

Galileo Galilei

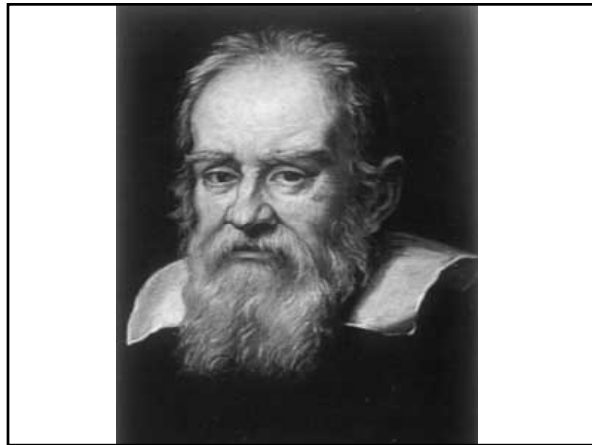
Practical Science Confronts Faith:

The First Round

Score: Faith 1, Science 0

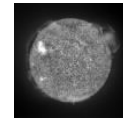


Born 1564 (Shakespeare also born; Michelangelo and Calvin die)



Galileo's Challenges to Aristotelian Thought

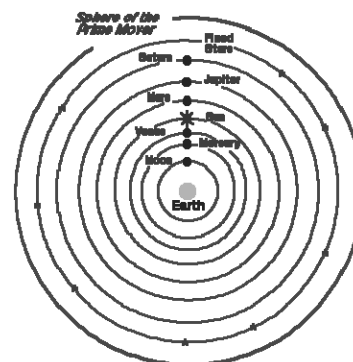
- Falling weights (a 2 pound ball falls as fast as a 4 pound ball)
- Parabolic motion (Stones dropped from a mast)
- The heavens are mutable (appearance of supernovas)
- Heliocentric model of the universe



Galileo's Path to Judgment: Background

- Ptolemy's system or model of the heavens (similar to Aristotle's views) held that all celestial orbs were perfect spheres
- The Ptolemaic model was also geocentric, i.e., it maintained that **all** celestial orbs revolved around the earth, the moon, planets, and sun directly, while the stars were part of a large crystalline sphere surrounding all. (Aristotle, in fact, said there were 55 crystalline spheres moving at different velocities.)

Ptolemaic or Geocentric Universe



Aristotle's Universe

Galileo's Path to Judgment: Background

- The Ptolemaic system had slowly been adopted as *a matter of faith* by the Catholic church.
- Aristotle and the scholarly *tradition* among religious school *authorities* were seen as the proper sources of knowledge.



Religious Response to the Copernican Theory that the earth revolves around the sun

“The eyes are witnesses that the heavens revolve in the space of twenty-four hours. But certain men, either from the love of novelty, or to make a display of ingenuity, have concluded that the earth moves; and they maintain that neither the eighth sphere nor the sun revolves. . . . Now it is a want of honesty and decency to assert such notions publicly, and the example is pernicious. It is the part of a good mind to accept the truth as revealed by God and to acquiesce in it.” (Philip Melancthon, 1549)

Religious Rejection of Copernican Theory

- [Copernicus was that fool who wished] “to reverse the entire system of astronomy.” (Martin Luther)
- [The heliocentric theory is] “foolish and absurd philosophically, and formally heretical, in as much as it expressly contradicts the doctrines of Holy Scripture in many places, both according to their literal meaning, and according to the common exposition and meaning of the holy Fathers and Doctors”. (The Holy Office of the Catholic Church, 1616)



Galileo's Path to Judgment -- II

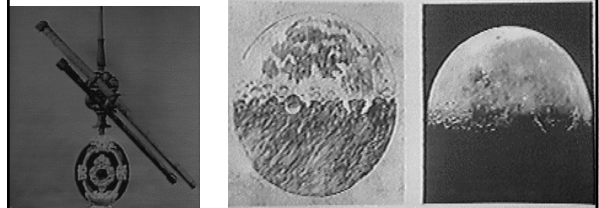
- 1277 -- The Bishop of Paris stated 219 propositions that were deemed heresy. Those holding those views could be excommunicated (or worse). That the earth moved was one point of heresy.
- 1543 -- Copernicus published De Revolutionibus; a model of the heavens that was heliocentric, i.e., it said the earth and other planets moved around the sun. (Although it was largely ignored at first, in 1616 the book was placed on the list of prohibited books.)

Galileo's Path to Judgment -- III

- 1610 -- Galileo published The Starry Messenger, which asserted that Copernicus's model was true not just a convenient model.
- 1616 -- Galileo (and others) were told that they could “neither hold nor defend” heliocentric views; that is, they could not claim as truth that the earth moved by a double motion.

The Starry Messenger -- 1610

Celestial Orbs (at least the moon as seen through a telescope) were not perfectly round and smooth. That *empirical* (scientifically tested) observation also was contrary to the *traditional view*.

