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**THE NEW SCIENCE OF THE  
SEVENTEENTH CENTURY**

# Introduction

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- The scientific revolution
  - Heliocentricity
  - A new mathematical physics
  - New method of inquiry
  - Science as a distinctive branch of knowledge
  - Natural philosophy—the philosophy of nature

# The Intellectual Origins of the Scientific Revolution

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- Medieval antecedents
  - Artists and their observations of the natural world
  - The magnetic compass
  - The printing press
  - Gunpowder

# The Intellectual Origins of the Scientific Revolution

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- Medieval antecedents
  - A fascination with light (optics and lens grinding)
  - A natural world created by God
    - Neoplatonism

# The Intellectual Origins of the Scientific Revolution

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- The Renaissance
  - Humanists placed low value on science
    - More interested in classical antiquity and the authority of the ancients
  - Arabic translations of Greek classics
  - Rediscovery of Ptolemy and Archimedes
  - The universe as machine



The Ptolemaic Universe, as Depicted in Peter Apian,  
Cosmographia (1540)

# The Intellectual Origins of the Scientific Revolution

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- The Renaissance
  - Developing collaboration between artisans and intellectuals
  - Building machines for practical use
  - The laws of perspective and optics
  - Alchemy and astrology

# The Intellectual Origins of the Scientific Revolution

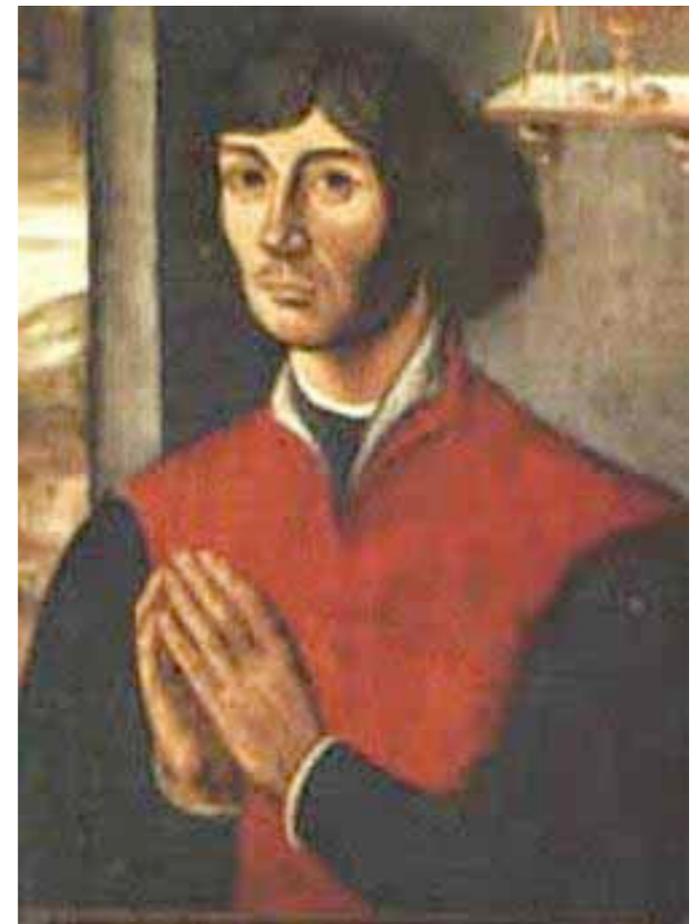
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- The Renaissance
  - Voyages of discovery
    - Travelers' accounts of foreign lands
    - Attacking the authority of the ancients

