The Galileo Myth

Robert P. Bauman
Professor of Physics Emeritus
University of Alabama at Birmingham

Galileo Galilei may well be the best known of the contributors to physics and astronomy. His successes and struggles are common knowledge: inventor of the telescope, discoverer of the moons of Jupiter, and advocate of the Copernican view that the Earth and planets move about the Sun; imprisoned and persecuted by the Pope and the Inquisition for his views on Copernicanism; compliant renunciation of his views and life imprisonment, but uncontrite. Some parts of this history are correct, but the truth is far more interesting and devious, and critical to understanding the building of the foundations of physics.

Undoubtedly spurred by the 350th anniversary of Galileo's death, as well as by the current excitement of space exploration, a strong renewed interest in Galileo has led to several new biographies[1, 2, 3] and related works[4, 5]. (There are, in addition, works such as Bertolt Brecht's *Galileo*,[6] which were clearly written for purposes having little to do with telling history.)

---

[1] James Reston, Jr., *Galileo: A Life*, Beard Books, Washington, D.C., 1994. Reston, a historian, is the son of the late well-known journalist James "Scotty" Reston.

[2] Wade Rowland, *Galileo's Mistake*, Arcade Publishing, New York, 2001. Rowland is a journalist with a recently acquired interest in the philosophy of science (M.A. 2001).

[3] Pietro Redondi, *Galileo: Heretic*, transl. by Raymond Rosenthal, Princeton U. Press, 1987. Redondi is a widely published science historian and editor.

[4] *E.g.*, Dava Sobel, *Galileo's Daughter*, Walker and Co., New York, 1999.

[5] John Brooke and Geoffrey Cantor, *Reconstructing Nature; The Engagement of Science and Religion*, Oxford Univ. Press, 1998.

[6] Bertolt Brecht, *Galileo*, a play, English version by Charles Laughton, Grove Press, New York; Introduction by Eric Bentley. There are two versions of the play, with different editorial intents.

However, despite new investigations and new methods, biographies of Galileo, including discussions of his scientific work and his writings, are enormously complicated by the overburden of myth, compounded by still enforced secrecy.[7] The only official deviation from the Copernicanism myth occurred in the late 17th century, in a brief, but complete, reversal by the Holy Office, now apparently conveniently forgotten.

Early History

The basic facts regarding Galileo are well known and generally undisputed. Galileo was born February 15, 1564 in Pisa, Italy. His father, Vincenzio Galilei, was a musician who, among other accomplishments, compared various definitions for notes of the scale and concluded that a musician's ear was superior to mathematical definition for harmony. He was also part of a group responsible for the development of the first opera. Because music did not pay well, Vincenzio operated a wool trading business and was constantly in need of money. He taught Galileo music, especially on the lute and organ, and pulled him from the inadequate local school, substituting home teaching.

To avoid the monetary problems he had faced and to supplement the meager classical education Vincenzio was able to give his talented son, he sent Galileo at age 11 to the Benedictine abbey of Vallombrosa to study Latin, Greek, mathematics, science, and drawing, as a novice, in preparation for medical studies.. At age 15 Galileo determined to join the order, but before he could take his vows, Vincenzio arrived and quickly removed his son. (His reason, or excuse, was an eye infection that was not being properly treated.) For two years Galileo studied wool trading with a relative, then entered the university at Pisa. Although he started in medicine, Galileo soon switched to mathematics. For financial reasons, he never graduated.

Galileo was a complex individual — robust, gregarious, quick to make loyal friends, but argumentative. He did not suffer fools gladly and was aggressively protective of his reputation for personal accomplishment, which facilitated making lasting enemies. He suffered numerous physical ailments, mostly undiagnosed, and apparently a willingness to employ his health as an excuse when it suited his purposes.

His early papers, circulated privately, on center of gravity and density, and lectures in Siena and Florence, led to an appointment to a Chair of Mathematics at Pisa (1589) and subsequently in Padua (1592).

Despite his relatively impoverished youth, Galileo developed a taste for the good life, and assumed, willingly or otherwise, substantial family economic burdens. His need for money drove him to activities such as invention of a delicate balance, ship design, a lift for irrigation water (for which a patent was granted), and military fortifications. He is better known for discoveries related to temperature (a proto-thermometer), pendulums, and especially, astronomy. He improved substantially on the design of the telescope imported from Holland and applied it to observations of the surface of the Moon, discovery and tracking of the moons of Jupiter, and

---

[7] Only carefully selected investigators have access to rigorously prescribed files, generally limited to files *not* concerned with unpublicized judicial investigations.

discovery of the stellar composition of the Milky Way and other diffuse groupings.

Publication of *The Starry Messenger* (*Siderius Nuncius*,1610), telling of his early discoveries with the telescope, led to international fame, an honorary appointment in Pisa, a move to Florence, under the protection of the Medicis, and a deep involvement with Prince Cesi's *Accademia dei Lincei*, a highly politicized philosophical and scientific group in Rome. In 1612, he published *Discourse on Floating Bodies*, based in part on unpublished work of more than a decade earlier.

