



The Scientific Revolution with Dr. Ted Davis

Lesson 4.2: The New World Picture: The New World Picture Accepted

Outline:

The New World Picture: The New World Picture Accepted

- Galileo and Newton made full acceptance of the Copernican theory possible.
- **The first important observational evidence** favoring Copernicus did not come until **Galileo Galilei (1564-1642)** turned his powerful new telescope on the heavens. From observations of Moon, Sun, Jupiter, and Venus, he found evidence that the heavens are just like the Earth – challenging the old hierarchical view of the heavens and the earth.
- Working in the vicinity of Venice, Galileo uses his telescope and his discoveries to advance his career.
- In the summer of 1609 something happened that changed his life forever – the telescope! Galileo heard about it, obtained additional information, and built one for himself. Although Galileo did not invent it, he used it brilliantly – both scientifically and politically.
- Soon after, he started observing the heavens and found breathtaking new things! He rushed into print, publishing his findings just a few weeks after finishing his observations in *Siderus nuncius* (1610). Additional observations were published separately, in *Letters on Sunspots* (1613) and *The Assayer* (1623).

What did Galileo see?

- **He sees** craters, mountains, and “seas” on the surface of the Moon.
- He used them to argue that the heavens are not “perfect”.
- He compares a section of the moon with “a region like Bohemia, if that were enclosed on all sides by very lofty mountains arranged exactly in a circle”. (Drake, p. 36)
- **He notices** that the sky is full of stars, hitherto unseen; the Milky Way is actually a “congeries” of stars, not a nebulous band of white light.
- **He discovers** four moons orbiting Jupiter. These were used to remove an objection to the Copernican system: there must be multiple centers of motion in the universe, since Jupiter clearly has moons of its own.
 - “We have moreover an excellent and splendid argument for taking away the scruples of those who, while tolerating with equanimity the revolution of planets around the Sun in the Copernican system, are so disturbed by the attendance of one Moon around the Earth while the two together complete the annual orb around the Sun that they conclude that this constitution of the universe is impossible. For...our vision



offers us four stars wandering around Jupiter like the Moon around the Earth.”

- Sunspots were also used to argue that the heavens are not “perfect”.
- “Horns” or “ears” on Saturn were seen as well as a full set of phases for Venus. Venus’ phases were also used to argue for Copernicus: they show that the Ptolemaic system is wrong – at least for Venus.
 - This shows a decisive argument against the old world system.
- Galileo also uses these new moons to get himself a new job! In a stroke of genius, decides to name the moons of Jupiter after Cosimo, his former pupil, who is now ruling Florence.
- **The final step** was taken by **Isaac Newton (1642-1727)**. Newton’s concept of universal gravitation explains motion in the heavens and on earth, with a single set of physical laws for the whole universe, not separate laws and properties for the heavens and the earth.
- **A big question:** What were the most important factors in convincing later scientists that Copernicus was right, even though parallax had still not yet been seen?
 - Galileo’s observations of many parts of the heavens, which gave brand new information.
 - Newton’s elegant mathematical theory of motion that brought a single harmonious order to the whole universe, explaining motion on the Earth as well as in the heavens. His physics make no sense apart from the Solar System.
 - Astronomer and historian Owen Gingerich has argued that Copernican astronomy did not triumph by suddenly producing conclusive “proofs” of the earth’s motion. Rather, it slowly became more persuasive, providing an account of the universe that was more coherent overall. “Proof” is more pertinent to mathematics, than to science.