

Rostovtzeff Lectures 2018

The Sky over Ancient Iraq

4 Astronomers, Temples, and Society: Babylonian Astronomy in Context

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April 11 2018



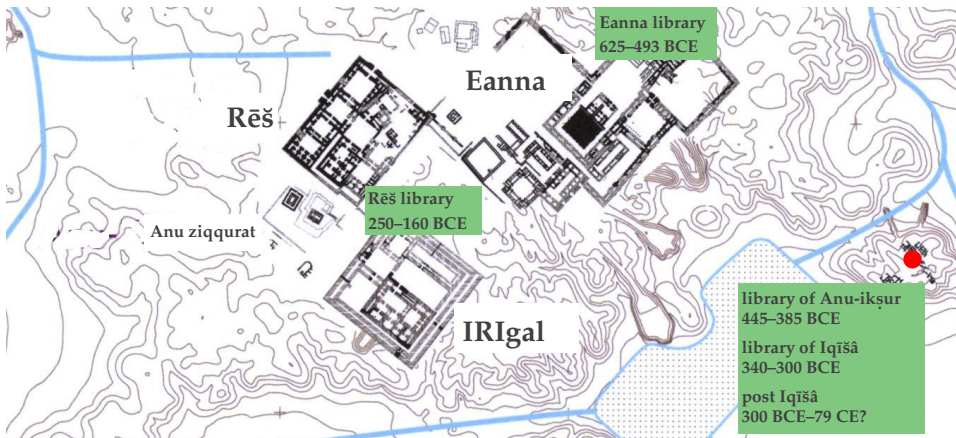
4 astronomers, temples, and society: Babylonian astronomy in context

- 1 institutional, social and practical setting of Babylonian astronomy ca. 400–50 BCE
- 2 new evidence for the transmission of Babylonian astronomy to Greco-Roman Egypt



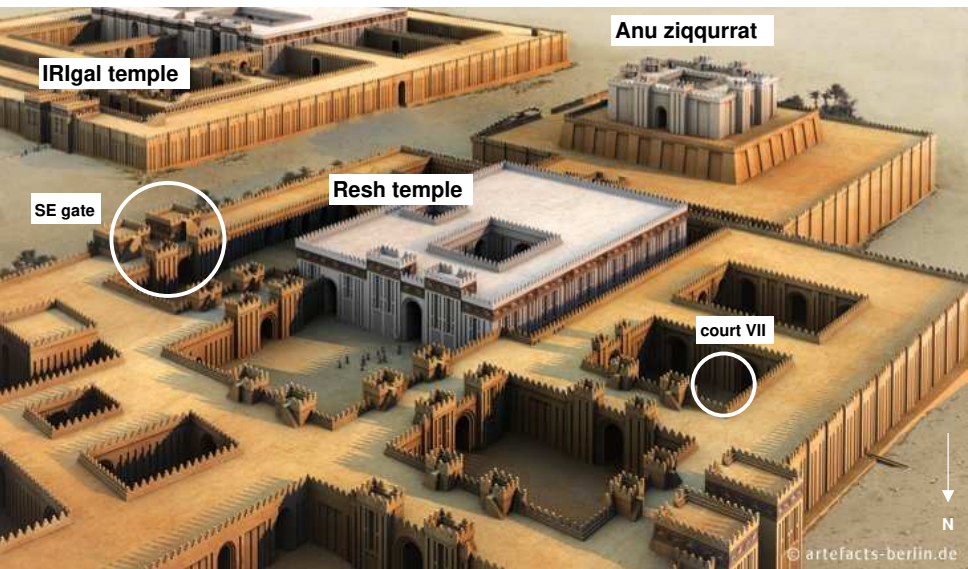
747 BCE	<i>Nabonassar</i>
Neo Assyrian era	
	<i>Assurbanipal</i>
625	Neo Babylonian era
	<i>Nebukadnezzar</i>
538	Persian era
	<i>Cyrus</i>
	<i>Xerxes</i>
331	<i>Alexander the Great</i>
Seleucid era	
141 BCE	Parthian era

Uruk: libraries with astral science



- excavated by German Archaeological Institute (DAI) since 1912
- three known findspots of libraries with astronomical sources (625-160 BCE)

