The Galileo Affair

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THE UNIVERSITY OF MELBOURNE

history & PHILOSOPHY OF SCIENCE

Victorian Certificate of Education

RELIGION AND SOCIETY

STUDY DESIGN

Unit 4: Religion, challenge and change

This unit focuses on the interaction over time of religious traditions and the societies of which they are a part. For a large part of human history religion has been a truth narrative, offering a means for finding answers to the big questions of life. Religious traditions are in a dynamic process of engagement and negotiation with members individually and collectively, as well as with other key institutions in wider society associated with power, authority and credibility. Religious traditions are living institutions that participate in and contribute to wider societies – both positively and negatively. They stimulate and support society, acting as levers for change themselves and embracing or resisting forces for change within society.

Religious traditions are in a constant state of development as members apply their talents and faith to extend the intellectual and aesthetic nature of the beliefs, of their expression and of the application to their lives. In the interaction of religious traditions and society there are also opportunities for development from significant challenges including the needs and insights of their membership, and of people and groups within wider society. These challenges and the religious tradition are influenced by broader contexts such as changing economic, political and social conditions.

A challenge is a situation that stimulates a response from society and/or religious traditions. Religious traditions take stances for or against challenges, or they take a stance of indifference. Consequently, actions are implemented which involve different aspects of the religious tradition. These actions may resist or embrace change and affect wider society and/or the religious tradition itself. A key aim beyond resolution of the challenge itself is for the religious tradition to retain integrity, authenticity and, ultimately, identity. However, the interaction between religious traditions and society may not always achieve these aims and there may be a series of interactions as a challenge is negotiated.

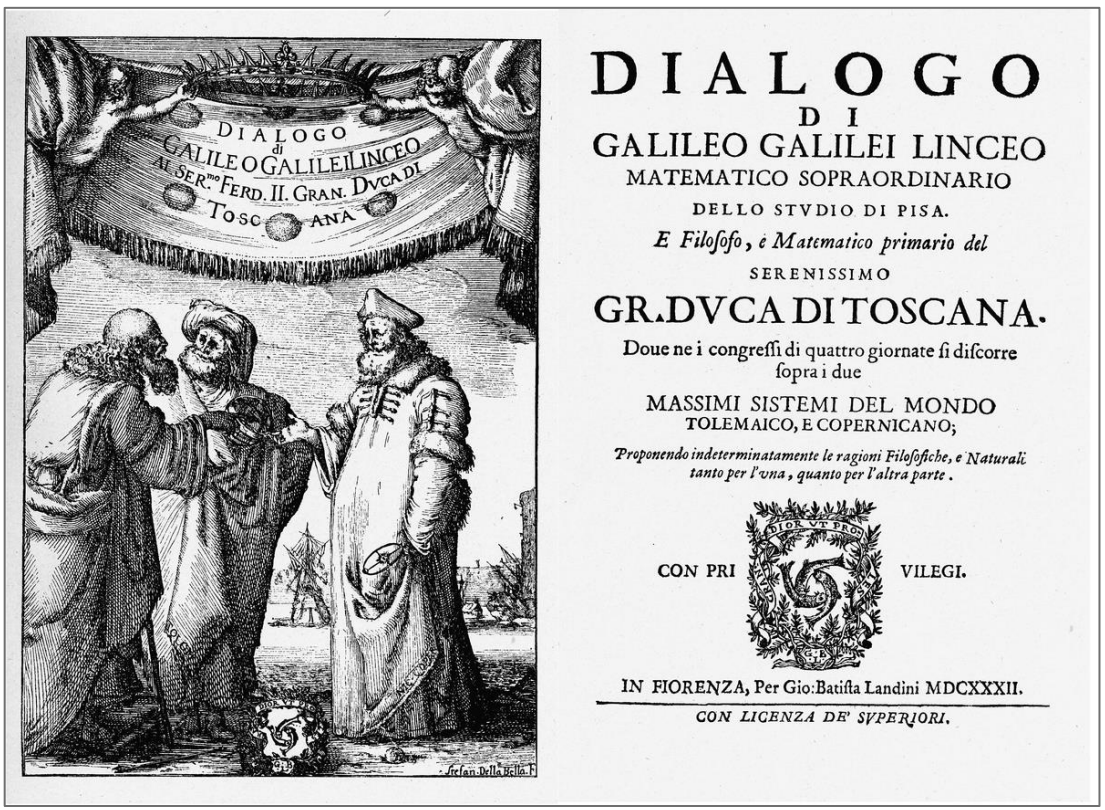
In this unit students explore challenge for religious traditions generally over time and then undertake a study of challenge and change for one or more than one religious tradition or denomination. Religious tradition/s or denomination/s are to be selected from one or more than one of the following: Buddhism, Christianity, Hinduism, Islam, Judaism.

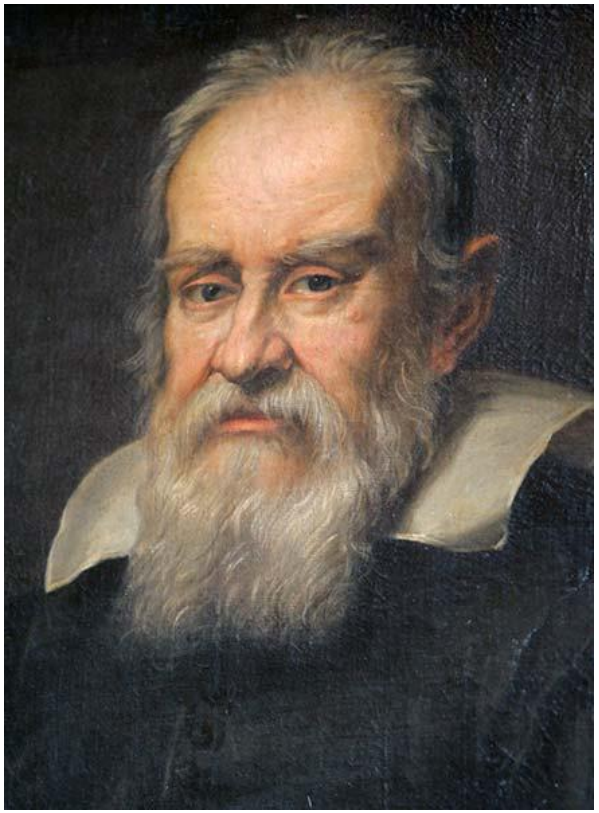
Students consider the aspects on page 9 in their investigation of selected religious tradition/s or denomination/s and religion in general.

