

Reminder: no food or
drinks in the planetarium!

Astronomy 4 - Solar System Astronomy

Reminders

Instructor: Dr. Ann Marie Cody

codyannmarie@fhda.edu

-Feel free to email me about course questions or astronomy in general.

Class website:

-*<https://amcody.github.io/astro4>*

Your one-stop shop for anything course related, including homework readings and exam practice material.

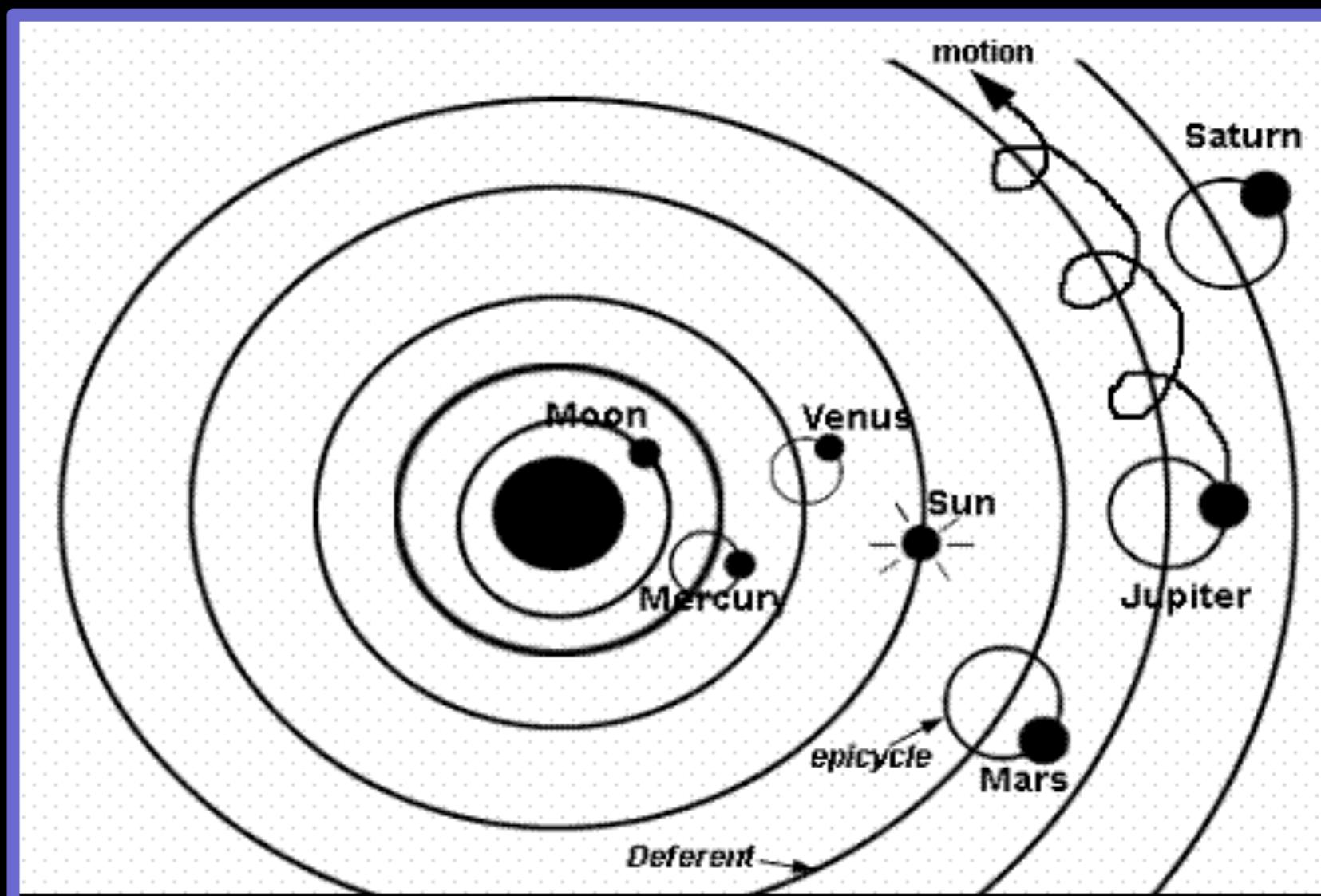
Lost and found:

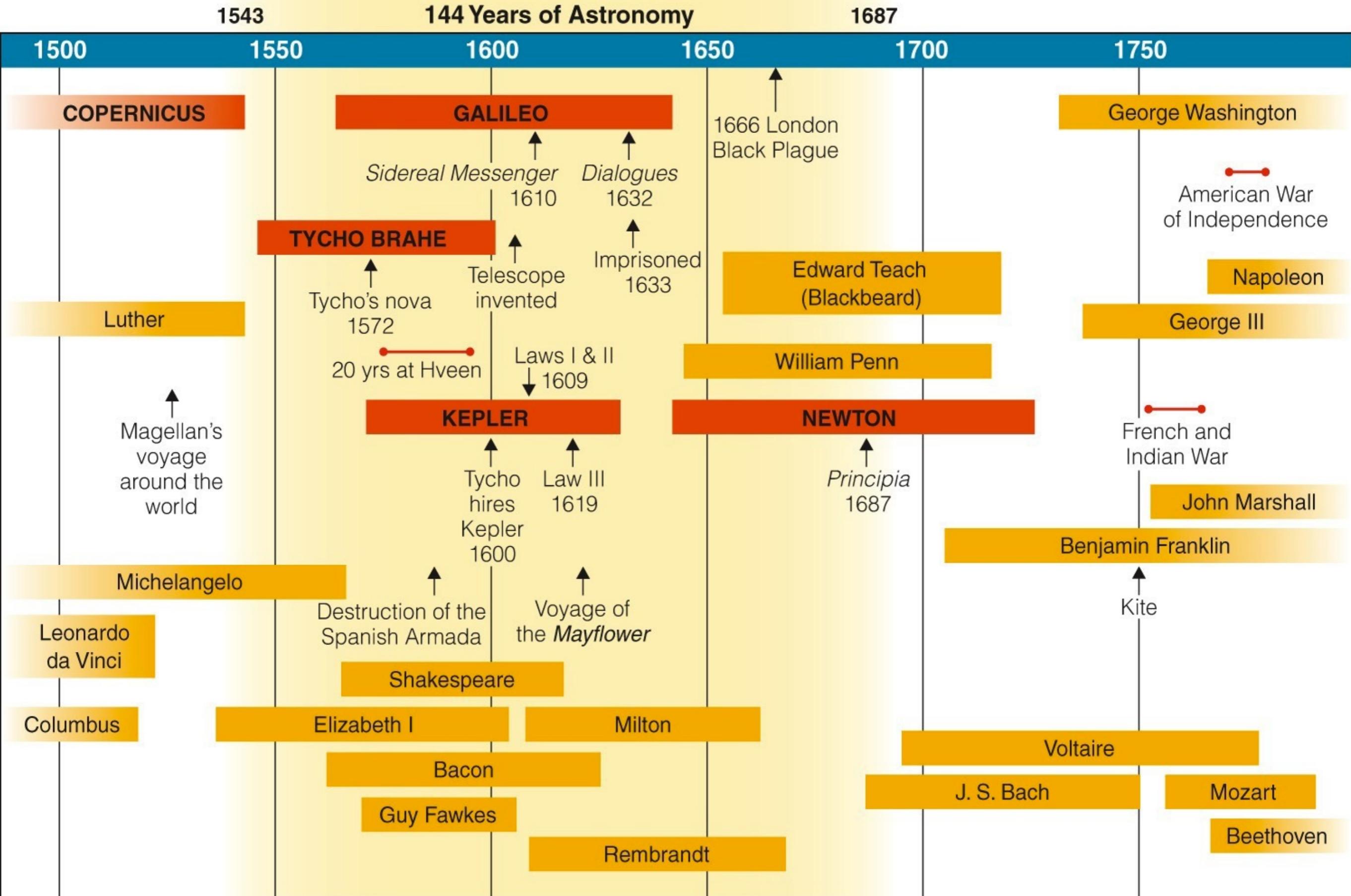
-At the end of class, check to make sure you aren't leaving anything behind. Any items will be added to the Lost and Found box in back.

Problem - Ptolemy's model was NOT accurately predicting the position of all the planets over time.

1) Retrograde motion was hard to reproduce

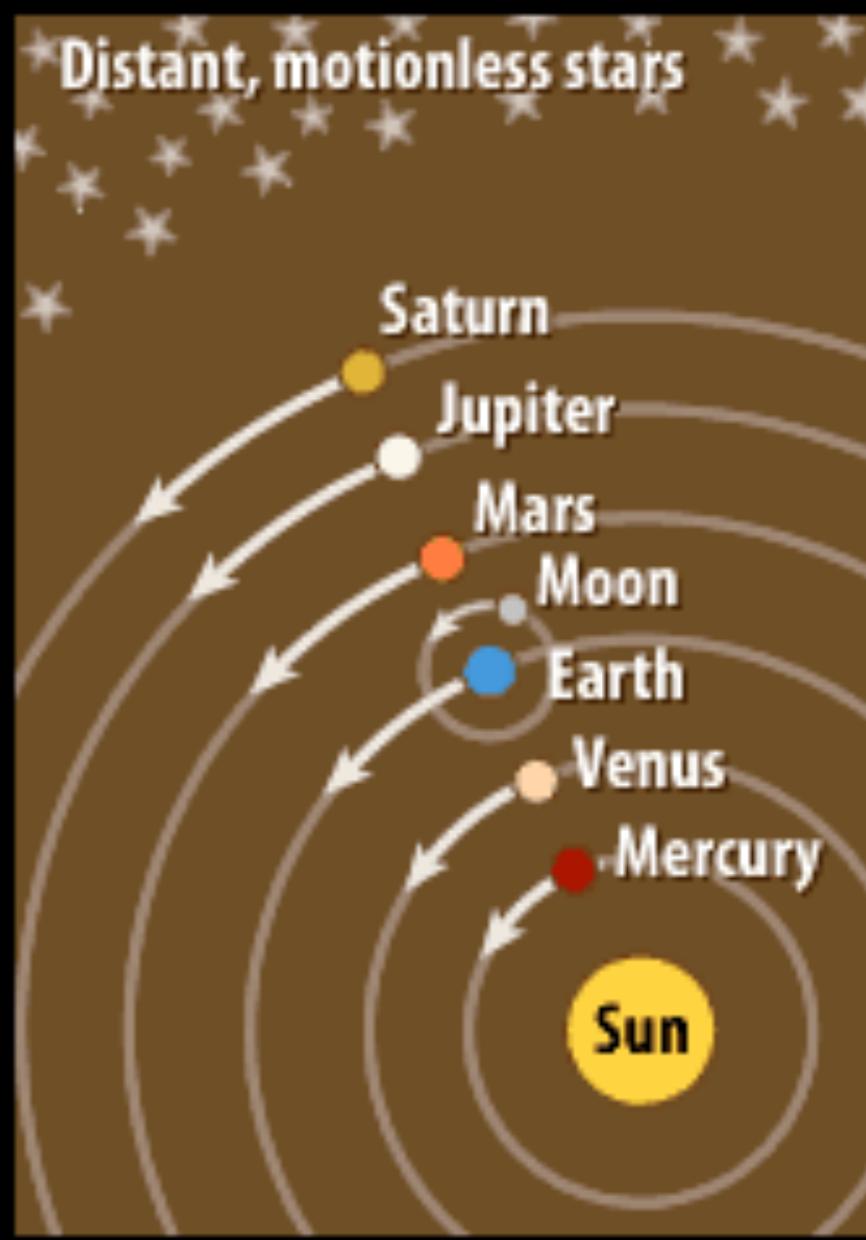
2) Had to keep adding smaller epicycles to reproduce planetary motion



