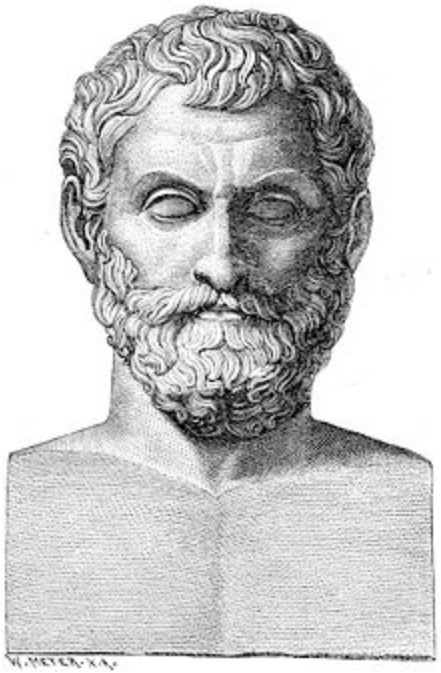


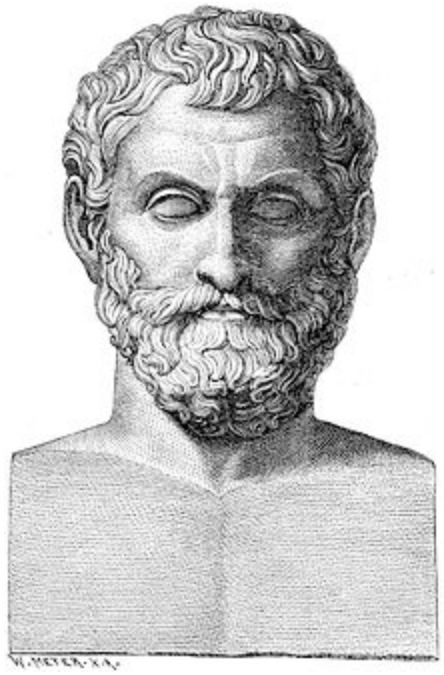
Thales of Miletus,
624 BC – c. 546 BC

The Greeks built on Egyptian and Babylonian achievements. It is from the Babylonians that we have a 7 day week, 360 degrees in a circle, the 60 minute hour, and the zodiac.

- regarded as the first philosopher
- attempted natural explanations of phenomena (without recourse to the gods)
- water is the substance of all things
- the first to study electricity and magnetism

ηλεκτρων

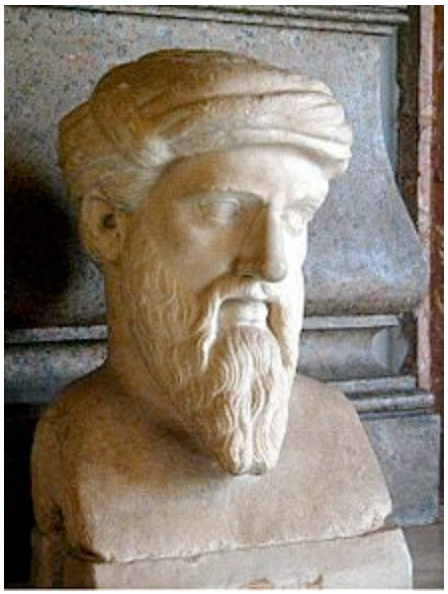
μαγνεσια



Thales of Miletus,
624 BC – c. 546 BC

Thales struggled with the concept of change:
What exactly was it that changed when an object moved, burned, or decayed? His answer was that the substance of the object remained invariant and that change occurred when the substance gained or lost different qualities. He regarded all things as being alive. This is called "hylozoism".

This is not as crazy at it sounds: all things that moved were associated with life.



