



Summary:

- Archaeoastronomy
- Models of the solar system
- The scientific method

Astronomy

A History

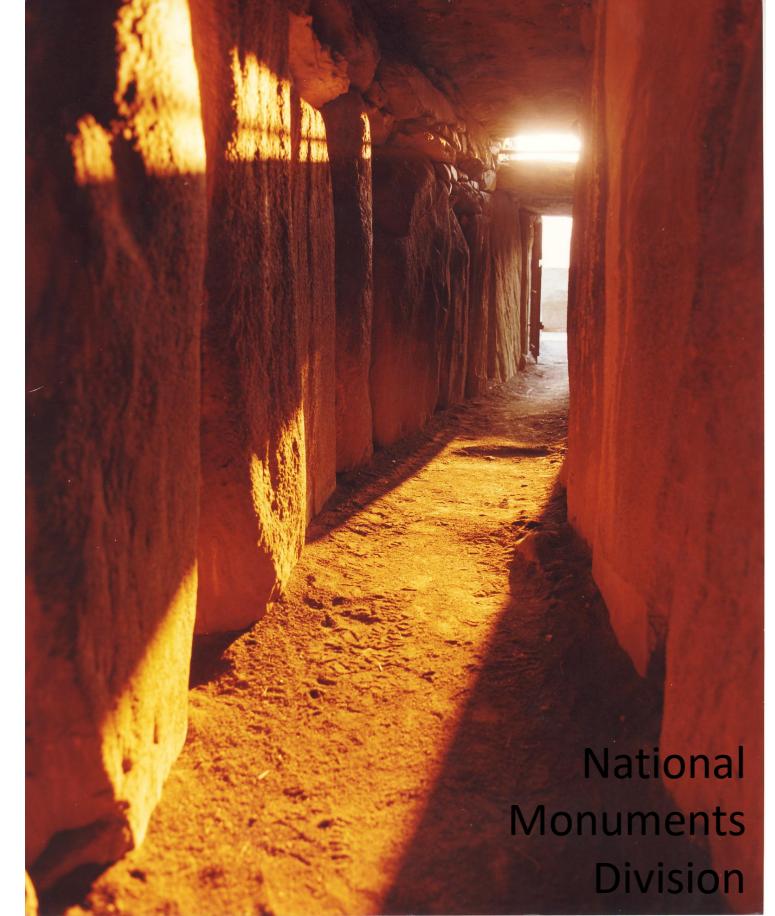


Archaeoastronomy

- The study of how celestial phenomena influenced ancient cultures



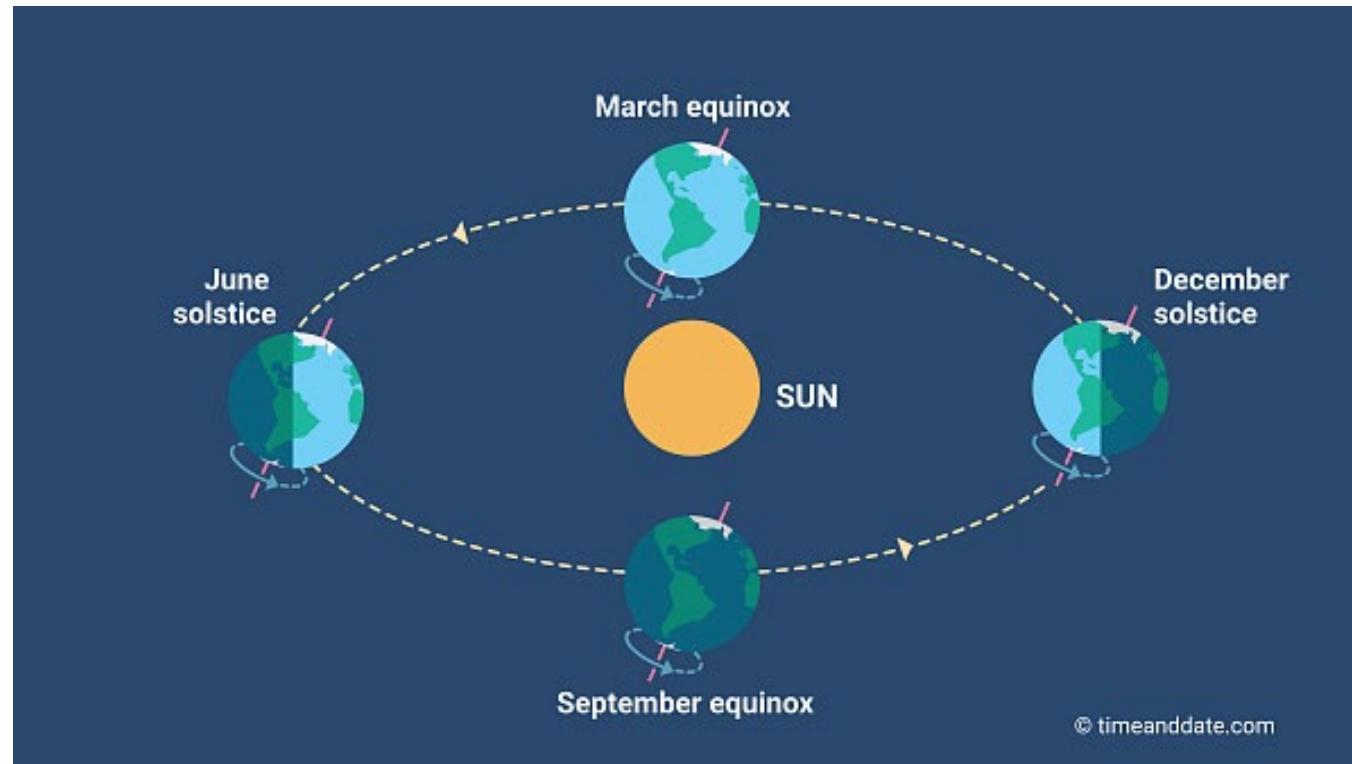
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National
Monuments
Division