Unit 4: Religion, Challenge & Change

- The *religious tradition*: Roman Catholicism
- The *challenge:* Heliocentrism? or Protestantism?
- The *stance* – The injunction of 1616?
- The publication of *The Dialogue on the Two Chief World Systems* in 1632
- The *action* – Galileo was tried on the charge of "vehement suspicion of heresy' in 1633.
- Each was shaped by *contingent historical circumstances*

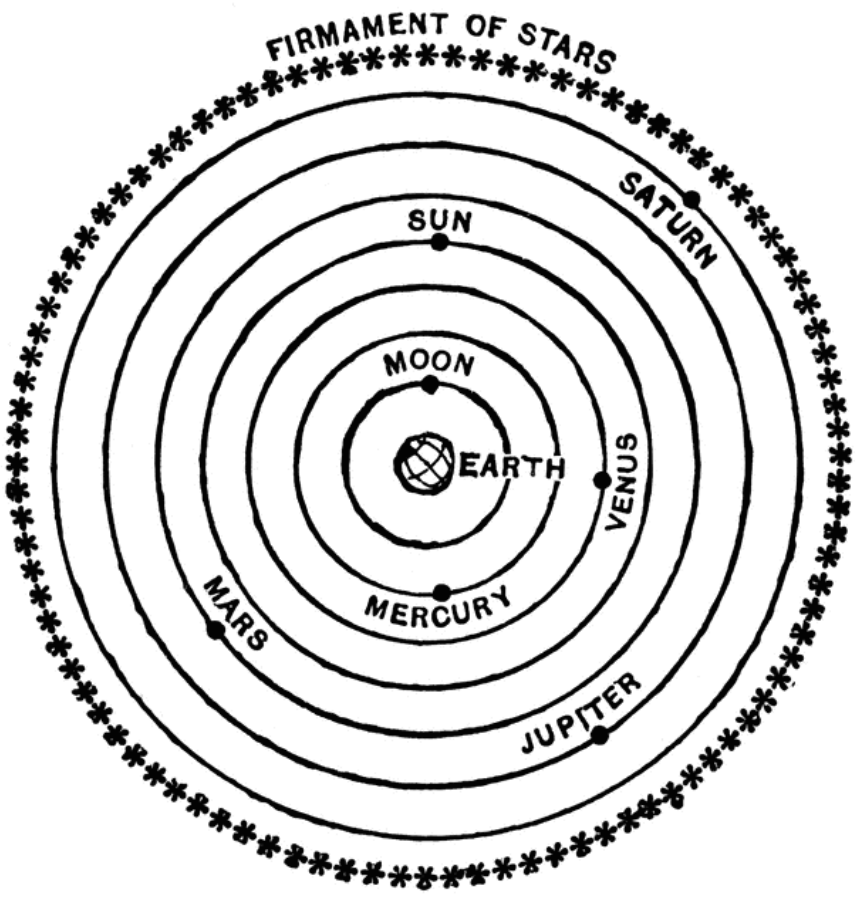
The Two World Systems





The Ptolemaic System

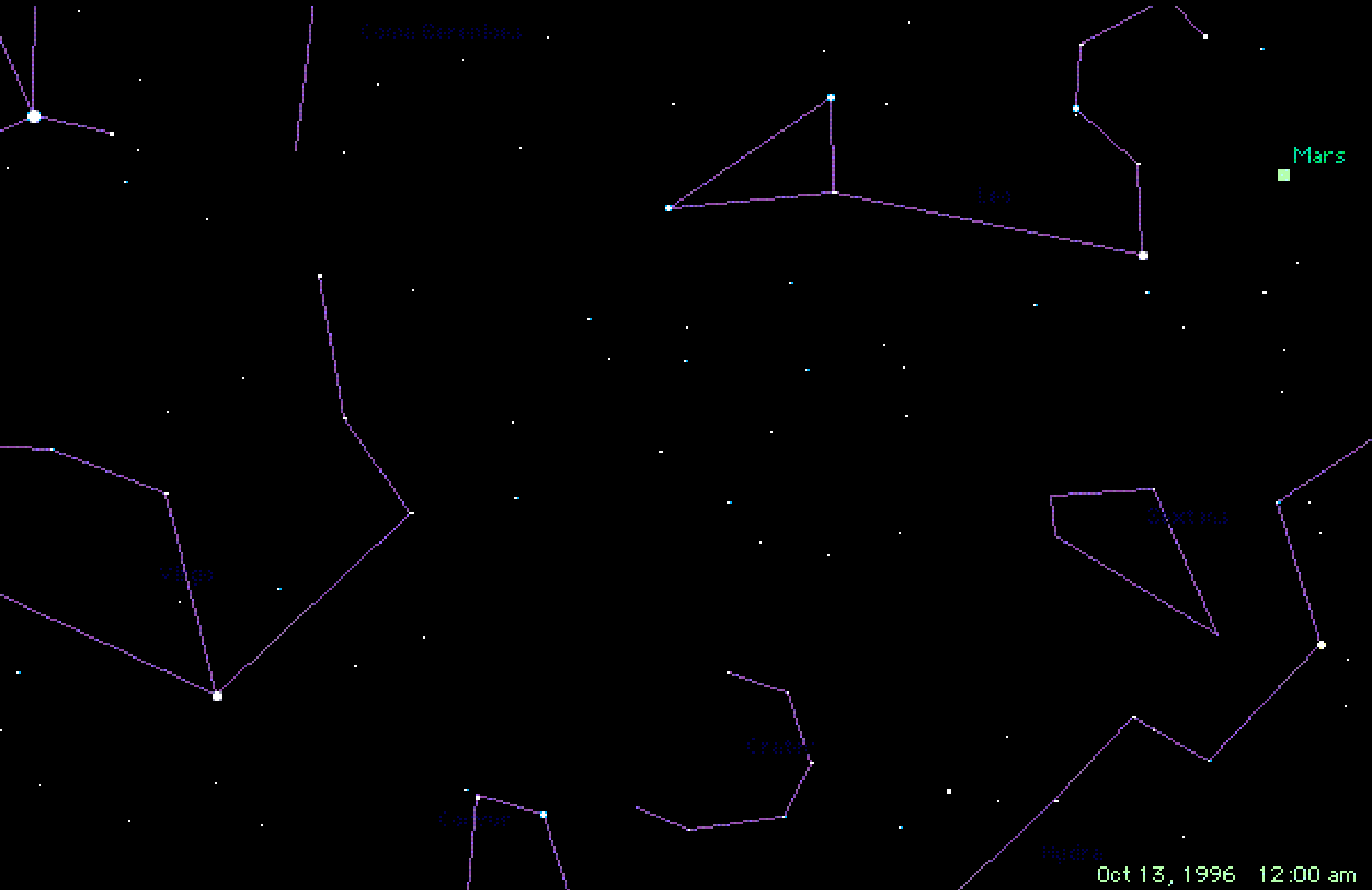
- Developed by Ptolemy of Alexandria in 2ndC CE
- The earth is spherical and immobile
- The earth is located at the centre of the universe
- The moon, sun, planets, and stars revolve around the earth
- The universe is spherical



