ASTRONOMICAL DATING OF BABYLONIAN TEXTS DESCRIBING THE TOTAL SOLAR ECLIPSE OF **"AE 175/SE 239"**

INTRODUCTION

The late Babylonian astronomical texts (LBAT) are of considerable astronomical and historical importance. [1]

Virtually all the LBAT were recovered from the site of Babylon in the 1870s and 1880s and are now mostly in the British Museum.

Most of the LBAT that contain observations can be divided into three distinct categories: astronomical diaries; compilations of reports of a specific type of phenomenon; and so-called 'goal-year texts'.[2]

Diaries form the prime source.[3]

Originally covering the whole date range from around "***750 B.C."*** to perhaps as late as ***"A.D. 100",*** each individual texts contained a detailed record for six or seven months of many types of phenomena: for instance, lunar and solar eclipses, conjunctions of the Moon and planets with stars, and planetary first and last visibilities and stationary points. The bulk of the materials in a diary was observational, but predictions of certain events – e.g. eclipses – are also included.

The Babylonian astronomers also assembled compilations of report of individual phenomena from the diaries.[4]

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[1] Journal for the History of Astronomy Volume 37 (2006) F. R. Stephenson and J. M. Steele, Astronomical dating…

[2] A.J. Sachs, „A classification of the Babylonian astronomical tablets of the Seleucid period", Journal of *cuneiform studies,* ii (1948), 271-90; H. Hunger, "Non-mathematical astronomical texts and their relationships" in N. M. Swerdlow (ed.), *Ancient astronomy and celestial divination* (Cambridge MA, 1999), 77-96.

[3] A.J. Sachs and H. Hunger, *„Astronomical diaries and related text from Babylonia,* i-iii

[4] H. Hunger, *Astronomical diaries and related texts from Babylonia, v (Vienna 2001)*

These texts sometimes cover several centuries. So-called ‘goal-year texts’ were also compiled from the diaries.[5]

Probably intended for use in predictions, these contain lunar and planetary data from special intervals before a selected date: the goal-year. For instance, Venus data are cited from 8 years previously and lunar data from 18 or 19 years prior to the goal-year. Although both compilations and goal-year texts are often severely damaged, they frequently contain information that has been lost from the diaries.

The Babylonians counted years from either the start of a king’s reign or the Seleucid Era (SE); however, some late texts also use the **Arsacid Era (AE)** in parallel.

Most years contained twelve lunar months; occasionally an intercalary month was inserted in order to keep the calendar roughly in step with the seasons. The lunar month commenced with the first visibility of the crescent Moon after conjunction. Months contained either 29 or 30 days, each day beginning at sunset. Unfortunately, in only a small proportion of instances is the date fully preserved; often the year number is missing.

The late Babylonian astronomers passed their messages by the so-called “Seleucid code” to succeeding generations.[6] But the finders of the clay tablet, those so privileged people, decoded the message mistakenly.

In this short study I try to scrutinize those clay tablets, accepted by academic science as the new “wonder weapon” supporting the correctness of traditional chronology, and I try to interpret the content of those tablets accurately, using the “Seleucid code” as I understand it.

[5] H. Hunger, *Astronomical diaries and related texts from Babylonia, vi (Vienna 2006)*

[6] Z. Hunnivári, The Seleucid Code 2008 Budapest

THE MESOPOTAMIAN TABLETS

In line with the river valleys of the Chinese Yangtse and Huangho, the Indus and Ganges from India, and the Egyptian Nile, the valleys of the Mesopotamian Tigris and Euphrates rivers were the most ancient cradles of human civilization.

Around 5,000 years ago, the first state formations of humanity were established there. In the 19th century, excavations performed at the Mesopotamian locations produced very rich findings. Archeologists found tens of thousands of small plates fully carved with the symbols of an ancient writing, and these are the plates that today are referred to as clay tablets.

Luckily for us we can safety state that any forgery of those tablets can be completely excluded from consideration. When those tablets reached the various museums, nobody could read them, or more precisely, nobody could interpret their meaning.