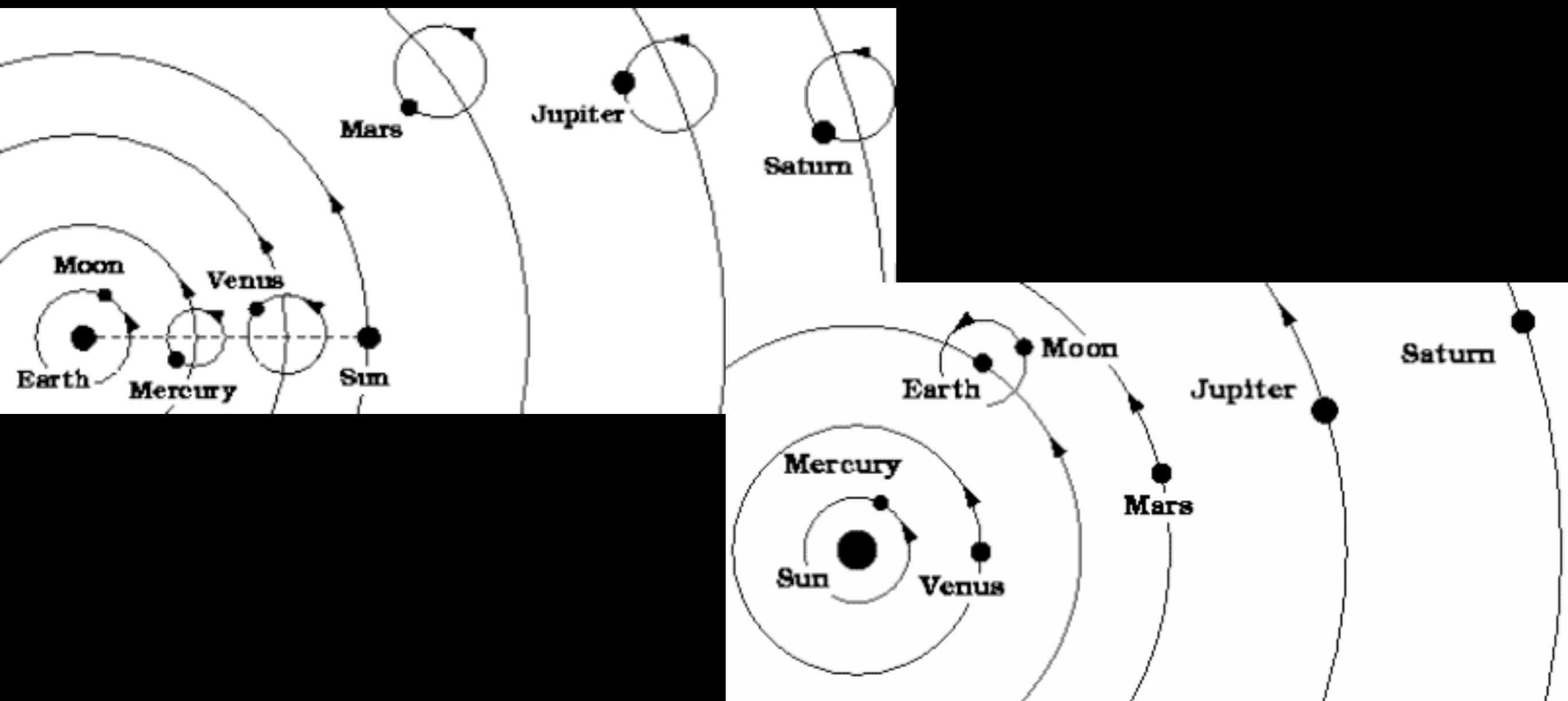


Copernicus (1473-1543 AD) believed that the Sun was the center of the universe and that Earth rotated on its axis and revolved around the Sun - this is call the **heliocentric model**

- The heliocentric model had been discussed occasionally before Copernicus's time.
- Copernicus, however, was the first person to produce a detailed model with substantial justifying arguments.



- However, the Copernican model failed to disprove the geocentric model immediately for one critical reason.
 - It could not predict the positions of the planets any more accurately than the Ptolemaic model could.



True or False: Columbus discovered that the Earth is round.

- A) True
- B) False



True or False: Columbus discovered that the Earth is round.

- A) True
- B) False

False: The Greeks knew



On the Ptolemaic system:

“A system of this sort seemed neither sufficiently absolute nor sufficiently pleasing to the mind.”

--Copernicus

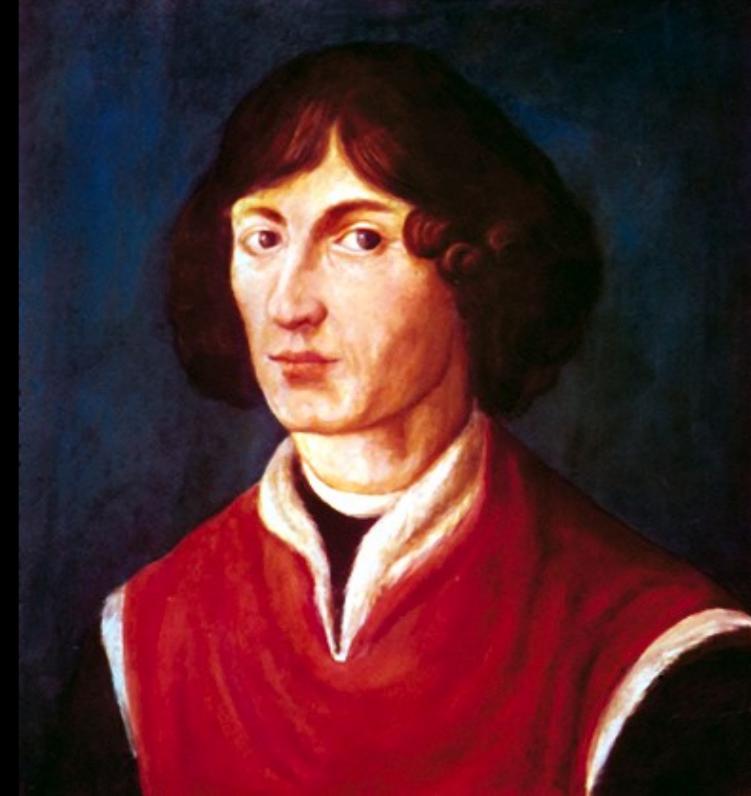
Why heliocentric NOW??

- Renaissance
- art
- literature
- medicine
- exploration

Copernicus (1473 – 1543 AD)

is known for :

1. First observations of the sun
2. First sun centered model of the solar system or universe
3. The world's best naked-eye astronomical observations in history
4. Creating first a theoretical model to explain planetary motions
5. Creating first a theoretical model for explaining gravity



A portrait painting of Nicolaus Copernicus, a Polish astronomer. He is shown from the chest up, wearing a dark red robe over a white collared shirt. His hair is dark and curly, and he has a serious expression. The background is dark.