The Motion of the Planets

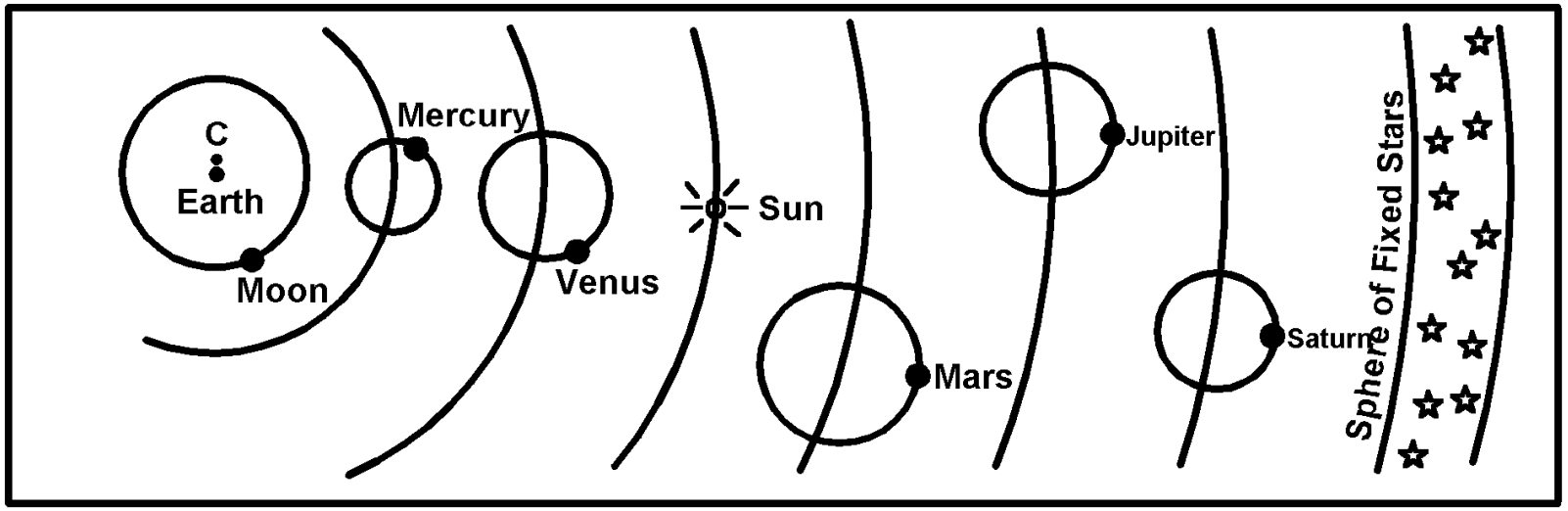
- All celestial bodies obey the principle of uniform circular motion.
- But the planets do not appear to move in regular circular paths.
- Planets exhibit certain ‘irregularities’, which became of central importance to Greek tradition of mathematical astronomy.
- The challenge for Greek astronomy was to find a system of uniform circular motions which accounted for the apparent motions of the planets

The Retrogression of Mars

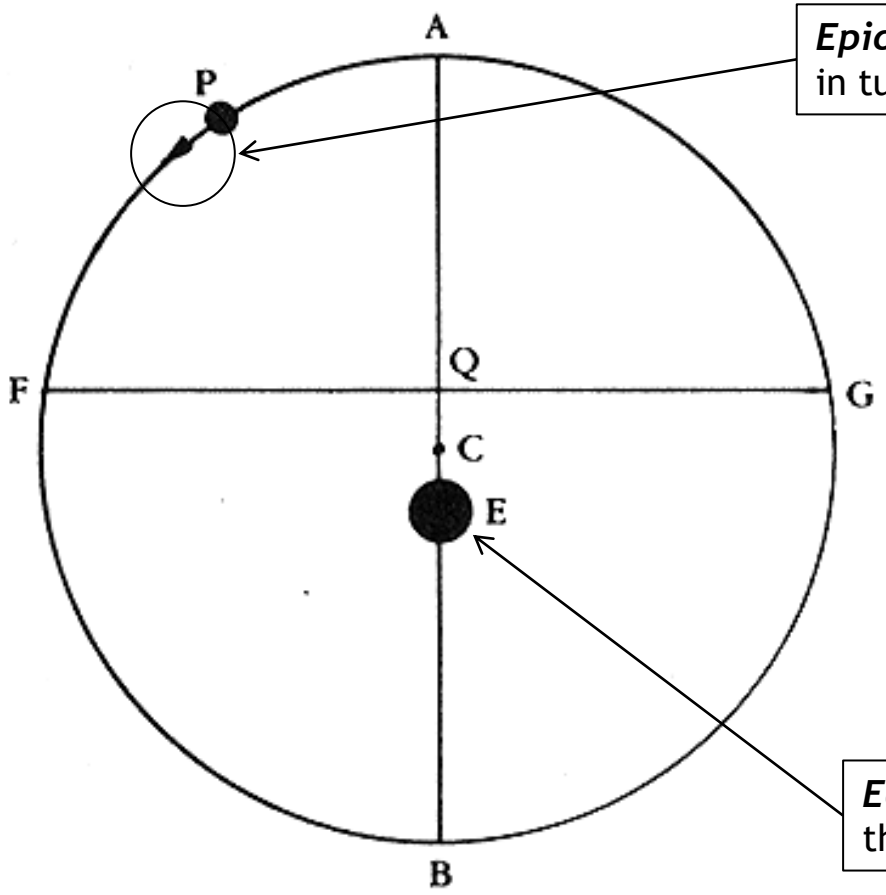


Ptolemy's Mathematical Astronomy

- https://www.youtube.com/watch?v=QKtWtYuReBU
- https://brunelleschi.imss.fi.it/itineraries/multimedia/PtolemaicSystem.html



The Devices of Ptolemaic Astronomy



Epicycle: The planet orbits a small circle, which in turn revolves around the earth

Equant: The speed of the planet is uniform with respect to an imaginary point Q.
The planet travels from A to F in the same time it takes to travel from F to B.