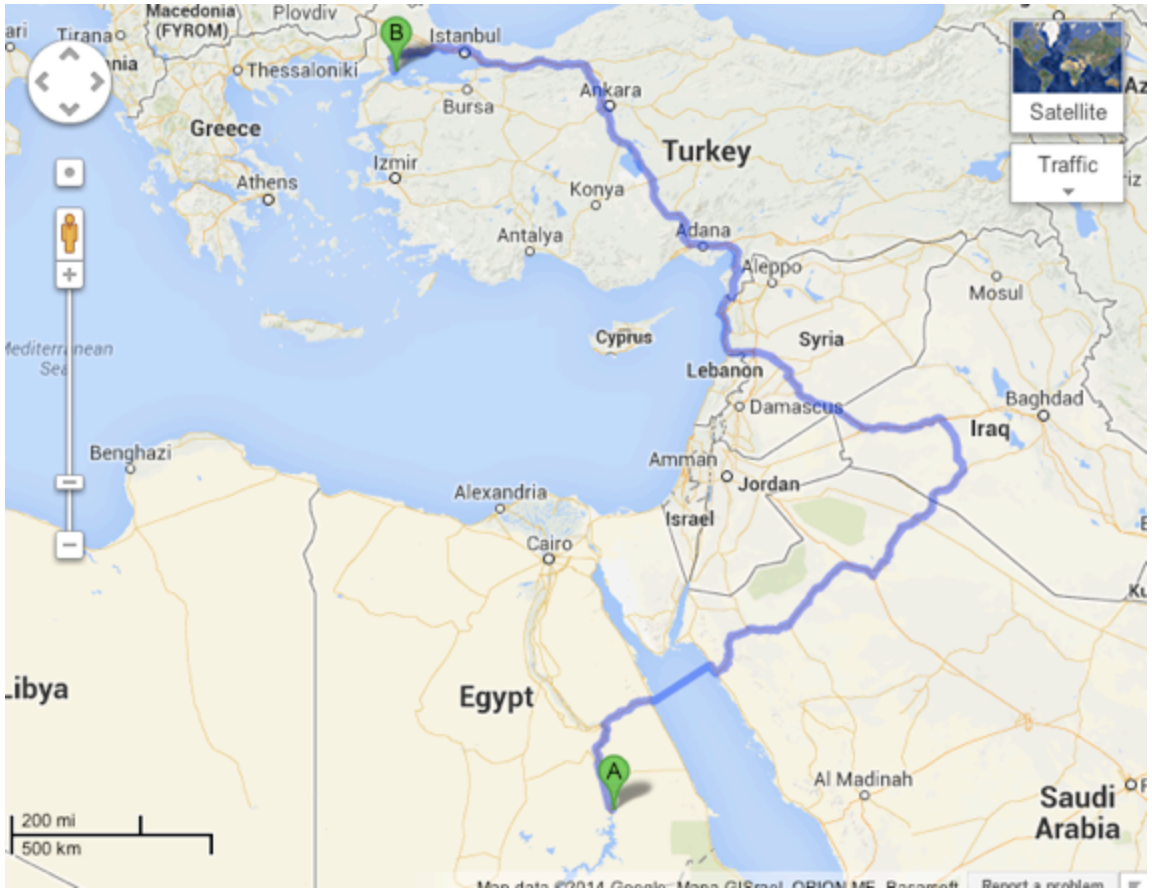
Pythagoras of Samos,
c 570 BC - c 495 BC

- regarded ‘number’ as primal
- started his own religion
- thought the Earth a sphere
- said Earth, moon, and sun circled a central fire
- music theory
- the Pythagorean theorem

the spherical Earth was likely a religious idea, as a sphere was regarded as the most perfect form.

Measuring the Earth

Dicaearchus of Messina (c 350 BC - c. 285 BC) used the measured distance of 20,000 stades between Syene (Aswan, Egypt) and Lysimachia and the difference of latitude of 25 degrees between these cities, to arrive at a global circumference of 288,000 stades (about 34,000 miles, the actual figure is 24,900 miles).



