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SOME ASTRONOMICAL DATES IN ANCIENT EGYPT AND BABYLON

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Abstract. One of the longest running debates in the field of ancient archeology concerns dating of the 1st Dynasty of Babylon and Egypt. In 1987, an international conference was held at Götteborg, Sweden. There was an attempt to solve the problem which chronology is the best,. but with little agreement among the participants. The basic dates are of those Hammurabi's regin: 1. 1856-1802, 2. 1792-1750, 3. 1728-1686, for High, Middle and Low chronology. These dates comes from "Venus Tablets" of Ammizaduga from the 1st Dynasty of Babylon.

Peter Huber, leading authority on the astronomical interpretation of the Tablets says:

"The Venus data Tablet is of very poor quality. It is, in fact, the worst data set I have seen as a statistician. From the number of discrepancies between duplicate texts and internal inconsistencies between dates of disappearance and appearance of the planet, and stated duration of invisibility, one may guess that 20%-40% of the dates recorded in the text must be grossly wrong." (James 1991:336)

These dates are related to the behavior of the planet Venus as is known today. A different approach was taken by John Weir whose investigations treat the evidence as reliable. He considers that observations were made to the north of Babylon, and found a better fit with the data. The abnormally long invisibility recorded for Venus in the year 12 might have been due to dust clouds raised by the volcanic explosion of Thera (Santorin in Aegean sea). He also thinks that "it would appear that some modifications in the shape of the Venus orbit has taken place since the time of Ammizaduga". A large body may have passed through the Solar system temporally perturbing the orbits of Venus, the Moon and the Earth (James 1991:337). Huber thought that it was improbable, but not to be excluded. The other problem is because the eruption of Thera on the basis on dendrochronology was c. 1623 BC. If we take date from Low chronology it would be about 50 years before the Tablets (1574 BC). The third pro blem is the name of Venus. Its name in Tablets is Ninsianna, but Dilbat was the more usual name in astronomical texts, and it was possible that it was different body. The following are the dates for Ammizaduga's 1st: year: 1702, 1646/38, 1582. There are other lower dates such as 1558 (Weir), 1466 (James), 1419 (Rohl). New archeological excavations at Tell El Dab'a provide strong evidence for lowering Egyptian dates, especially during the Middle Bronze Age (Bietak). This has produced a ripple effect in Mesopotamia. Other evidence comes from the North Levantine city of Alalakh (IV-VII level) (Gates). This has an effect on Anatolian chronology. The leading authority for Hittite (Wilhelm, Boese, Gurny), and for Egypt (Beckerath, Kitchen, Vente &

van Siclen) also accept the Low chronology (Gorny 1989:88). Recent investigations bring new enigmas. Rohl (1998:430) examined lunar dates and conjunctions of Venus and the Moo. He kept statistics of coinciding the exact days on the 30th day of lunar mo nth. According to him there're 25 true and 5 false dates for the High chronology (1702 B.C), 14(11), for the Middle (1582 BC), 18(7) for the Low (1582 BC) and 25(2) for the Ultra-Low (1419 BC) chronology. In our opinion the Middle and the High chronology is out of date on the chronological ground, but the Ultra-Low chronology does not fit the existing lists of Babylonian and Assyrian kings. An attempt of James and Rohl to lower the dates over 200 years is not based on the firm archaeological and historical facts. The assumption of more parallel dynasties in Egypt and Babylon is not supported by the strong evidence. Because of that we propose a different approach. We shall start with Egyptian chronology. The chronology from the 12th to 18th. dynasties is very well determined with lunar dates and the heliacal rising of Sirius. The problem is the period before that from which we have only the lunar dates and some kings lists. Every lunar date may be repeated on the same date of the Egyp tian calendar after $25 \cdot N$ years, where N is the whole number. A further lowering by 14 years adjusts sunrise-day to dawn-day. Usually it is spoken about **psd**, i.e. "the lunar crescent was not visible before sunrise" (conjunction of the Sun and the Moon) or **smdt** i.e. Full Moon. The other problem is the place of the observations of Sirius or *arcus visionis*. This is the angle between Sirius and the Sun when the star is first observed. Modern calculations show that this angle is 7.5 degrees, with Sirius 2 degrees above the horizon, and the Sun 5.5 bellow it. *Tetraeris* is the four-year phase during which the heliacal rising was observed on the same day of the year. Every four years this phase moved backward one day because of extra quarter-day of the sideral year not accounted for in the Egyptian civil calendar. For every degree of latitude southward of Memphis, the heliacal rising is observed one day earlier which means a reduction by four years per day per degree of latitude. that is, the d ifference between the civil year and the sideral year to which heliacal rising are tied. Great pyramid was investigated by several scientists, among them were Petrie, Budge, Smith, Lagrange, Newcomb. Thanks to the articles by Davidson and Aldersmith we can get some geometrical, astronomical and chronological information. Well known is the famous Taylor-Herschel's pyramid analogy. In their opinion a pyramid inch or the holly inch was the five hundred millionth part of earth's circumference per axis. (1 pyramid inch=1.001 inch=2.54254 cm). The exact value of circumference is 12756.69 km, and calculated from pyramid is 12712.70 which means the difference of c. 45 km. The Egyptians knew the value of number $\pi = 3.16$. Erathosten (the 3rd century BC) corrected the value of the royal cubit (28 inches) by circa 5 mm, measuring the circumference of the Earth. It was 40000 km and $r = 6329$ km which means the difference of circa 50 km. The value of the pyramid inch now is 1.868 cm, and the royal cubit is 0.524 m or 0.52304 m. The problem arises because the Egyptians had used the holly cubit (25 holly inches) which might cause confusion. We are not sure about the exact value of an inch. A slight deviation is the object of different calculations. The only thing we know for sure is the ratio of golden mean. On the basis of investigations by Czech scientists (Gika (1987) 19:25), the ratio of the height h of the pyramid little triangle and the half side is the golden mean Φ. The construction starts from the sum

