

FOUR LECTURES ON GALILEO

Summaries

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1. Facts and Myths in the Trial of Galileo

This lecture begins by stating and defending a number of conceptual distinctions and procedural orientations that are useful for the proper understanding and evaluation of Galileo's trial. One is the avoidance of both anti-clerical and anti-Galilean extremes and myths. Another is that there were both substantive disagreements about scientific physical facts and procedural differences about methodological rules or epistemological principles. A third such point is that the epistemological controversy was multi-faceted and included at least the problems of the observability of truth, the legitimacy of artificial instruments, and the scientific authority of Scripture. Fourth, we must distinguish between the factual correctness and the rational cogency of the historical agents. Fifth, one must distinguish between essential correctness and total correctness, and admit that one can be essentially right even if one has committed some minor errors. Sixth, it is important to distinguish intellectual from non-intellectual factors, and realize that even if the crucial factors were intellectual, by themselves they were insufficient to bring about the outcome. Finally, the non-intellectual factors were themselves complex and multi-faceted and involved at least some personal-psychological factors and some political-institutional ones.

Then I go on to discuss the most important part of the historical intellectual background. This was Copernicus's astronomical hypothesis of the earth's motion, which I interpret primarily as a novel, original, non-negligible, but inconclusive argument for an old and previously discarded idea. The opposition to Copernicus was not merely religious, theological, and biblical, but involved many parts of traditional culture, and this is best seen from the many arguments advanced against the earth's motion based on principles of motion from physics, on astronomical observation, and on the epistemological principle of the reliability of the senses. Some typical examples of these arguments are discussed in detail.

After this conceptual orientation and historical background, I go on to relate the details of the story of the trial. Galileo's university research into the physics of motion (in the years 1589-1609) convinced him that the mechanical objections to the geokinetic hypothesis could be refuted and that the new physics could provide the basis for the possibility of the earth's motion; however, as of 1609, he had not published anything on the subject. His telescopic discoveries of 1609-1613, most of which he did immediately publish, enabled him to refute almost all of the observational astronomical objections to the Copernican hypothesis; those discoveries also provided some new evidence in favor of it. At this point he came increasingly under attack for theological and biblical reasons, and in December 1613 he found the occasion to write a considered and nuanced refutation of the scriptural objection; he did this in a private unpublished letter to his disciple Benedetto Castelli, which however began circulating widely.

After a formal complaint was submitted, the Inquisition launched an investigation, which yielded two results in 1616. Galileo received a private warning from cardinal Robert Bellarmine, forbidding him to hold or defend the earth's motion. And a decree was published by the Congregation of the Index, declaring that the earth's motion was physically false and contradicted Scripture; that attempts to show otherwise were condemned; and that Copernicus's 1543 book was temporarily banned until revised. Issued in 1620, these revisions eliminated suggestions that the earth's motion is physically true and compatible with Scripture and conveyed the impression that Copernicus treated the earth's motion merely as an hypothesis useful for astronomical calculations.

Galileo kept quiet until 1623, when an old admirer became pope Urban VIII. This encouraged Galileo to write the *Dialogue on the Two Chief World Systems* (1632), which showed that the pro-Copernican arguments were much stronger than the pro-geostatic ones. However, his enemies raised several complaints. A key charge was that according to a document found in the Inquisition files, in 1616 Galileo had been forbidden to discuss the earth's motion in any way whatever, and the *Dialogue* obviously violated this special injunction. Another charge, was that, in any case, the book defended the earth's motion, which he had been forbidden to do. Thus he was summoned to Rome to stand trial, which began in April 1633. At the first interrogation, Galileo denied that in 1616 he had been issued the special injunction and introduced a certificate signed by Bellarmine to that effect; Galileo also denied that his book defended the earth's motion, claiming instead that it showed the geokinetic arguments to be inconclusive. This deposition and Bellarmine's certificate led to an impasse, which was resolved with an out-of-court meeting between the Inquisition's commissary and Galileo, during which he was persuaded to plead guilty to the charge of having defended the geokinetic thesis, in exchange for leniency. Thus at the next deposition he admitted having defended the earth's motion but insisted that this was unintentional. The trial concluded in June 1633 with a sentence that did not exhibit the promised leniency: he was found guilty of "vehement suspicion of heresy"—an intermediate category of religious crime; the *Dialogue* was banned; he had to recite an abjuration, expressing sorrow and cursing his errors; and he was to be under indefinite house arrest.

(For more details, see my *The Galileo Affair: A Documentary History*, Berkeley: University of California Press, 1989.)

2. Methodological and Theological Aspects of Galileo's Condemnation

This lecture begins by distinguishing and clarifying the theological, the legal, and the scientific aspects of Galileo's trial. The main theological problem concerns the nature and validity of the concept of heresy under which he was found "vehemently suspected of heresy." The paramount legal issue involves the identity, relevance, and admissibility of the religious precept to which Galileo was bound by the developments of 1616. The methodological problem is the question whether Galileo's condemnation, though perhaps grounded on wrong theological and legal reasons, nevertheless embodied a deeper scientific wisdom. For example, though the substantive scientific belief for which Galileo was cited—the earth's motion—is indeed true, perhaps his arguments were illogical and his procedure was not in conformity with the proper methodological principles.