Solstice

The time when the sun is at its highest or lowest point in the sky, giving us the longest (summer) and shortest (winter) days of the year





Stonehenge





Mayans - Chichén Itzá



Richard Cohen

Egypt – Great Pyramids



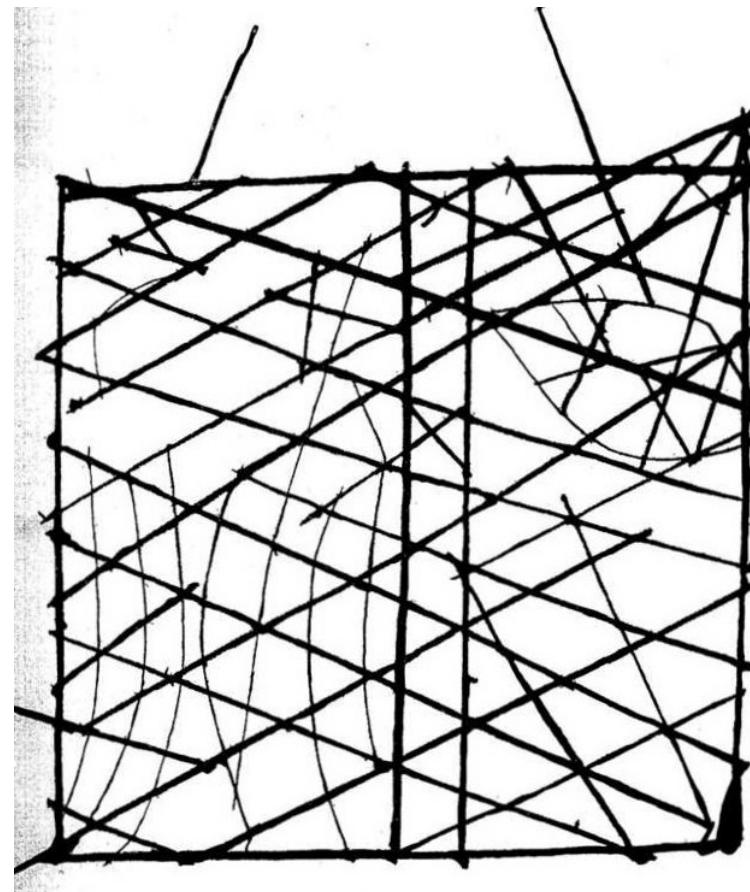


Antikythera mechanism



Thanassis Stavrakis/AP

Polynesian Navigation



NZETC



Hawaii - Makahiki



Tony Hallas/Science Faction/Corbis

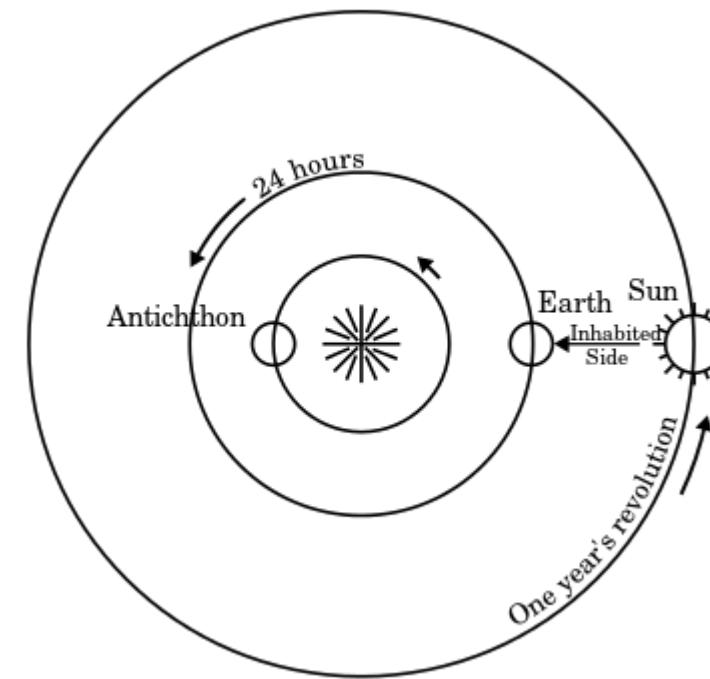
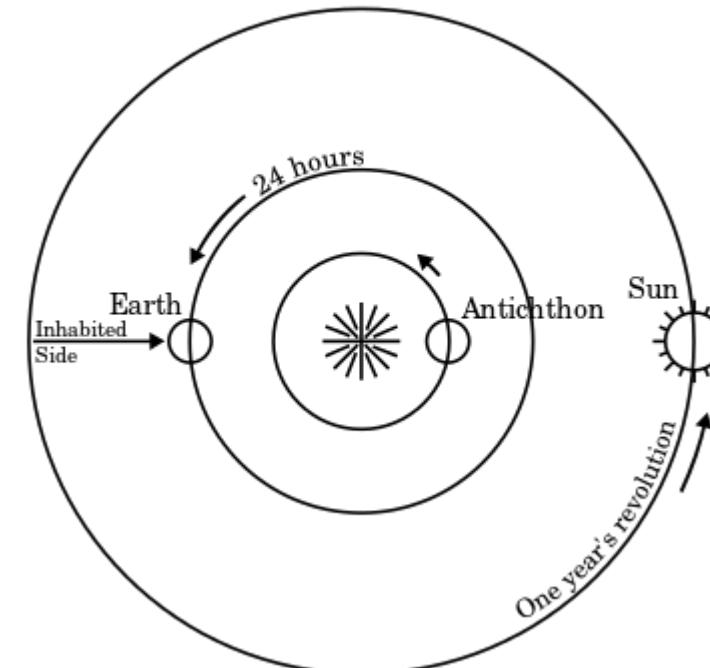
Solar System Models

