

Solar Eclipse Time Series Clusters

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Abstract

Science started with the combined observation of natural events with an efficient writing system to keep memory of them. Before the Phoenician Thales had reached the age of 37, the sky over the City of Miletus had been the scene of ten solar eclipses. Those that Thales observed were enough for him to recognize the time series patterns behind his famous prediction. The predicted eclipse probably led him to detect the so called Saros cycle.

Lunar & Solar Eclipses Clusters

In 1991, in his book *How the Shaman Stole the Moon*, William H. Calvin described how Shamans could predict lunar eclipses without any complex calculations, as long as they were fine being wrong sometimes. Observations of lunar eclipses reveal they mostly occur at intervals of 6 lunar months or multiple of 6, i.e.: 12, 18, 36, or a month earlier, i.e.: 17 or 35 lunar months.

Over the years, I have come across solar eclipses occurring at intervals of six, twelve & eighteen new moons:

1. At the age of 11, together with my dad, we went to the roof of the apartment building where we lived in Geneva. He had fixed a glass slide to the end of a cardboard tube and cautiously blackened it for safe viewing. This allowed us to view partial solar eclipses on two occasions. It turns out that they were exactly **6 new moons** apart.
2. Listing the dates of forthcoming solar eclipses in Nîmes, where I currently live, I noticed that the ones in 2026 and 2027 will be **12 new moons** apart.
3. In 2002, during a French CNRS mission in Angola, I had pointed out to the attending students that the forthcoming solar eclipse and the preceding one were **18 new moons** apart.

In 2004, Dirk Couprie suggested, that based on available data, Thales of Miletus could have deduced that three consecutive solar eclipses would span a total of **35 lunations**.

Early Observations of Solar Eclipses

Between the age of 13 and 37, [Thales](#) had the opportunity to observe several solar eclipses over Miletus and must have been curious to find out the **shortest time-lapse** between two consecutive eclipses. The list below, with exact dates computed with Xavier Jubier's retrodiction freeware [5MCSE](#), illustrates the solar eclipses which Thales would have been able to observe. Apart from the 11th eclipse in the list, which was predicted by Thales, it is unknown which eclipses he previously recorded and what the visibility conditions were like. However, given his prediction, Thales must have made enough observations to enable him to discover the solar eclipse time series clusters.

#	Time-lapse Lunations		Solar eclipses over Miletus				Height	%	Saros #57
			Date	Local time	sunset	sunrise			
1	223	35	18 [	-610.04.17 / 17:58	18:39		7°	<20%	
2			17 [	-609.09.30 / 08:37			30°	58%	
3			18 [	-607.02.13 / 15:42			20°	76%	
4			18 [	-606.07.30 / 09:41			53°	62%	
5					-602.05.18 / 08:11		36°	49%	-05
6		35	18 [		-596.07.09 / 05:09	04:47	3°	72%	
7			17 [		-595.12.23 / 16:55	17:00	-0.1°	61%	
8			18 [		-593.05.09 / 08:19		36°	46%	
9		35	17 [		-587.07.29 / 19:17	19:26	0.6°	93%	
10			17 [		-586.12.14 / 11:04		27°	74%	
11			18 [		-584.05.28 / 17:58	19:14	13°	97%	-04
				<i>Thales prediction</i>					

It should be highlighted, that all the solar eclipses Thales could observe were *partial* solar eclipses. Combined with the fact that the geographical locations for viewing a *total* solar eclipse are very strict, this leads to the assumption that neither Thales, nor anybody in his surroundings would have been aware of this rare natural phenomenon. The first *total* solar eclipse, in this part of the world, to have been accurately reported was observed on the 29th day of the 13th lunar month of year 175 of the [Seleucid Era](#). This took place 450 years after Thales. The first solar eclipse quoted in the Chinese Chronicles, i.e.: on [-708.08.17](#) might well have been total.

Prior to his prediction, Thales might have identified the 17, the 18 and the 35 new moon time series. However, he could not yet have identified the 223 new moon Saros cycle. The patterns he recognized were the sole basis for his famous prediction. This *simple* approach goes contrary to widespread beliefs that Thales had instead used sophisticated mathematical calculations. Generations of historians have presumed Thales' prediction as being for a total solar eclipse, or else dismissed his scientific work as folklore.