of $(a/2) + h = 144 \cdot L$ where $L = 0.524\ m$ (royal cubit). Fibonacci's array is array of elements whose every member is sum of the two terms before it. Fibonacci's array is configuration of 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 and so on. From the equation $x^2 - x - 1 = 0$ we get two solutions for X:

$$x = \frac{(1+\sqrt{5})}{2} \qquad x = \frac{(1-\sqrt{5})}{2} \tag{1}$$

$\Phi = a(n)/a(n-1) = 1.618$ is the ratio of golden mean.

$$2\frac{h}{a} = 1.618 \qquad \Rightarrow \qquad 4h = a(1+\sqrt{5}) \tag{2}$$

$$c = \frac{a}{4}(1+\sqrt{5}) \qquad H = \frac{a}{4}(\sqrt{2+2\sqrt{5}}) \tag{3}$$

The ratio of pyramid's height H and perimeter of basis O is:

$$\frac{H}{O} = \frac{H}{4a} = \frac{(\sqrt{2+\sqrt{5}})}{16} \approx \frac{\pi}{2} \tag{4}$$

where $\underline{\pi} = 3.144606\ \pi = 3.14159$,

$$55^2 + 70^2 = 7925 \qquad 89^2 = 7921 \tag{5}$$

where $H = 7O \cdot 4 \cdot L$, $h = 89 \cdot 4 \cdot L$ and $a/2 = 55 \cdot 4 \cdot L$.

The astronomical data are impressive. One supposition was that the pyramid was a temple dedicated to the Sun. It is supposed that there had been a spherical gnomon on the top which had served for determining the azimuth and declination of the Sun and as the sun clock also. If it is true the pyramid's height was 146.73 m then it was 149 m high with this instrument, which means one billionth part distance from the Earth to the Sun. Till the golden mean it is 146.72 m, but it measured 138.75 m without lining. The pyramid's angle is $\alpha = 51°50'4"$ which means the deviation of angle F by only 26". The deviation from the direction north-south is irrelevant. The northwest angle is 89°59′58", the northeast angle is 90°03′02", the southeast angle is 89°56′27" and southwest angle is 90°00′33" (Edwards 1993). Angle β of the descending passage is 26°34′23" and deviates from earth's axis at the time of building of pyramid (2623 BC), 2°25′ (the axis was inclined 23°59′31.65" exactly). Giza is the place where there are three greatest pyramids Cheops's, Chephren's and Mycerinos's. Cheops's is the highest and is situated 31°11′ E, 30°01′ N. Northern or polar passage got their name because Thuban (α Draconis) was the polar star which could have been observed from the pyramid. Edwards (1993:283-5) cited that beyond the Queen's chamber had existed north air channel which had been directed at an angle $\gamma = 31°$ toward the basis. The altitude of the star Thuban can be have been:

2654 BC	$\alpha = 12h30m51s$	$\delta = 89°11'07"$	$h = 30°49'$
2623	$\alpha = 12h26m41s$	$\delta = 89°00'29"$	$h = 31°00'$
2592	$\alpha = 12h24m51s$	$\delta = 88°50'06"$	$h = 31°10'$