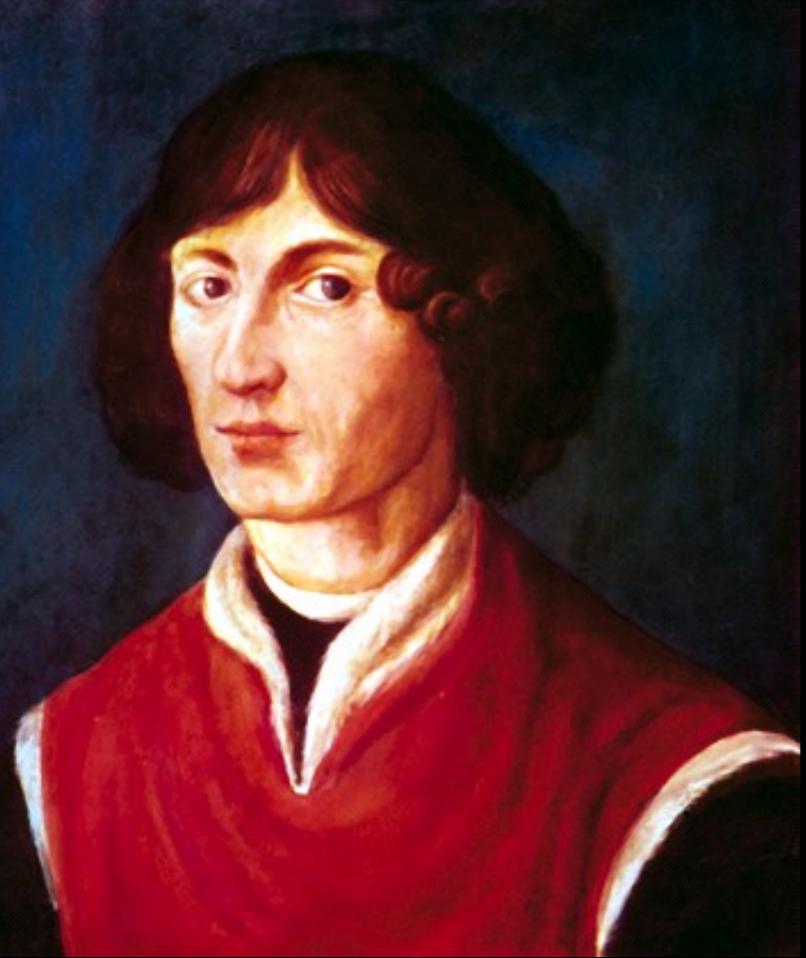
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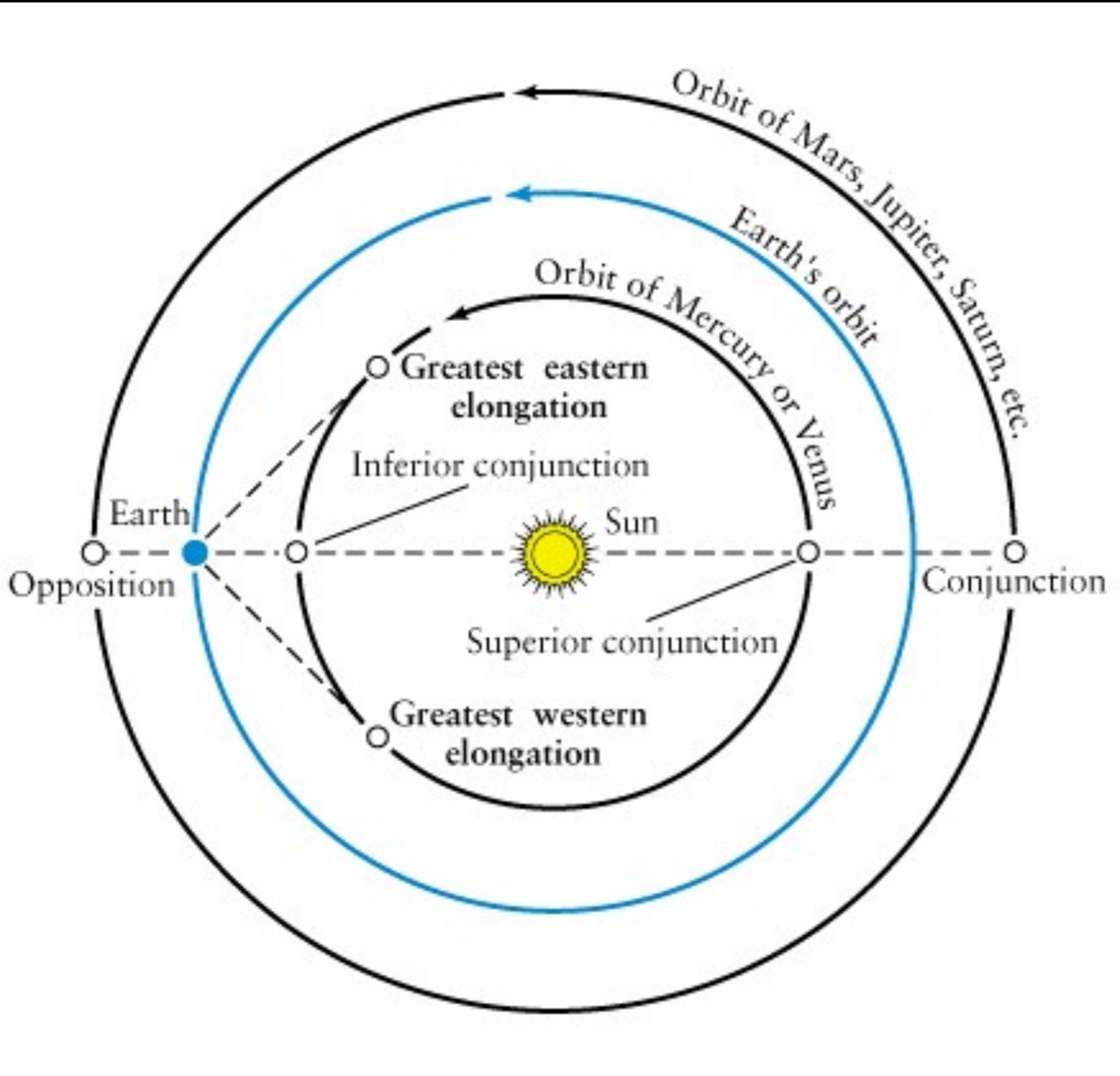
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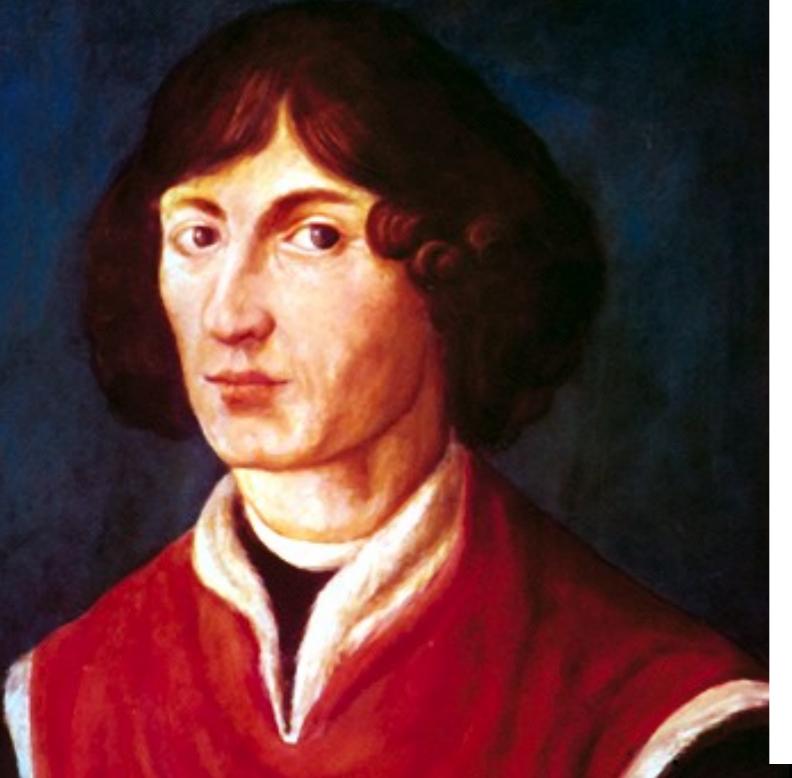
1. Was a priest and Lawyer
2. Had artificial wooden and silver noses
3. Probably died of Mercury poisoning
4. Rumored to have died of a bladder burst
5. Was blind at the time of his death
6. Was labeled a heretic by the church



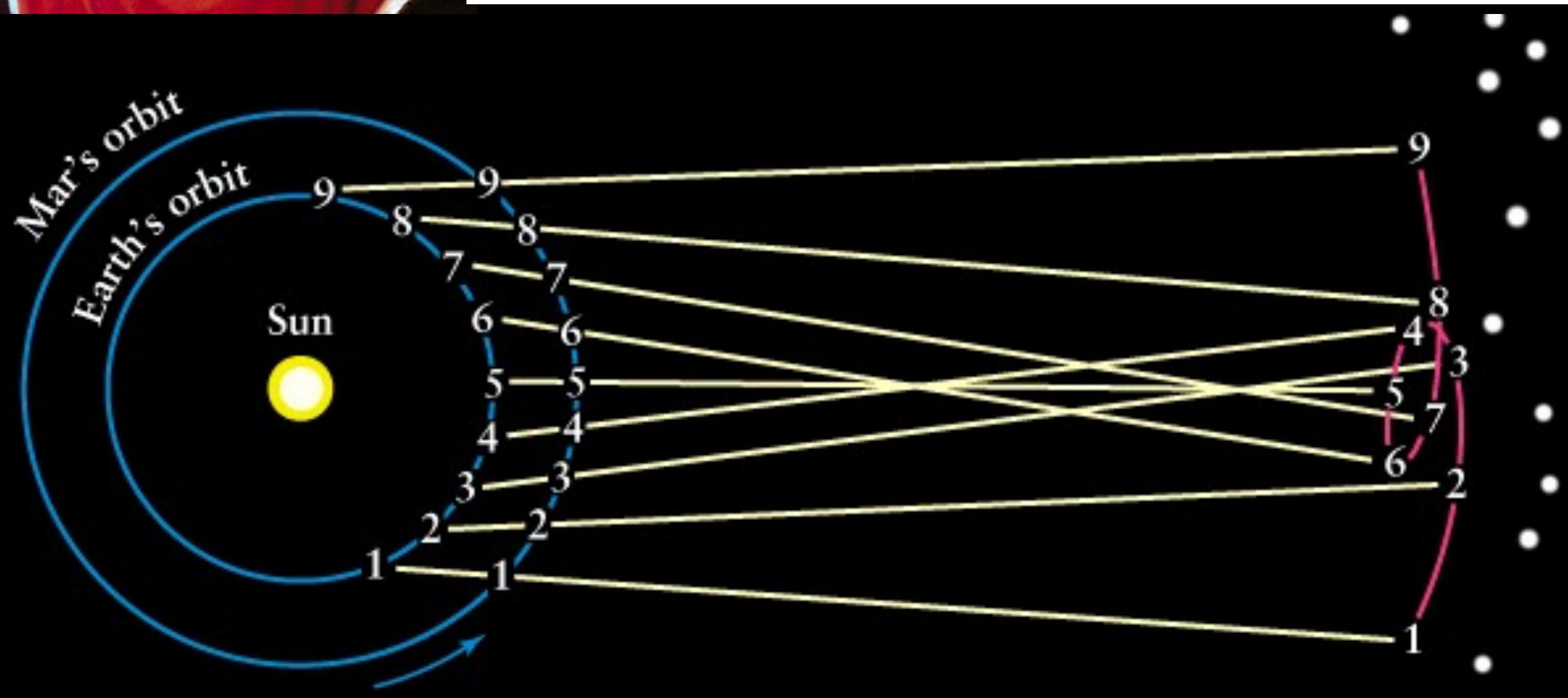
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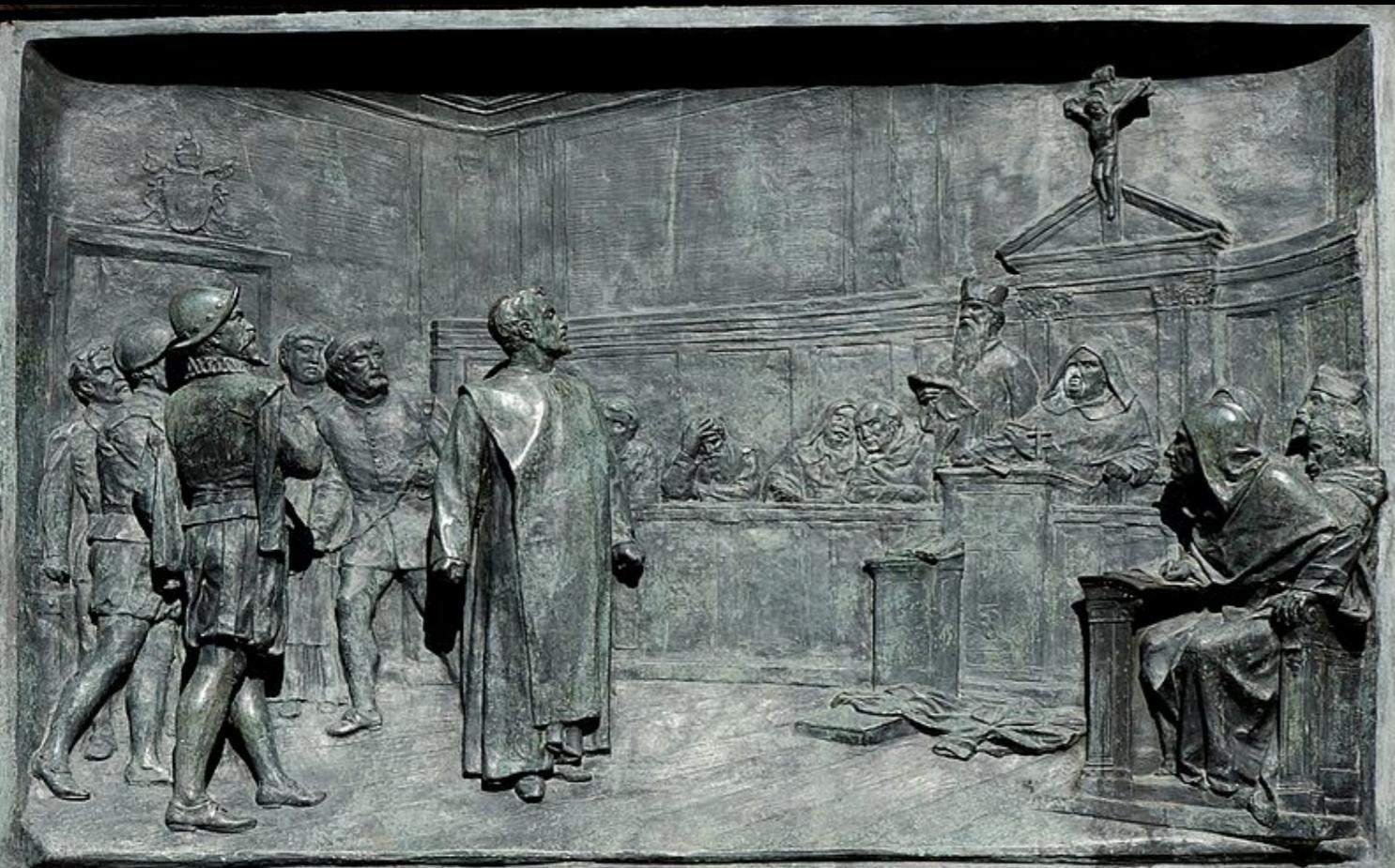
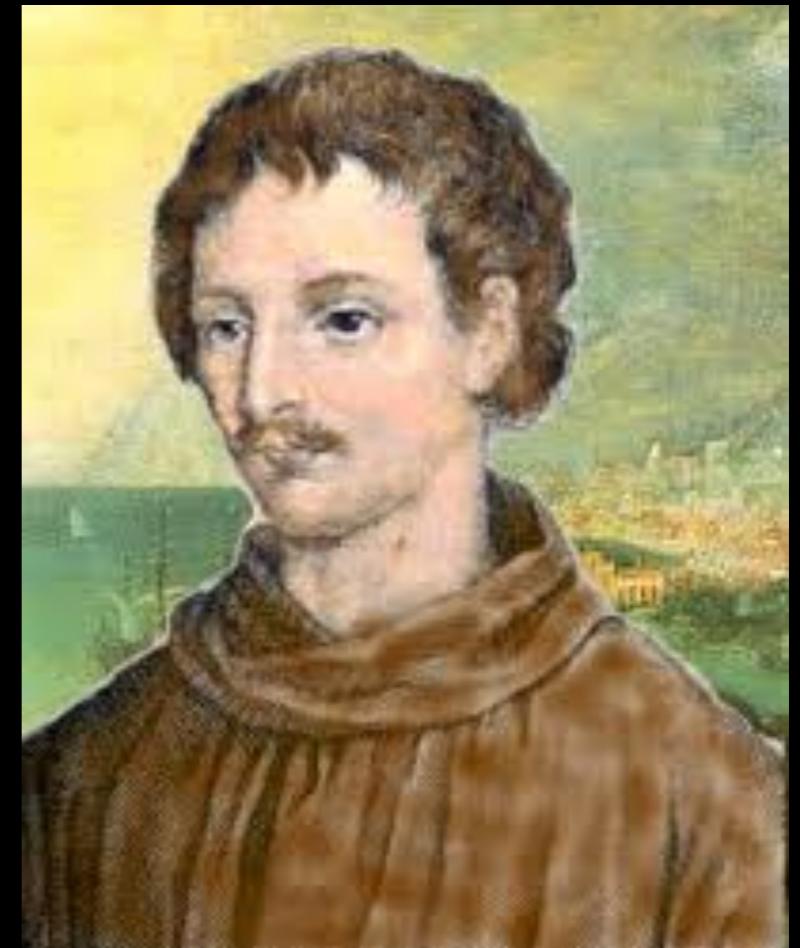