Uruk, Rēš temple

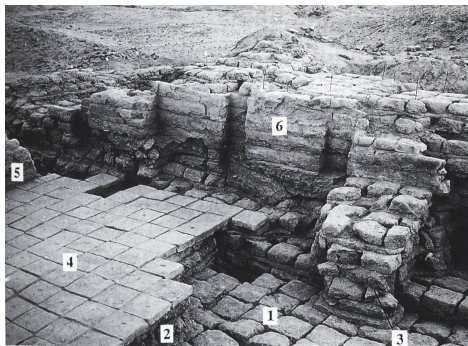
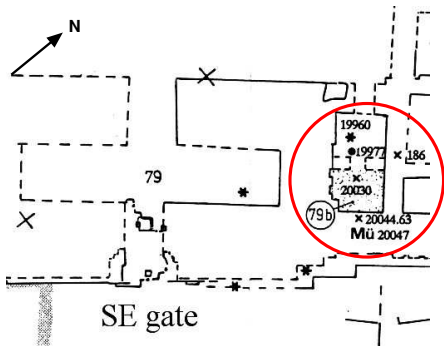


reconstruction of Rēš complex (ca. 200 BCE) with known findspots of astronomical tablets

Uruk, Rēš temple: the library

scholarly library in room (79b) off south-eastern gate:

astral science, mathematics, rituals, lamentations, omens, lexical & literary texts, letters, legal acts



from: Kose 1998, *Uruk. Architektur IV*, AUWE 17

- ca. 280 tablets excavated 1912/13, partly in pits near SE gate (Istanbul, Berlin): at least ca. 80 astronomical
- ca. 100 tablets (Paris, Chicago, Yale, Berlin) acquired through market ca. 1912: ca. 30 astronomical
- ca. 170 tablets excavated 1959/60 in room 79b (Baghdad, Heidelberg): 1 astronomical
- timespan: ca. 250–160 BCE

Uruk, Rēš temple: colophons



A 3415 (ca. 200 BCE)
mathematical astronomy, computed table, Evening First of Venus



Tablet of Anu-bēlšunu, lamentation priest (*kalû*) of Anu, son of
Nidinti-Anu, descendant of Sîn-lēqi-unninni.
Hand of Anu-aba-utēr, his son.