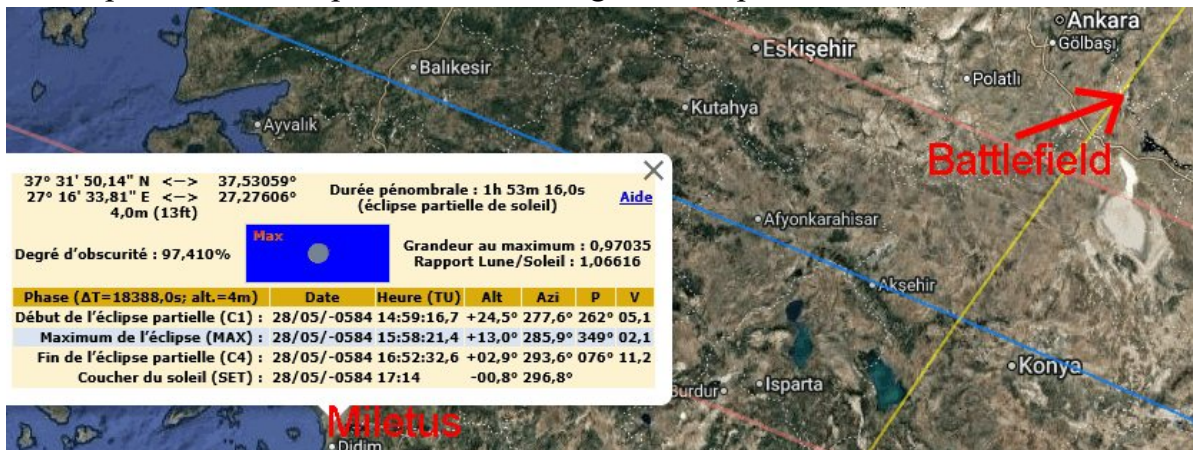
Thales' discoveries

Based on his prediction, it can be assumed that Thales made the following discoveries:

1. The shortest time-lapse between two consecutive solar eclipses is 17 or 18 new moons (the aforementioned time lapses of 6 or 12 did not occur during this period).
2. In a 17 or 18 new moons cluster, eclipses occur alternately between morning and afternoon.
3. A time series beginning with a 17 new moon cluster will be followed by an 18 new moon cluster, or vice versa.
4. Two eclipses separated by 35 new moons, the second occurs either in the morning (up to 3 hours later) or in the afternoon (up to 2 hours earlier).

Eclipse prediction vs. Saros cycle

Time series were exactly what Thales needed to foretell, up to 1½ year in advance, a *partial* solar eclipse over Miletus. Therefore, after the winter -586 solar eclipse, Thales made the rational prediction of an astronomical event on **May 28th, -584**. Note that Thales has been lucky: he could not have imagined that a prediction for a late afternoon solar eclipse based on observations at Miletus could not automatically apply to another site located 540 km eastward of Miletus, and, of course that the phase of the eclipse would be so high at both places.



Path of the solar eclipse on May 28th, -584 retrodicted by X. Jubier's 5MCSE

After his successful prediction, I like to speculate that Thales might have interpreted the 5th & 11th eclipses of the list as an 18 solar years *low frequency cycle*, proportional to the common 18 lunar month *high frequency cycle*. He might have been comforted in this erroneous deduction by hearing from Phoenician merchants that the time interval between the first two solar eclipses mentioned in the Chinese Chronicles were separated by 6 times 18 years. According to this hypothesis, Thales of Miletus, and not Babylonian astronomers, would have discovered the validity of the Saros cycle for solar eclipses.

Conclusion

In humanity's long journey from myth to science certain moments stand as turning points. The earliest recorded came when Thales of Miletus predicted a late afternoon partial solar eclipse which became instrumental in ending a war raging for over five years. This event has been today retrodicted to -584.05.28 at 6 p.m. local time. Beyond its political consequence, the episode marks a cultural shift: Thales by the methodic analysis of his 25 years long observation of natural events led him to the discovery of solar eclipses time-series clusters. This very first scientific prediction model enabled him to predict, several lunar months ahead of time, a phenomenon once thought to lie in the realm of the gods. This day, Science emerged from shamanism, Gods were no longer necessary to explain Nature.

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