

Rostovtzeff Lectures 2018

The Sky over Ancient Iraq: Babylonian Astronomy in Context

2 Keeping the Watch: Babylonian Astronomical Diaries and More

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lecture 2: keeping the watch – Babylonian astronomical diaries and more

schedule

- 1 astronomical diaries and more – sources, content
- 2 production of a diary
- 3 predicting the future, explaining the past



747 BCE	<i>Nabonassar</i>
	Neo Assyrian era
	<i>Assurbanipal</i>
625	Neo Babylonian era
	<i>Nebukadnezzar</i>
538	Persian era
	<i>Cyrus</i>
	<i>Xerxes</i>
331	<i>Alexander the Great</i>
	Seleucid era
141 BCE	Parthian era

1 astronomical diaries and more – sources

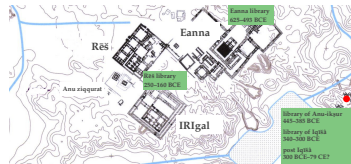
reports

- astronomical diaries: ca. 1000, 652–60 BCE
- eclipse reports: ca. 100, 747–10 BCE
- excerpts: ca. 100, ca. 600–50 BCE

predictive texts

- Almanacs: ca. 100, 261 BCE – 75 AD
- Normal Star Almanacs: ca. 100, 292–50 BCE
- Goal Year texts: ca. 100, 236–56 BCE
- Goal Year procedure texts: ca. 5, 600(?)–100 BCE

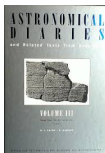
geographical distribution: roughly 99% from Babylon, 1% from Uruk, few from Nippur



British Museum

Babylon

Uruk



H. Hunger & A. Sachs, *Astronomical Diaries and Related Texts*, Vols. I–III, V–VII

1 astronomical diaries – content

Babylonian term: "regular watch" (*našāru ša ginê*)

- ca. 1000 tablets from Babylon, nearly all in British Museum; 2 from Uruk
- range of dates: 652 BCE – 60 BCE (most from 380–60 BCE)
- each diary covers 6, sometimes 4 or 7 calendar months

content of each monthly section

- 1 celestial phenomena from day to day
- 2 market rate of six commodities (barley, sesame, dates, "mustard", "cress", wool)
- 3 zodiacal signs of the planets (after ca. 400 BCE)
- 4 level of river Euphrates
- 5 historical events

1 celestial phenomena

- 1 passages of Moon and planets by "Normal Stars"
- 2 synodic phenomena of planets (first/last appearances, stations)
- 3 6 time intervals between moonrise/set and sunrise/set ("Lunar Six")
- 4 solstice and equinox dates
- 5 occasional other phenomena: comets, shooting stars, etc.
- 6 weather: winds, clouds, rain, etc.

1 astronomical diaries – content

example: BM 41581 (*ADRT II*, No. –168A)

- arrived in British Museum June 25 1881 along with ca. 800 tablets, including ca. 300 with astral science
- edition: Sachs & Hunger, 1989, *Astronomical Diaries and Related Texts*, Vol. II, No. –168A
- coverage: months V–VIII of year 143 of Seleucid Era (Aug/Sept–Nov/Dec 169 BCE)

upper edge

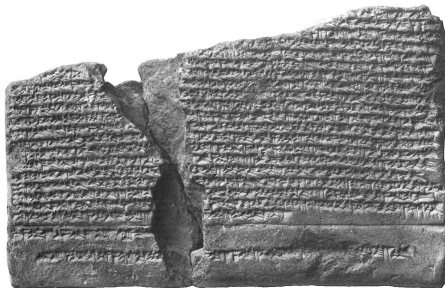


“Regular watch from month V [to the end of] month VIII of year 143, king Antiochus.”

obverse



reverse



1 astronomical diaries – content

example: BM 41581 (*ADRT II*, No. –168A)

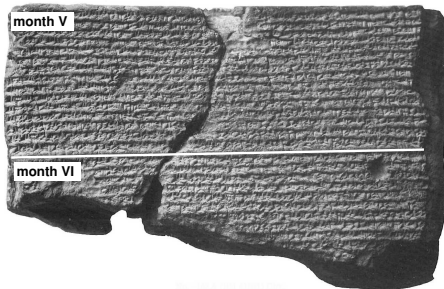
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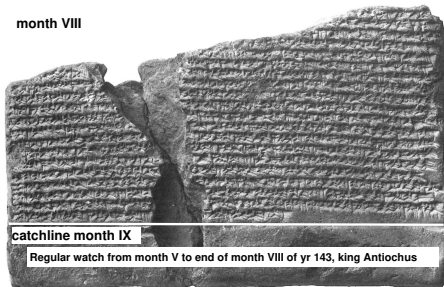