Eccentric: The earth is placed just off the centre of the planetary orbit

Medieval Attitude to Astronomy

To assert the existence of an eccentric sphere or an epicyclic sphere is *contrary to nature… The epicycle and the eccentric are impossible… what we have is something that fits calculation but does not agree with reality.*

Averroes, *Metaphysics* (c. 1190)

However I have already explained to you ... that all *this does not affect the astronomer.* For his purpose is not to tell us in which way the spheres truly are, but to posit an astronomical system in which it would be possible for the motions to be circular and uniform and to correspond to what is apprehended through sight regardless or not of whether things are thus in fact.

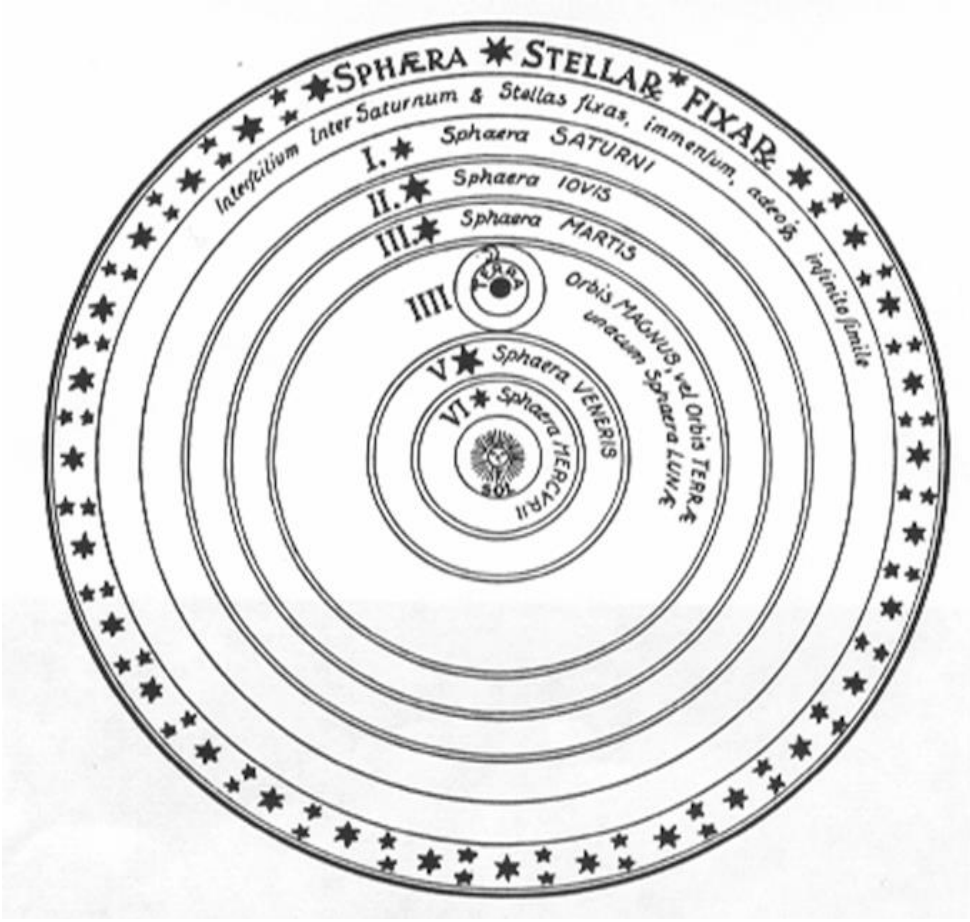
Maimonides, *Guide for the Perplexed* (c. 1200)

The Copernican System

In 1512 Nicholas Copernicus proposed the sun was the centre of the universe

In this system, the earth was the third planet, rotating on its axis every day and revolving around the sun every year.

De revolutionibus orbium coelestium (1543)



Copernican Astronomy

- Copernican modeled his astronomy on the Ptolemaic system. It retained
  - the spherical model
  - uniform circular motion (eliminating the equant)
  - epicycle-deferent system (even with a double-epicycle for the moon!)
  - finite spherical universe

- Copernicus' system offered a *more elegant* solution to the problem of planetary motion than Ptolemy's.

- It used fewer epicycles (but still employed epicycles and eccentrics)

- It was *no* more empirically accurate than Ptolemy's system.

How Accurate was Astronomy?

For a few weeks every 32 years, *both the Ptolemaic and Copernican predictions for the position of Mars are off by close to 5 degrees*

Tycho Brahe's observed errors		
	Longitude	**Difference**
Copernican tables	342° 0′	−4° 7½′
Tycho's observation	346° 7½′	
Alfonsine [Ptolemaic] tables	351° 26′	+5° 18½′

In 1609 Kepler proposed a new astronomy to overcome these discrepancies based on the idea that *the planets moved in elliptical orbits. This was rejected by Galileo.*

Osiander's Preface (1543)

[Since the astronomer] cannot in any way attain to the true causes, he will adopt whatever suppositions enable the motions [of the celestial bodies] to be computed correctly from the principles of geometry for the future as well as the past… *These hypotheses need not be true or even probable*. On the contrary, if they provide a calculus consistent with the observations, that is enough.

Andreas Osiander, *De Revolutionibus* (1543)

The Copernican Theory

A number of astronomers actually *used* the Copernican system to make calculations of planetary motion in the 16th C.