Each of these famous astronomers/scientists helped improve our model for the solar system by making new observations or taking new data

- Ptolemy
- Pythagoras
- Aristarchus
- Copernicus
- Tycho
- Kepler
- Galileo

Pythagoras

570 – 495 BCE





Ancient Greeks

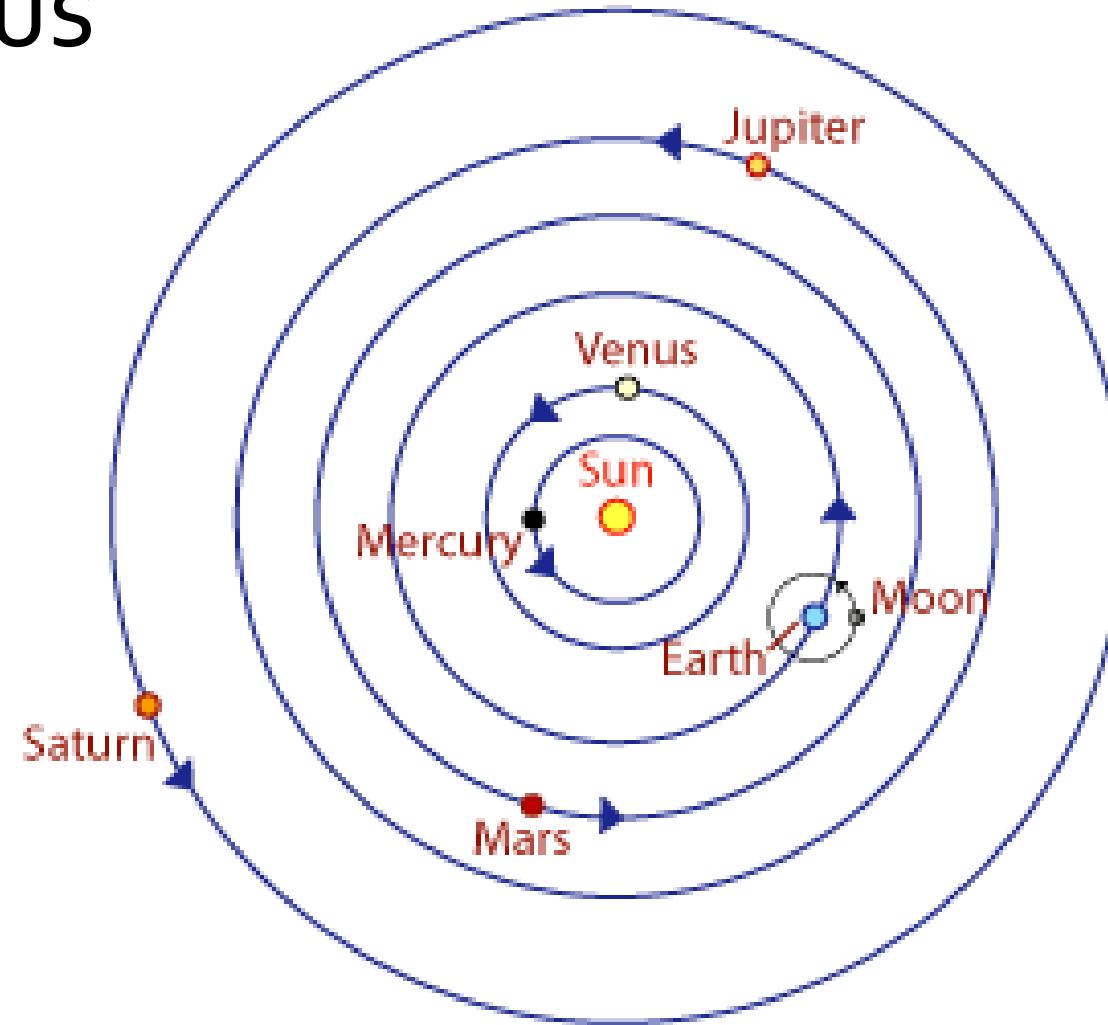
- Eudoxus (409 – 356 BCE): Model of 27 nested spheres
- Aristotle (384 – 322 BCE): Universe can be divided in 2 parts:
 1. Imperfect, changeable Earth,
 2. Perfect Heavens (described by spheres)

Aristotle expanded Eudoxus' model to use 55 spheres!



