

Astro 190 Winter 2018

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- Required text: Ostriker & Mitton (\$25?)
 - *One or two chapters per week*
- About math and algebra
- About homework, term papers, & guest lectures
- About grades
 - homework (7@50% total), 2 term papers (15+25%), participation (10%)
- About the struggle
 - Thinking and visualizing are key parts of the course
 - *I’m here to help!*

Reading: Prologue, Chapter 1 this week

Homework 1: coming by email in a day or two. Due January 14. Research: *use the internet as needed.*

Is there a cosmic purpose?

Any answer lies far beyond the scope of science!

When Did Humanity Begin to Ponder the Birth and Purpose of the Universe?

- There is a preponderance of evidence that there was a Birth
 - We have a corpus
- There is no evidence that the Universe has a purpose
 - We don't have an agreed or testable purpose or motivation
 - So we fake it!
 - Cultures love to make up stories (“cultural stories”)
 - with no interest in evaluating their veracity
 - Typically, the stories invoke sentient and powerful deities with oversized abilities (that are impossible for mortals) and diverse motivations who control events and our experiences (if not our very lives)
 - What are some Judeo-Christian examples?

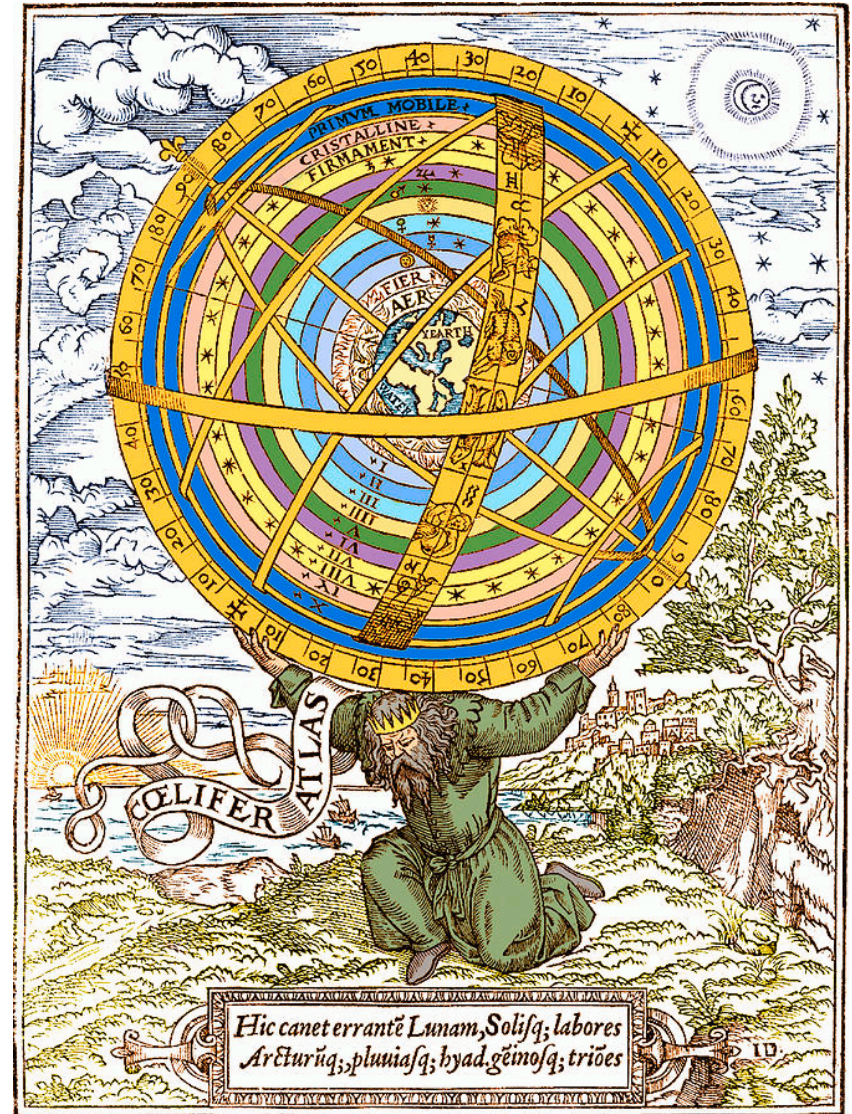
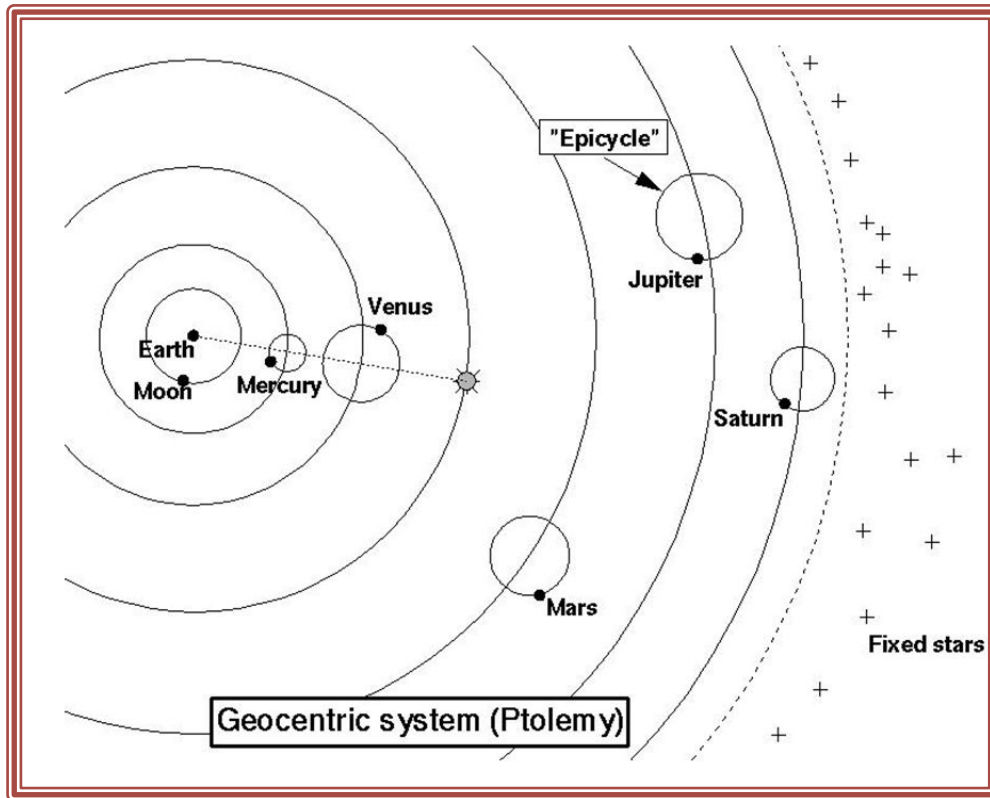
The ancient Greeks invented science as a means to understand their world