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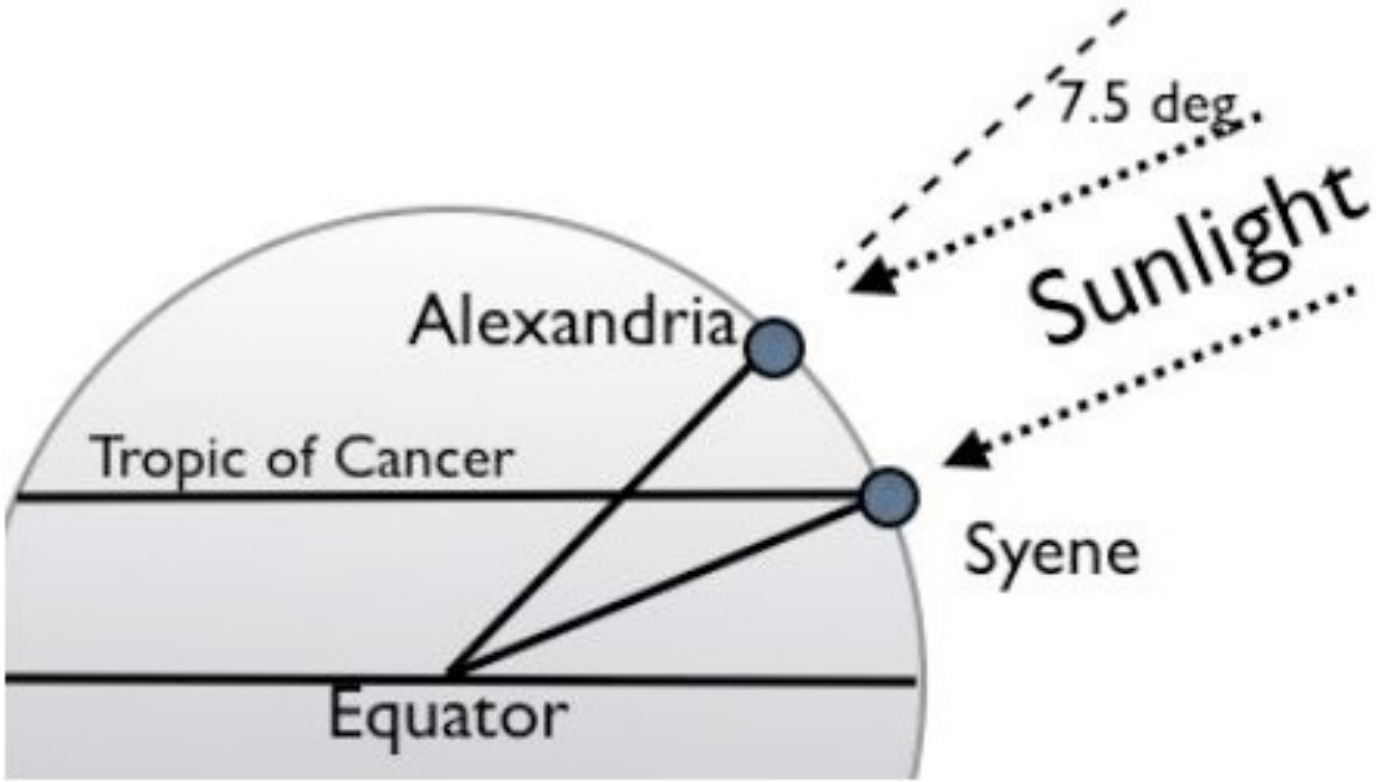


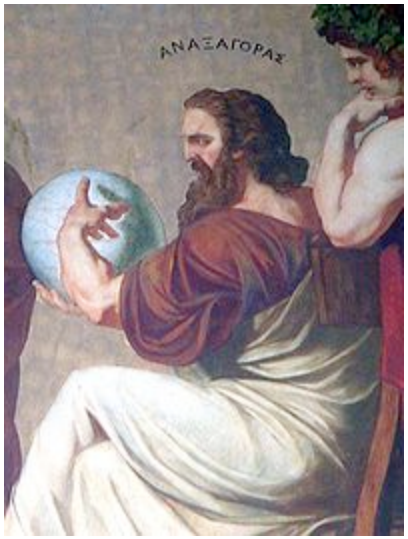
Measuring the Earth

Other estimates using similar methods were made by Eratosthenes, Archimedes, and Aristotle. The computation of Posidonius (c. 135 BC - 51 BC) was based on the difference in ascension of the star Canopus as seen at Rhodes and Alexandria. An estimate of the distance between these cities led to a value of 24,000 miles for the circumference of the Earth. This value was taken up by Ptolemy, and his authority was sufficient to make it the accepted size of the Earth for the next 1500 years.

The assumption of a good model led directly to an important discovery about nature!

Q: what historical figure used Ptolemy's calculation to justify his voyage of discovery?

A: Columbus



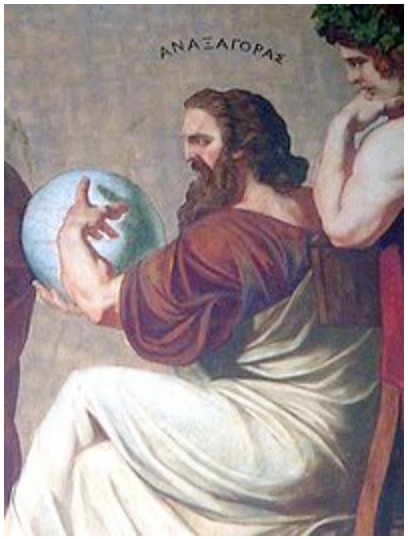
Anaxogoras of Clazomenae,
c 510 BC - c. 428 BC

"The descent to hell is the same from every place."

- the moon is lit by reflected sunlight
- lunar eclipses are due to the Earth's shadow
- solar eclipses are due to the moon's shadow

For Anaxagoras, who was the first to put in writing, most clearly and most courageously of all men, the explanation of the moon's illumination and darkness, did not belong to ancient times, and even his account was not common prop- erty but was still a secret, current only among a few and received by them with caution or simply on trust. For in those days they refused to tolerate the physicists and star- gazers as they were called, who presumed to fritter away the deity into unreasoning causes, blind forces, and necessary properties. Thus Protagoras was exiled, and Anaxagoras was imprisoned and with difficulty saved by Pericles. -- Plutarch

- unfortunately, he also thought the Earth and planets were disks



Anaxogoras of Clazomenae,
c 510 BC - c. 428 BC

"The descent to hell is the same from every place."