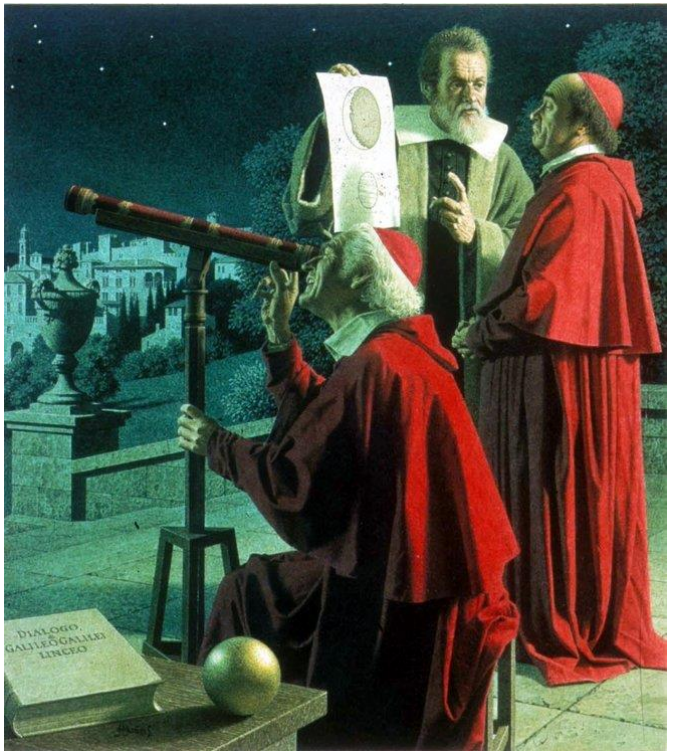
But they did *not* regarded it as representing the *true structure* of the cosmos

- Philipp Melanchthon (1497-1560)
- Giovani Magini (155-1617)
- Erasmus Reinhold (1511-1553)

Reinhold used the Copernican system in his *Prutenic tables* (1551)

Galileo Galilei (1564-1642)

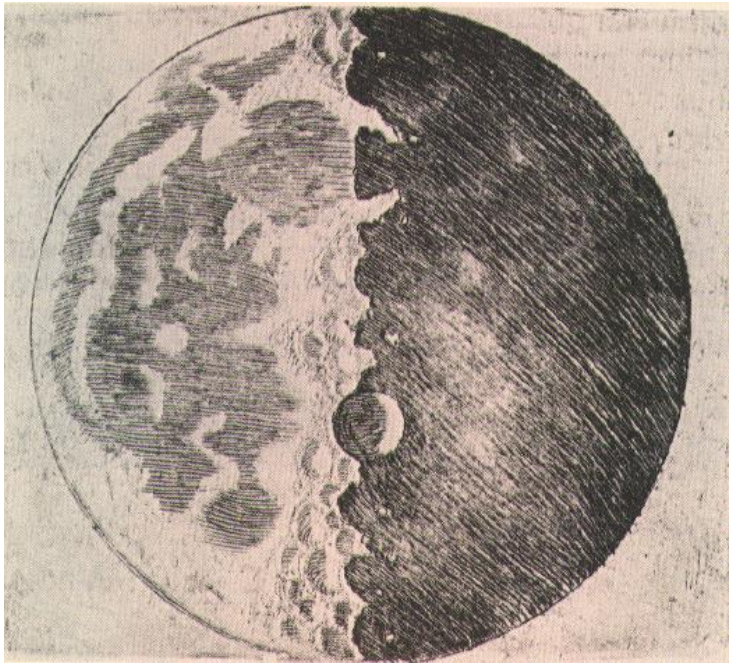
In 1609-1613, the Italian mathematician and philosopher, Galileo Gailei made a series of sensational new observations using a telescope



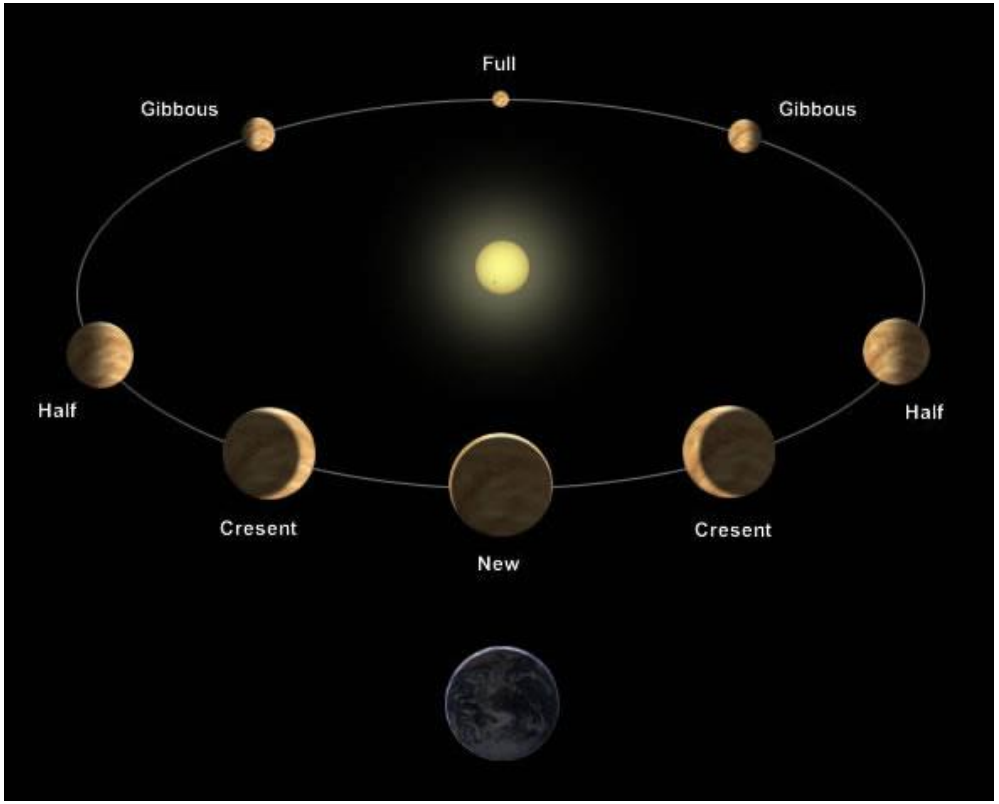
New Discoveries in the Heavens

Galileo's observations challenged the terrestrial-celestial distinction.