- The ancient Greeks inherited a set of argumentative and powerful supernatural beings from earlier local cultures. Their decisions allegedly (but mysteriously) explain our experiences.
 - “gods of the gaps”: replacing ignorance with fables-legends
 - The same type of history applies to Judaism (Gary Martin lecture)
- Science began when Thales et al. (~624-546 BCE) embraced the heretical notion that experience is governed by natural, universal, and timeless laws that we are capable of
 - recognizing and articulating (science and math) and
 - exploiting for our benefit (engineering)

Early Cosmology

- The early physical laws and concepts of cosmology arise from
 - careful observations of the skies and motions of the planets using primitive technology,
 - vivid imaginations, and
 - intense determination to fill the gaps
 - (later assembled into a credible cosmology by Aristotle and Plato)
- **Geocentric** model for the cosmos.
 - Earth is huge and massive, so it takes the central position
 - **Is geocentrism really only egocentrism?**

Geocentrism



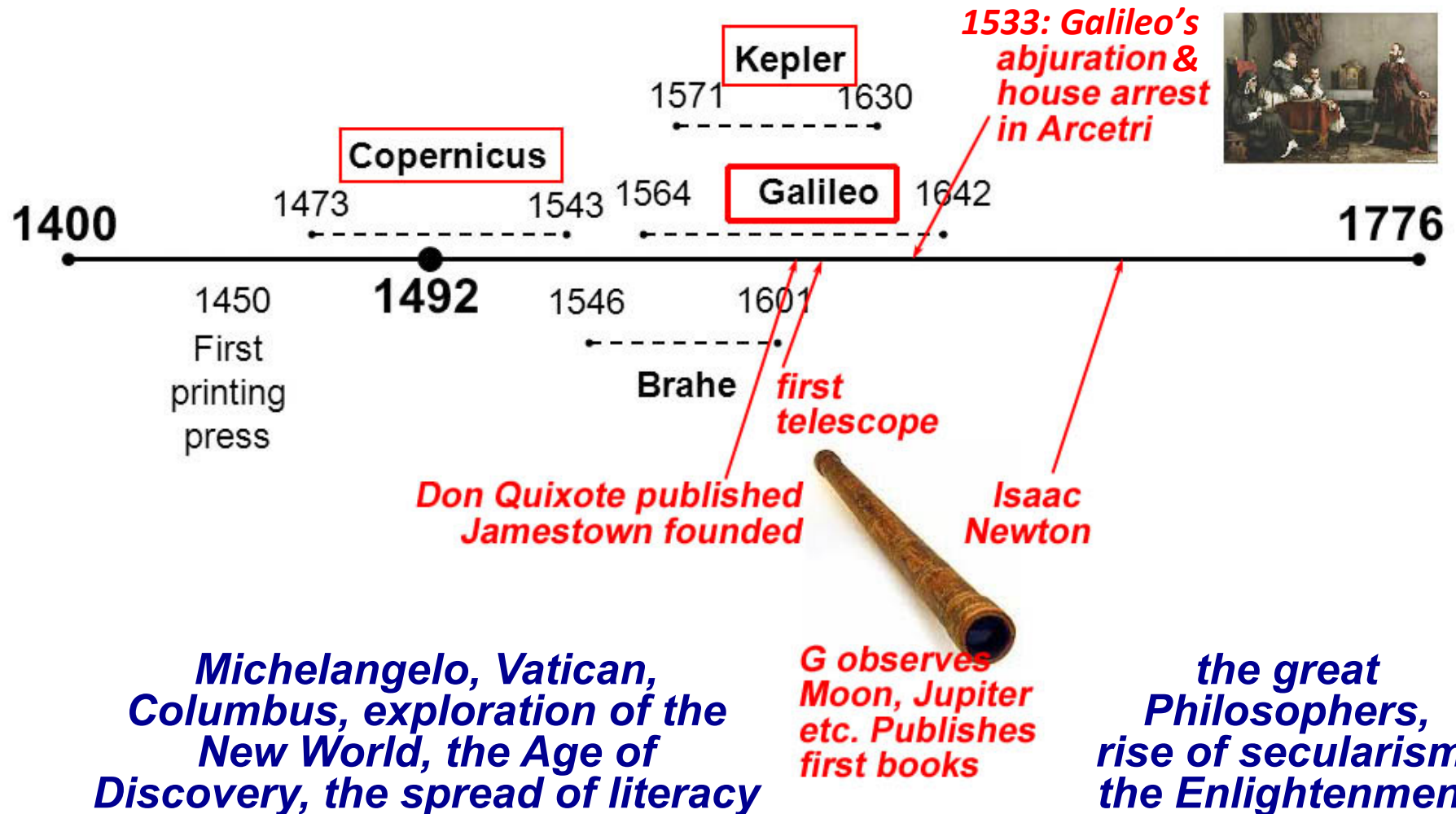
***Geocentrism:
It seems so right!***

Why don't you believe it now?