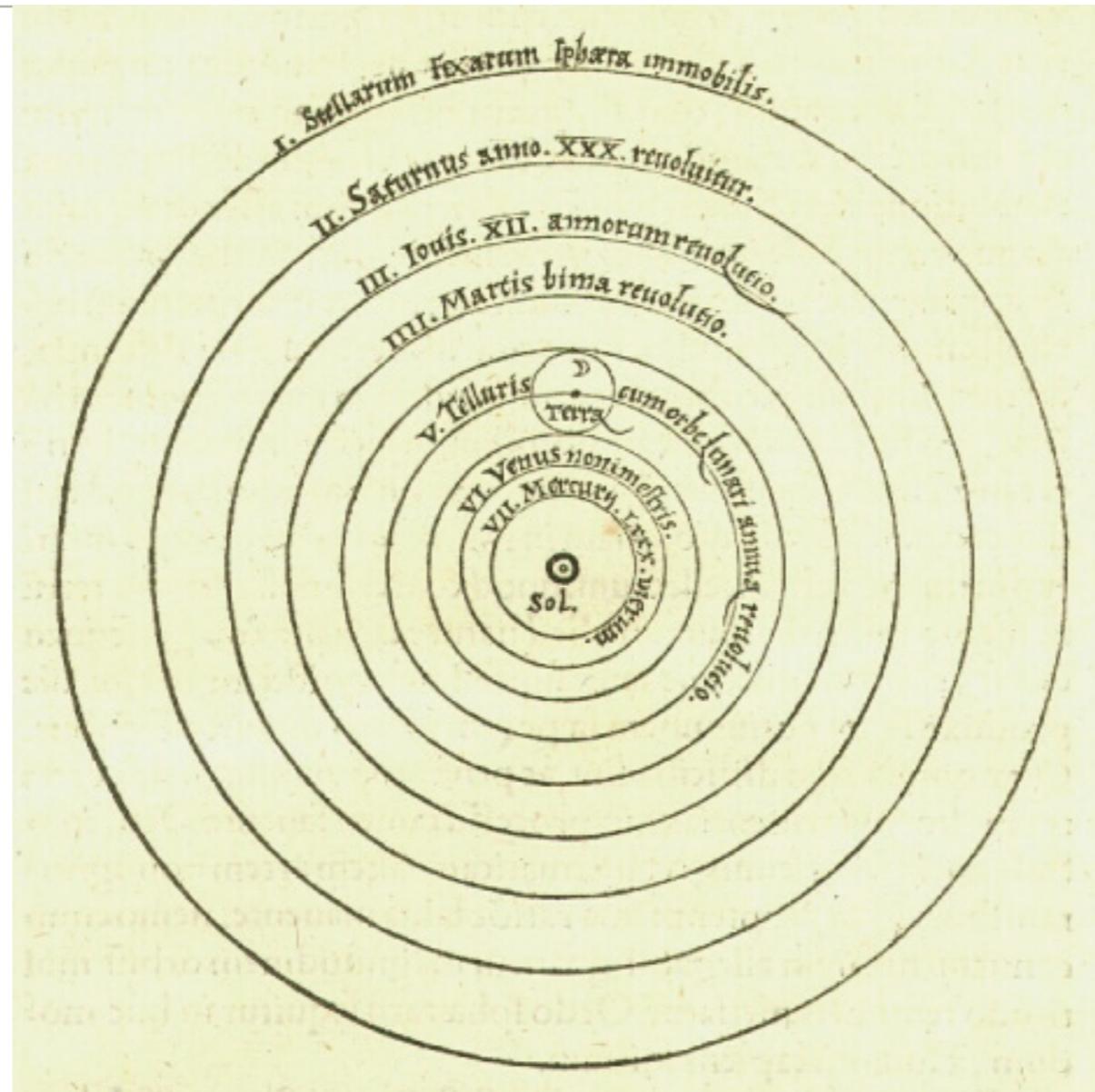
# The Copernican Revolution

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- Ptolemaic system had become too messy
- Copernican system
  - The earth moved and was not the center of the planetary system
  - The earth rotated on its axis and orbited the sun



Nicolaus Copernicus  
(1473–1543)



The Copernican Universe (1543)