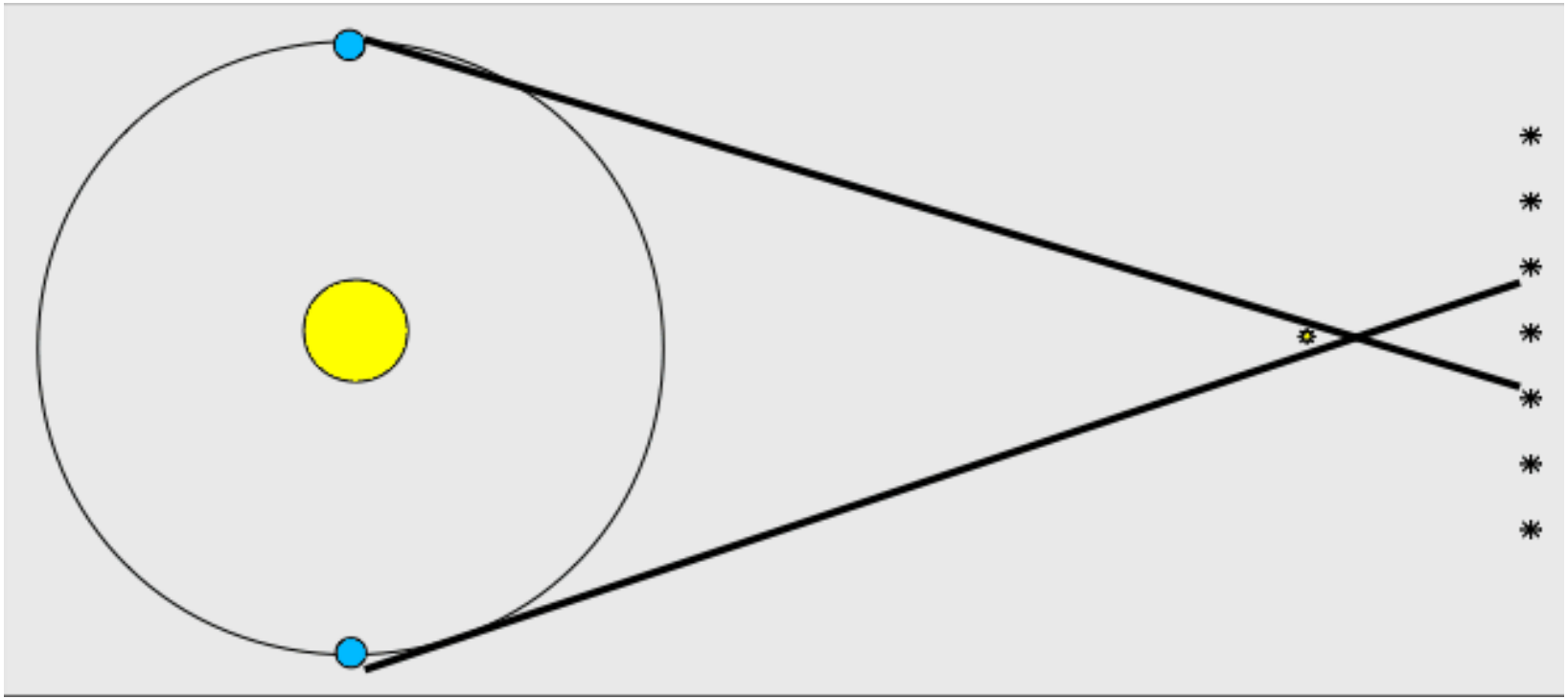
- craters and valleys on the the moon (1609)
- moons of Jupiter (1609)
- phases of Venus (1610)
- sunspots (1612)
- handles of Saturn (1613)



The Phases of Venus



The Absence of Stellar Parallax



To explain this absence, Copernicans proposed that the stars must be hundreds of times further away than previously assumed.

Arguments against Copernicanism

1. A moving earth violated Aristotelian physics.

2. If the earth is rotating, why does a cannon ball fired directly upward fall to the same spot, and not miles to the west?

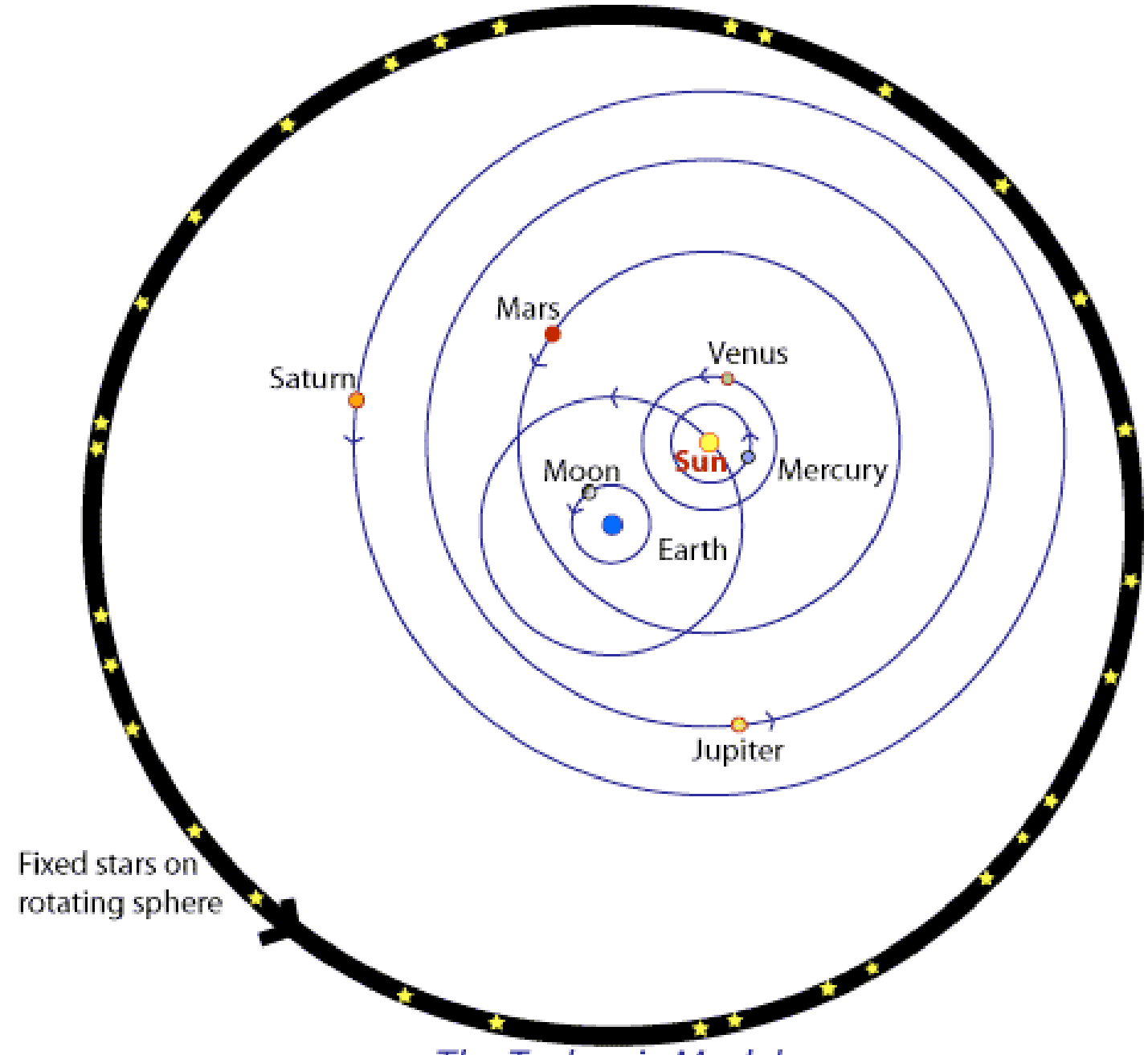
3. The “Coriolis effect” (the rotation of the earth should cause a cannon ball fired to the north to deflect to the east)