Uruk, Rēš temple: career of a scholar

tablets mentioning Anu-aba-utēr

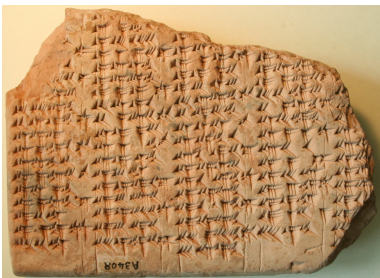
tablet	(ACT)	findspot	content	filiation	role	title	collaborator	date SE (predictions)
1	W 20030,6	SE gate 79b niche	building ritual	12[a]	scribe	broken	Anu-bēšunu (father)	9 II 112
2	A 3415	(400) ?	MA:ST Venus A ₀	123a	scribe	–	Anu-bēšunu (father)	broken (111–135)
3	VAT 9154+U 109+	(171) court VII	MA:TT Moon B	1[2]3a	scribe	scribe of <i>EAE</i>	Šamaš-ētir//Ekur-zākir	broken? (115–124)
4	U 153+VAT 7828	(165) near SE gate	MA:TT Moon B	123a	scribe	broken	broken	broken (...132?–156?..)
5	U 135	(163) near SE gate	MA:TT Moon B	12	scribe	broken	Šamaš-ētir//Ekur-zākir	broken (117–?)
6	A 3408	(192) ?	MA:DT Moon B	[12]a	scribe?	lamentation priest of A&A	[Šamaš-ētir?//Ekur-zākir?]	13 III 118 (118)
7	AO 6476+U 104	(600) near SE gate	MA:ST Jup. A	12a	scribe	lamentation priest of A&A	Šamaš-ētir//Ekur-zākir	12 VII 118 (113–173)
8	A 3434	(601) ?	MA:ST Jup. A	[1]23a	scribe	lamentation priest of A&A	Šamaš-ētir//Ekur-zākir	118 (115–181)
9	A 3426	(640, 820) ?	MA:ST,PT Jup B"	123a	scribe	broken	Anu-bēšunu (father)	119 (...131–161...)
10	VAT 7815	? ?	calender text	123a	scribe	scribe of <i>EAE</i>	Anu-bēšunu (father)	14 X 120
11	VAT 7816	? ?	calender text	1[23]a	scribe	[scribe of <i>EAE</i>]	[Anu-bēšunu (father)]	broken
12	A 3432+AO 6491	(102) ?	MA:ST Moon B	[12]a	scribe?	broken	Anu-bēšunu (father)	12 XII 120 (121)
13	AO 6485+6487	(135) ?	MA:ST Moon B	123a	scribe	scribe of <i>EAE</i>	Anu-bēšunu (father)	I 12[1] (113–130)
14	A 3405	? ?	MA:ST planets	123a	scribe	scribe of <i>EAE</i>	Anu-bēšunu (father)	14 X 121 (60–70)
15	AO 6448+VAT 7847	? ?	123a	scribe	scribe of <i>EAE</i>	Anu-bēšunu (father)	broken	
16	VAT 7852	(161) ?	MA:TT Moon B	[12]3a	'owner'?	broken	[Anu-uballiṭ?//Ekur-zākir?]	5 IV 124 (124–156)
17	A 3419+U 95+	(174) near SE gate	MA:TT Moon B	[12]a	'owner'?	lamentation priest of A&A	[Anu-uballiṭ?//Ekur-zākir	V 124 (124–131)
18	AO 6481	(501) ?	MA:ST Mars A	12a	'owner'	–	Anu-uballiṭ//Ekur-zākir	4 IX 124 (123–202)
19	VAT 7819	(702) ?	MA:ST Saturn B	[1]2a	'owner'	lamentation priest [of A&A]	Anu-uballiṭ//Ekur-zākir	124 (123–182)
20	AO 6480	(620) ?	MA:ST Jupiter B	[1]2[a]	'owner'?	broken	broken	broken (127–194)
21	AO 6492	(194) ?	MA:DT Moon B	123a	'owner'	scribe of <i>EAE</i> , lamentation priest of A&A	Anu-balāssu-iqbi (cousin)	28 VI 130 (130)
22	W 20030,1	SE gate 79b niche	temple ritual	12a	'owner'	–	Anu-balāssu-iqbi (cousin)	21 VI 136
23	A 3418	(802) ?	MA:PT Saturn	12a	'owner'	lamentation priest of A&A	broken	broken
24	AO 6458	? ?	Ištar's exaltation	12 [?]	'owner'	–	–	–
25	AO 6484	? ?	mathematics	12 [?]	'owner'	scribe of <i>EAE</i>	broken?	broken
26	W 20030,111	SE gate 79b	MA:AT	[1]23[a]	'owner'?	broken	broken	broken

MA=Mathematical Astronomy (AT=Auxiliary Table; DT=Daily motion Table; PT=Procedure Text; ST=Synodic Table; TT=Template Table; A,B=System A,B)

- phase 1: scribe of tablets ("hand of PN")
- phase 2: "owner" of tablets ("tablet of PN")

Uruk, Rēš temple: locus of advanced education

writing tablets for one's education



tablet 6 (A 3408)

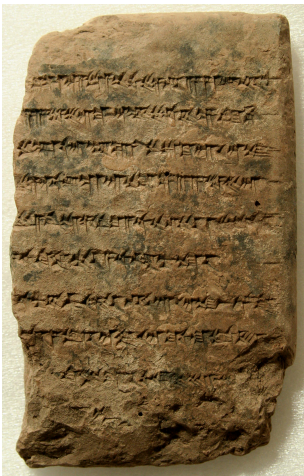
mathematical astronomy, Moon, daily motion table



[... Hand of Anu-aba-utēr, son of Anu-bēlšunu], descendant of Sîn-lēqi-unninni, lamentation priest of Anu and Antu, from Uruk. For his education he wrote it and placed it. Month III, day 13, [year] 118, Antiochos and Antiochos, his son, were kings.