Galileo was generally recognized by 1610 as the leading scientist of Europe (and hence of the world) and was soon recognized as the official Catholic scientist. He counted among his friends the Barberinis, including Cardinal Antonio Barberini, Francesco Barberini, named Cardinal in 1623 (at age 26,) described as the most powerful man in Rome (though deficient at diplomacy), and Cardinal Maffeo Barberini, brother of Antonio and uncle[8] of Francesco. Maffeo became Pope Urban VIII in August, 1623. Galileo had many other friends, especially among the Dominicans, the Jesuits, the nobility, and the lay intelligentsia. There was a new openness to thought in Italy, particularly after the election of Pope Urban VIII. It was the peak of the Renaissance in Italy, led earlier by Leonardo da Vinci, Michelangelo, and others but pursued diligently in the early 17th century by Florentine society as well as by many in Rome, especially in the Church,[9] including faculty of the Collegio Romano.

Galileo explored new realms of science and astronomy, and published his ideas, even though there were some who opposed him and his ideas. In his late sixties, he was brought before the Inquisition and recanted his statements about the Copernican model, following which he was placed under house arrest for the remainder of his life. He subsequently lost his sight, attributed to an untreated eye infection that spread quickly from one eye to the other, although a later visitor ascribed his blindness to cataracts, which has led many to assume the problem arose from looking at the Sun through his telescope. (He projected images of the Sun to view them.)

The Myth

As typically expressed, the myth of Galileo was that he was persecuted by the Church for discovering the truth; he was "guilty of having seen that the Earth moves around the Sun." The myth grew rapidly. For example, part of the myth was that Galileo was an antagonist of the Church. The Church fought back and won. It is easy to elaborate on such a myth, which has now established deep roots based on very little hard evidence.

In the 16th century, nearly everyone, especially among the educated, and therefore the clergy, accepted Aristotle, for lack of an alternative. Aristotle and Ptolemy had been incorporated into Christian theology and doctrine by Aquinas. As a mathematician, Galileo was an expert who

---

[8] The Italian word for nephew is *nipote*, from which comes the term *nepotism*.

[9] The term Church here always designates the Roman Catholic Church and its official organization and representatives.

lectured on these topics until he became disenchanted and rejected both the physics of Aristotle and the astronomy of Ptolemy, and freely said so. Quite naturally, many of the opponents, as well as the supporters, of Galileo's discoveries were clergy. Accordingly, Galileo has been labeled as anti-clergy and anti-Church. It followed, presumably, that the Church fought this heretic, with persecution including the usual forms of imprisonment and torture.

The myths generally associate Galileo with Giordano Bruno, primarily because among a long list of attitudes, heresies, and condemnatory statements by Bruno were statements in support of Copernicus' model, expanded to include an infinite universe and multiple universes, all without observational support. Therefore, the myth proceeds, Bruno was executed because of his Copernican views. Hence Galileo faced, potentially, the same sentence and was tormented by the same Inquisitor, Cardinal Bellarmino, "hammer of the heretics".

The fallacy persists that hindsight is 20-20. When the myth is accepted as the starting point, it becomes the driving force for interpretation of sketchy history. There is a nearly overwhelming temptation "to squeeze events into a preconceived mould".[10]

Thus, for example, Rowland accepts the myth (after removing some of the more obvious attachments, such as torture and imprisonment in a dungeon) and explores the psychology of Galileo in his fight with the Church. Starting with the conclusion that the problem arose with the Scientific Revolution, Rowland has discovered the shocking information that science often seeks new knowledge rather than human happiness. "Curiosity is not *always* a bad thing [emphasis in original]... [but it] needs to be kept in check"... Science is no longer as good and pure as it was in the days before science.[11] Rowland concludes the Church, not Galileo, was right, a conclusion not shared by many who have studied the history. The conclusion relies heavily on a journalist's lack of understanding of the science Galileo reported, as well as a common-place deep-seated antagonism to science. He creates and then effectively destroys straw-man caricatures of science.

A far more detailed report has been written by Reston, with credible written documentation, supplemented by conversations, thoughts, and personal motivations, with incredible detail. He carefully nurtures and fertilizes the myth. His impulse for simplification and dramatization often leads to conflict with his own statements and quotations.

Printed Communication

Galileo's scientific discoveries, conflicting with old ideas, were a consequence of the independent thinking encouraged by the Renaissance and the development of Gutenberg's printing press. As the volume of printing began to increase, Gutenberg's movable type (1436-50) became a necessity and, itself, the source of an explosion in the quantity of printed material. Not only did the Bible become available to the masses of Christian laymen, but also scholars gained access to

---

[10] Brooke and Cantor, *op. cit.*, p. 109. One is reminded of the axiom of experimentation — a hundred repetitions of a biased experiment is merely one hundred times more misleading than one biased experiment.

[11] Rowland, *op. cit.* pp. 18-23.

the works of ancient Greece and Rome as well as more current explorations in religion, philosophy, and science. Whereas the navigational aids of Ptolemy's astronomy,[12] along with the interpretation of Aristotle by Thomas Aquinas, had been generally accepted for lack of conflicting information, now the works of other Greek philosophers, who disagreed with Aristotle and with Ptolemy, were becoming available for comparison, and comparisons became inevitable. The printing press made it possible for educated people all over Europe to acquire books, and thus for the first time to discover that Aristotle's opinions were not fully representative of Greek thought of his time.