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obverse



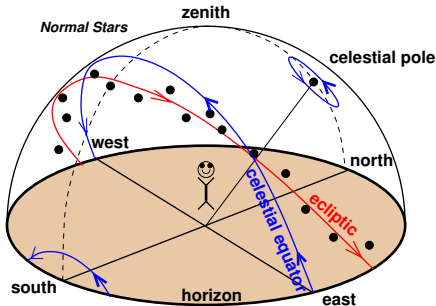
reverse



1 astronomical diaries – content

month V, day 1 (lines 1–2)

[Year] 143, king Antiochus. Month V, the 1st, sunset to moonset: 12 (UŠ); it was bright [...], it was low to the sun. The moon was 2 cubits in front of the Bright Star of the Furrow, the moon being 1 cubit 8 fingers [low] to the south, it stood 2 1/2 cubits [in front of Sat]urn to the west, the moon being 3 cubits 8 fingers low to the south.



unit of time: 1 UŠ (“time degree”) = 4 modern minutes (360 UŠ = 1 day)

- Babylonian day began at sunset
- Babylonian month began with first appearance of lunar crescent at sunset

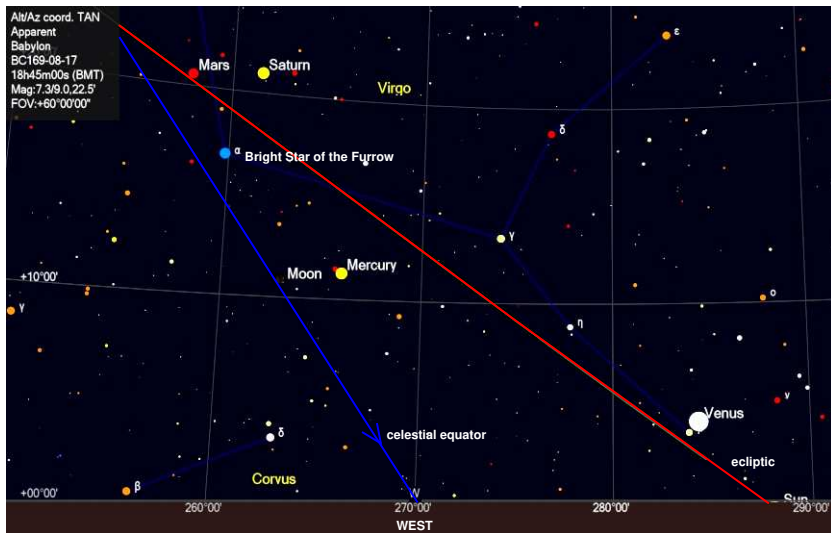
units of distance: 1 cubit = 24 fingers $\approx 2.2^\circ$

- “in front of”, “behind” = along ecliptic in sense of daily rotation of sky
- “above”, “below” = perpendicular to ecliptic

1 astronomical diaries – content

month V, day 1 (lines 1–2)

The moon was 2 cubits in front of the Bright Star of the Furrow (α Vir), the moon being 1 cubit 8 fingers [low] to the south, it stood 2 1/2 cubits [in front of Sat]urn to the west, the moon being 3 cubits 8 fingers low to the south.

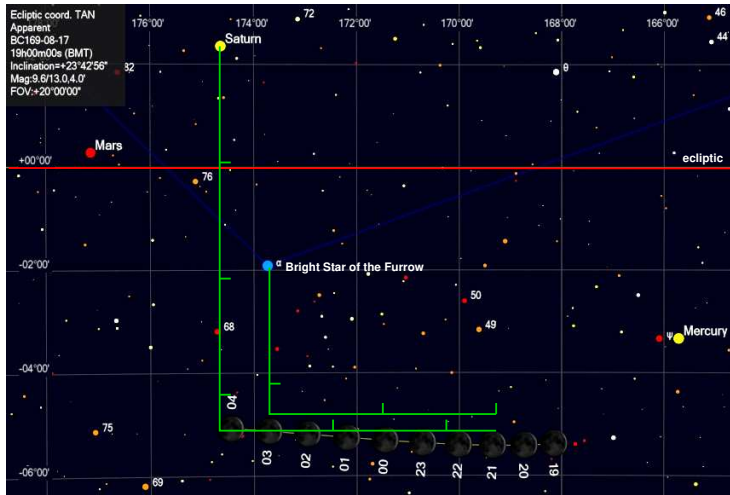


Babylon, western horizon, sunset (6:45 PM) August 17 169 BCE (beginning of day 1, month V, year SE 143)