Uruk, Rēš temple: locus of advanced education

writing tablets “for establishing a position”



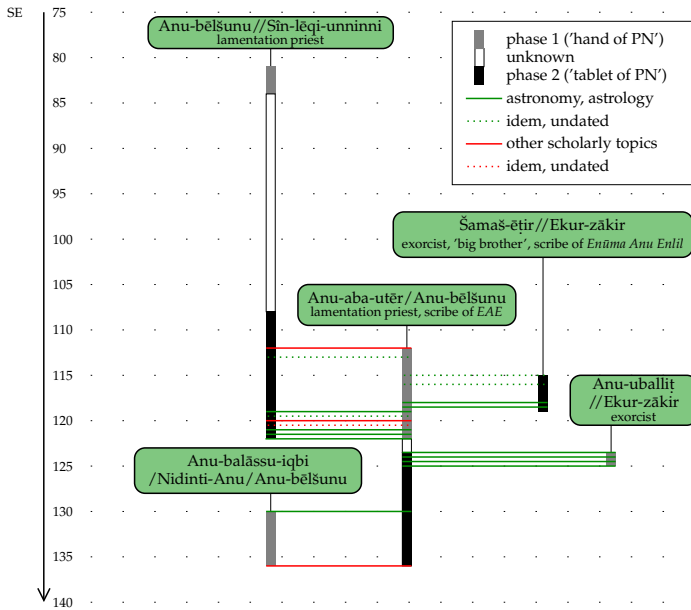
tablet 21 (AO 6492)

mathematical astronomy, Moon, daily motion table

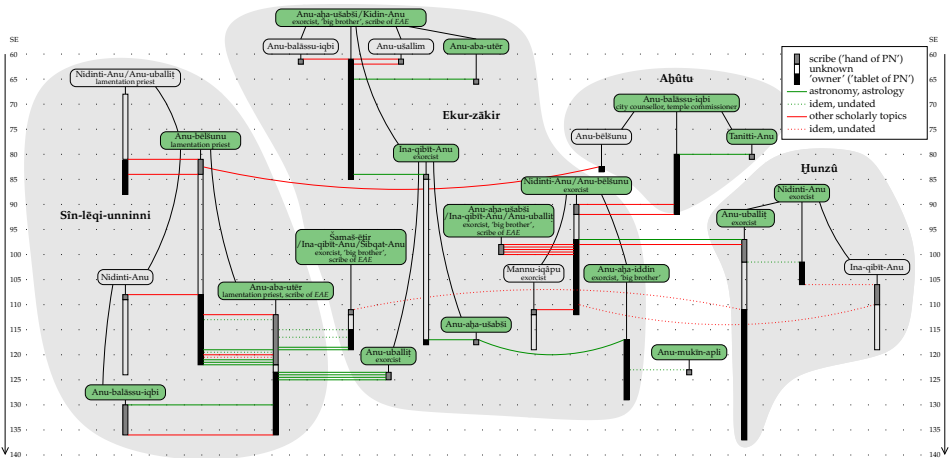
Tablet of Anu-aba-utēr, son of Anu-bēlšunu, son of Nidinti-Anu, descendant of Sîn-lēqi-unninni, scribe of *Enūma Anu Enlil*, lamentation priest of Anu and Antu, from Uruk. The hand of Anu-balāssu-iqbi, son of Nidinti-Anu, his brother, wrote it; for healing his life, for lengthening his days, for the well-being of his offspring, for establishing his position, for not suffering from disease (he placed it). Whoever honors Anu and Antu will [not] carry it away in thievery. Whoever carries it away, may Adad and Šala carry him away. 'Uruk', ... month VI, day 28, year 130, [Seleukos] was king.

Uruk, Rēš temple: scholarly interactions

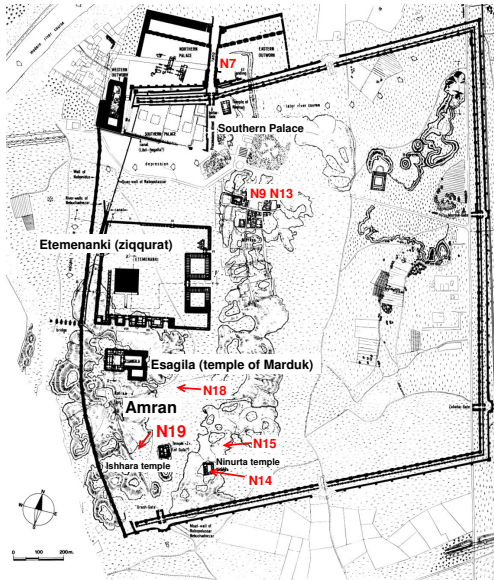
Anu-aba-utēr's collaborations



Uruk, Rēš temple: network of the astronomers



Babylon, Esagila temple



1. Babylon, city plan, after the survey in autumn 1974.



reconstruction of ziqqurat Etemenanki and Esagila (Ontario Museum)