Post-Roman Cosmology

- Geocentrism morphed from a geometric-mathematical model to theological dogma before the early Renaissance
 - at first we didn't have the tools to evaluate the model
 - there were no contending models that worked any better
 - The Vatican insisted that geocentrism reflected God's intention of placing us at the very (and unique) center of the action
 - The Renaissance was an era of increasing literacy, curiosity, and skepticism of established notions
 - Copernicus proposed a radical model of the Sun at the cosmic center
 - Galileo was a cynic of everything Aristotelian. The telescope provided him with a vital new tool to undermine geocentrism. He used it brilliantly.
 - First, his images of the orbiting Jovian moons G's showed that the Earth is not the center of all orbital motions
 - Soon thereafter telescopic his observations of the phases Venus were starkly incompatible with geocentrism

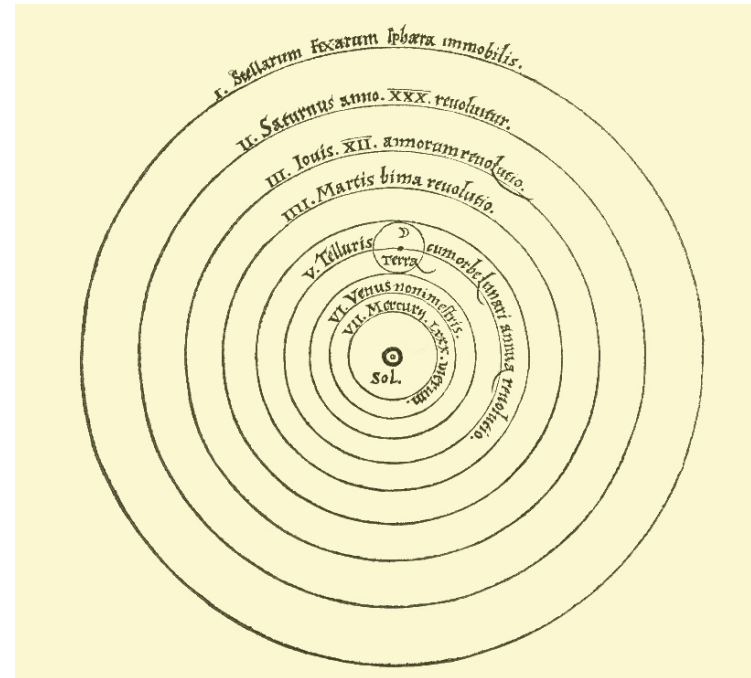
Timeline: Renaissance Astronomy and the second great Era of Discovery



Nicolas Copernicus

(1473-1543, primarily Poland)

Sun in Greek:
"ilios" ἥλιος



Heliocentrism: The currently fashionable model.

