



The Scientific Revolution: Its Classical and Christian History with Dr. Ted Davis

Lecture 17: The New Mechanics of Galileo: Physics on a Moving Earth

Outline:

The New Mechanics of Galileo: Physics on a Moving Earth

- Copernicus gave the Earth a double motion:
 - Spinning on its axis daily at hundreds of miles per hour
 - Revolving around the sun annually at tens of thousands of miles per hour
- But, we can't seem to tell from ordinary experience that the Earth is moving at all. As Galileo put it, "The crucial thing is being able to move the earth without causing a thousand inconveniences [i.e., inconsistencies]." He tried to explain why a moving Earth is not contradictory to, or inconsistent with, our ordinary experience. It wasn't an easy task.
- What are these "inconveniences"?
 - Falling bodies should not fall vertically to a spinning earth. They should be left behind—deflected toward the west as the earth moves out from under them as they fall.
 - Clouds and birds in flight should likewise be left behind.
 - Objects (like you and I) should fly off a spinning earth, like mud flies off a spinning wheel. (Galileo never gave a good answer for this one, although he tried.)
 - If the center of the earth is not also the center of the universe, then why do objects fall at all?
 - What is the cause of heaviness, if Aristotle was wrong? (Galileo knew that he had no answer for this one; he freely admitted that he did not know what gravity actually is.)
- Aristotle: Natural vs Violent Motion
- From doing real experiments with balls rolling down inclined planes, Galileo was able to imagine what would happen if the ball were rolling on a perfectly smooth, horizontal surface.
 - Thought experiments
 - In the absence of friction, on a perfectly smooth plane, a perfectly round ball will roll forever. It will not come to rest. Thus, motion and rest are both equally "natural" for the ball.
- The dialogue on two chief world systems (Ptolemy and Copernicus) The conversation involves three "interlocutors":



- Salviati (named for a friend of Galileo), who speaks for Copernicus—and thus, for Galileo
- Sagredo (also named for a friend of Galileo), a neutral party
- Simplicio—Galileo claimed to make a pun on the name of the medieval Aristotelian, Simplicius, but the name implies he's an idiot. Simplicius speaks for Aristotle and Ptolemy—but also in effect for the Pope!
- The dialogue happens over four “days”
 - Day one: The destruction of Aristotelian cosmos by various arguments
 - Day two: The possibility of the Earth's diurnal motion demonstrated; a new physics based on inertia is introduced; the Earth is compared with a moving ship
 - Day three: Evidence of the Earth's annual motion from astronomy is presented
 - Day four: The “proof” of the Earth's double motion is seen in the explanation of the cause of the tides in the oceans
 - Unfortunately, Galileo is badly mistaken about his argument from the tides and other arguments he offers for the unambiguous truth of Copernican astronomy. He simply isn't able to prove what he thinks he can prove—even though his astronomical observations and the notion of horizontal inertia do persuade many that the Earth probably does rotate on its axis and revolve around the Sun.
 - Galileo ends the book by placing a statement of the Pope's view of science in the mouth of Simplicio—the interlocutor who loses all the arguments, is often made fun of, and clearly speaks for the Pope. This gets Galileo into very hot water!
 - A key papal advisor, Melchior Inchofer, thinks that Galileo treats all those who disagree with him as “mental pygmies.”