Retrograde motion is an apparent motion caused when one planet moves from being behind another planet to being in front of the other planet.



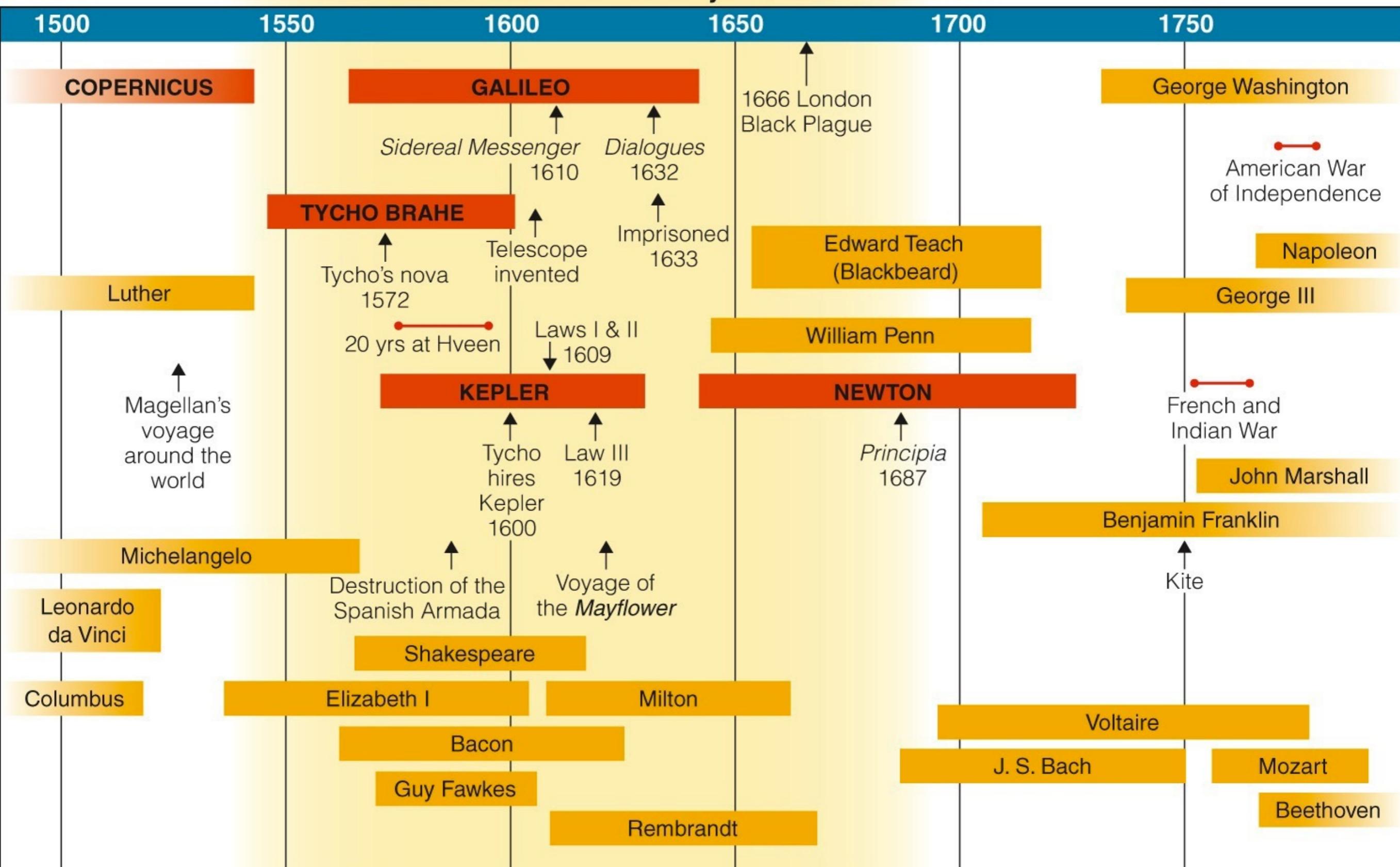
- Giordano Bruno (1548-1600) proposed that the Sun was a star and that the Universe contained an infinite number of inhabited worlds
- The Roman inquisition found him guilty of heresy and had him burned at the stake



1543

144 Years of Astronomy

1687



Tycho Brahe (1546-1601)



