Some authors assume **Thales** measured the **size** of the Sun by **timing** the sunrise. However, its duration **changes** with season and location, which makes this **unfeasible**.

The Asymmetric Sunrise Effect on Thales' Alleged Measurement of the Sun Angular Size

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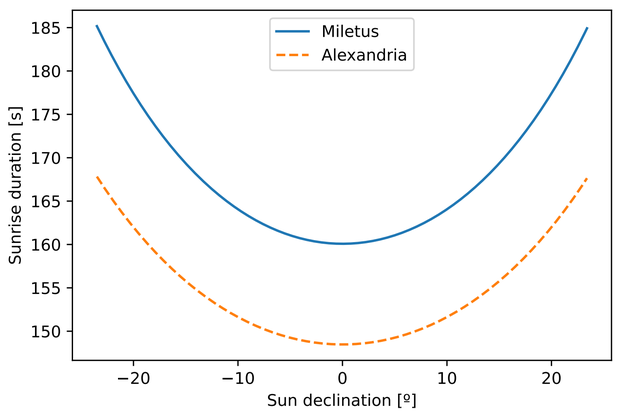
Thales and the size of the Sun

According to classical authors, Thales of Miletus was the first to correctly measure the angular size of the Sun, $\theta_\odot \approx 0.5°$, in the 6th century BC. Several modern authors assume he used Cleomedes' method, i.e. measure the duration of the sunrise, which is proportional to the solar size, $\theta_\odot^\perp = (\Delta t/24h) \times 360°$. This equation, however, is only valid during an equinox, for an observer at the Equator.

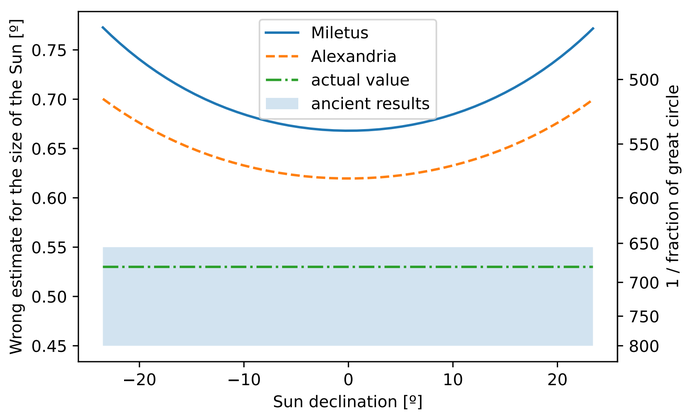
Duration of sunrise

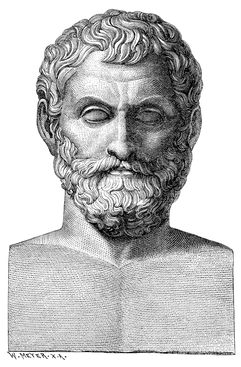
In general, the Sun will not rise perpendicular to the horizon, nor exactly due East. This makes the sunrise take longer (eq. 2), and to depend on the latitude of the observer and the declination of the Sun (therefore on the time of the year).



What would Thales have measured

If Thales had used the duration of sunrise from his hometown, he would have overestimated the size of the Sun by 26-46% (eq. 3). He could not have corrected for the asymmetric sunrise effect with the geometry of his time. Thales either used a different method, or the value was corrected before written down and attributed to him.





Ask me for the details!

In the equations, z is the altitude angle, t is time, ϕ is the latitude of the observer, δ is the declination of the Sun, $\theta_\odot$ is the actual angular size of the Sun, while $\theta_\odot^\perp$ is a wrong estimate for it.

Rate at which the Sun rises from horizon:

$$\frac{dz}{dt}\Big|_{z=0} = \frac{15''}{1s}\cos\phi\sqrt{1-\sin^2\delta\sec^2\phi}. \qquad (1)$$

Duration of the sunrise:

$$\begin{aligned}\Delta t &= \frac{1s}{15''}\frac{1}{\cos\phi}\frac{1}{\sqrt{1-\sin^2\delta\sec^2\phi}}\theta_\odot \\ &= 127s\frac{1}{\cos\phi}\frac{1}{\sqrt{1-\sin^2\delta\sec^2\phi}}. \qquad (2)\end{aligned}$$

Wrong estimate for the angular size of the Sun, neglecting the asymmetric sunrise effect:

$$\theta_\odot^\perp = \theta_\odot\frac{1}{\cos\phi}\frac{1}{\sqrt{1-\sin^2\delta\sec^2\phi}}. \qquad (3)$$

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