1 astronomical diaries – content

month V, day 1 (lines 1–2)

The moon was 2 cubits in front of the Bright Star of the Furrow (α Vir), the moon being 1 cubit 8 fingers [low] to the south, it stood 2 1/2 cubits [in front of Sat]urn to the west, the moon being 3 cubits 8 fingers low to the south.



Babylon, 7 PM Aug. 17 until 4 AM Aug 18 169 BCE (day 1, month V, year SE 143)

sunset: 6:45 PM, moonset: 7:41 PM, **suggested time of observation: near moonset**

1 astronomical diaries – other content

lines 2–11 (continuation of celestial report: month V days 2–29)

Night of the 2nd, the moon [stood] 2 1/2 cubits behind Mars t[o the east, the moon being ...] low to the south; the north wind blew. Night of the 3rd, the moon was 3 cubits below the Southern Part of the Scales (α Lib), the moon [having passed] a little to the east. (*etcetera* ...)

lines 12–15 (market rates, zodiacal positions, river level, historical section)

That [mon]th the equivalent of 1 shekel of wrought silver was: very good barley, 1 kur 1 pān 5 sūt; dates, 1 kur 4 pān 1 sūt, at the end [of the month], 2 kur; mustard, 3 kur; cress, 2 pān 4 sūt; sesame, 1 pan 1 sūt 3 qa; wool, [... minas]

At that time Jupiter was in Leo; around the 22nd, Venus's first appearance in the west in Virgo; at the end of the month, it was in [Libra]; around the 25th, Mercury's first appearance in the east in Virgo; Saturn: in the beginning of the month in Virgo; around the 19th, Saturn's last appearance in the beginning of Libra; Mars was in Libra.

That month the river level receded by 1 cubit, in total the gauge was 31.

That month I heard as follows: king Antiochus marched victoriously through the cities of Meluḥḥa and [...]. The (Greek) citizenry [organized] a procession and a ritual according to Greek custom [...]

units of capacity: 1 kur = 5 pān, 1 pān = 6 sūt, 1 sūt = 6 qa (1 kur \approx 180 l, 1 pān \approx 36 l, 1 sūt \approx 6 l, 1 qa \approx 1 l)

units of weight: 1 mina = 60 shekel (1 mina \approx 500 g, 1 shekel \approx 8.3 g)

2 production of a diary

- diaries produced by collective of (ca. 15?) scholarly priests connected to Esagila temple
- observations \Rightarrow preliminary reports \Rightarrow diaries for usually 6, sometimes 4 months

preliminary reports (Mitsuma 2015)

- 1 “preliminary diaries”: astronomical data, sometimes also river level, market data, historical events, for up to 30 days
- 2 “short diaries”: data from all categories for up to 2 months

“preliminary diary” with celestial data for days 26–28, month I, year SE 127 (April/May 185 BCE):



No. -184 A (BM 31581) Lower edge



Year 127, month I, night of the 26th, last part of the night, clouds were in the sky; the moon was 3 1/2 cubits behind the Rear Star of the Head of the Hired Man (α Ari). [The 26th], thin clouds were in the sky. (*etcetera*)

BM 31581 = ADRT II No. -184A; Y. Mitsuma, 2015, “From Preliminary Diaries to Short Diaries ...”, *SCIAMVS* 16, 53–73