Tell Amran = findspot of astronomical tablets from British Museum

tablets with astral science excavated by Koldewey:

N7: stray find (1 tablet)

N9, N13: stray find + private houses (3)

N14: private archive in Ninurta temple (1)

N15: archives in private houses (4)

N18: archive in private house (1)

N19: archive in private house or official building (10)

O. Pedersen 2005, *Archive und Bibliotheken in Babylon*

Babylon, Esagila temple: allotments to the astronomers

list of barley allotments

Obverse

Barley for the allowance of the astronomers (“scribes of Enūma Anu Enlil”), from month I until the end of month XII of year 6, in the care of Aḫḫē-[-...].

- 1 kur: Ea-iddin, son of Šumâ;
- 1 kur: Ea-apla-iddin, son of Ea-iddin;
- 1 kur: Libluṭ, son of Marduk-šumu-līšir;
- 1 kur: Balāṭu, son of Marduk-šumu-līšir;
- 1 kur: Bēl-apla-iddin, son of Bēl-bullissu;
- 1 kur: Bēl-uballit, son of Bēl-aḫḫē-iddin;
- 1 kur: Bēl-bullissu, son of Arabi;
- 1 kur: Ea-bullissu, son of Ea-lūmur;
- 1 kur: Nergal-tēšī-ētir, son of Iddia;
- 1 kur: ... [...]

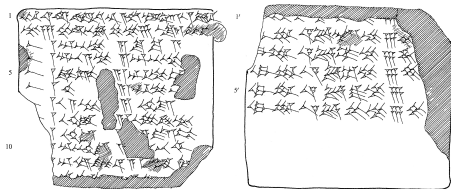
- 14 astronomers, incl. fathers and sons, simultaneously employed
- 1 kur = ca. 180 l ⇒ 6 l/day
- in total ca. 100 allotment lists, remnants of temple archive (Esagila)
- barley, dates, wool, garments
- other recipients: (wives of) bakers, butchers, craftsmen, exorcists, goldsmiths, cultic singers, ...
- there was a “provisioning official of the astronomers” (CT 49 181)

YBC 11549, 399–311 BCE (Artaxerxes II – Alexander IV)

Reverse

[...]

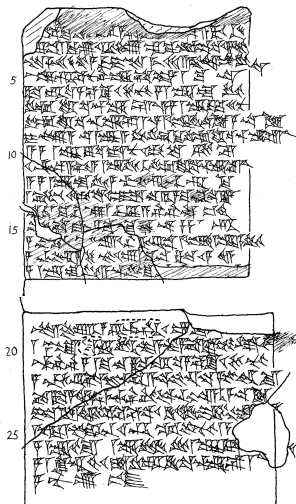
- 14 kur barley, allowance of month VIII, year 6.
- 14 kur barley, allowance of month IX, year 6.
- 14 kur barley, allowance of month X, year 6.
- 14 kur barley, allowance of month XI, year 6.
- 14 kur barley, allowance of month XII, year 6.



Babylon, Esagila temple: tenure procedures

from a protocol of the temple council:

BM 35559, Jan. 14th 118 BCE



(...) One mina (= 500 g) of silver, Babylon standard, and the arable land of Bēl-aba-ušur, the astronomer, son of Bēl-rēmānu, astronomer, which he enjoyed for carrying out the observations (“keeping the watch”), we had assigned to Nabû-apla-ušur, lamentation priest, astronomer, son of Nabû-mušētiq-udda.