Aristarchus

310 – 230 BCE

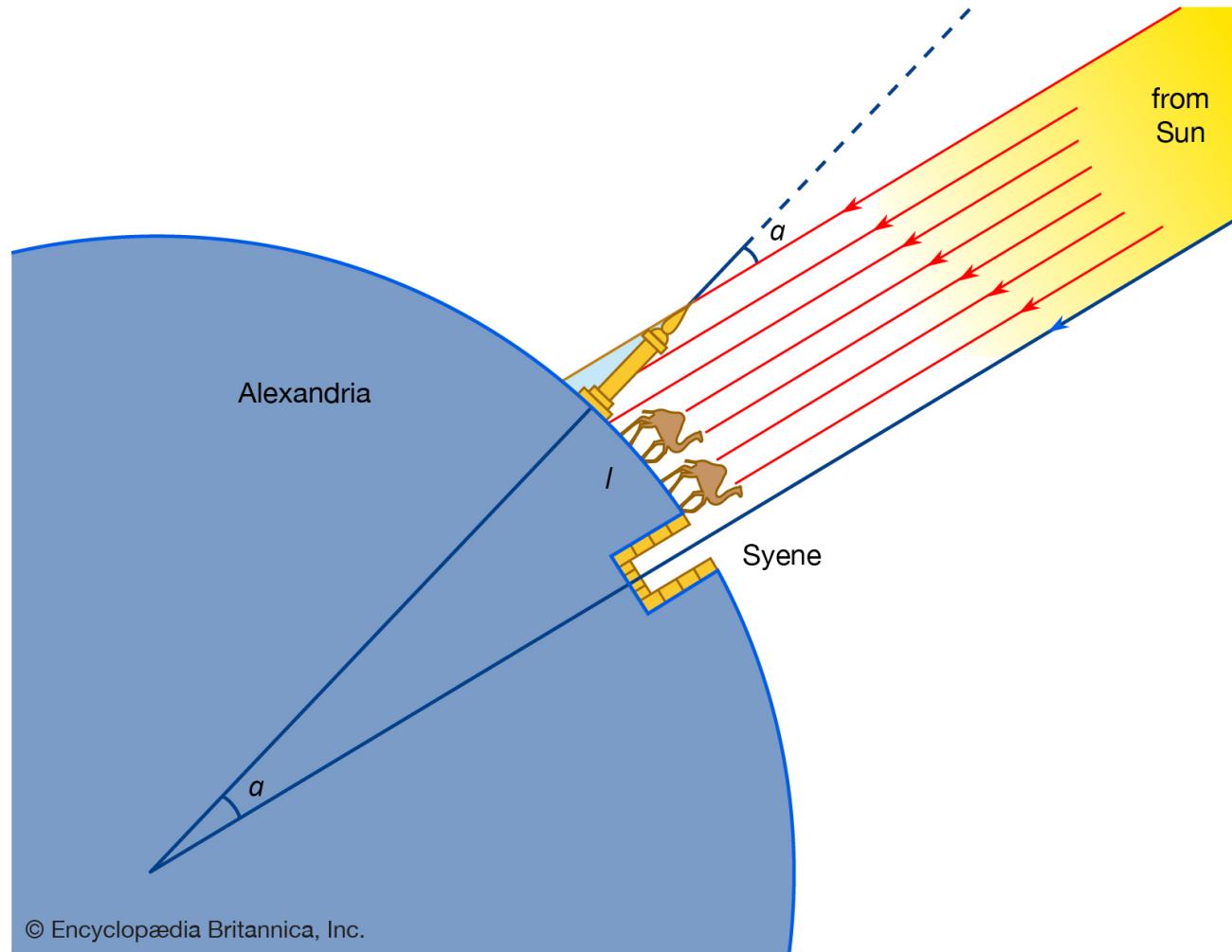


*Aristarchus' Heliocentric Model
(Not to scale)*



Eratosthenes

276-194 BCE



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Angular distance between
Syene and Alexandria:
 $\sim 7^\circ$

Linear distance between
Syene and Alexandria:

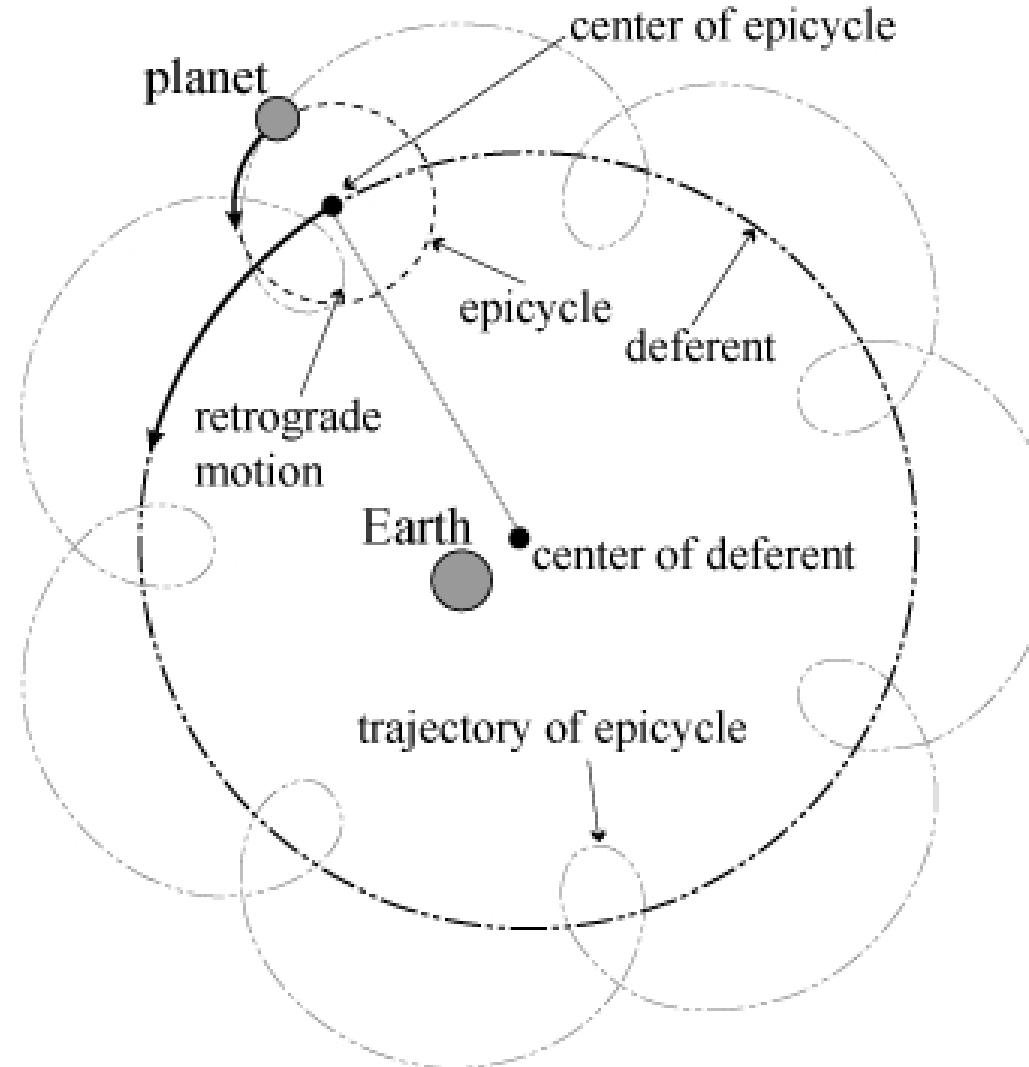
$$\sim 8,000 \text{ km}$$
$$360^\circ / 7^\circ = 51.4$$

$$8,000 \text{ km} \times 51.4 =$$

\rightarrow Earth Circumference $\sim 41,200 \text{ km}$ –
better than any previous radius estimate.
Actual circumference = 40,075 km

Ptolemy

100 – 170 CE



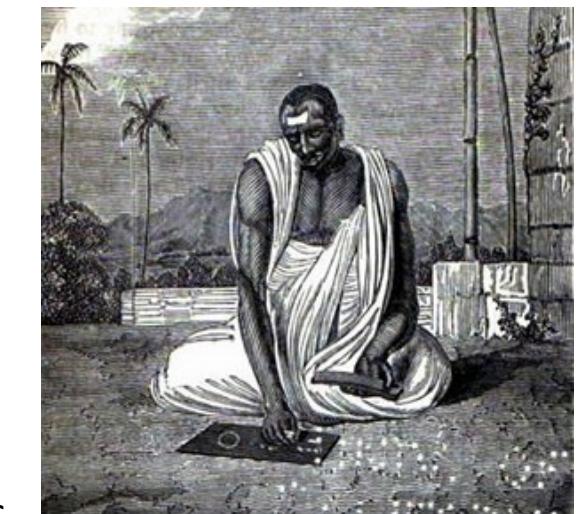
Indian Astronomy

Āryabhaṭa (476 - 550 CE)

- believed that the planets and the Moon shine by reflected sunlight
- proposed the motion of the stars is due to Earth's rotation
- Islamic, Chinese, and European astronomy is based on this work

Brahmagupta (598 - 668 CE)

- calculated the instantaneous motion of a planet
- gave correct equations for parallax
- theorized that all bodies with mass are attracted to the earth



Chinese Astronomy

- Were considered the most persistent and accurate observers of celestial phenomena anywhere in the world before the Islamic astronomers
- Shi Shen (4th century BCE) was aware of the relation of the moon in a solar eclipse
- Xuan Ye school (~280 CE)
 - viewed the heavens as infinite in extent
 - celestial bodies as floating about in the infinite
- Shen Kuo (1031–1095 CE) used the models of lunar eclipse and solar eclipse in order to prove that the celestial bodies were round, not flat