The middle solution is the best. With regard to the angle in the descending passage a little bit smaller observing was under the suspicion. Lemesirije (1997) cited that cuts in the descending passage pointed to the position of the star Alcyone from constellation Taurus (in Pleiades) when it was situated in the same plane with Thuban and then equinox was on 01.03.2111 BC. This was not of interest for our chronology, but indicates the meaning of observing. For the precise determining of the chronology, the lunar dates of the 4th Dynasty are of great help. The start of Cheops's reign is determined with the help of Sothis calendar. Because the Egyptian calendar differs from Julian by quarter-day every year, for 1460 years difference is exactly one year. Because of that the Egyptians observed the rising of Sirius which appeared on the same day of the year (20.07 i.e. the 1st Thot) 139 AD, 1322 BC, 1781 BC when started Egyptian New Year. On the basis of investigations of Neugebauer, Milojcic, Scharf we reached the conclusion that the 4th Dynasty couldn't have begun to reign later than 2580 BC because the calendar was then corrected. Klein (1966:103) got the interval 2623±43 BC for the beginning of reigning 4th Dynasty by statistical analysis. For that reason we shall search in this interval the lunar dates. There is the 16th year of Cheops on **III šmw 20**. It was on 22.04.1610 BC i.e. full Moon with the conjunction and **psd** on 8.04.1610 BC. Then we can take the beginning of Cheops's reign 2625 BC. Herodot claims that preparations for building the pyramid lasted 10 years and it was under building 30 years in all (Her II 124). There is an inscription about his 34th year of reign. Hence his reign lasted 2625-2592 BC. By now this date varying from 2714 to 2560 BC as beginning of his reign (O'Mara 1997:81; Malek 1986:124). Snefru, his predecessor has an inscription dated **II prt 14** from his 29th year of reign on 22.11. 2631 BC. This was the conjunction on 24.11.2631 BC and **psd** on 23.11.2631 BC. The beginning of the 4th Dynasty was 2659 BC. The lunar dates and dates of heliacal rising of Sirius determine the beginning of the 12th Dynasty. Depending on the place of observing the dates differ from each other 50 years. The last ruler of the 12th Dynasty Menthuhotep V Nebtowyre has inscription from his 2nd year the date on II aht 15 whose Julian date was 2.03.2045 BC when there was conjunction. Luft determined the 7th year Senwosret III, 1854 or 1829 BC, O'Mara, 1868 BC, Parker, 1843 BC, Kraus, 1818 BC. Here we think that 1829 BC the best fit with the end of the 11th Dynasty 1939 BC (8 years of Menthuhotep V). Till the beginning of the 12th Dynasty remains 7 + 34 + 42 + 20 i.e. 1836 BC+103=1939 BC. It is known that the 22nd ruler of the 13th Dynasty was Neferhotep Khasekhemre who, after Low chronology ruled 1714-1703 BC (1741-1730 BC after Middle chronology) in the time of Jantin of Byblos and Zimrilim from Mari (1715-1695 BC/1779-1759 BC). Neferefre, from the 5th Dynasty, had recorded his 6th year bf III aht 24 i.e. 01.07.2493 BC at the time of conjunction. The Fifth Dynasty was reigning from 2529 to 2383 BC. Pepi I from the 6th Dynasty had recorded his 37th year 2318 BC, so that the 6th Dynasty reigned 2383 to 2195 BC. On the basis of data from Turin Canon and reigns of some kings and Texts of Pyramids Pepi I reigned 52 years in all, and his successor Merenre 11 years. Pepi II reigned 95 years, Merenre II and Nitokerty 3 years. The Seventh and the Eight Dynasty reigned 22 years alltogether. The First intermediate period lasted 2170-2081 BC because the 11th Dynasty reigned after Turin Canon 143 years (Malek 1982). After Manethon Dynasty, the 10th reigned 185 years, but it seemed that he

assigned that period to the 9th and 10th Dynasty, which was vanquished between the 14th and 30th year of Menthuhotep II. The best year would be the 22nd year i.e. 1985 BC. In fact it is 100+85=185. In the second version of Manetho gave 100 years to the 9th Dynasty. Middle chronology (MC) after Hayes (l971:994-6), Low (LC), after Malek (1986:124), New (NC).

EGYPT DYNASTY	MC	LC	NC
IV	2613	2573	2659
V	2493	2454	2529
VI	2345	2311	2383
VII-VIII	2181	2140	2192
IX,X	2160-2040	2123-2040	2170-1985
XI	2133	2123	2081
XII	1991	1980	1939
XIII	1786	1801-1648	1760/59-1637

The reigning of Babylonian dynasties was determined with 4 eclipses. Babylonian calendar is lunar one and it has 354 days and every 19th year the eclipse fell on the same day of the calendar. The Babylonians didn't correct the calendar every year assuming that the first 12 years had 12 months each and the succeding ones 7 had 13 months each that makes 235 months in all. Because of that we allowed an error of plus 30 days counts from the same day of Babylonian calendar. The correct calculating were from 5 century BC. The reigning of Sargon is taken as from his 4th successor Sharkalishari to the beginning of the 3rd Dynasty of Ur. Now it is reckoned between 104 and 106 year. There were recordings of eclipses of the moon which were omens for the end of the reigning king. There are: (Rohl 1998:430-33):

(1) In the time before the anarchy in Akkad when Elulu was the reigning king, 14 Nisan (March-April).