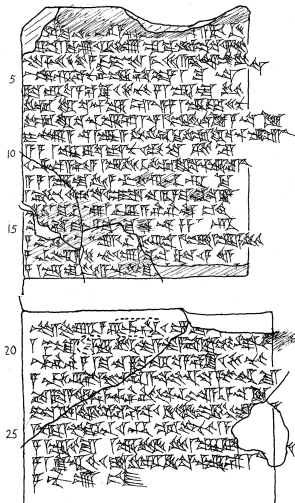
Bēl-aba-ušur: original holder of position
Bēl-ušuršu: his son who claims it
Nabû-apla-ušur: current holder of position

F. Rochberg, 2000, in: Festschrift Oelsner, 359–375

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Now Bēl-ušuršu, astronomer, son of the previously mentioned Bēl-aba-ušur, has come forward, and demonstrated to us that he is capable of carrying out all observations and we have seen ourselves that he is capable of carrying out the observations ... we have approached the mentioned Nabû-apla-ušur that he may relinquish the field and the 1 mina of silver, the income of Bēl-aba-ušur, the father of Bēl-ušuršu...

Bēl-aba-ušur: original holder of position

Bēl-ušuršu: his son who claims it

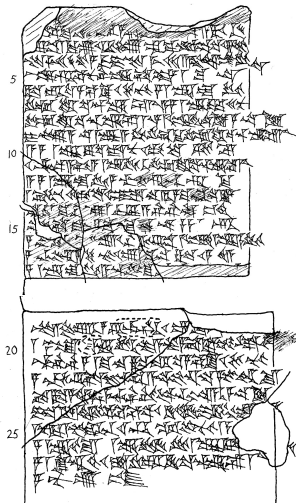
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From this year onwards we shall pay him (Bēl-ušuršu) annually from our silver for carrying out the observations and producing the “computed tables” and the “measurements” together with Lābaši, Murānu and Marduk-šāpik-zēri, the sons of Bēl-bullissu, (with) Bēl-aḥḥē-ušur and Nabû-mušētiq-uddi, the sons of Itti-Marduk-balāṭu, and with the other astronomers.

Bēl-aba-ušur: original holder of position

Bēl-ušuršu: his son who claims it

Nabû-apla-ušur: current holder of position

F. Rochberg, 2000, in: Festschrift Oelsner, 359–375

Diodorus Siculus (ca. 100–50 BCE), *Library of History* 2.29.3–6

The training which they receive in all these matters [astrology and divination] is not the same as that of the Greeks who follow such practices. For among the Chaldeans the scientific study of these subjects is passed down in the family, and son takes it over from father, being relieved of all other services in the state. Since, therefore, they have their parents for teachers, they not only are taught everything ungrudgingly but also at the same time they give heed to the precepts of their teachers with a most unwavering trust. Furthermore, since they are bred in these teachings from childhood up, they attain a great skill in them, both because of the ease with which youth is taught and because of the great amount of time which is devoted to this study (...).

Babylonian scholarly practices: a Greek perspective

Diodorus Siculus (ca. 100–50 BCE), *Library of History* 2.29.3–6

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The barbarians, by sticking to the same things always, keep a firm hold on every detail, while the Greeks, on the other hand, aiming at the profit to be made out of the business, keep founding new schools and, wrangling with each other over the most important matters of speculation, bring it about that their pupils hold conflicting views, and that their minds, vacillating throughout their lives and unable to believe at all with firm conviction, simply wander in confusion.



Anu-aba-utēr's tablet 13 (AO 6485+6487): mathematical astronomy, lunar table

Tablet of Anu-bēlšunu, lamentation priest of Anu, son of Nidinti-Anu, descendant of Šin-lēqi-unninni, from Uruk.

Hand of Anu-aba-[utēr, his son], astronomer, from Uruk.

Uruk, month I, year 12[1], Antiochos was king.

Whoever reveres Anu, Enlil and Ea [shall not take] it [away] by theft.

Computation, wisdom of Anu, secret of the [great] god[s], wisdom of the scholars. One who knows may show [one who knows]; one who does not know may not [see it. Restriction] of Anu, Ellil and [Ea, the great gods.]