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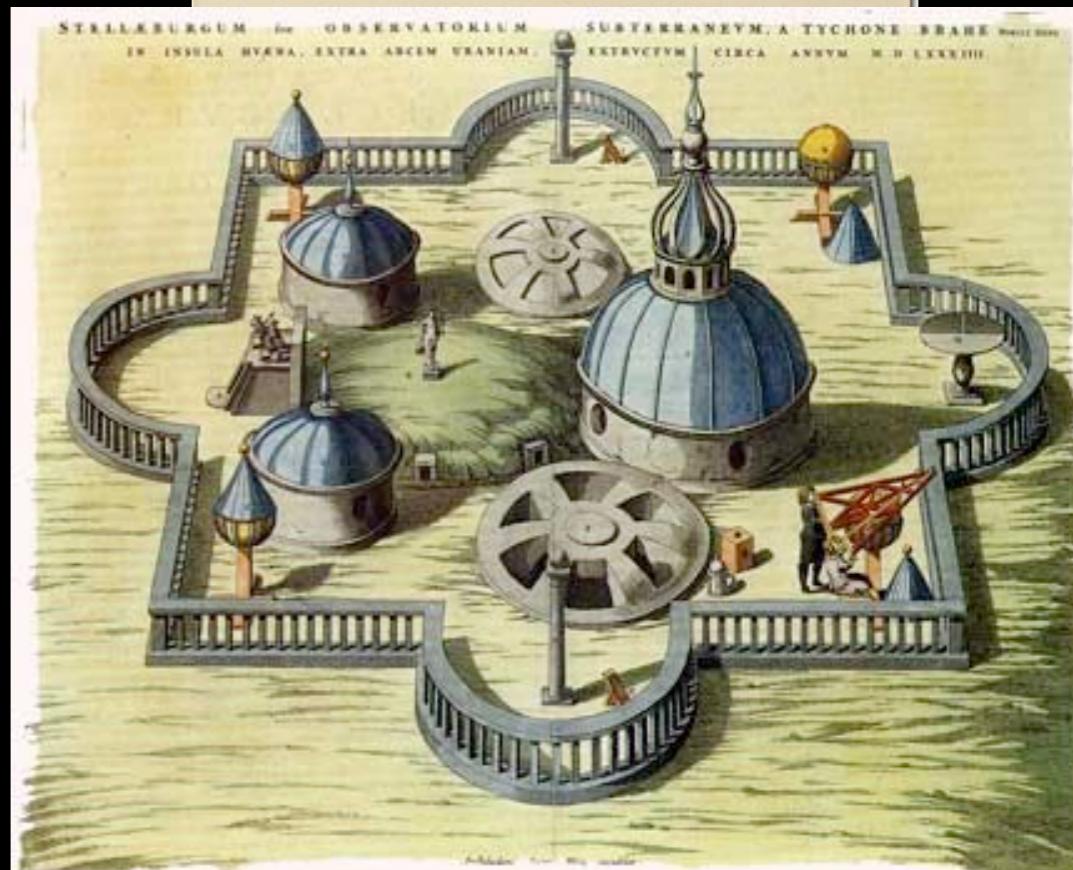
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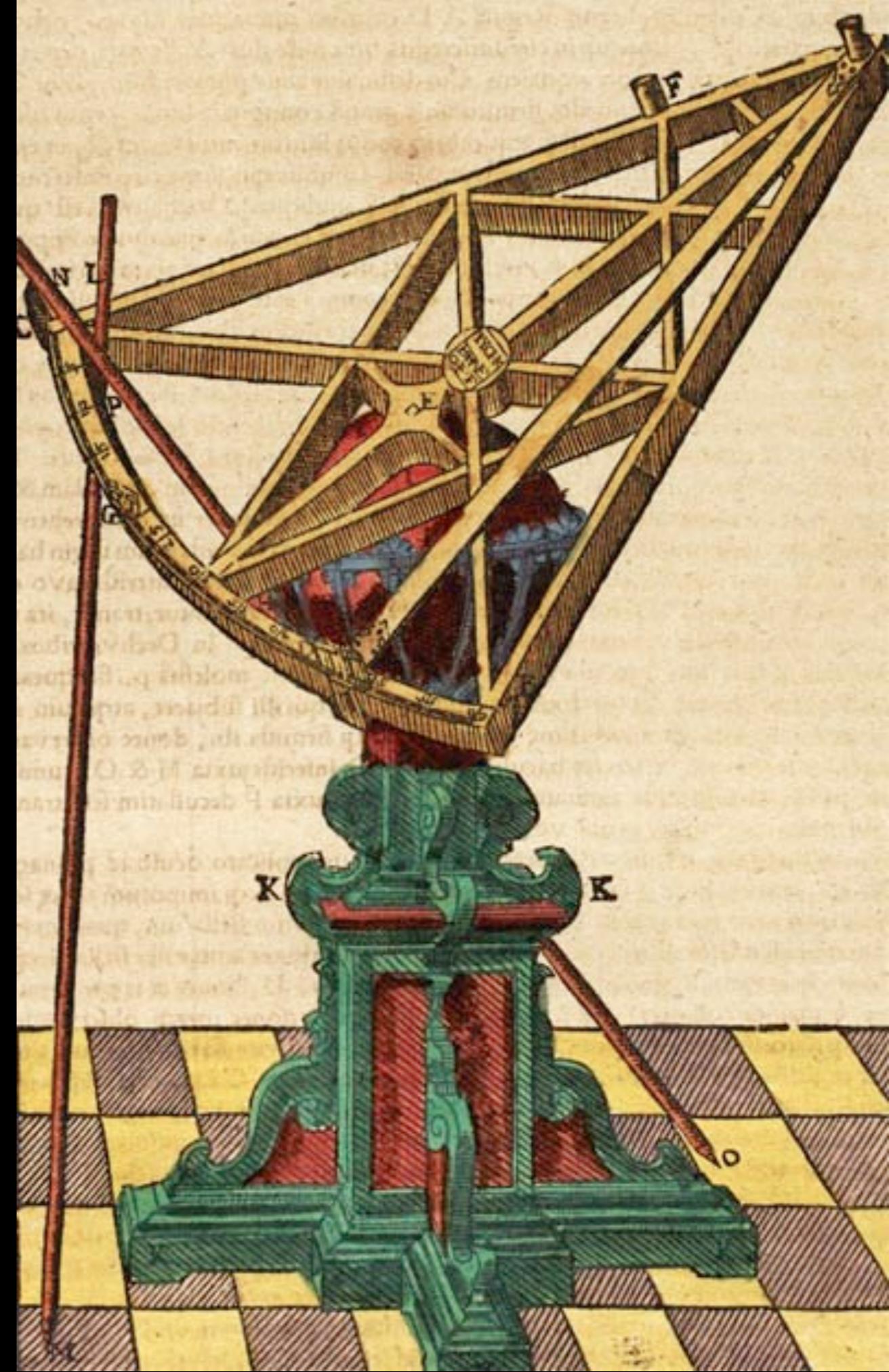
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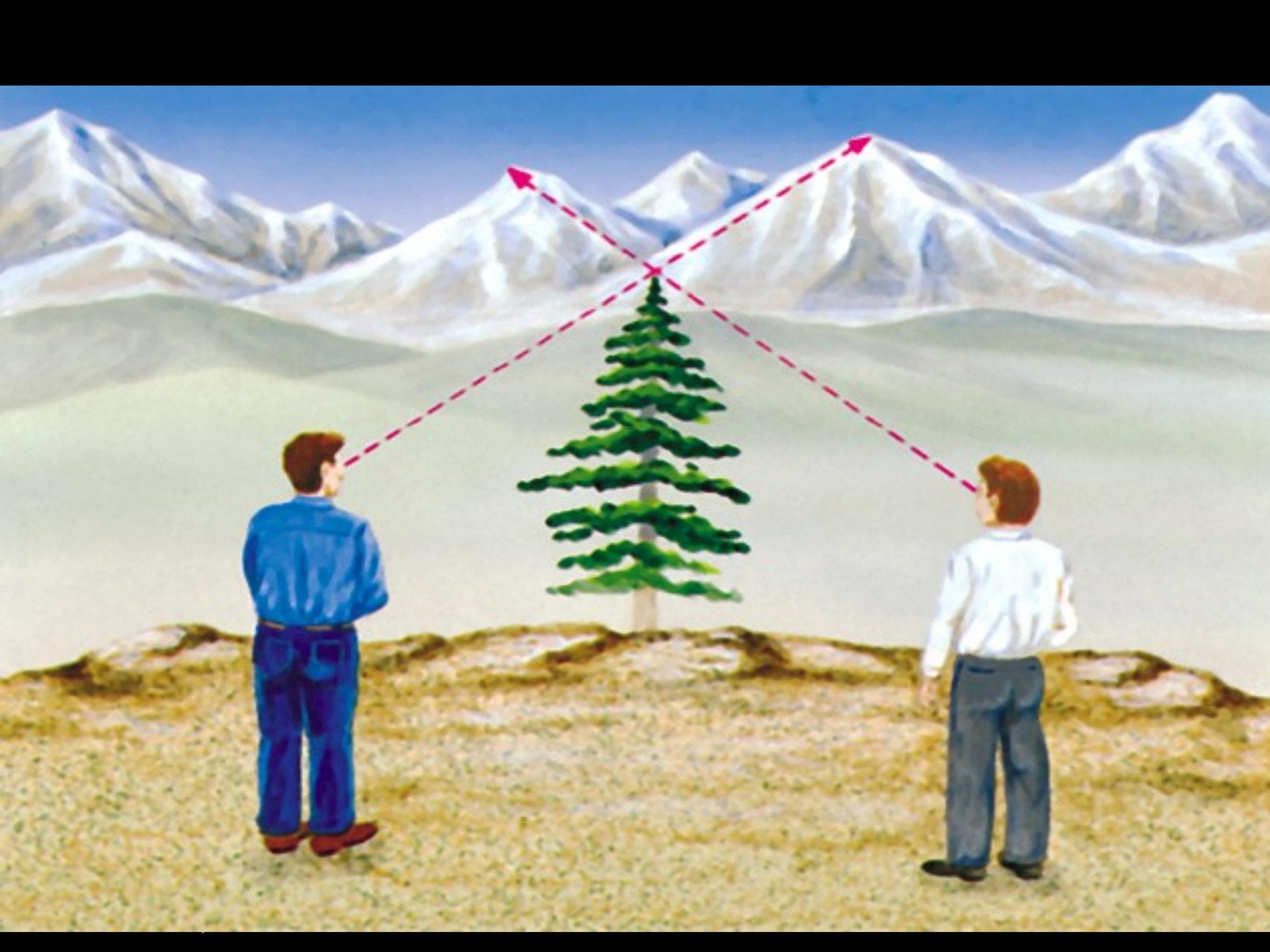
What do we
mean by
“Greatest
Naked-eye
Astronomer?”

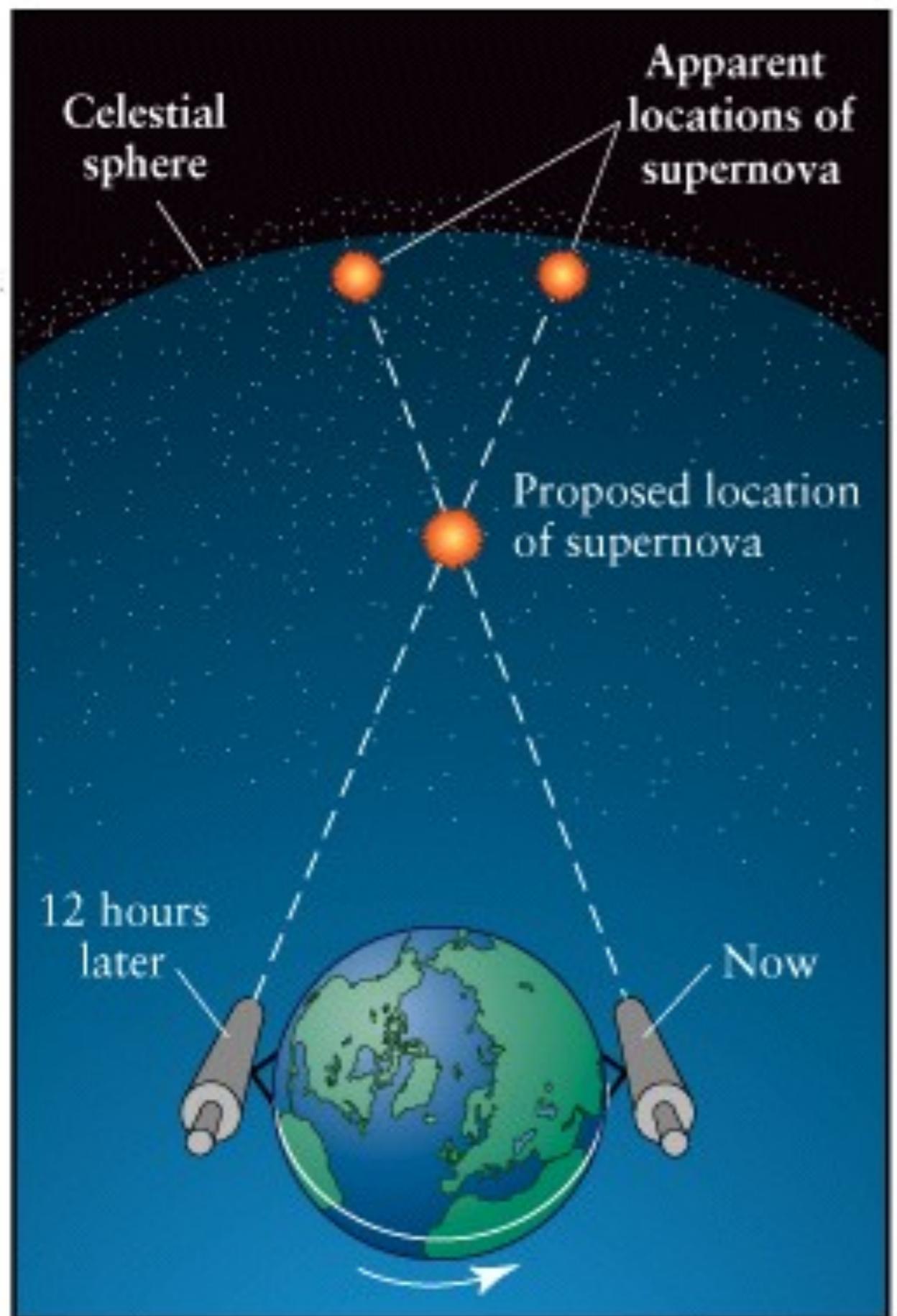


- Tycho Brahe (1546-1601) is remembered, in part, for wearing false noses to hide a dueling scar from his college days.
- Tycho lived BEFORE the invention of the telescope.
- His observatory was equipped with instruments for measuring the positions of the sun, moon, and planets using the naked eye and sights.

