sufficiently close connection with the solar year, the problem of finding a strict relation between the beginning of the Athenian year and the position of the sun has been a recurrent subject of discussion among modern scholars. The assumption that Hekatombaion 1 always fell on the first new moon after the summer solstice has been called "a dogma" by Pritchett [1]. Yet, a look at Table 4, knowing that solstice was on June 26, seems to support this belief. However, this is hardly surprising because for the time period under discussion, in which there was a narrow link with the Babylonian calendar, it is just a consequence of the empirical fact that the Late-Babylonian year began shortly after the spring equinox. For the period before about 150 BC, however, thus in the absence of periodic Athenian intercalations, the problem remains open.

While it may be assumed that the dates given in Table 4 for the beginning of a year are never in error by more than two or three days, this can be different for other Athenian months, as there is insufficient epigraphical evidence to confirm that intercalations always occurred in the same month (e.g. after Poseideon). In addition, one may have to take account of the survival of an "archontic" calendar, which is known to have existed at least until 122 BC (for the epigraphical references, see e.g. [10]). If this was the case, and accepting the doubt about the calendric system on which a given date is actually based, an additional uncertainty of several days may affect our results.

It should be noted that this search for a correlation between Julian dates and the Late-Hellenistic calendar of Athens was prompted by a dating problem which occurred recently in the context of the Athenian new-style coinage, a topic which will be discussed in more detail elsewhere.

This article is dedicated to Prof. W. Kendrick Pritchett, of the University of Berkeley, California, in admiration for his untiring insistence on the need to rely, in Greek epigraphy, only on objective methods, and to resist the permanent temptation "to see what one expects to see". Prof. Pritchett is the scholar who has done more than any other for our understanding of the Athenian calendar. I would not venture to link his name with this modest contribution without his consent, but it would be imprudent to conclude from this that he shares all my opinions.

APPENDIX

Counting with residuals

The usual way of counting is not necessarily the most practical one for all applications. Thus, if we know that February 3 is a Monday, we have no problem in finding out that February 25 is a Tuesday. To do this, we first form the difference 25 – 3 = 22, and then note that this is three times 7 days plus one day. However, this is reasoning in "modulo counting", where the module is m = 7 (i.e. a week). If we are interested only in the days of the week, it is legitimate to consider all those day numbers n (within a given month) as equivalent which, upon division by 7, leave the same residual r. This is expressed by writing

$$n = r \pmod 7.$$

Such a way of counting is appropriate when there are strict periodicities, such as a week (with m = 7 days), but also applies to the Metonic cycle (with m = 19 years).

What counts for the intercalation is not the absolute year number, but the position of a year within the Metonic cycle, and this is given by the residual r. Hence, for the module m = 19, the year numbers N = 3, 22, 41, 60, ..., for example, correspond to the same year in a Metonic cycle, since for all of them we have

$$N = 3 \pmod{19}.$$

Note that the residual r is always a positive integer, with values between 0 and m–1, whereas N may be negative. For illustration we consider the decompositions

$$N = 102 = 7 \pmod{19}, \text{ since } 102 = 5 \times 19 + 7;$$
$$N = -65 = 11 \pmod{19}, \text{ since } -65 = -4 \times 19 + 11.$$

We can only arrive at a simple and general formula for the position R of a specific year Y in the Metonic cycle if we decide to use the so-called astronomical counting of years, in which BC 1 is identified with the year Y = 0, so that, for instance, BC 71 becomes year Y = –70. Since an Athenian as well as a Babylonian year always covered parts of two Julian years, they are usually written such as 134/3 BC, or likewise AD 134/5. For simplicity in the transformation we agree to denote them by the first year. With these conventions adopted, we arrive at the following general formulae for the position R of a year Y in the Metonic cycles

— for Athens: $R_A = 1 + (Y + 11) \pmod{19}$,
— for Babylon: $R_B = 1 + (Y + 5) \pmod{19}$.

Two numerical examples will illustrate how easy these two relations are to apply:
— Let the year be AD 122/3, i. e. Y = 122.

— For Athens, since Y + 11 = 133 = 7 × 19 + 0, i. e. r = 0,
we find R_A = 1, which is an ordinary year,
— for Babylon, since Y + 5 = 127 = 6 × 19 + 13, i. e. r = 13,
we find R_B = 14, which is an intercalary year.

— Let the year be 119/8 BC, i. e. Y = –118.

— For Athens, since Y + 11 = –107 = –6 × 19 + 7,
we find R_A = 8, which is an intercalary year;
— for Babylon, since Y + 5 = –113 = –6 × 19 + 1,
we find R_B = 2, which is an ordinary year.

Again, the character of a year can be found from Table 1.

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