*You have been taught that this model is correct.
Is that what makes it more credible than other models?*

Giordano Bruno

(1548-1600, primarily Tuscany)

There are countless suns and countless earths all rotating round their suns in exactly the same way as the seven planets of our system.

The unnumbered worlds in the universe are all similar in form and rank and subject to the same forces and the same laws.

Destroy the theory that Earth is the centre of the universe.

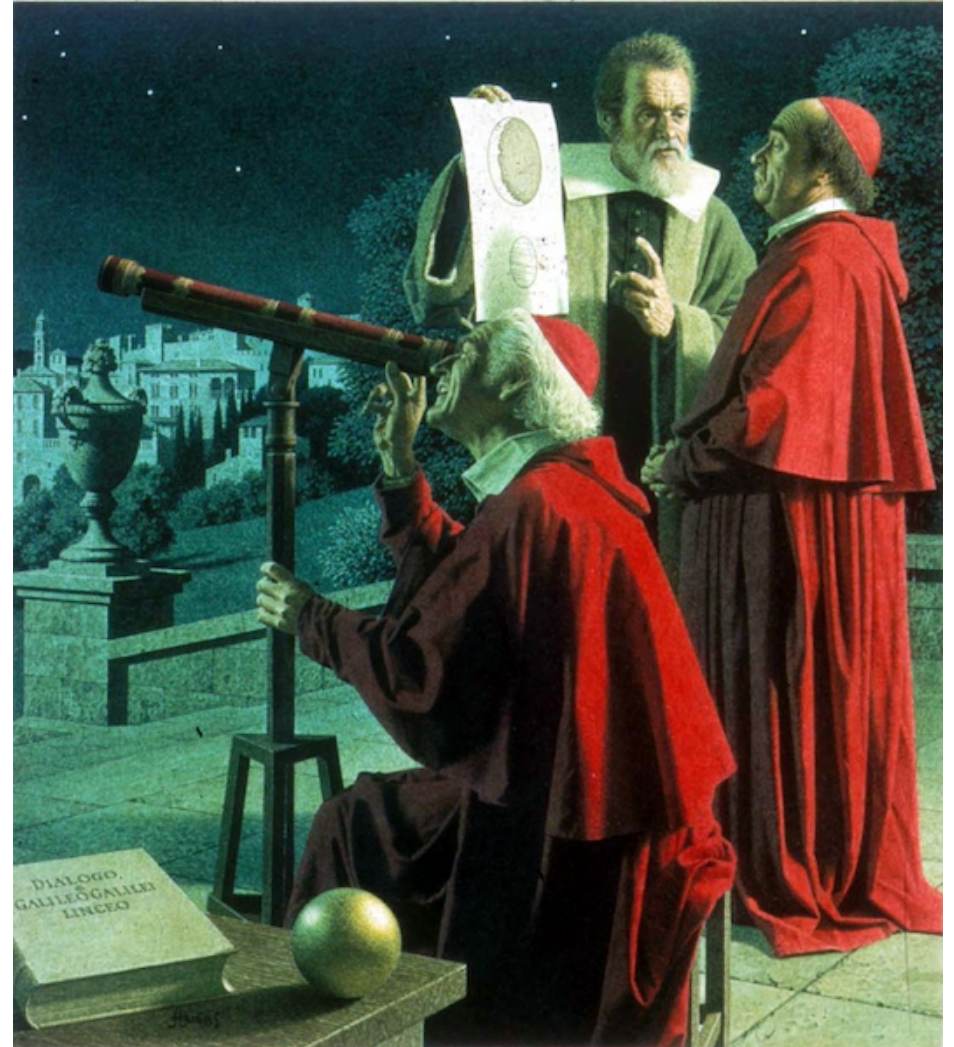
Take comfort, though, when all men will be enlightened.