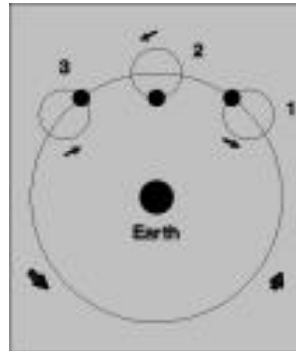


The Starry Messenger --1610 --II

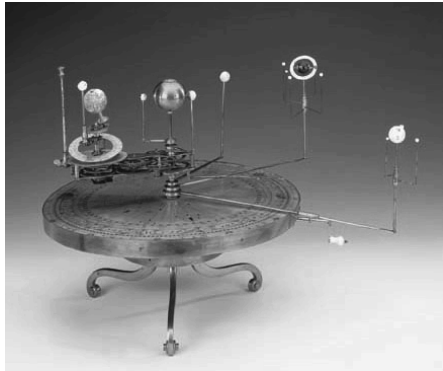
- Four moons (Galileo called them stars) were revolving around Jupiter.
- Tradition had held that all celestial objects revolved around the earth.



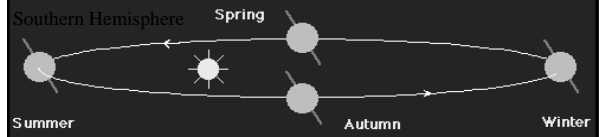
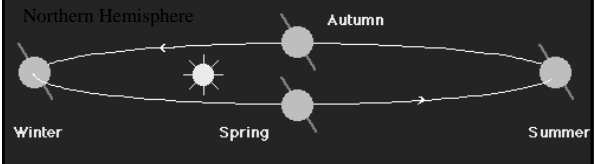
Ptolemaic Model—Earth Centered



Copernican or Heliocentric Model of the Heavens

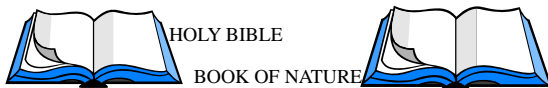


Galileo's Explanation of the Seasons



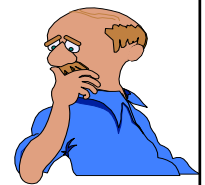
Galileo's "Two-Books" Argument

Galileo, in dispute with Aristotelian scholars, argued that God had written not only the Holy Bible, but had also written the "Book of Nature," in the code language of mathematics. He argued that both "books" could be studied to find the mind and will of God; indeed, the "Book of Nature" could be used to help us interpret the Holy Bible.



What Are the Difficulties in Accepting the Copernican model of the Heavens?

- Diurnal motion--the rotation of the earth to make day and night
 - It doesn't feel like we are traveling 24,000 miles an hour
 - Why don't we fall off?



What Are the Difficulties in Accepting the Copernican model of the Heavens?

- Annual motion--the revolution of the earth around the sun each year
 - Why doesn't the earth just shoot off into space instead of making an orbit?

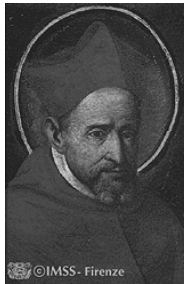


Cardinal Bellarmine's Response-I

“To demonstrate that the appearances are saved by **assuming** the sun at the center and the earth in the heavens is not the same thing as to **demonstrate that in fact** the sun is in the center and the earth in the heavens. I believe that the first demonstration may exist, but I have very grave doubts about the second; and in case of doubt one may not abandon the Holy Scriptures as expounded by the holy Fathers.”

Cardinal Bellarmine's Response-II

“I add that the words *The sun also riseth, and the sun goeth down, and hasteth to the place where he ariseth* were written by Solomon, who not only spoke by divine inspiration, but was a man wise above all others, and learned in the human sciences and in the knowledge of all created things, which wisdom he had from God.”



Dialogue Concerning the Two Chief World System -- 1632

- Galileo tried to avoid conflict with the Church
- He praised the church's opposition to heliocentrism
- He criticized those who grumbled at the Catholic church's taking a position on a matter of science
- He wrote an imaginary dialogue among three deceased people
- He stated that he was only writing to show northern countries that Italians understood the arguments for heliocentrism.

Dialogue Concerning the Two Chief World System -- 1632 --II
Three Aims

- 1- To show that experiments which could be done on earth are not sufficient to show whether the earth moves
- 2- To examine celestial phenomena to show how they strengthen the Copernican hypothesis
- 3- To speculate about the implications of the Copernican or heliocentric hypothesis

Why Did the Church see Galileo's Work as Threatening?

- The Church felt its power threatened already by Protestant rebellions
- Ptolemy's model had become a doctrine
- Authority--Galileo had been trained in secular schools, not by church scholars
- Method--Galileo was relying on empirical methods (the scientific method), not on tradition and church authority
- Appeal--While Copernicus had published for church scholars--in Latin--, Galileo wrote in vernacular Italian for the general public

The Inquisition's Judgement--1633



(In 1992, after a 13 year review, Pope John Paul II declared the church was wrong to condemn him.)

- Galileo was placed under house arrest for the rest of his life.
- He was twice taken to a place of torture and shown the instruments as if he were to be tortured.
- His books were banned.
- He was forbidden to write more on astronomical subjects.

The Turning of the Tide

Galileo was badly defeated, but the seeds of reliance on scientific inquiry were planted. The war was enjoined on many sides as practical science spread the emphasis on empirical ways of knowing. Science and reason had a strong foothold.