# The Copernican Revolution

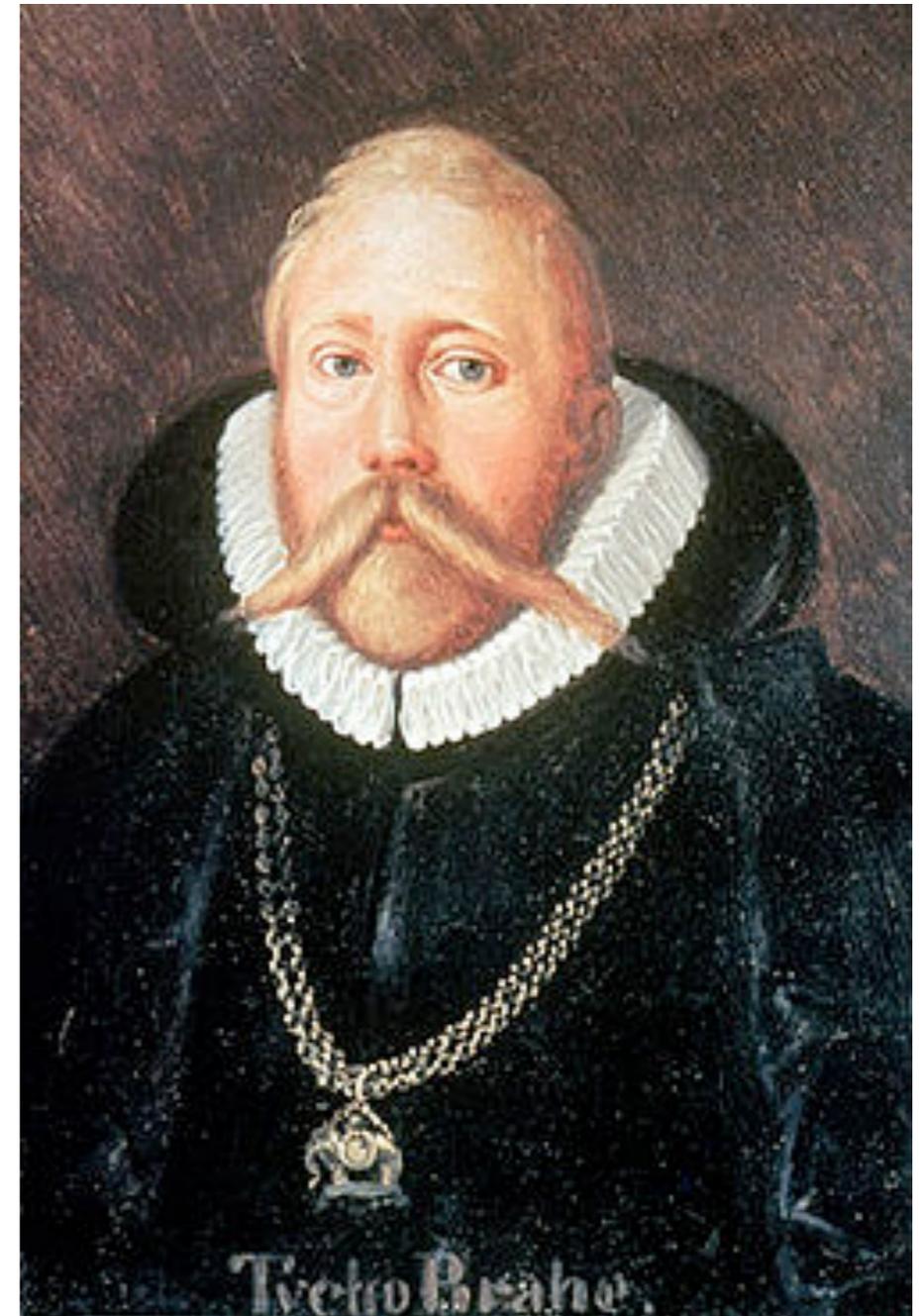
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- Nicolaus Copernicus (1473–1543)
- Believed he had restored a pure understanding of God's plan but was troubled by its implications
- New problems and inconsistencies
- *On the Revolutions of the Heavenly Spheres* (1543)