The first thesis I establish is that the trial involved explicitly at least one methodological disagreement, a dispute over whether it is proper to pursue a physical theory that is contrary to the Bible. I argue that this methodological issue is inherent in the relevant documentary and historical evidence, and that to admit its existence allows one to avoid two opposite extremes: one is the anti-clerical myth that Galileo was condemned for having seen and proved the truth; the other is the anti-Galilean suggestion that he deserved condemnation for his hasty, premature, and zealous commitment to the Copernican cause. Thus the Galileo affair has a doubly methodological component. One issue is implicit and involves the question whether Galileo was scientifically correct *de jure* as well as *de facto* in believing that the earth moves; to examine this problem requires an analysis of Galileo's *Dialogue on the Two Chief World Systems*. The other issue is explicit and turns on the question of exactly what relevant methodological principles Galileo felt he could be accountable for, as regards the connection between science and the Bible; this requires an analysis of Galileo "Letter to the Grand Duchess Christina."

My analysis of the *Dialogue* shows that Galileo cannot be charged with the methodological transgression of being biased; or for engaging in fallacious reasoning; or for not perceiving that his justification of Copernicanism is not a conclusive demonstration; or for having a hasty, excessive commitment to the earth's motion. My analysis of the "Letter to Christina" shows that it is partly a plausible plea for freedom of scientific inquiry because its central conclusion is that physical propositions capable of conclusive demonstration should not be condemned even if they conflict with the Bible; and partly it is a threefold criticism of the biblical objection against Copernicanism because it tries to show that this argument from authority is based on a premise (1) which does not support the conclusion, (2) which in general cannot be known independently of the conclusion, and (3) which is questionable or false.

(For more details, see my *Galileo and the Art of Reasoning*, Boston: Reidel, 1980; and my "The Methodological Background to Galileo's Trial," in *Reinterpreting Galileo*, ed. William A. Wallace, pp. 241-72, Washington, DC: Catholic University of America Press, 1986.)

3. Science and Philosophy in Galileo's *Dialogue on the Two Chief World Systems*

This lecture consists of two parts. The first is a meta-methodological discussion about the proper way to read Galileo's *Dialogue on the Two Chief World Systems*. The second is a critical analysis of the passage on the argument from vertical fall.

The *Dialogue* is a multi-dimensional work, and as such it can be read from the points of view of science, philosophy, history, rhetoric, and literature; it is also susceptible to a variety of conflicting interpretations along any one dimension, and this hermeneutical pluralism can take such forms as apriorism and empiricism, deductivism and inductivism, quantitative mathematicism and qualitative nonchalance, and causal explanationism and a-causal descriptivism; the book also cries out for evaluation as well as interpretation, and thus challenges the reader to properly distinguish and interrelate these two cognitive stances, and to properly justify the respective types of claims; and the book invites application of the distinction between theory and practice and challenges the reader to properly integrate them, insofar as it does not always mean what it says or say what it means, and insofar as there is not always a correspondence between its methodological reflections and its concrete scientific analyses. Each of these four traits is problematic enough; however, they also criss-cross each other, and so the difficulties are compounded. To be sure, these apply only at the level of the analytical reading of

the book, for at the level of intuitive reading the book is sufficiently successful as a literary achievement that the reader is assured of an enjoyable and engrossing experience. However, for the scientist, philosopher, or historian the context is precisely one of analytical reading, and so the problem cannot be ignored. To solve the problem, I introduce the notion of a classic, in the sense of “a man for all seasons,” and the notion of judgment, defined as the art of avoiding one-sidedness and extremes.

With the benefit of these distinction and in the context of such an approach, the second part of this lecture examines the passage in the Second Day of the *Dialogue* where Galileo discusses the anti-Copernican argument based on vertical fall. The vertical-fall objection may be reconstructed as follows: the earth does not rotate because bodies fall vertically, and this could not happen if the earth rotated. Galileo criticizes this argument in several ways. He begins by distinguishing between actual and apparent vertical fall. Insofar as the argument refers to actual vertical fall, it is shown to beg the question. Insofar as it refers to apparent vertical fall, it depends on a premise asserting the impossibility of mixed motion; he undermines this premise as groundless by arguing in support of such mechanical principles as conservation and superposition of motion. Galileo also criticizes the argument insofar as it presupposes the principle of naïve empiricism, according to which there is correspondence between appearance as revealed by normal sensory observation and physical reality; for this purpose he defends what may be called a principle of critical empiricism.

(For more details, see my *Galileo on the World Systems: A New Abridged Translation and Guide*, Berkeley: University of California Press, 1997.)

4. Retrying Galileo, 1633-1992

In 1633 the Inquisition condemned Galileo for holding that the Earth moves and the Bible is not a scientific authority. This ended the trial whose origin dated back to 1613, involving issues of both scientific fact and methodological principle. But a new controversy began, continuing to our own day—another trial about the original trial, or a series of re-trials of Galileo, as it were. This subsequent controversy is about interpreting and evaluating the original trial and so partly reflects the original issues. But it has also acquired a life of its own, with debates on whether, for example, science and religion are incompatible, whether political expediency must prevail over scientific truth, and whether scientific research must bow to social responsibility. The subsequent controversy has two main strands: the historical aftermath consists of events stemming more or less directly from the original episode and involving either actions by the Church or developments in the history of science, philosophy, or culture; the reflective commentary consists of countless interpretations and evaluations of the original episode that have been advanced in the past 350 years. Although the literature on the affair is enormous, the story of the aftermath has never been told, and the reflective commentary has never been systematically examined. Or more precisely, these things had never been done, until my own investigation, contained in my latest book entitled *Retrying Galileo, 1633-1992* (Berkeley: University of California Press, 2005).