K. Stevens 2013, *Secrets in the Library: Protected Knowledge and Professional Identity in Late Babylonian Uruk*, Iraq 75, 211–253

Babylonian scholarship as protected knowledge



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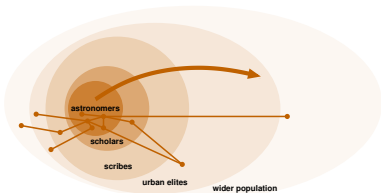
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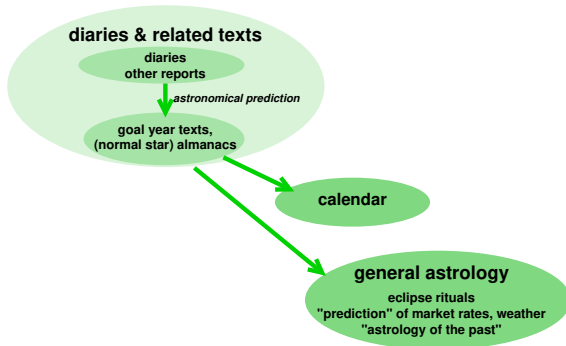


Babylonian astronomers – a thought collective?

Ludwik Fleck (1896–1961), pioneer of sociology of science
Genesis and Development of a Scientific Fact (1935/1979)

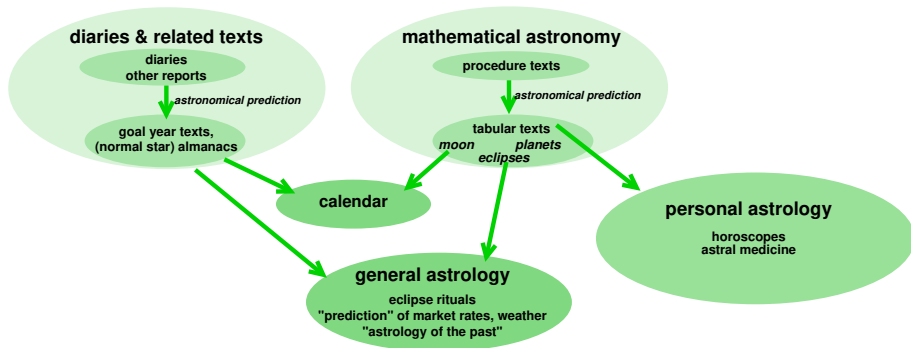
- knowledge produced in *thought collectives*
- its members share a *thought style*

Babylonian astronomy: practical context



Babylonian astronomy and its possible applications 750 BCE – 75 AD

Babylonian astronomy: practical context



Babylonian astronomy and its possible applications 750 BCE – 75 AD

new evidence for the spread of Babylonian mathematical astronomy to Egypt



Babylonian mathematical astronomy in Egypt



Translation		
i	ii	iii
		4 22 3/4 10
		4 0 4 1/10
		4 37 3/4 10
		3 15 4 1/10
		2 52 3/4 10
		2 30 4 1/10
		2 7 3/4 10
		2 0 5 [
	additive	2 22 3/5
		2 45 5 [
		3 7 3/5
		3 30 5 [
1:...		3 52 3/5
1:.. 20 3x		4 15 [5
1 20 50	subtractive	4 21 1/10 10
1 51 40		3 58 4/10 10
1 48 0		3 36 1/10 10
1:.. 6 50		3 13 4/10 10
1:.. 30		2 51 1/10 10
1 4 20		2 28 4/10 10
1:.. 54	additive	2 6 1/10 10
1:..		2 1 20 [
1 6 14		2 23 50 [
1:..		2 46 20 [
1:..		3 8 50 [
1 0		3 31 20 [
1	subtractive	3 53 50 [
1:..		4 16 20 [

P.Colker, ca. 50 BCE–50 CE
(Neugebauer 1988, 1989; Jones 1997)



G
2,42;46,40
2,20;16,[40]
1,57;46,40
2,9;52,30
2,32;22,30
2,54;52,30
3,17;22,30
3,39;52,30
4,2;22,30
4,24;52,30
4,11;31,40
3,49;1,40
3,26;31,40
3,[4;1,40
2,41;31,40
2,19;1,40
1,56;31,40
2,11;7,30
2,33;37,30

BM 34580+, 103/2 BCE
(Neugebauer 1955; Steele 2010)

G = duration of synodic month –29 days
zigzag algorithm (moon system B)

some important publications:

B. van der Waerden 1972, "Ägyptische Planetenrechnung", *Centaurus* 16, 65–91

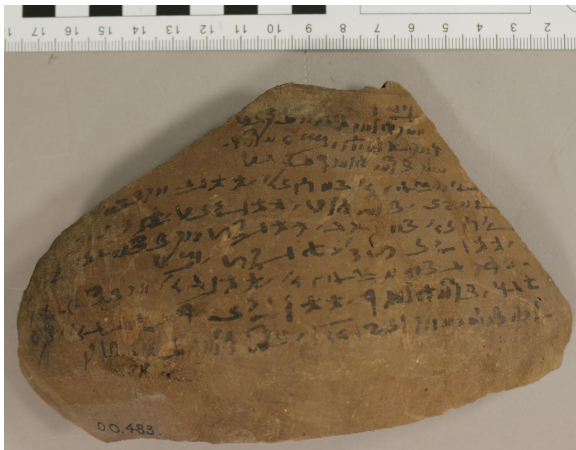
O. Neugebauer 1989, "From Assyriology to Renaissance Art", *PAPS* 133, 391–403

A. Jones 1999, *Astronomical Papyri from Oxyrhynchus*

Otto Neugebauer (1989):

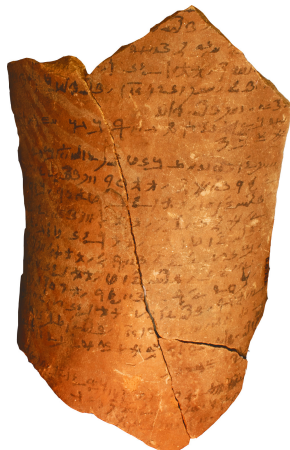
(...) our fragment demonstrates the existence of persons, not known to us from contemporary treatises, who were studying Babylonian astronomy (e.g., intelligent professional astrologers), from ephemerides written in Greek, thus without the need to consult cuneiform tablets. Needless to say, this opens an entirely new aspect on the transmission of Babylonian astronomy to the Greeks and on the spread of scientific knowledge in late antiquity.

two demotic ostraca with procedures for Mercury systems A₁, A₂



Text 1 = O.Ashm.Dem. 483

- in Ashmolean Museum (Oxford)
- date: ca. 1–50 AD; from Thebes?

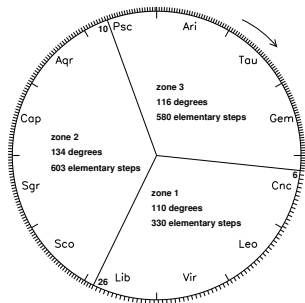


Text 2 = O.Ashm.Dem. 525+732+763

publication with **Andreas Winkler** (2018 forthcoming), in: "The Scaffolding of Our Thoughts. Essays on Assyriology and the History of Science in Honor of Francesca Rochberg, CJ Crisostomo et al. (eds.)

Text 1 (O.Ashm.Dem. 483): Mercury, Evening First, system A₁

- 1 Mercury:
- 2 its western rising: 1513,
- 3 its great place: 480. The method of
- 4 its part of western rising: 1513.
- 5 From Cancer 6° until Libra 26° makes 110 degrees, proceeding
- 6 at the rate of 0;20°, as the part of rising, 3 (of them) make 1 degree. You shall multiply 3 times 110, it makes 330.
- 7 From Libra 26° until Pisces 10° makes 134 degrees, proceeding at the rate of 0;13,20°, as the part of rising, 4 ½ (of them)
- 8 make 1 degree. You shall multiply 4 ½ times 134, it makes 603.
- 9 From Pisces 10° until Cancer 6° makes 116 degree, proceeding at the rate of
- 10 0;12°, as the part of rising, 5 (of them) make 1 degree. You shall multiply 5 times 116, it makes 580.
- 11 You shall add (the) number(s) to one another, it makes the part of rising '1513' again.



(1 dash = 5 elementary steps)

terminology

swsw = degree: loanword from Akkadian *šūšu?*

“western rising” = evening first (EF)

“rate”, “part of rising” = elementary step (= δ)

- Babylonian algorithms Mercury systems A₁ and A₂ (also known from Oxyrhynchus)
- no duplicates or parallels known (Demotic, Greek, Babylonian)
- first explicit evidence for “elementary steps”
- raises many questions about the process of transmission