# Tycho Brahe (1546–1601)

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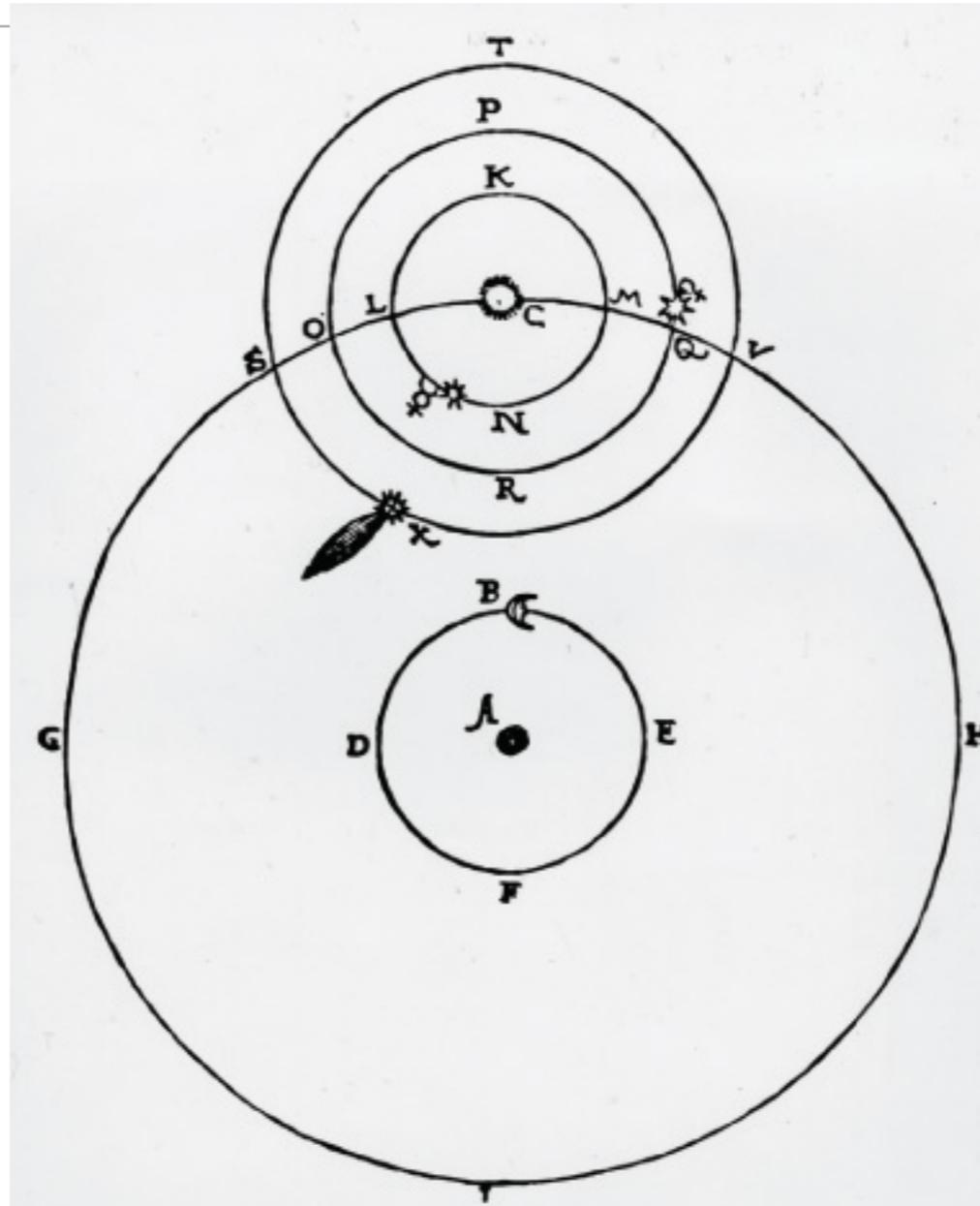
- Born into the Danish nobility
- A champion of observation
- Observed the appearance of a new star (nova) in 1572
- Built his own observatory



# Tycho's Observations and Kepler's Laws

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- Tycho Brahe (1546–1601)
- Tycho not a Copernican
  - Planets orbited the sun, the whole of which orbited a stationary earth
- Court astronomer to Rudolph II at Prague



Tycho Brahe's Universe (c. 1572, A, earth; B, moon; C, sun)