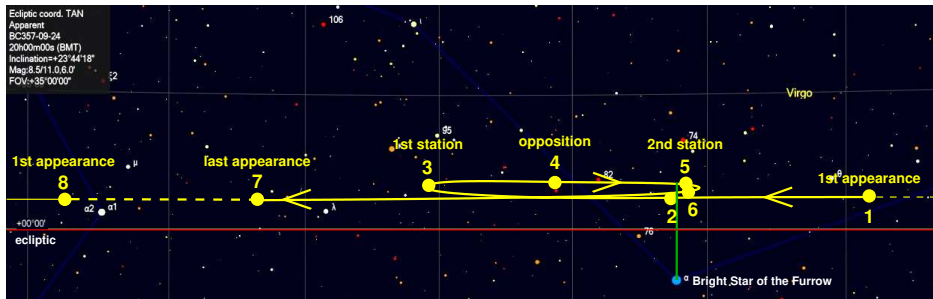
2 production of a diary

short diary month IX + preliminary diary month X, year SE 116 (Dec 196 – Jan 195 BCE)

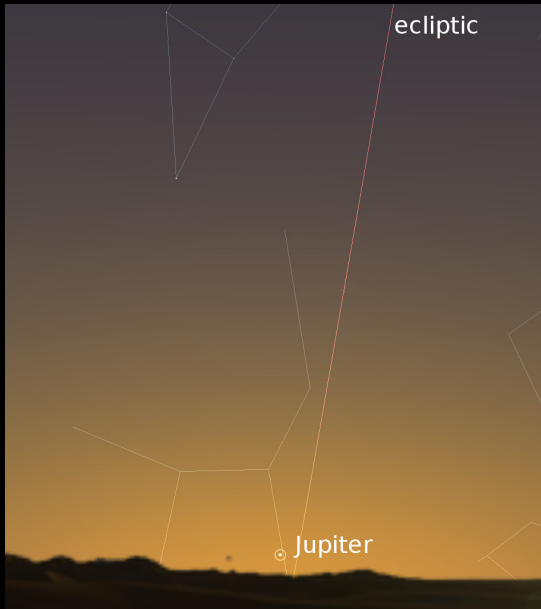


3 from observation to prediction

Jupiter during years 2–3 of Artaxerxes III (357–356 BCE)



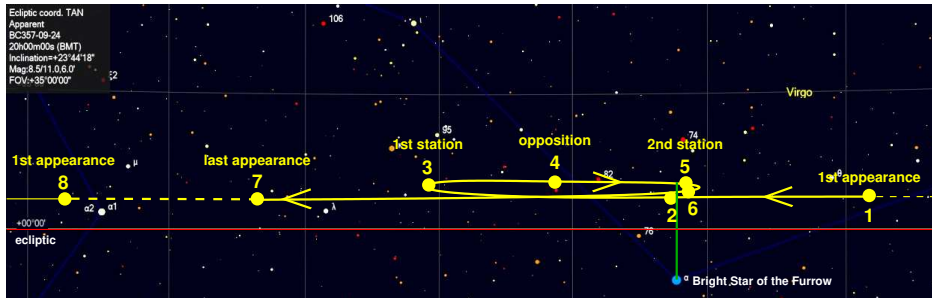
- 1 [Year 2 of Artaxerxes III], month VI, 29th: first appearance in Virgo, rising of Jupiter to sunrise 14 UŠ, ideal first appearance on 27th.
- 2 Month VIII, night of 3rd, end of night, it was 1 2/3 cubits above the Bright Star of the Furrow (α Vir).
- 3 Month XI, 1st, stationary in east in Libra; not observed.
- 4 Month XII, 27th: opposition (to sun).
- 5 Year 3, month I, 25th, stationary in west 1 2/3 cubits above the Bright Star of the Furrow, 4 fingers back to the west.
- 6 Month II, night of 14th, beginning of night: moving back to east it was 1 2/3 cubits above the Bright Star of the Furrow.
- 7 Month VI, 7th: last appearance in Libra.
- 8 Month VII, 9th: [first appearance] in Libra, it was bright, rising of Jupiter to sunrise 13 (UŠ), ideal first appearance on 8th.



first appearance (eastern horizon, just before sunrise)

3 from observation to prediction

Jupiter during years 2–3 of Artaxerxes III (357–356 BCE)



synodic cycle (from 1 to 8): average distance of 33.1° covered in 13.5 months

investigation of longer data set would reveal:

71 calendar years (65 cycles): good period for Jupiter's synodic phenomena

83 calendar years: good period for Jupiter's star passages

3 from observation to prediction: Goal Year methods

prediction for "Goal Year" Y using observations of:

Mercury: Y - 46

Venus: Y - 8

Mars: Y - 79 (synodic phenomena)

Y - 47 (star passages)

Jupiter: Y - 71 (synodic phenomena)

Y - 83 (star passages)

Saturn: Y - 59

Moon: Y - 18

predictable by this method:

planets: synodic phen., star passages

moon: eclipses, Lunar Six intervals

not predictable by this method:

star passages of the moon

irregular phenomena (comets etc.)