Towards the end of the 19th century, the cuneiform writing of the tablets came to be deciphered and their content understood. For the purposes of my study, the clay tablets with astronomical content are the important ones, especially the records made by the Babylonian astronomers during the eras of the Seleucids, and the Parthian Arsacides.

At the starts of the 20th century the Babylonian chronology was accepted by general agreements, thus year 311/312 of the Seleucid Era is equivalent to the year CE 1 of our Common Era.

The key to the date recalculation is the following relationship:

CE 1 = SE 311/312

http://www.timeanddate.com/calendar/index.html?year=1&country=23

By studying several more dated tables (BM 33850, BM 36763+36891, BM 36724, BM 34050, BM 34669+BM 34918)[7] I came to the results, that the

[7] Z. Hunnivári, The Seleucid Code 2008 Budapest

difference between my proposal and the “key to the recalculation” is constantly 196 years!

I gave this difference of 196 years the name of “Seleucid code”, according to which CE 1 is not other than year 115/116 of the Seleucid Era.

CE 1 = SE 115/116

For easy reference our code can be re-written into another form:

SE 311/312 = CE 197!

The publication of the Hungarian Calendar in 2002 established as a fact that a difference of nearly 200 years exist between the CE dating (astronomical) and the AD time-counting connected to the birth of Jesus Christ (historical).[8]

Consequently, my “Seleucid code” can also have the following form:

SE 311/312 = CE 197 = AD 1!

http://www.timeanddate.com/calendar/index.html?year=197&country=23

In this paper I made a detailed analysis of the clay tablets describing a very famous solar eclipse, and the goal-year text tablet with similar content.

[8] Z. Hunnivári, Hungár naptár, Jézus Krisztus Kr. u. 194-ben született, (Budapest 2002)
Z. Hunnivári, The Hungarian Calendar, 200 years which will shake the world (Budapest, 2004)

Detailed study of the clay tablets BM 45745

In what follows, we have used the translations by Sachs and Hunger.[9]

This text is badly damaged and scarcely 20% of the original survives. Nevertheless, it contains a remarkably detailed account of a total solar eclipse.

In its original condition, a diary typically covered six or seven lunar months. However, the obverse of BM 45745 preserves only entries from the 13th day to the end of one month, while on the reverse are entries from the 12th day to the end of a separate month. The text contains three direct indications of date. On the obverse there is a mention of the "son of Antiochus".

On the reverse of the tablet is a year number (x75) – where x represents an illegible sign – and mention of King Arsaces.[10]

Using the BM 34034 goal-year tablet (a goal-year text) it has been proved that the missing sign (X) was the number 1. Meaning that the date was 175.

Colophon (across cols. III and IV)

"sá ana MU-1-me1.34-KAM Ar-sá-ka-a LUGAL kun-nu-u"

"…which were established for year 194, king Arsaces"

Consequently the dating of the tablet was performed according to the Arsacid era (AE) time counting, and the discussed solar eclipse can be connected to the year of AE 175. For perfect certainty let us check once again in details the BM 45475 tablet.

Left edge

3 […MU-1-me]-1.15-KÁM Ar-sá-ka- [a LUGAL]

3 [….year 1]75, [king] Arsaces

The dating is clearly Arsaces 175, which is equal to the SE 239 year.

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[9] A.J. Sachs – H. Hunger, Astronomical diaries…Vol. iii p. 182-185
[10] JHA Vol. 37 (2006) F.R. Stephenson and J.M. Steele, Astronomical dating… p. 56

Using the starry night pro v4.5 software (purchased by me in 2003) and my "Seleucid code" I hereby will check the contents of the clay tablets.

Applying my "Seleucid code" the discussed date in the Julian calendar will be:

CE 125!

AE 175 XII2 0 = SE 239 XII 0 = CE 125 March 23

On the reverse of the tablet are the following important reports: on the night of the 15th of the month, a lunar eclipse in which the Moon was close Alfa Libr; on the evening of the 25th, a conjunction of Mercury with Alfa Tau ; on the 29th day, the total solar eclipse; and finally on the night of the 29th, a close approach of Venus (then said to be stationary) to beta Tau.[11]

Let us study in details these important records converting the dates into Julian calendar dates:

CE 125 Apr. 3

5' […Night of the 13th beginning of the night, the moon was] 4 fingers below gamma Virginis…

CE 125 Apr. 5/6 (lunar eclipse about 4-5 h a.m.)