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burn
the In



Galileo Galilei (a pesky nerd)

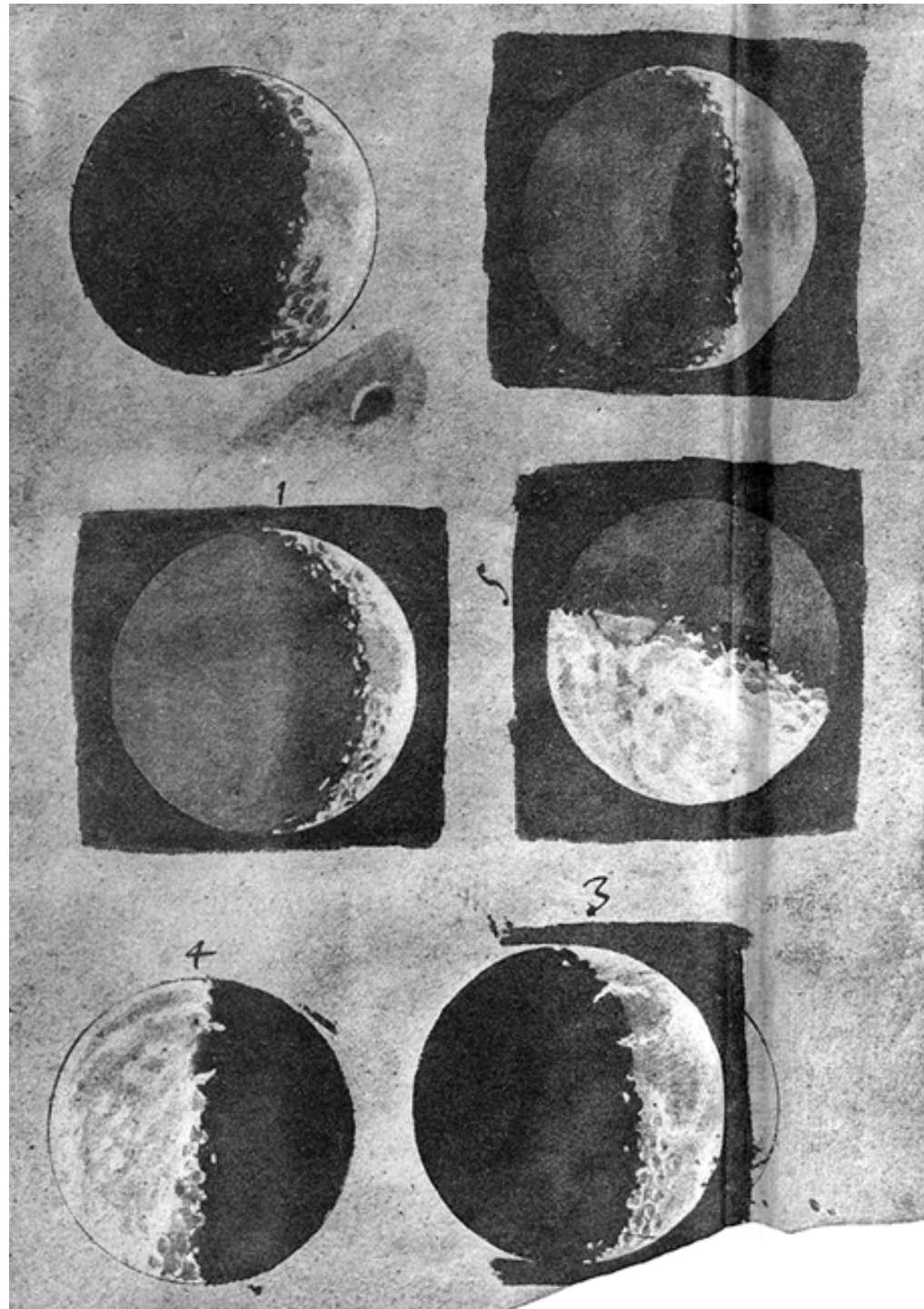
(1564-1642, primarily Tuscany)



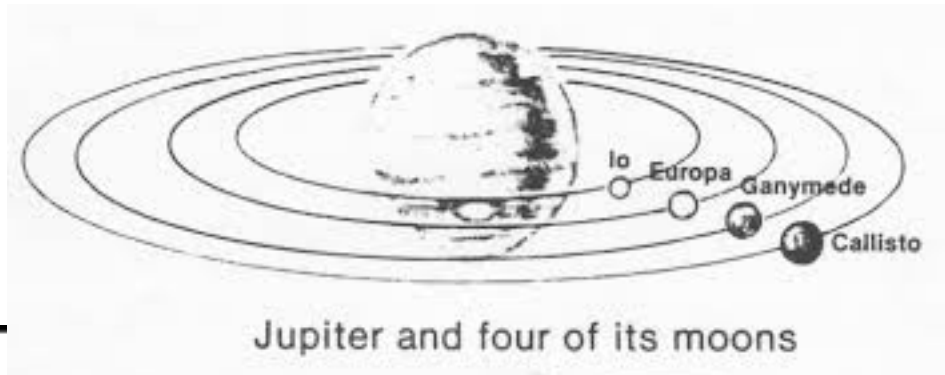
Galileo's observations stripped the myths of heavenly perfection and our divine place in the heavens.