4. If the does in fact earth move, what is the *cause* of the earth’s motion?

5. Telescopic observations of the stars showed that they would have to be bigger than the entire planetary system (in a Copernican universe).

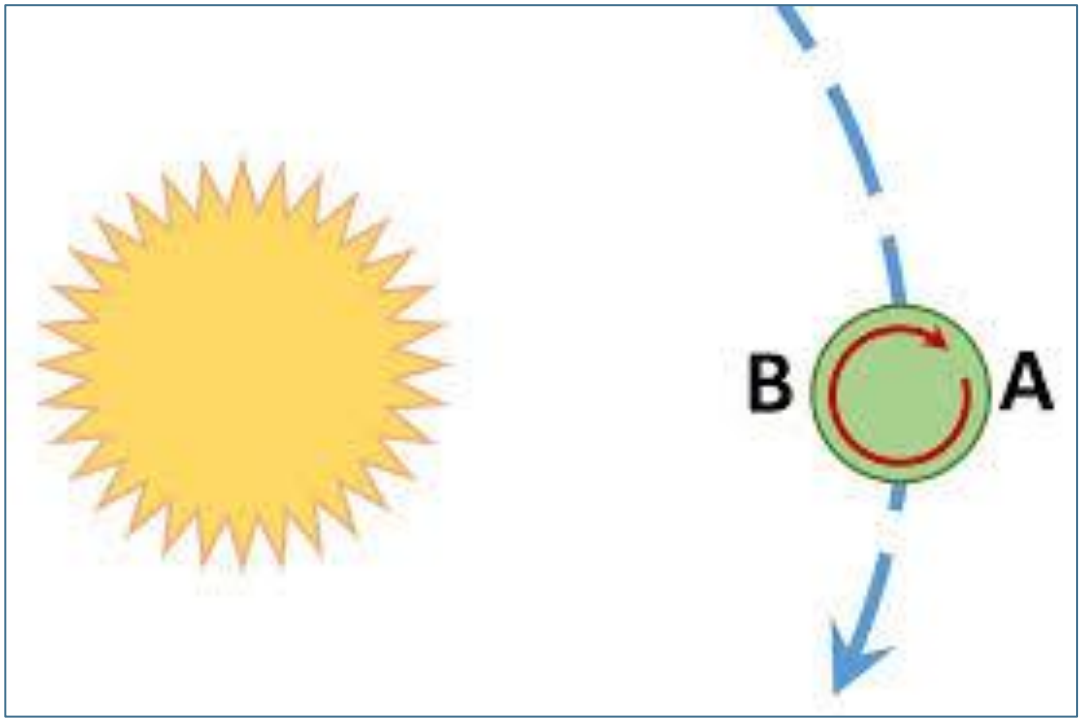
An Alternative: The Tychonic System

- In the Dialogue, Galileo treated the *two* chief world systems: the *Ptolemaic* and the *Copernican*
- But in 1580, the Danish astronomer Tycho Brahe had developed an alternative geo-heliocentric model
- By 1630 most Jesuits believed the choice lay between *Tycho* and *Copernicus*.
- Tycho's system was widely endorsed.



The Tychonic Model

Galileo's Theory of the Tides



Conclusion: In 1633 it was *rational* to oppose Copernicanism

The Interpretation of Scripture

Protestantism	Catholicism
• *Sola scriptura* • Rejection of any original infallible authority other than the Bible. • All secondary authority is derived from the authority of the Scriptures	• The Patristic tradition • The Church reserves sole authority over the correct interpretation of scripture

The Decree of the Council of Trent

Furthermore to control petulant spirits, the Council decrees that, in matters of faith and morals pertaining to the edification of the Christian doctrine, *no one, relying on his own judgment and distorting the Sacred Scriptures to his own conceptions, shall dare to interpret them contrary to that sense which Holy Mother Church*, to whom it belongs to judge of their true sense and meaning, has held and does hold, or even contrary to the unanimous agreement of the Fathers, even though such interpretations should never at any time be published. Those who do otherwise shall be identified by the ordinaries and punished in accordance with the penalties prescribed by law.

Decrees of the Council of Trent, (1545-1563) Session IV, 8th April 1546.

Was Copernicanism Compatible with Scripture?

- Geostatism (the stationary earth) agreed with a *literal interpretation* of Scripture in several places
  - 1 Chronicles 16:30
  - Psalm 93:1
  - Psalm 96:10
  - Psalm 104:5
  - Ecclesiastes 1:5
  - Job 26:7 (varied interpretations)

- Heliocentrism contradicted the prevailing theological support of the theory

Interpreting the Bible Literally?

- It was generally agreed that some biblical language should be interpreted figuratively
- The scriptures refer to π as 3/1 or 21/7. Archimedes showed the ratio is really $\approx$ 22/7.
- There is no reason to think that biblical writers *intended* their words to be taken in an excessively literal fashion.
- Every passage must be dealt with on its own merits.