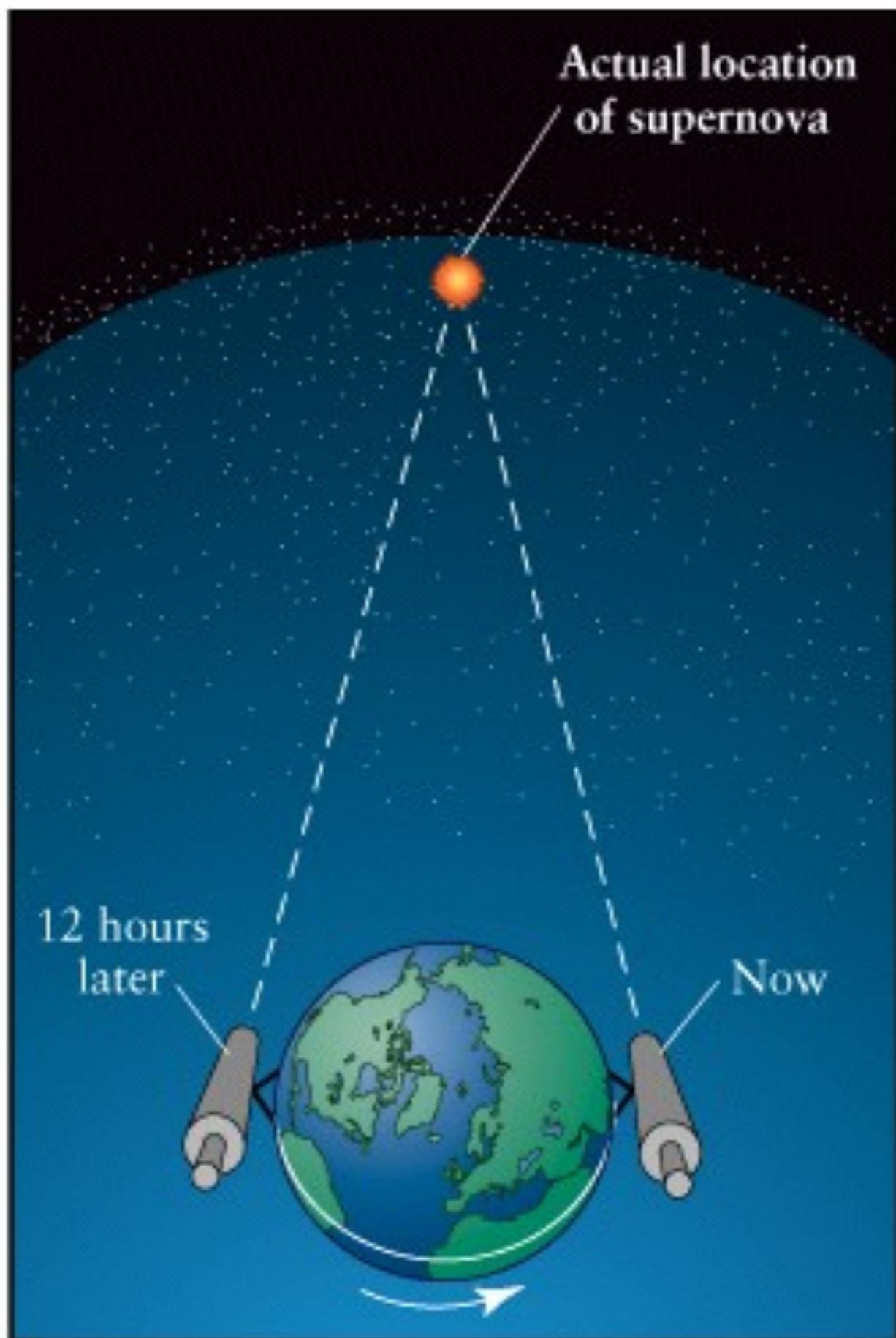








a



b

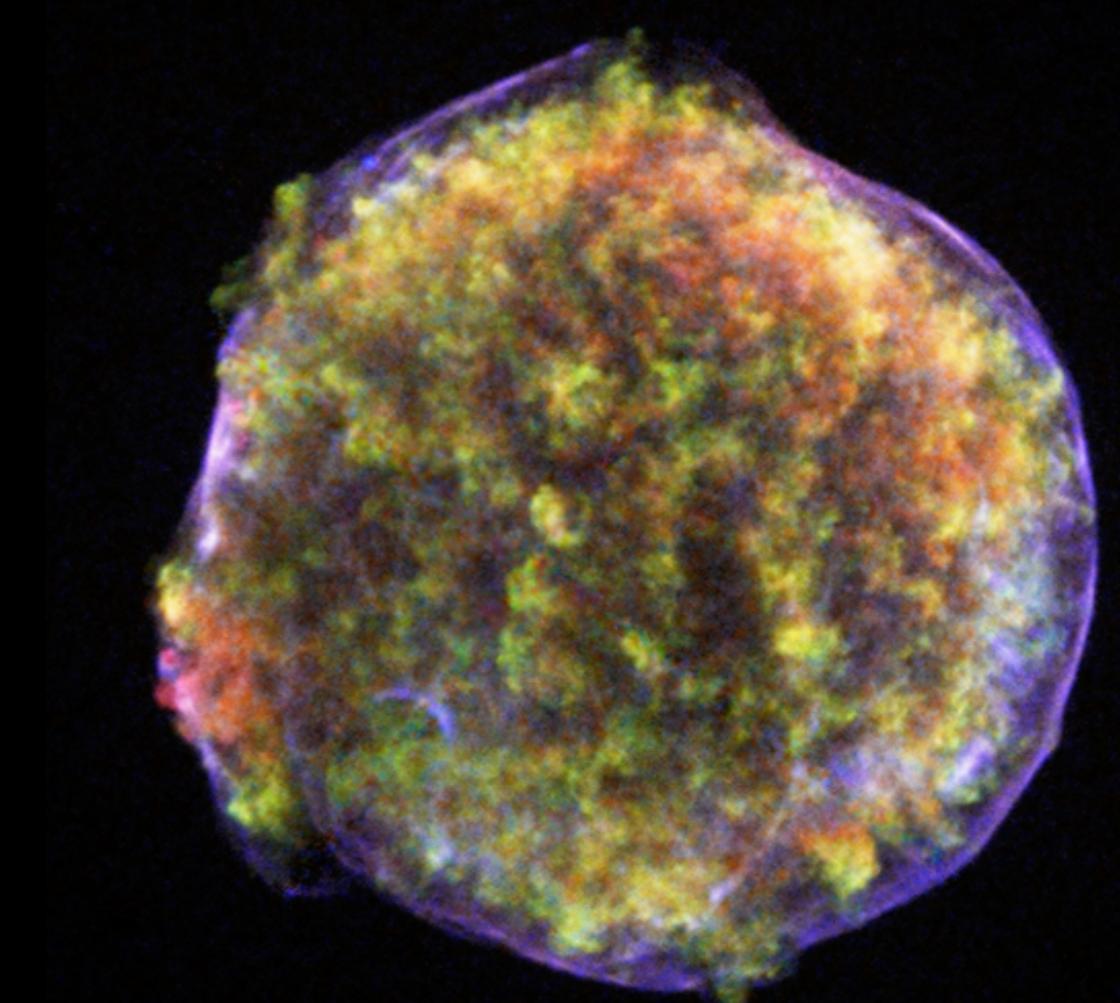
Tycho Brahe measured distances using parallax that disproved ancient ideas about the heavens

- He observed a supernova in 1572 and with this showed that the heavens were both changing and had a dimension of distance; this troubled scholars who previously thought the heavens were unchanging.
- He showed that comets were objects that occurred in the region of the planets, not in Earth's atmosphere.

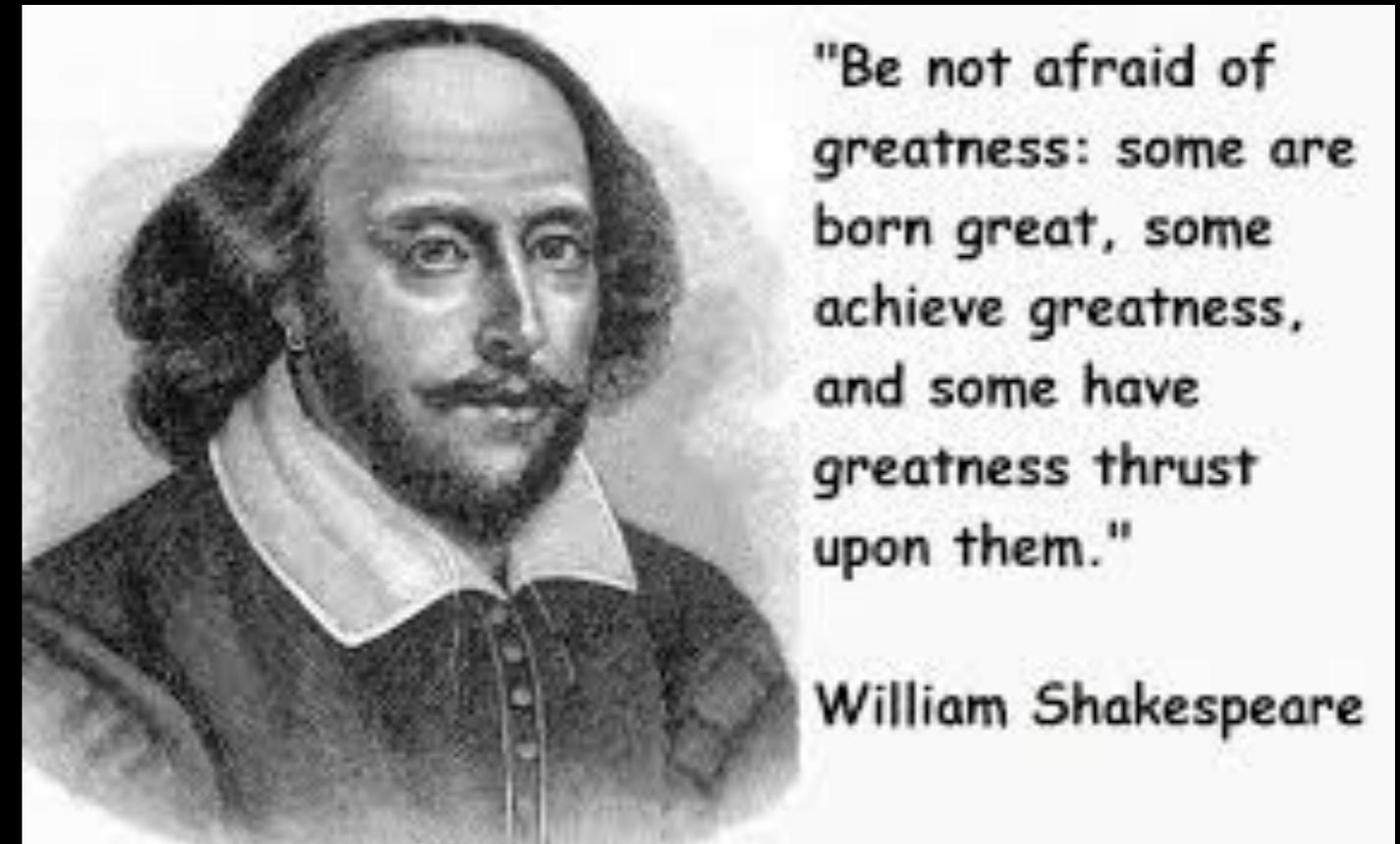
- In 1572, astronomers were startled to see a new star—now called Tycho’s supernova—appear in the sky.

- Tycho measured the new star’s position and showed it had to be far beyond the moon and was something changing in the supposedly **unchanging** starry sphere.

Modern X ray image of Tycho’s supernova



Brahe, Kepler and Galileo were all alive at about the same time which was the time of Shakespeare in the 1600s



Tycho's contemporary, Johannes Kepler had become a believer in the Copernican hypothesis.

By 1606, he developed
THREE Law's of planetary
motion



During his career, **Galileo Galilei** (1564-1642) adopted the Copernican model.