7' […] 15 degrees of night maximal phase; when it began to clear, it cleared in 18 degrees of night from east to north and west […]

8' […] stood there, the remainder of the planets did not stand there; 3 ½ cubits in front of Alfa Librae it was eclipsed;

CE 125 Apr. 6/7

9' [last part of the night,] the moon was 3 ½ cubits below beta Librae

CE 125 Apr. 10/11 Jupiter and Mercury are rising together …

[11] JHA Vol.37 (2006) F.R. Stephenson and J.M. Steele, Astronomical dating…p. 57

11’ Around the 20th, Jupiter[…]

CE 125 Apr. 16/17 Mercury was 4 cubits above Jupiter, and Venus was 4 cubits above Alfa Tauri

12’ [N]ight of the 25th , Mercury was 4 cubits above [….]

CE 125 Apr. 21 Solar eclipse

13’…The 29th, at 24 degrees after sunrise, solar eclipse; when it began on the south and west side, […]

14’ [Ven]us, Mercury, and the Normal stars were visible;

I cannot interpret the remainder of the translation. For me it is meaningless…

14’…Jupiter and Mars, which were in their period of invisibility, were visible in its eclipse […]

MÚL-BABBAR u AN sá ina bi-ib-lu ina AN-KU 10-sú IGI me[…]

Here is one possible reconstruction;

Being close to the eclipse the Venus and Mercury were visible, while being at a greater distance from the eclipse, the Jupiter and Mars were scarcely visible during the time of the eclipse.

15’ it threw off (the shadows) from west and south to north and east; 35 degrees onset, maximal phase, and clearing; in its eclipse, the north wind which was set [….]

http://eclipse.gsfc.nasa.gov/5MCSEmap/0101-0200/125-04-21.gif

There can be no reasonable doubt that any solar eclipse in which four planets and several stars were visible was fully total. The fact that the above entry does not directly mention totality is presumably due to textual damage; there are two significant gaps in the text.

It is fairly true that "for purposes of illustration" J.M. Steele and F.R. Stephenson adopted an extremely wide range for the tablet – from between 750 BC and AD 100 – examining a period of 850 years, but they were still short of another 25 years in their searching range, so they could not find the real pretendant, that is the really correct eclipse which was recorded by the Babylonians on our discussed tablet.

In its appearance the solar eclipse of 136 BC Apr 15 was very similar to the one proposed by me…

http://eclipse.gsfc.nasa.gov/5MCSEmap/-0199--0100/-135-04-15.gif

But it was no more than just very similar, and the erroneous dating (chronology) unfortunately resulted in false conclusions.

Consequently, in my opinion, the below preliminary statement of their article was a bit premature conclusion:

"Combining the various results, 136 B.C. is already emerging as the only viable date for the text, even before discussion of the four other key lunar and planetary records."

The lunar eclipse of CE 125 Apr 6

It is my firm believe that the Babylonian astronomers could measure the degrees/time with high precision, or in cases when they had an obstacle for measurements, they could calculate precisely, using their accumulated data.

The Babylonians observed certain time intervals around conjunction and opposition of moon and sun, which A. Sachs called 'Lunar Six'[12]. They are:

After conjunction:

[12] Defined in JCS 2 (1948) 281.

na time from sunset to moonset

Around opposition:

SÚ time from moonset to sunrise

na time from sunrise to moonset

ME time from moonrise to sunset

GE6 time from sunset to moonrise

Before conjunction:

KUR time from moonrise to sunrise

The record of the lunar eclipse (reverse, lines 6' to 8') has been translated as follows:

Night of the 15th, moonrise to sunset 8 degrees 40' clouds, I did not watch; all ni[ght…] 15 degrees of night maximal phase; when it began to clear, it cleared in 18 degrees of night from east to north and west […] stood there, the remainder of the planets did not stand there; 3 ½ cubits in front of Alfa Lib it was eclipsed at…