Galileo's first telescopic observations:
The Moon (Padova, 1609).

Talk about imperfect heavenly bodies!



and this

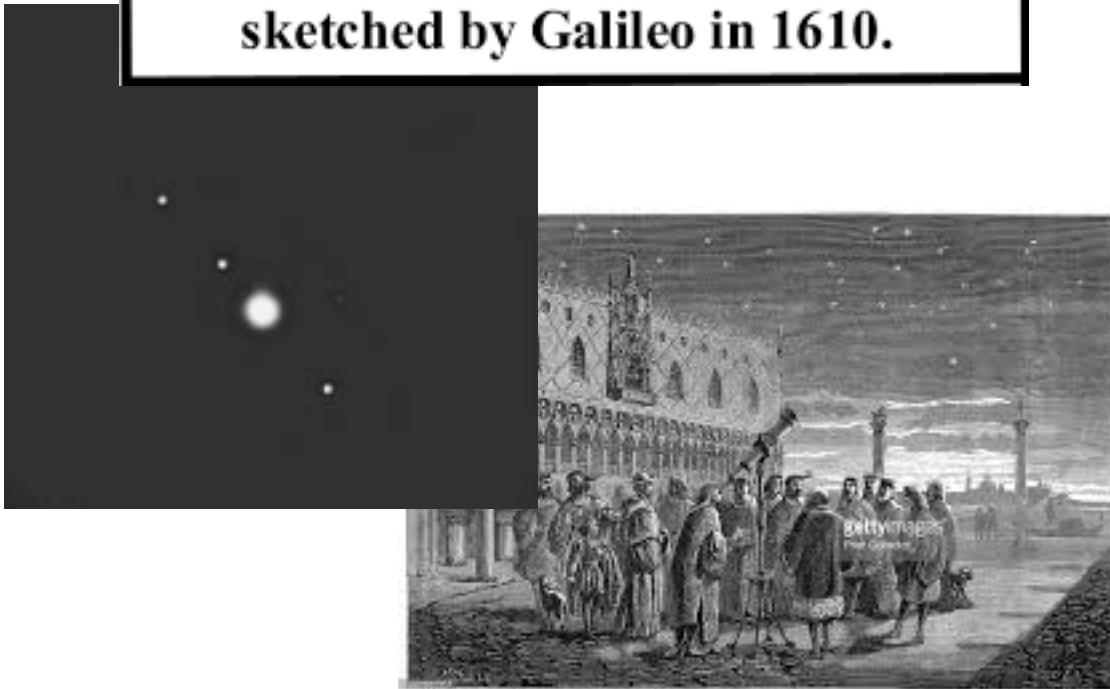


Jan 7	Jan 8	Jan 13	Jan 15

Jupiter and its moons as seen and sketched by Galileo in 1610.

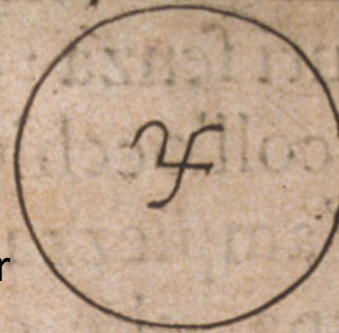
Observationes Iovis
1610

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3. mane	** ○ *
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3. mane	○ * *
3. Ho. r.	* ○ *
7. mane	* ○ **
6. mane	** ○ *
8. mane H. 13.	* * * ○
10. mane	* * * ○ *
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13. mane	* * ○ *
14. mane	* * * ○ *

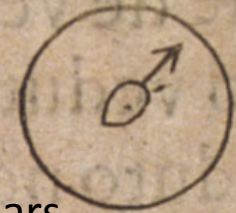




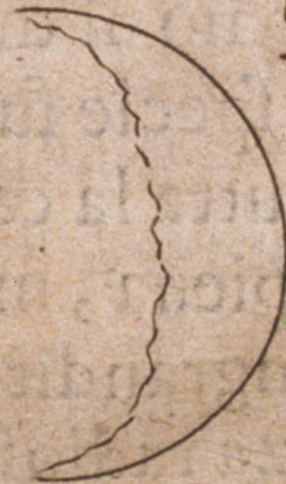
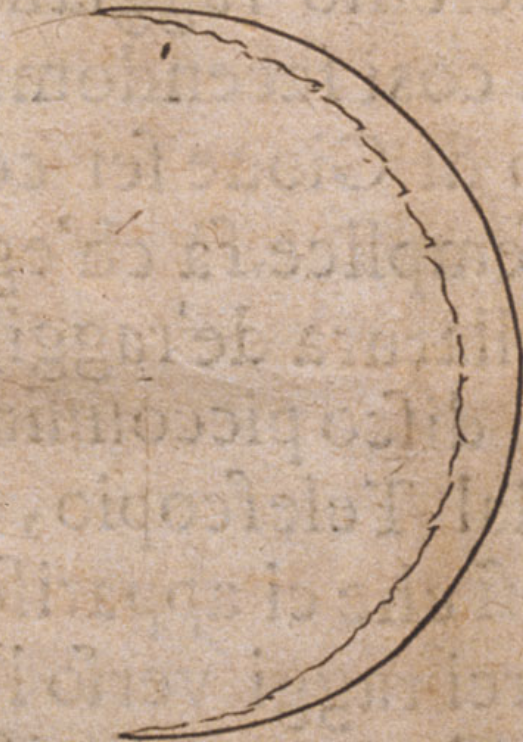
Saturn