- He did NOT invent the telescope but was the first to use it for astronomy
- Observations led him to fully adopt the Copernican model





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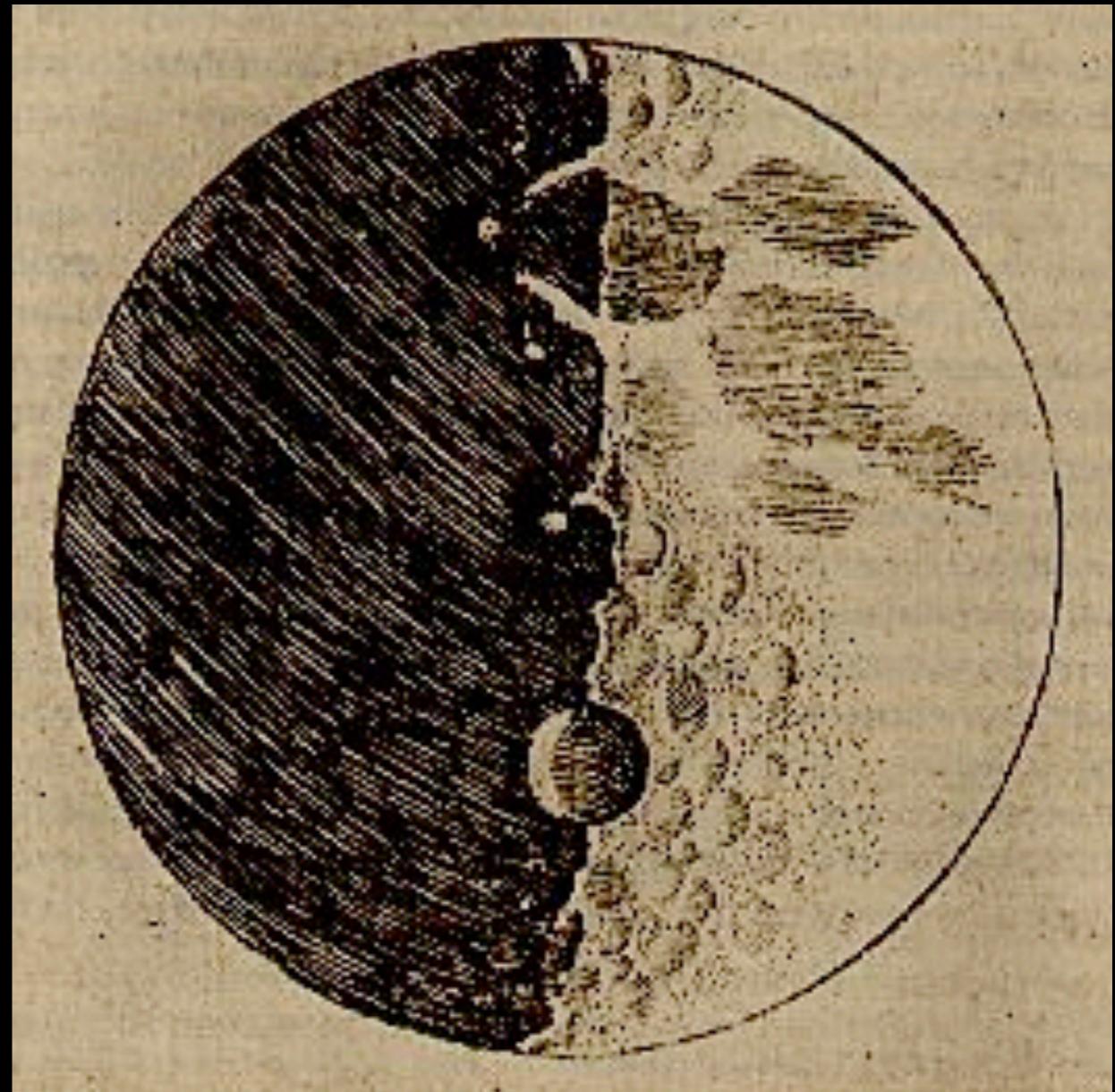
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Galileo's Observations

1) The moon is not perfect.

- It had mountains and valleys on its surface.
- Galileo used the shadows to calculate the height of the mountains.



Galileo's Observations

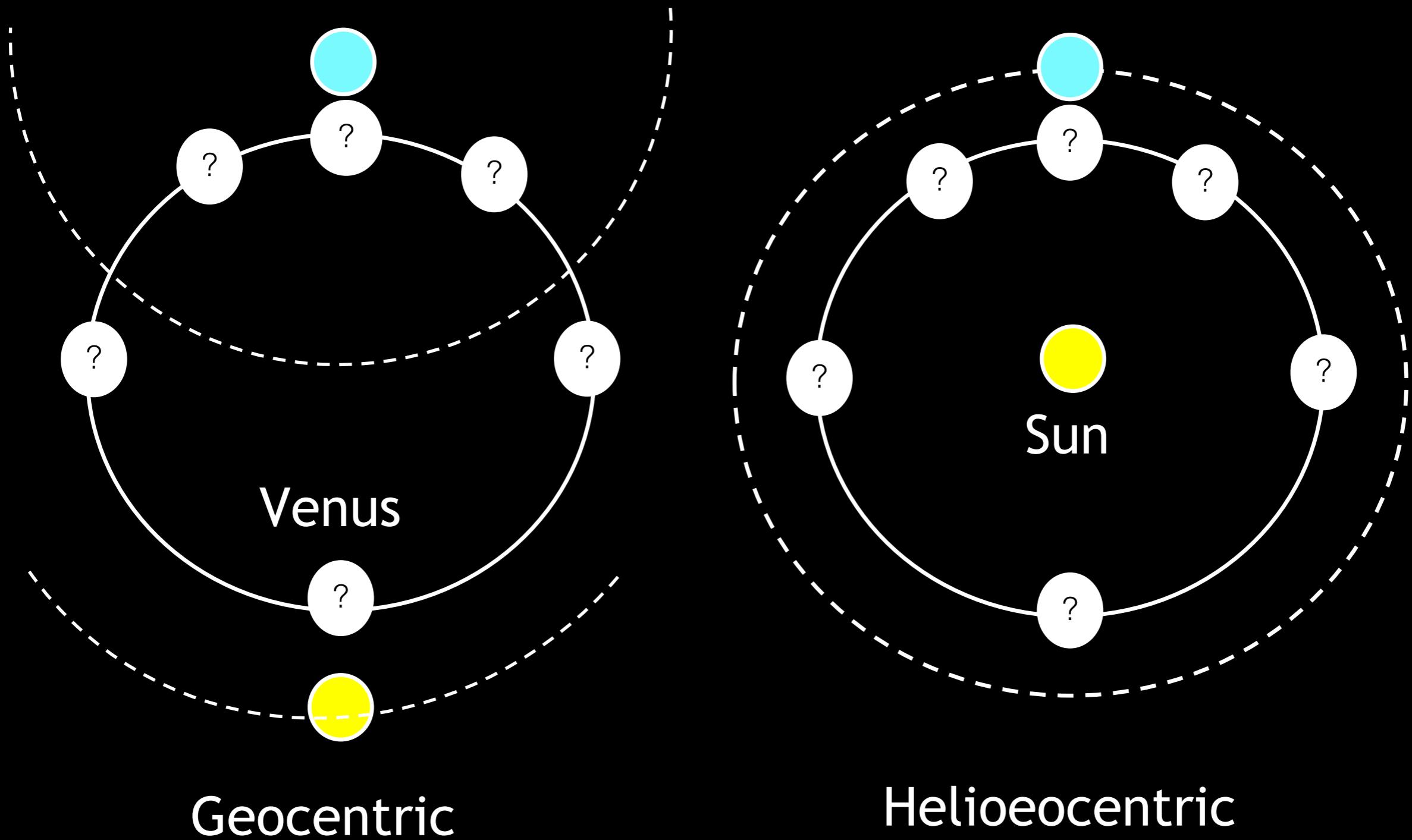
2) Four new ‘planets’ circling Jupiter.

- Today, these ‘planets’ are known to be the Galilean moons of Jupiter.
- Put another planet at the “center” of its universe

Observations January 1610			
2. Jan. 1610	Mar 11-12	O **	
30. March		** O *	
2. Febn.		O ** *	
3. March		O * *	
3. Feb. 5.		* O *	
4. March		* O **	
6. March		* * O *	
8. March 1610		* * * O	
10. March		* * * O *	
11.		* * O *	
12. H. 4. Augt.		* O *	
13. Augt.		* * O *	
14. Augt.		* * O *	