On the evening preceding the lunar eclipse, it is apparent that clouds prevented observation so that – as was common practice – the calculated interval between moonrise and sunset was inserted instead. Unfortunately, on this occasion the time interval is damaged. Later that night, the sky must have cleared sufficiently for the eclipse to be seen. Although the time of first contact and the duration of the first stage of the eclipse are missing, the durations of both totality and the closing stages are preserved – as well as the observation that the Moon was near Alfa Lib. It should be emphasized that the reports of two separate time intervals, the direction of motion of the shadow, and mention of proximity of the Moon to a star all indicate an observed eclipse.[13]

The above account does not give any indication as to the degree of obscuration of the Moon; the eclipse might have been either total or partial. At

[13] JHA Vol. 37 (2006) F.R. Stephenson and J.M. Steele, Astronomical dating…p. 60

any given location, lunar eclipses are frequently visible – some 95 every century. Hence taken alone, a report of a lunar eclipse is only of very limited value for dating purposes. However, the fact that this eclipse was observed 14 days before the solar eclipse discussed in the previous section is important.

It is not unusual for a lunar eclipse to take place some two weeks before a solar obscuration since then the Moon is close to the opposite orbital node.

However, such an event is by no means a regular occurrence.

All experts accepted unanimously that the goal year text (BM 34034) was related to the very same year (175) as the BM 45745 clay tablet.

Based on this certain fact we can check and complete our data relating to the eclipses.

1' Year 175

2' Month XII2, (the 1st) sunset to moonset: 11 degrees 20'

3' clouds and mist, when I watched I did not see it.

...

5' The 15th moonrise to sunset: 7 degrees 40'; clouds, I did not watch.

6' The 15th sunrise to moonset: 3 degrees; measured (despite) clouds.[14]

Lines 5' and 6' of the record confirm that there was a lunar eclipse during the night, and after studying the recorded degree data it is obvious that the eclipse happened just before the morning lightening.

At another place on the tablet we can read the followings:

14' Year 175

15' Month XII2, night of the 15th, moonrise to sunset: 7 degrees 40'

[14] H. Hunger, Astronomical diaries…Vol. VI p. 270-271

16' clouds, I did not watch. When Corona culminated,

17' lunar eclipse: when it began on the south and east side,

18' in 18 degrees of night

19' it made 8 fingers. ***At 1 béru***

20' before sunrise

Using the starry night pro v4.5 software for retro calculation we gain different degree value, but I rather trust in Babylonian astronomers than in our modern scientists who retro calculated back to a time distance of 2000 years, allowing the uncertainty of the delta T to influence their calculations.

By the way, the difference between the recorded and the retro calculated values is not so considerable, it is about 3-4 degrees.

Explaining this in astronomical terms for the sky above we can compare the followings:

the recorded moonrise to sunset: 7 degrees 40' measured before the lunar eclipse ,

and the retro calculated moonrise to sunset: only 3 degree for the same moment before the lunar eclipse

What it means that the measured Moon was in a higher position by 4 degrees (24 minutes) in the sky, therefore the lunar eclipse had ended considerably later, at 1 beru (= 30 degrees or 2 hours), just before the morning started to lighten.

The recorded data measured after the lunar eclipse are in complete harmony with this, no need for me to alter anything to "2 berus".

The measured in the morning sunrise to moonset value of "-3" degrees stands against the retro calculated value of 2 degrees 36'.

The above mentioned difference in 5 degrees or 25-30 minutes gives us such a result that the lunar eclipse occurs 5-6 hours later.

Conclusion

Based on the very possible hypothesis that I have found the year of CE 125 on the discussed clay tablet there will be drastic changes in the identification of other lunar eclipses.

Many lunar eclipses which recently are qualified as “observed” events will become “predictions”, while a big part of the present “predictions” will be changed to “observed”.

The above discussed difference of 30 minutes will also affect the solar eclipses, especially those early morning ones which were classified as “not visible” because of the retro calculated low position of the Moon.

Anyhow, this small study of mine can offer two corner-stones for the experts in retro calculations. They might use them to modify their equations in order to perform the more accurate retro calculations in the future.

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