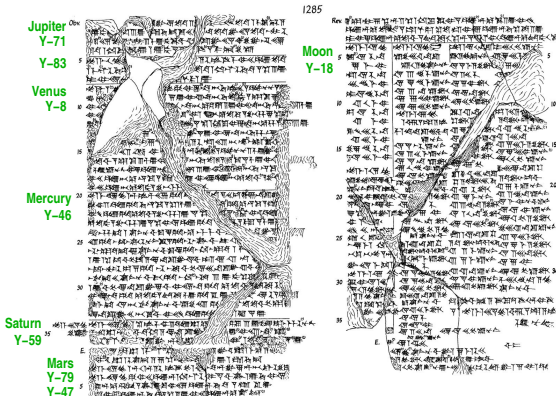
predictive texts based on Goal Year methods:

Goal Year texts: ca. 100, 236–56 BCE

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Almanacs: ca 100, 261 BCE – 75 AD

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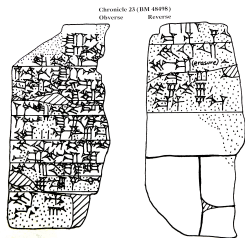


Goal-Year text for 194 SE (118/7 BCE), from Babylon

BM 34034, H. Hunger, 2006, ADRT Vol. VI. Goal Year Texts, No. 69

3 economic and historical sections – explaining the past

market rates in the Babylonian Chronicles (“Market Prices Chronicle”):



[At the ti]me of [...] ... kur of wool [...] the market value ... [...]
At the time of [...] was purchased [...] ⁶10 minas of copper, market rate
of [his] land [...]
At the time of Hammurabi [...]
At the time of Kurigalzu [...] sesame: 3 pān, wool: 3 minas [...]
Year 21 of Merodach-baladan [...] 1 kur; barley: 1 kur; dat[es: ...]
Year 13 of ... [...]. Year 9 of Nebukadnezzar [...]
Year 1? of Mar[duk... ...] 1 sūt 3 qa [...] ... [...] 1 sūt, ... qa [...]
Years 10, 11, 12, 1[3 ...] barley: 1 kur ... [...] for 4 shekels ... [...]
Year 5, year 6 ... [of Nabû-šuma-iškun? ...] sūt 4 qa [...]

- BM 48498 (Grayson ABC No. 23), from Babylon, written ca. 650–50 BCE
- market rates from Hammurabi (1750 BCE) until Nabu-šuma-iškun (748 BCE)

astrological procedure for “predicting” ⇒ explaining? market rates (*SpTU* I 94):

If you want to make a prediction for the region of the market rate of barley: BROKEN – you investigate the course of the planets and you observe the first appearance, the last appearance, the station, the opposition/conjunction, the approaching, the faintness and brightness of the planets, and the zodiacal sign in which they begin to ascend and descend, and then you make a prediction for your year, and it will be correct.
(...)

If the Moon takes up a high path in the region of Akkad: in Akkad the market rate will increase. If it takes up a low path: the market rate will decrease.

- *SpTU* I 94, from Uruk, library of diviner Iqīšā, ca. 330 BCE

3 economic and historical sections – explaining the past

compilation of lunar eclipse reports ("Saros Text") for 609–447 BCE



Xerxes year 21, month III, day 14 (June 5, 465 BCE)

[Month III, ...], at 18 UŠ [...], 40 UŠ (duration of) onset, tot[ality and clearing]. The "garment of the sky" was present. It was eclipsed in the area of the Four Rear (Stars) of Pabilsag (Sagittarius). (There was) a second month VI. Month V, the 14th, Xerxes: his son killed him.

tablet: BM 32234 = ADRT V No. 4), from Babylon, written after 447 BCE

possibly relevant entry from omen series When Anu and Enlil, Tablet 20 (lunar eclipses):

If an eclipse occurs in month III, day 14: a powerful king who won renown will die and his son, who was not named for the kingship, will seize the throne and there will be hostilities, variant: pestilence.