Islamic Astronomy



- Muslim scholars developed spherical trigonometry and algebra
- Abd al-Rahman al-Sufi (904-986 CE)
 - Book of Fixed Stars
 - First to record observing the Andromeda galaxy and the Large Magellanic Cloud
- Nasir al-Din al-Tusi (1201-1274 CE)
 - Tusi couple
 - Explains the apparent linear motion of heavenly bodies on the basis of circular motion

Islamic Astronomy

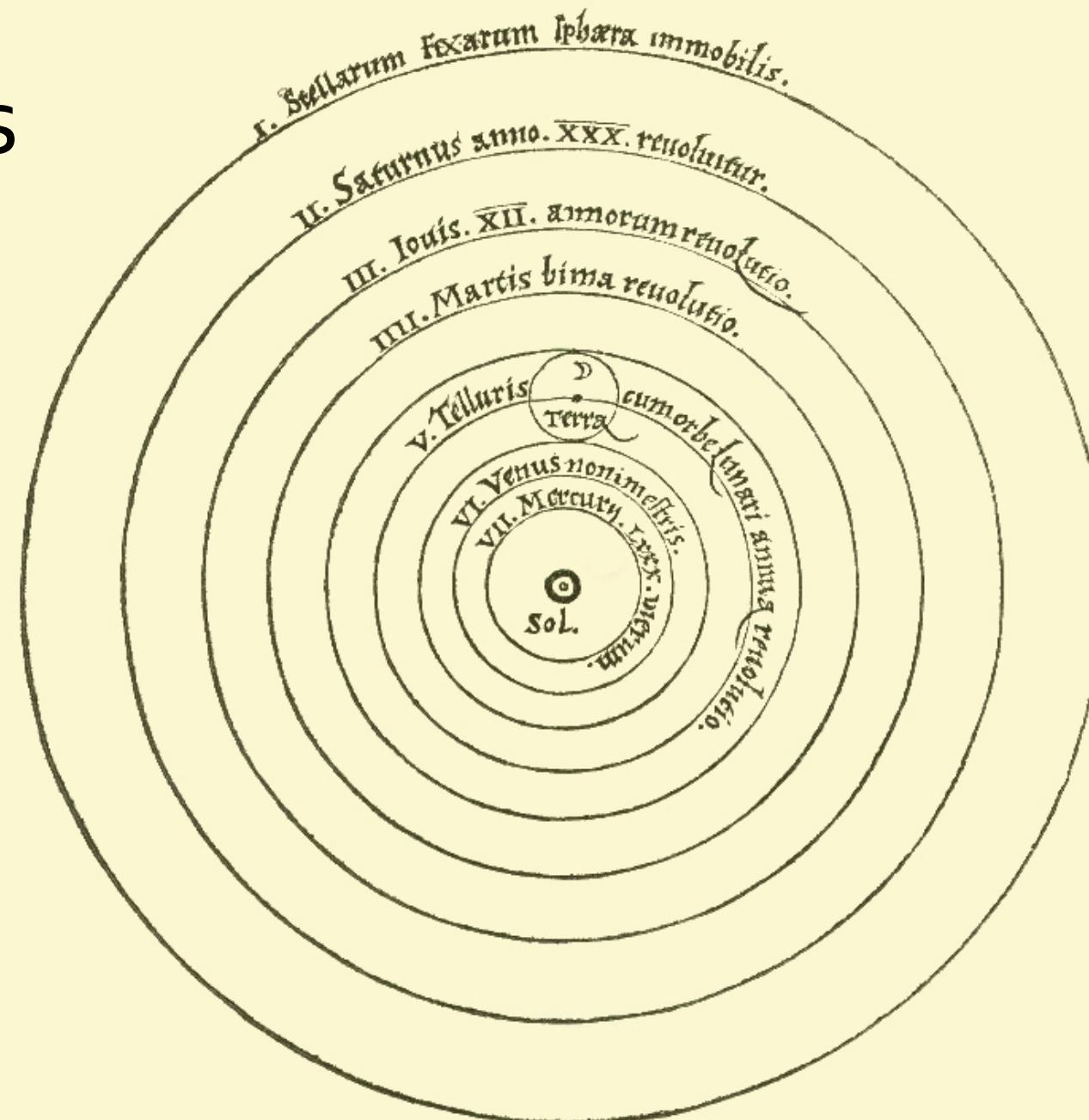


- Ibn al-Haytham (965-1040 CE)
 - the “father of optics”
 - his work developed camera obscura
 - his work aided in development of telescopes
 - started the foundations of the scientific method
- Many schools and mosques that taught math and astronomy were overseen by Muslim women
- Mariam al-Astrulabi (mid 900s CE Syrian female)
 - perfected the making of astrolabes
 - used to calculate altitude of celestial bodies in the sky