Jupiter



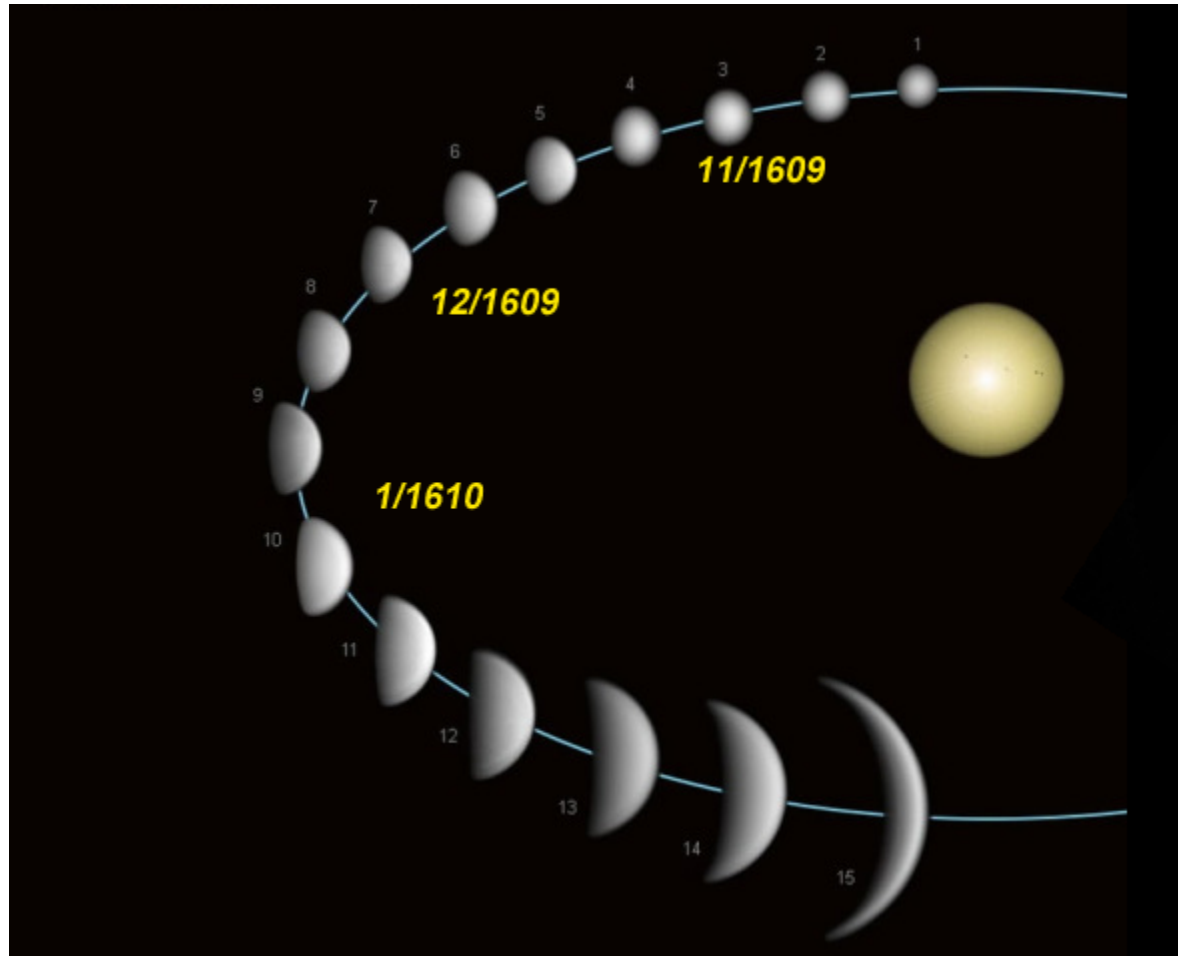
Mars



Venus

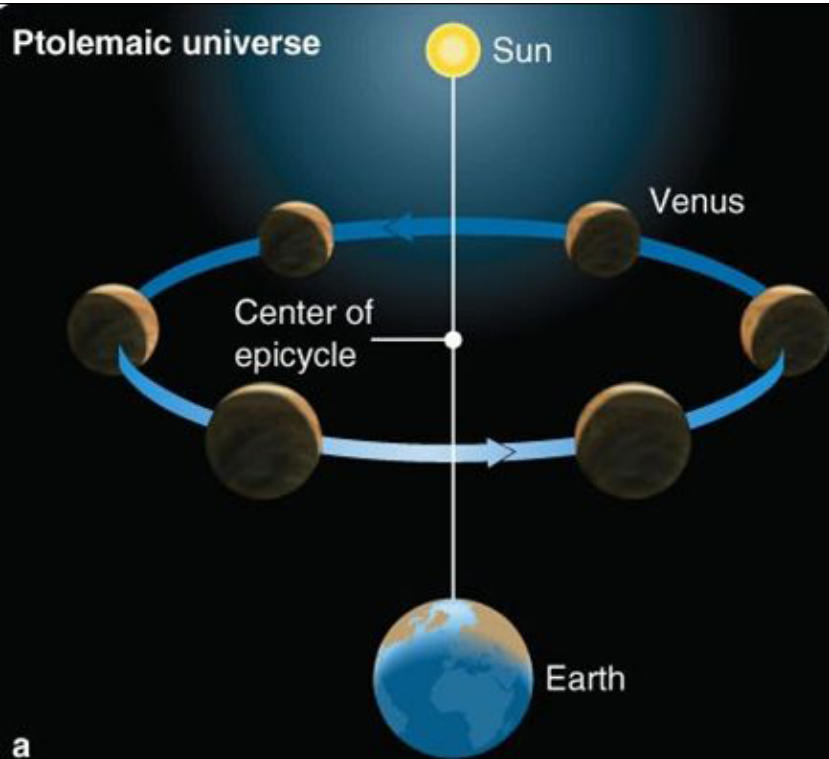
The “phases” of Venus:
inconsistent with geocentrism!

Phases of Venus Galileo saw this:



"The bible teaches us how to go to heaven, not how the heavens go." – Cardinal Baronius
(mistakenly attributed to Galileo)

