

Questions on "Galileo's Dialogue"

Use the video clip "Galileo's Dialogue" and your knowledge (from PPT given in class) to answer the questions below.

1. Describe Ptolemy's geocentric model of the universe.
2. Describe Copernicus' heliocentric model of the universe. Explain how the Copernican system threatened Church doctrine.
3. Explain the significance of Galileo's observations of Jupiter and its moons.
4. What other important contributions did Galileo make to astronomy?
5. Galileo's *Dialogue* literally changed the world. Describe the public's initial reaction to his work. Why was Galileo's book more influential than earlier writings on the same topic?
6. Why did Galileo's *Dialogue* offend the church?
7. Discuss Galileo's decision to recant his heliocentric views. Do you consider this cowardice, or did he have no other choice? What would you have done in his situation and why?

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ESSAY

Contrarian's Contrarian: Galileo's Science Polemics

By GEORGE JOHNSON

1 Arthur Koestler, an iconoclastic thinker who could always be counted on for a catchy title, called his history of cosmology "The Sleepwalkers." The way mankind lurched and stumbled toward the truth reminded him "more of a sleepwalker's performance than an electronic brain's."

2 Obsessions and fixations were as common as brilliant chains of reasoning, and every step forward seemed to be countered by two steps sideways and a half step back.

3 The most erratic of the somnambulists on this zigzag trail was the man often called the father of modern science, Galileo. Far from being the selfless hero of popular legend who championed scientific truth over blind religious faith, he comes off in Koestler's book, published in 1959, as a vain glorious self-promoter spoiling for a fight.

4 The primary reason he was hauled before the Inquisition, Koestler argued, was not for teaching Copernicus's view that Earth and the planets revolved around the Sun, but for offending so many of his sympathizers — and, most important, for insisting that Copernicanism was not just a theory, but an indisputable truth.

5 Pushing this idea further, two new books, "Galileo's Mistake," by Wade Rowland (Arcade Publishing), and "Galileo in Rome" by William R. Shea and Mariano Artigas (Oxford University Press), almost seem to sympathize with the inquisitors, making Galileo look like the dogmatist.

6 That may be going overboard, but contrarian views have the virtue of jarring the brain from its slumber and forcing one to consider an old story in a new way. The trial of Galileo is usually cast as a black-and-white battle between faith and reason. But something far more interesting may have been at stake: a fight over the very nature of what is meant by a scientific theory.

7 Even Galileo's detractors concede his brilliance as a scientist. His work on mechanics, the motion of pendulums and of balls rolling down inclined planes, helped open the way for the modern view of a universe that operates not by godly caprice, but according to discernible mathematical laws. By showing with his telescope that Jupiter had moons, he demonstrated that not everything revolved around the Earth. By showing that Venus had moonlike phases, he made a strong case that at least this one planet traveled around the Sun.

8 Neither discovery, however, proved that Copernicus was right. The data could also be explained by a rival theory, championed by Tycho Brahe — a masterpiece of compromise in which Mercury, Venus, Mars, Jupiter and Saturn revolve around the Sun and the whole whirling assemblage orbits Earth.

9 When science alone was not enough to sustain an argument, Galileo pulled out the polemics. He was that rarity among physicists, one who could write in a clear, persuasive and entertaining way. His "Dialogue Concerning the Two Chief World Systems," in which three noblemen, Salviati, Sagredo and Simplicio, meet in Venice to argue over the relative merits of Ptolemy's ancient Earth-centered cosmos and the newer Sun-centered Copernicanism, may be the first great piece of popular science writing.

10 The book was also his downfall. It was Galileo the writer, not Galileo the scientist, who got himself into trouble. Like so many people who are good with words, he succumbed to the temptation of making his opponents seem not just wrong, but also stupid.

11 In the dialogue, it is the naïve apologist for Ptolemaic astronomy who is given the belittling name Simplicio, and from his mouth comes the very argument against Copernicanism made by the one man Galileo could not afford to offend, Pope Urban VIII.

12 No matter how well a theory seems to account for the phenomena, Simplicio argues, it may still be illusory. A God of infinite ability may have made a universe far too subtle and complex to be fathomed by feeble human minds.

13 Like many of Galileo's sympathizers, Urban felt that he had been mocked. A friend and supporter was turned into an enemy.

14 But this was far more than a personal squabble. The authors of "Galileo in Rome" say his most damaging offense was overstating his case, contending that he had proved Copernicus to be right and Ptolemy to be wrong. (With a slightly different thrust, Mr. Rowland argues that Galileo's mistake was insisting on science as the only means of obtaining truth.)

15 There is something to the argument. Though Galileo had been admonished not to advocate Copernicanism, Urban had no objection to his presenting it as a hypothesis, one of several possible explanations for celestial motion. Taking a similar tack, biblical creationists call for the story of Genesis to be taught side by side with evolutionary biology.

16 To the Roman church, the systems of Ptolemy and Copernicus were just models, ways for mortals to predict astronomical events. Ptolemy could accurately account for the movements of the planets, if one pretended that they traveled not just in circles, but in circles within circles around a stationary Earth.

17 Add enough of these "epicycles" and the predictions could be honed as precisely as you liked. No one probably believed that the planets really careened like a loop-the-loop carnival ride. The Ptolemaic system was intended as a device for making calculations, not as a picture of the universe.

18 In other words, the map is not the territory — an argument with a very modern ring. Centuries after Galileo's book was banned, the physicist J. M. Jauch resurrected Salviati, Sagredo and Simplicio to discuss whether a new theory called quantum mechanics provided a true picture of an underlying reality or was just a convenient mathematical tool. He called his book "Are Quanta Real? A Galilean Dialogue" (Indiana University Press, 1973).

19 Faced with conflicting theories that both account for the facts, scientists lean toward the one that is the more elegant and economical. But here, Koestler showed, Galileo was on thin ice. To preserve the illusion that the planets move in perfect circles, Copernicus also had to resort to a convoluted arrangement of epicycles.

20 It was Galileo's contemporary, Kepler, who made the crucial breakthrough, replacing the circles with ellipses and dispensing with the Ptolemaic curlicues. Galileo, obsessed as any ancient with what Koestler called the "circular dogma," would barely give Kepler the time of day. He also dismissed Kepler's notion that the tides were caused by the pull of the Moon as mere astrological superstition. The rhythmic sloshing, Galileo wrongly insisted, was a natural result of the combined motions of Earth's daily revolution and its orbit around the Sun. He considered that to be the real clincher to the Copernican argument, proof that Earth did not stand still.

21 For all his virtues, Galileo, mind firmly shut, was using an incorrect argument to promote a cosmology that has turned out to be wrong. The folly of the inquisitors was treating this bullheaded fumbling — the essence of the scientific search — as a crime.