Copernicus

1473 – 1542 CE

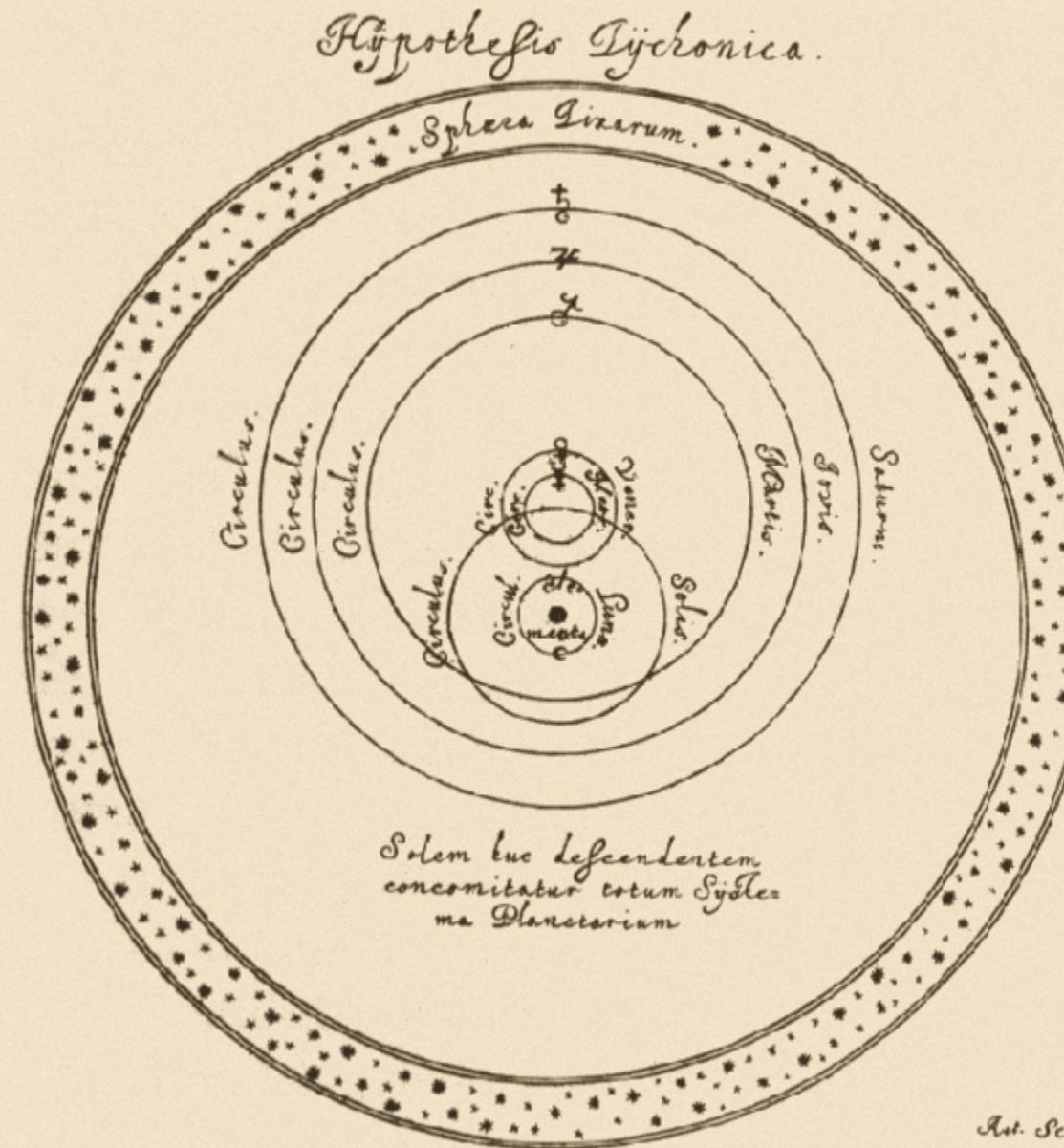


Nicolaus Copernicus



Tycho

1546 – 1601 CE

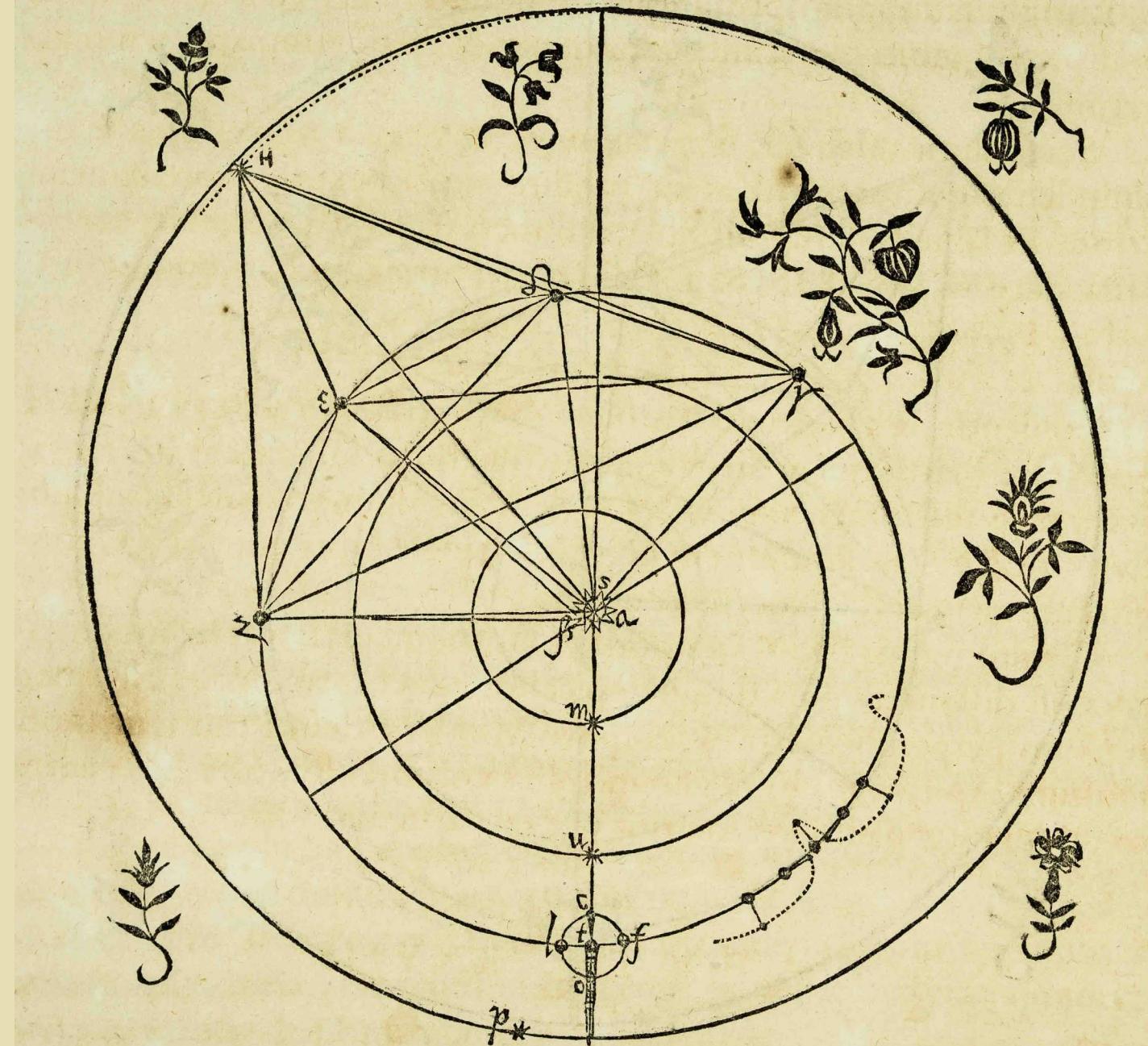


Tycho Brahe



DE MOTIB. STELLÆ MARTIS

Kepler
1571–1630 CE



Galileo

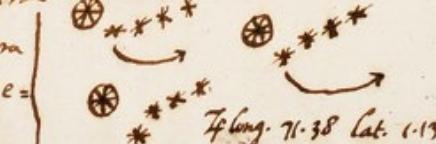
1594 – 1642 CE

Sexto Principio.

Galileo Galili Humilis. Servo della Ser. V.^a in uigilando asciugiamo, et ad ogni spiro p^o potere nō solam satisfare alcarico che tiene della lettura Di Matematicis nello Studio di Padova,

Scribere denuo determinato di presentare al ^{sextu} Principio l'Uchiale et N^o p^o essere di giuramento inestimabile p^o ogni regozio et infreca marittima o terrestre stimo di tenere questo nuouo artifizio nel maggior segreto et solam a disposizione di S. Ser. L'Uchiale curato dalle più reuite speculazioni di prospettiva ha il vantaggio di scoprire Legni et Vele dell' inimico p^o due hore et più di tempo prima ch^e egli sia sopra noi et distinguendo il numero et la qualita de i vasselli giudicare le sue fortezze palestirsi alla caccia al ambattimento o alla fuga, o pure anco nella campagna aperta vedere et particolarmente distinguere ogni suo moto et preparamento.

Offid 7. di Genaro
Giorni si uedde astri 7. * occi:
Adi 8 astri 9. * 10. 11.
7. * era dūq^o diretto et no retrogradò 11.
Adi 11. si uedde in tale costituzione 12.
Il 13. si ueddono vicinissime à Giorni 4 stelle * * * meglio astri
Adi 14 è nubolo * * *
Il 15. * * * * la prossima 7 era la m^o la 4 era distante dalla 3^a il doppio tanta
Lo spazio delle 3 ore etali no era maggiore del diametro di 7 et erano in linea retta.



The Heliocentric Model

- Galileo's observations of the phases of Venus and the Galilean moons of Jupiter proved that not everything orbits the Earth
- His observations of sunspots and lunar craters proved the heaven was not perfect
- He suggested that we couldn't measure stellar parallax yet and that some stars are so distance they have no parallax
- Galileo showed that we can move with the motion of the Earth around the sun (as can the moon) without being left behind as Earth moved in its orbit by formulating an early version of Newton's first law of motion

How does this evolution follow the Scientific Method?

Steps of the Scientific Method



Observation

Which type of fertilizer works the best?



Question



Hypothesis



Results



The hypothesis was proven correct.

PEER REVIEW!

Conclusion



Up next:

The Earth: Orbit