(2) In the time of the dead of Tiriqan, king of Guti who was killed by Uthu Kegal the king of the 5th Dynasty of Uruk, 14 Duzu (June-July).

(3) In the time of Shulgi's death (UR III), 14 Simanu (May-June).

(4) In the time of Ibi-Sin's death at the end of UR III, 14 Adaru (February-March).

(5) Calculated date is 13.03.2126 BC (preumbral).

(6) Calculated dates are 16.07.2048 BC (by day, umbral), 06.07.2047 BC (by night, preumbral).

(7) Calculated date is 26.05 1981 BC. (partial).

(8) Calculated dates are 26.03.1940 BC (umbral) and 04.03.1938 BC (preumbral).

The most important date is the defeat of Guti by Tiriqan. It was probably 2048 BC, by day, when it was the battle. Dynasty Ur III have come to power soon, and reigned 107(108) years. Shulgi reigned 66 years after the beginning of Ur III. Zarlagab was contemporary of Sharkalishari (2151-2126 BC) predecessor of Elulu (Elulumesh), who, according one version (Hallo 1971:711) reigned 21 year after the beginning of Guti. Then Sargon, the first ruler of Akkad reigned 2268BC, Zarlagab (Jarlagash (Sharlag(?)) 2130-2124 BC, Elulu of Akkad (Elulumesh) 2124-2118 BC, Dynasty of

Akkad 2268-2087 BC. Guti reigned 2139-2048 BC, Uruk IV 2084-2054 BC, Uthu Kegal (Uruk V) 2054-2047 BC, Ur III 2047-1940 BC. The Middle chronology is after Rohl (1998) and Djakonov (1984). The Low chronology is 64 year shorter.

DYNASTY	MC		LC	NC
AKKAD	2340	2316-2137	2276-2095	2268-2087
URUK IV	2159	2146-2116	2085-2055	2084-2054
URUK V	2119-2112	2116-2109	2055-2048	2054-2047
GUTI	2208-2117	2200-2109	2144-2053	2139-2048
UR III	2112-2004	2113/1-2006/3	2048-1940	2047-1940
BABYLON I	1894-1595	1894-1595	1830-1531	1830-1531

References

Barbarin, G. (ed.): 1936, *Le Secret de la Grande Pyramide*, Paris.

Davidson D.: 1924, *The Great Pyramid*, London.

Edwards, I.E.S.: 1993, *Pyramids of Egypt*, London.

Gika, M.: 1987, *Filozofija i mistika broja*, Novi Sad.

Gorny, R.L.: 1989, *Environment, Archaeology and History in Hittite Anatolia* in *BA* **52**, 78-96.

Hallo, J.C.: 1971, *Gutium in Reallexikon der Assyrologie und vorderasiatischen Archäologie*, ed.E.Ebeling (6 vols., to date 1928-1983), 709-720

Hayes, W.C.: 1971, *Chronological Tables (A)* in *Egypt. CAH*, **1.2**, 994-996.

James, P.J.: 1991, *Centuries of Darkness*, London.

Клейн, Л.: 1966, К прочности и надежности абсолутной хронологии Египта, *ВДИ 1966(4)*, 94-105.

Lemesirije, P.: 1997, *Nostradamus - Konačni obračun*, Beograd.

Malek, J.: 1986, *In the Shadow of the Pyramids (Egypt during the Old Kingdom)*, Cairo.

Mendelssohn, K.: 1986, *The Riddle of the Pyramids*, London.

Mostovic, A.: 1984, *Mi u kosmosu*, Gornji Milanovac.

O' Mara, P.F.: 1996, *Can the Gizeh Pyramids be Dated Astronomically (III)* in *DE*, **35**, 97-115.

O' Mara, P.F.: 1997, *Can the Gizeh Pyramids be Dated Astronomically (IV)* in *DE*, **38**, 63-82.

Rohl, D.: 1998, *Legend - The Genesis of Civilization*, London.

Stadelman, R.: 1985, *Die Ägyptische Pyramiden*, Darmstadt.

Young, D.W.: 1988, *A Mathematical Approach to Certain Dynastic Spans in the Sumerian King List* in *JNES*, **47**, 123-129.

Literature

BA Biblical Archaeologist(now Near Eastern Archaeology), Baltimore.
BASOR Bulletin of the American Schools of Oriental Research, New Haven
DE Discussions in Egyptology, Oxford.
JNES Journal o Near Eastern Studies, Chicago
CAH Cambridge Ancient History, (ed.), Cambridge.
ВДИ Вестник древней истории, Москва