Galileo's Observations

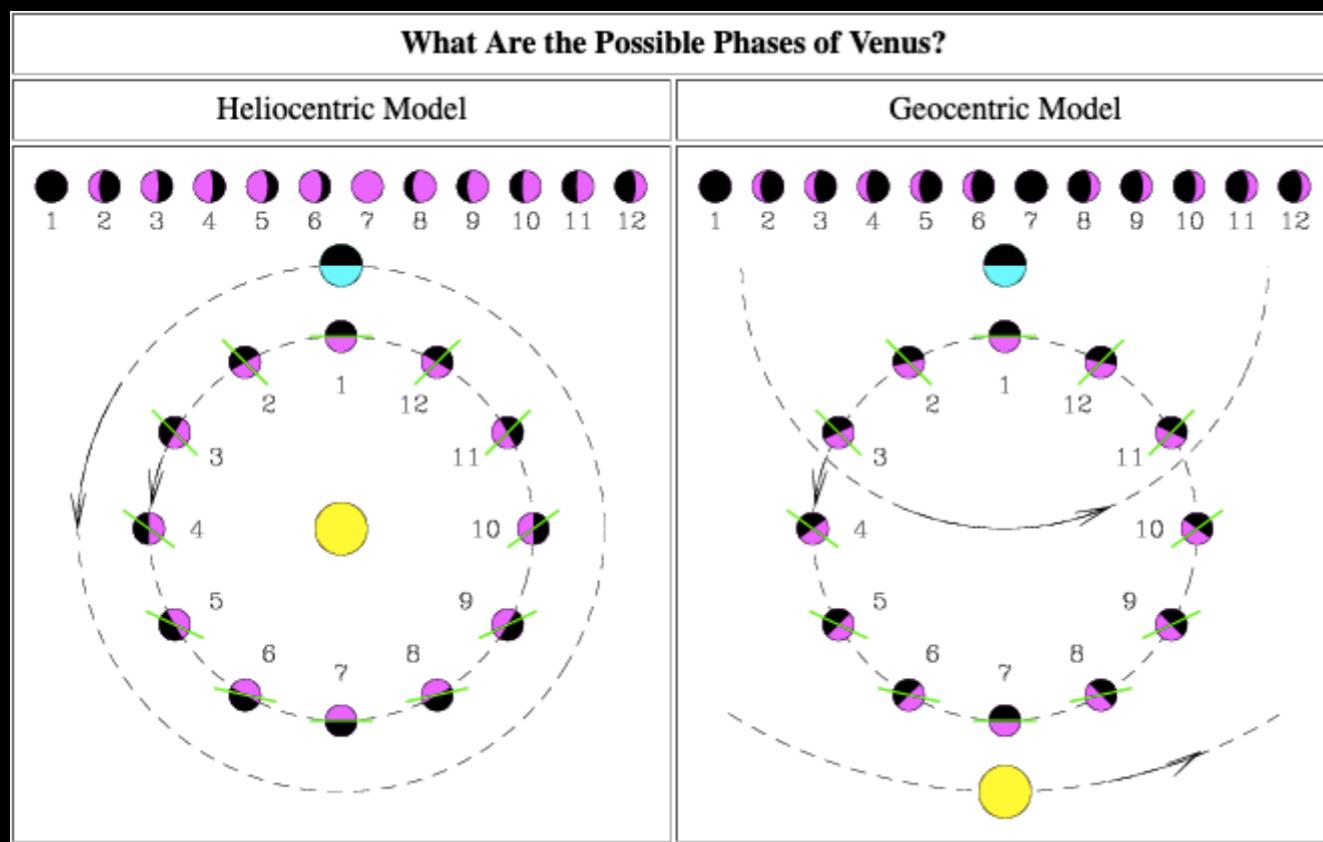
3) Phases of Venus



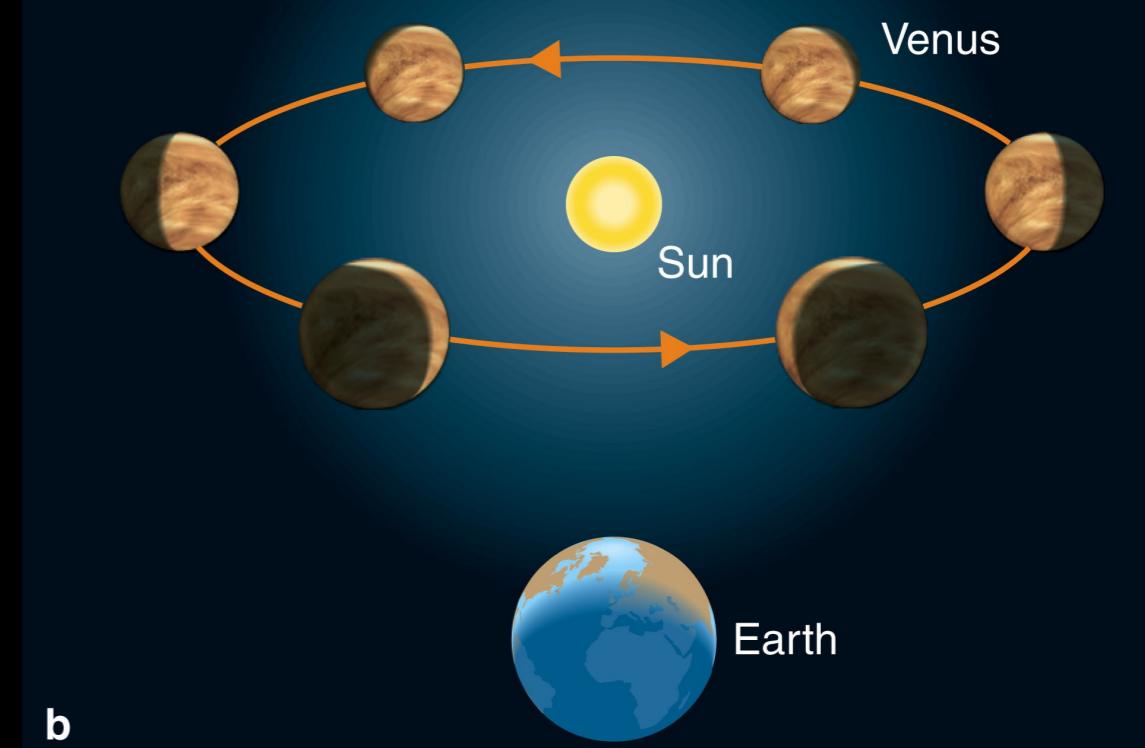
Galileo's Observations

3) Phases of Venus

- Only if the Sun is at the center of Solar system will Venus has phases



Copernican universe



Galileo's Observations

4) Stars in the Milky Way

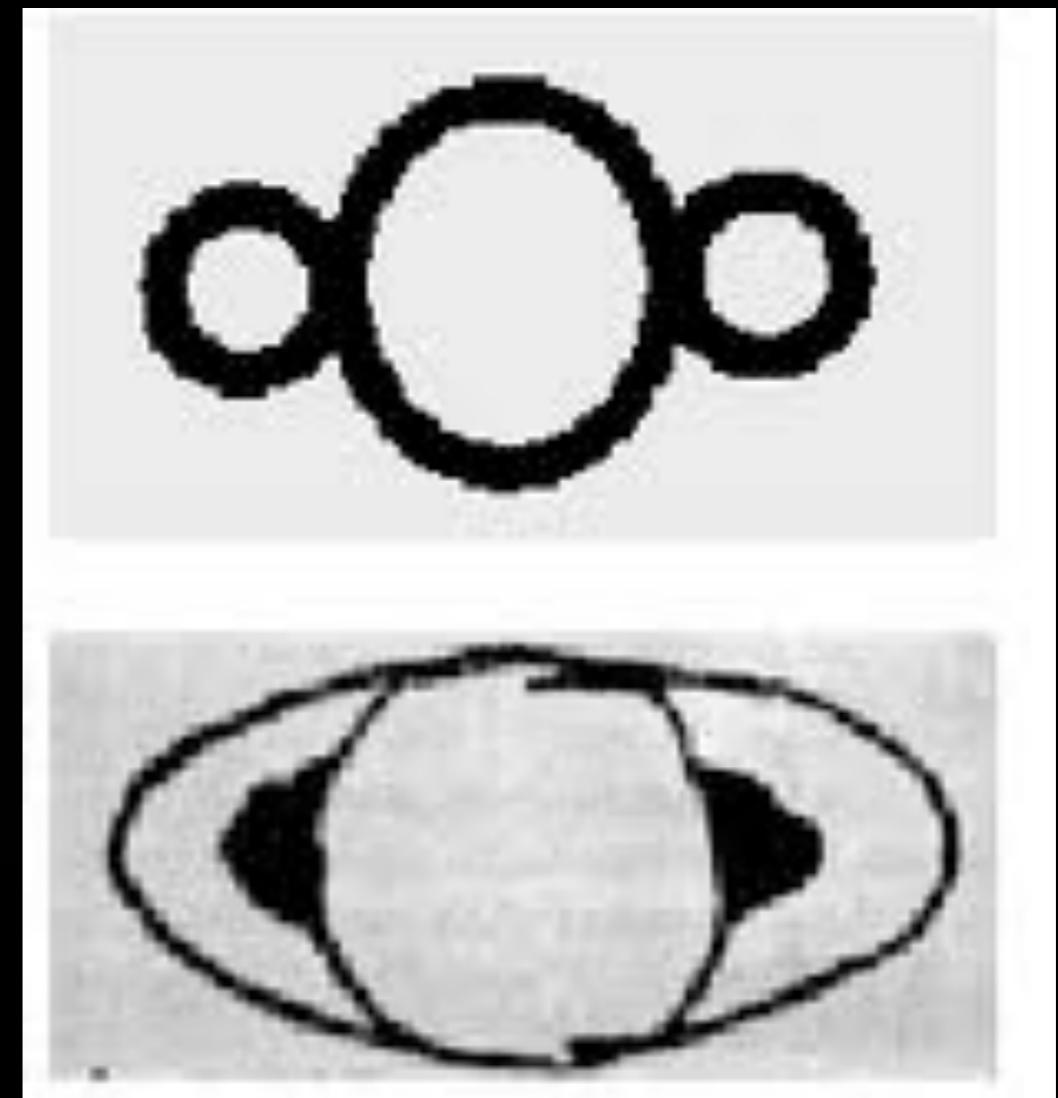
- Galileo saw that the Milky Way is made of individual stars adding to the imperfections of the spheres



Galileo's Observations

5) Saturn has rings

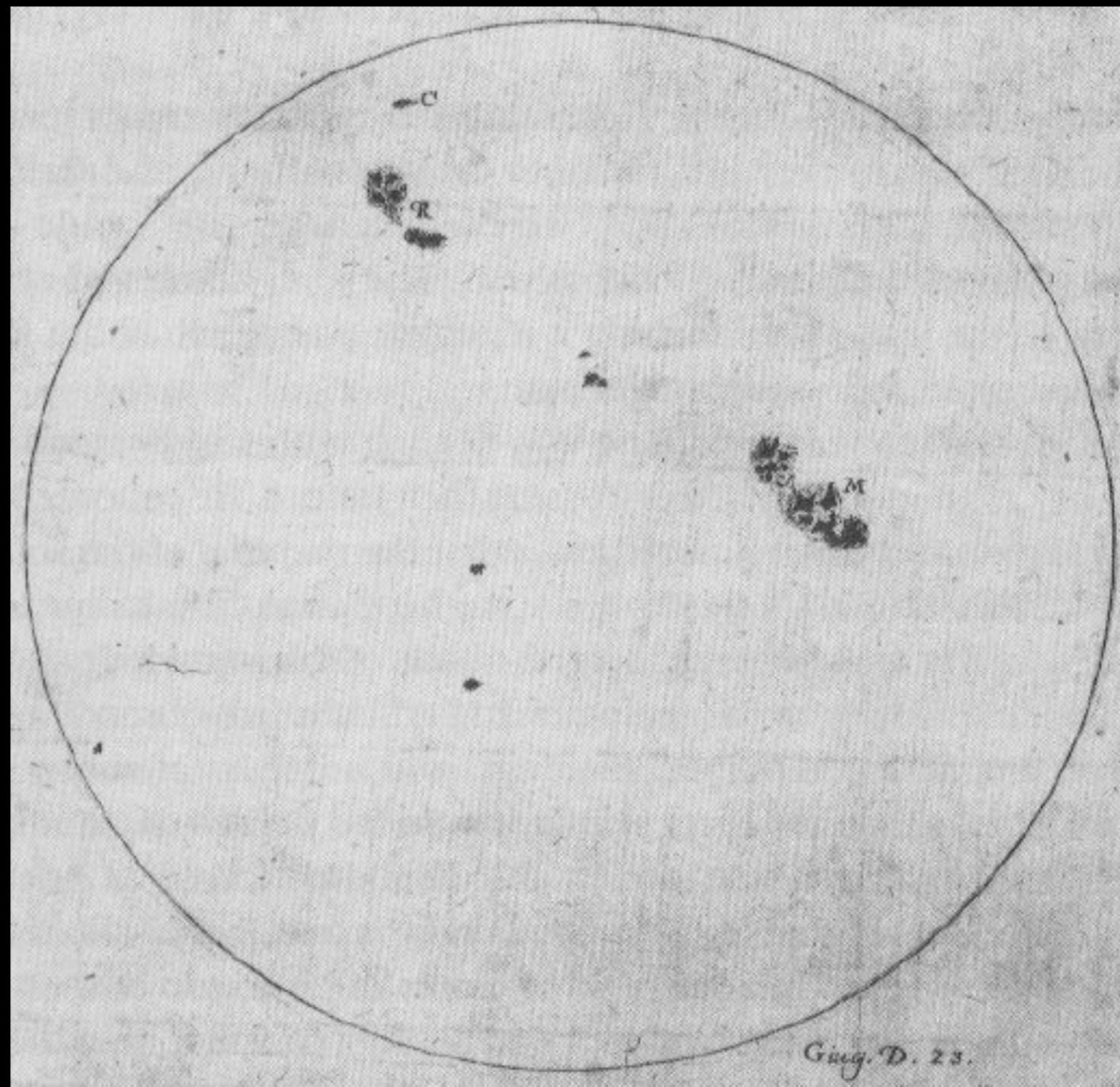
- Not a perfect sphere



Galileo's Observations

6) Sunspots

- Sun not a perfect sphere
- Galileo went blind in his old age



After Galileo aimed his telescope to the skies, it was apparent that wonders existed beyond what our naked eye can see



Trial of Galileo

- After publishing his findings, Galileo was interrogated by the Inquisition which condemned him NOT for heresy but for disobeying the orders given him in 1616.
- He was sentenced to life imprisonment and was confined to his villa for the next 10 years
- He died there in 1642, 99 years after the death of Copernicus

1992 - Pope John Paul II claims the sentence was a mistake

2008 - Vatican declares him a hero of faith and science