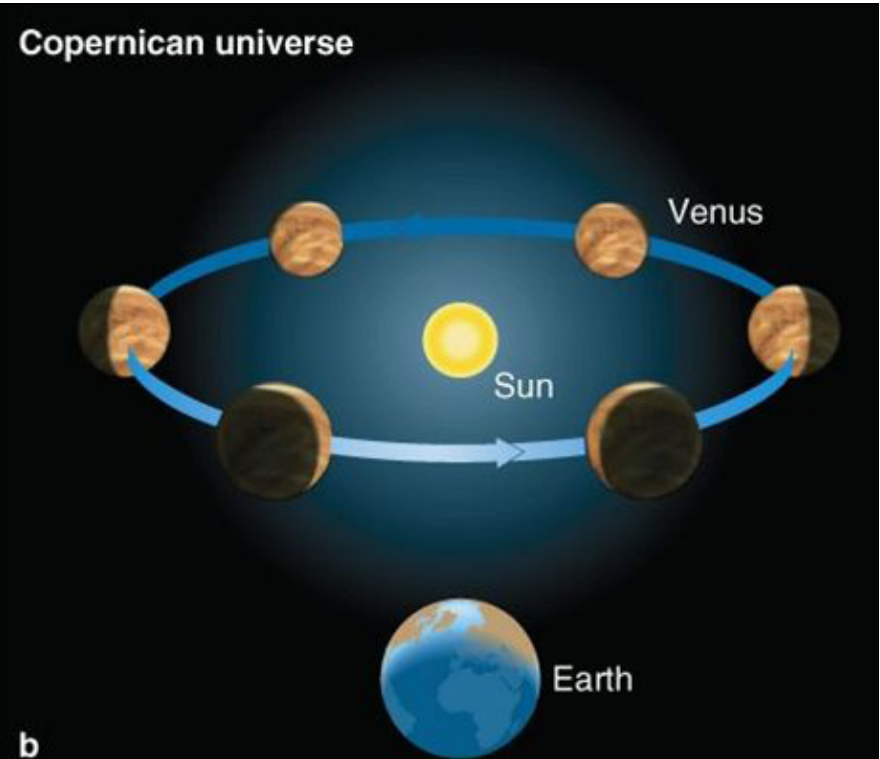
Geocentric Model



a

a) If Venus moved in an epicycle on the Earth-Sun line, it would always appear as a crescent.

Heliocentric Model



b

b) Viewed through Galileo's telescope, Venus is seen to go through a full set of phases, consistent with the Copernican world-view, and contradicting the Ptolemaic one.