Grand Duchess Christina (1565-1637)

Galileo's *Letter to the Grand Duchess Christina* (1615)

- God is the author of two books – the book of nature and the book of scripture – which cannot come into conflict with one another
- *The literal reading – "the unadorned grammatical can lead to error"*
- Appeal to St Augustine: *where natural philosophy has evident fact or proof, one should interpret the scriptures accordingly*.
- Purpose of the Bible is to teach faith and morals: *"The intention of the Holy Spirit is to teach us how to go to heaven, not how the heavens go"* (Cardinal Baronius)
- Where the scripture appear to refer to parts of nature, they have to given an ethical and theological interpretation.

The Church's Stance on Heliocentrism

Cardinal Robert Bellarmine (1542-1621)

Bellarmine's Letter to Foscarini

[When discussing the Copernican system] you … act prudently when you content yourselves with speaking *hypothetically and not absolutely*… But to want to affirm that the Sun, *in very truth*, is at the centre of the universe and only rotates on its axis without traveling from east to west, and that the Earth … revolves very swiftly around the Sun, *is a very dangerous attitude and one calculated not only to arouse all Scholastic philosophers and theologians but also to injure our hold faith by contradicting the Scriptures*… [A]s you know, *the Council of Trent forbids the interpretation of the Scriptures in a way contrary to the common agreement of the Holy Fathers*. Now if your Reverence will read, not merely the Fathers, but modern commentators on Genesis, the Psalms, Ecclesiastes, and Joshua, you will discover that all agree in interpreting them literally as teaching that the Sun is in the heavens and revolves round the Earth with immense speed and that the Earth is very distant from the heavens, at the centre of the universe, and motionless.

Bellarmine to Foscarini, 4 April 1615

Bellarmine's Letter to Foscarini

I say that whenever a true demonstration would be produced that the sun stands in the centre of the world and the earth in the third heaven, and that the sun does not rotate around the earth but the earth around the sun, *then at that time it would be necessary to proceed with great caution in interpreting the scriptures which seem to be contrary, and it would be better to say that we do not understand them than to say that what has been demonstrated is false*. But I do not believe that there is such a demonstration, for it has not been shown to me… I have the greatest doubts about the [possibility of such a demonstration]… And in case of doubt one should not abandon the Sacred Scriptures as interpreted by the Holy Fathers.

Bellarmine to Foscarini 12 April 1615

The 1616 Judgment

In early 1616 the matter was referred to “qualifiers”. Their judgment was

- The proposition that the Sun is stationary at the centre of the universe is "*foolish and absurd in philosophy, and formally heretical since it explicitly contradicts in many places the sense of Holy Scripture according to the proper meaning of the words according to the common interpretation among the Holy Fathers and of learned theologians*"

- The proposition that the Earth's is not at the centre of the world and is not immobile, but moves as a whole and also with a diurnal motion "*receives the same judgment in philosophy; and ... in regard to theological truth it is at least erroneous in faith*”.

  Holy Office, 24th February 1616.

The 1616 Injunction Against Galileo

The Most Holy Father has ordered the illustrious Cardinal Bellarmine to call before Galileo and to advise him to abandon the said opinion [Copernican theory]; and if he should refuse to obey, the Commissary, before a notary and witnesses, should impose on him an injunction to abstain completely from teaching or defending that doctrine and opinion or from discussing it; and if he should not agree, he is to be imprisoned.

Pope Paul V to Cardinal Bellarmine 25 April 1616.

Pope Paul V (1551-1621)

Three Documents

1. Inquisition minutes note Bellarmine's official report that Galileo acquiesced when advised of the decision by the Holy Office (3rd March 1616)

1. An unsigned (Illegal?) report of the meeting in Rome saying Galileo "*was told not to hold, teach, or defend it in any way whatever, verbally or in writing*."

   Galileo did *not* know of the existence of this document.

1. A letter from Bellarmine to Galileo, stating he could not "hold or defend" the Copernican view, but leaving open whether he was permitted to *discuss* it.

   The Holy Office did *not* know of the existence of this latter until Galileo produced it during the Trial of 1633.

Mixed Messages?

- In 1624 Galileo granted 6 audiences with the new Pope, Urban VIII, his old friend (Maffeo Barbernini).
- Galileo was permitted to *discuss* the Copernican view so long as it remained within *mathematical astronomy*.
- The Pope reiterated the theological argument that one could never *prove* the heliocentric view to be true.
- Galileo began writing *The Dialogue*.

The Thirty Years War (1618-1648)

One of the longest and most destructive conflicts in human history (8 million fatalities)

The Turmoil of the 30-Years War

- Initially a war between various Protestant and Catholic states in the fragmented Holy Roman Empire, gradually, it developed into a conflict involving most of the great European powers
- Disputes over internal politics and the balance of power increasingly dominated the war. Tensions between France and the Hapsburg powers escalated.
- By 1630 Catholicism was on the verge of becoming extinct in Germany.
- Pope Urban VIII, elected with support of French Cardinals, was accused of sympathizing with France, which opposed the Empire in the war
- The Spanish ambassador, Cardinal Borgia, threatened to impeach the Pope in 1632.

The Trial of 1633

The publication of the *Dialogue* deeply angered the Pope. Galileo was duly summoned to Rome to answer the charge of “vehement suspicion of heresy”

The Downfall of Galileo

- Punishing Galileo would send a highly visible message. *The Pope still controlled powerful men*. Far more than Copernicanism at stake!
- Galileo had become a pawn in a political game. He was to be a ritual sacrifice
- The rhetoric surrounding Galileo was always harsher than his actual treatment. A*fter* the outcome had been arranged, Urban made Galileo into an example.
- Torture was never authorized. Galileo was sentenced to imprisonment, commuted to house arrest, and was forced to recite the 7 penitential psalms a week for 3 years.
- He was prohibited from ever publishing again, though he did.

Was the Galileo Affair a Case of Science *versus* Religion?

- What appear to be conflicts between science and religion are often conflicts over political power and authority.
- The Galileo affair was an affair of immense complexity
- It was not (simply) a conflict between science and faith, rationality and irrationality, nor simply a matter of the suppression of intellectual freedom.
- Conflicts between science and religion are often between rival scientific interests, or conversely between rival theological factions.

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Short Course: May 24 – June 14 2018

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