# Johannes Kepler (1571–1630)

- Served as Brahe's assistant
- Everything had been created according to mathematical laws
- Mathematics as the language of God
- Mathematical perfection and musical harmonies



# Tycho's Observations and Kepler's Laws

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- Johannes Kepler (1571–1630)
- Three laws of planetary motion
  - Planets travel in elliptical orbits
  - Speed of the planets vary with their distance from the sun
  - Magnetic forces keep the planets in orbital motion

# Tycho's Observations and Kepler's Laws

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- Johannes Kepler (1571–1630)
  - *Cosmographic Mystery* (1596)
  - *New Astronomy or Celestial Physics* (1609)
  - *The Harmonies of the World* (1619)
  - Broke down the distinctions between the heavens and the earth

# New Heavens, New Earth, and Worldly Politics: Galileo Galilei

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## (1564–1642)

- Galileo the man
  - A witty and persuasive writer (wrote in Latin and Italian)
  - A popularizer of the non-Aristotelian approach to science
  - Impatient with those who opposed him

# New Heavens, New Earth, and Worldly Politics: Galileo Galilei

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## (1564–1642)

- Galileo the man
  - A new relationship between religion and science
  - Controversy and the collision course with the Church

# New Heavens, New Earth, and Worldly Politics: Galileo Galilei

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## (1564–1642)

- The telescope
  - Built his own telescope in 1610
  - Observed the features of the moon, the moons of Jupiter, and sun spots
  - A challenge to heavenly perfection
  - *The Starry Messenger* (1610)

# New Heavens, New Earth, and Worldly Politics: Galileo Galilei

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(1564–1642)

- The need for a patron
  - Disliked power of university authorities
  - Turned to princely courts
  - Took a position as tutor to the Medicis

# New Heavens, New Earth, and Worldly Politics: Galileo Galilei

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(1564–1642)

- Conflict with the Church
  - A Dominican monk denounced Galileo's ideas as a dangerous deviation
  - *Letter to the Grand Duchess Christina de Medici* (1615)
  - One can be a sincere Copernican and a Catholic
  - Understanding the physical world is best left to the natural philosopher

# New Heavens, New Earth, and Worldly Politics: Galileo Galilei

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## (1564–1642)

- Conflict with the Church
- 1616: the Inquisition declares heretical the proposition that the earth moves
- Copernicus' s *De Revolutionibus* is placed on the Index of Forbidden Books

# New Heavens, New Earth, and Worldly Politics: Galileo Galilei

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(1564–1642)

- Conflict with the Church
- *A Dialogue Concerning the Two Chief World Systems* (1632)
  - Inquisition banned the book
  - Galileo ordered to stand trial in 1633
  - Recanted his beliefs and placed under house arrest for life

# New Heavens, New Earth, and Worldly Politics: Galileo Galilei

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(1564–1642)

- The legacy
  - The theory of inertia
  - Law of falling bodies
  - *Two New Sciences* (1638)
  - Combined discovery, observation, experiment, and mathematics

# New Heavens, New Earth, and Worldly Politics: Galileo Galilei

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(1564–1642)

- The legacy
  - Suggested universal laws of motion
  - The new science moves out of Italy to northwest Europe

# ISSAC NEWTON

1642-1727

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*Mathematical Principles of  
Natural Philosophy or  
Principia, 1697*



# CONSEQUENCES OF THE SCIENTIFIC REVOLUTION

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- Creation of an international group of scientists connected and competing to create and discuss knowledge
- New way to create knowledge with the scientific method
- Inspired a revolution in applied science by the 18th century

# FURTHER READING

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- Steven Shapin, *The Scientific Revolution* (2000)
- Margaret Jacob, *The Cultural Meaning of the Scientific Revolution* (1988)
- Lynn Schiebinger, *The Mind Has No Sex? Women in the Origins of Modern Science* (1989)
- Margaret J. Osler, *Rethinking the Scientific Revolution* (2001)
- Dava Sobel, *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Day* (1995) and *Galileo's Daughter* (1999)
- <http://www.onbeing.org/program/asteroids-stars-and-love-god/68> - interview with two astronomers at the Vatican Observatory.