Aristotle complained that Nous was invented solely for that purpose.

Cosmogony

cosmogony: the origin of the cosmos (or solar system).

- everything was originally bound in a chaotic mixture

- it was set in a rotary motion at one point by Nous (or mind)

- Nous is capable of generating motion and of imbuing life and was possessed of all knowledge and power

- the motion gradually spread into a vortex that separated out air, clouds, earth, and water. Eventually the Earth coalesced from the vortex.

- the stars were formed by stones that caught fire and were hurled away from the Earth.

Empedocles of Acragas
c. 490 BC - c. 430 BC

He was known as the "laughing philosopher"

Acragas -> Roman Agrigentum -> modern Agrigento

Empedocles of Acragas
c. 490 BC - c. 430 BC

The Four Elements

[from the elements] sprang all things that were and are and shall be, trees and men and women, beasts and birds and water-bred fishes, and the long-lived gods too.
-- Empdeocles

The Four Elements

Empedocles of Acragas
c. 490 BC - c. 430 BC

- change was described by the formation of new combinations of the elements

- change was driven by opposing forces called *love* and *strife*.

The Atomists

Democritus
(c 460 BC - c 370 BC)

- rock -> gravel -> sand -> powder -> ?

- for the *atomists* the process ends at the level of atoms, which are small indivisible bits of matter

- thus there must be a *void* between the atoms

Note how the model leads to an important concept!

- there are infinitely many kinds of atoms, everything is built of them, they are in perpetual motion.

"By convention there is colour, by convention sweetness, by convention bitterness, but in reality there are atoms and space." -- Democritus

The Atomists

Democritus

(c 460 BC - c 370 BC)

And at the gates the brazen statues show
Their right hands leaner from the frequent touch

Of wayfarers innumerable who greet.
We see how wearing-down hath ‘minished these,

But just what motes depart at any time,
The envious nature of vision bars our sight.

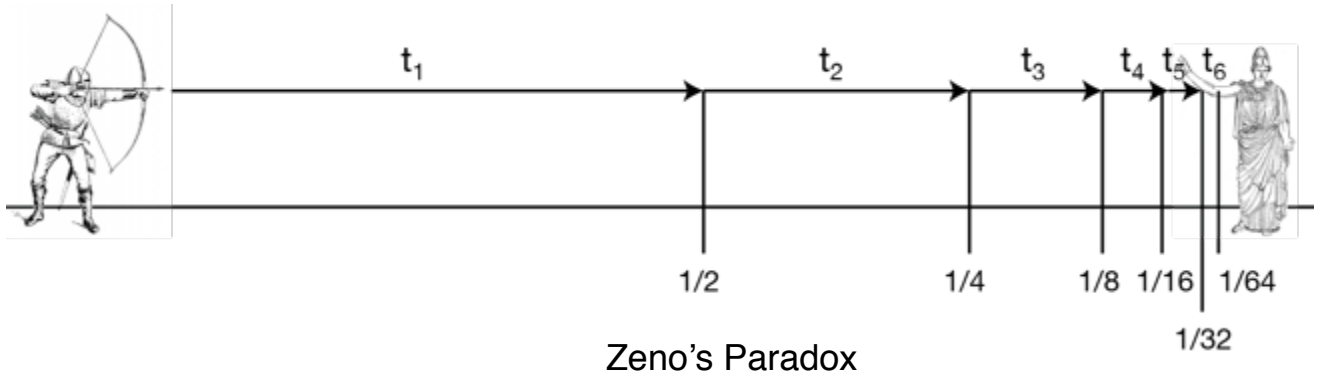
-- Lucretius

The Atomists and the Void

Democritus
(c 460 BC - c 370 BC)

- Lucretius argued that the void is necessary to explain how gasses and fluids can change shape, while metals can be molded without changing their basic material properties.

- Zeno argued that void is needed to allow movement, but saying that the void exists means that it is not nothing, therefore a void cannot exist.



Zeno's Paradox

The Atomists and the Void

Democritus
(c 460 BC - c 370 BC)

We should never enter into arguments about the infinite, for since we are finite, it would be absurd for us to determine anything concerning the infinite; for this would be to attempt to limit it and to grasp it. -- Descartes

This is like saying you cannot imagine being Spanish if you are German!