The printing press was also instrumental in providing rapid news dissemination. Suppression of news did not disappear, but it was becoming more difficult. This had an important bearing on the questions facing Galileo and the Church, recognized by principals on both sides. As foretold by Galileo, with accurate premonition, "If ... anyone ... settled that the opinion that the Earth moves is a heresy, and if afterward demonstration, observation, and necessary concatenation would prove that it does move, into what embarrassment he would have brought himself and the holy Church."[13, 14]

Printing was also critical to finding support for Luther and his followers who wished to speak for (*i.e.*, pro-test) individual rights and obligations to study the scriptures. A direct consequence was the Counter-Reformation, led off by the Tridentine Conferences (three sessions, in Trent, northern Italy, between 1545 and 1563), to which Protestants were invited but not attracted. The Roman Church found itself in what most would consider an impossible situation. It became necessary to define what the Church stands for, but the argument could not rely heavily on its primary source, the Bible, for that would amount to acceptance of the Protestant thesis. Emphasis was therefore placed on Church doctrine, as enunciated by the Church itself. Laymen were specifically forbidden to interpret Scripture. Even more broadly, the Council of Trent had declared books to be the vehicles of heretical infection in Catholic countries, and this attitude persisted into the 17th century.

Science and Conflict

---

[12] Ptolemy assumed a spherical Earth, but because he selected the wrong datum from the Greeks, he underestimated the diameter of the Earth, which strongly encouraged Columbus' crossing of the Atlantic.

[13] Letter to Froidmont, quoted in Ludovico Geymonat, *Galileo Galilei: A Biography and Inquiry into His Philosophy of Science*, McGraw-Hill, 1965; p. 229. Cardinal Bellarmino, often described now as the principal antagonist of Galileo on the issue, made a strikingly similar statement. The Church did not make the mistake of declaring the opinion that the Earth moves to be a heresy, but did make the mistake of allowing the public to believe it held such an opinion.

[14] Brooke and Cantor, *op cit.*, p. 114.

By the 17th century, the Jesuits (members of the Society of Jesus, founded in 1540) had taken over from the Dominicans as self-appointed protectors of the true faith. Although the Society included a majority of the scientists and mathematicians of the day, as a matter of official policy they made no distinction between "thought" and "experiment" as sources of new ideas, accepting neither imagination, nor reasoning, nor direct observation (sensual experiences). They accepted only "authority", elevated to the level of dogma. They believed that science, like law, should accept the authority of precedence and tradition, and at that time, authority meant Aristotle. They "... put Aristotle's statements and interests on a par with those of Theology and Faith."

Although Galileo was in almost all respects a thoroughly obedient and reverential medieval Catholic, he had the necessary protestant attribute of the scientist — he believed in his own ability to read nature (and to interpret Scripture). As he expressed it, God created the universe and God revealed the content of the Scriptures, although the latter were subject to human translation and interpretation. God could not be in conflict with Himself, so if there was an apparent conflict between nature and Scriptures, it must be that we do not understand the meaning of Scriptures. The Jesuits said where such apparent conflicts arise, it must be because we do not understand the observations of nature.[15]

There were significant attacks during the Middle Ages and the Renaissance on Aristotle's physics other than astronomy, including free-fall acceleration. Some writers have described in detail Galileo's demonstration at the Tower of Pisa, considering it curious that neither Galileo nor his contemporaries ever wrote about this 'very public' demonstration and assuming it was this lack of documentation that casts aspersions on a much later account. Such an assumption totally ignores the physical implausibility of such a demonstration, especially as contrasted with the "absurd" experiment by Girolamo Borro of dropping weights from a window.[16]

Galileo's experiments on balls rolling down inclined planes were feasible, especially for a

---

[15] It was apparently certain Jesuits and their followers that Duke Virginio Cesarini had in mind when he moved from supporting Aristotelianism to become a member of the *Accademia dei Lincei*, denouncing "some vain and pertinacious philosophers whose science was opinion and, what is worse, other people's and not their own." Redondi, *op. cit.* p. 92.

[16] For some discussion of this point, see Brooke and Cantor, *op cit.*, p. 125. Despite the misleading 19th century drawing, there is no railing to support the hypothesized experimenter who would be standing precariously on a downward sloping, curved concrete surface, from which (at least in 1988) the edge was well out of reach. By contrast, nearby buildings provide easily accessible windows, of approximately the same height, from which weights could easily be dropped. There is also a significant discrepancy between "reported" results and realistic expectations. For this point, see Carl G. Adler and Byron L. Coulter, *Am. J. Phys.* **46** (3), 199 (1978) They have shown the actual variation in rate of fall caused by air resistance is much greater than Galileo claimed, suggesting he tried to illustrate a point without having actually done the experiment, and the point he wanted to make was not that usually assumed.

trained musician who could beat time, with a water clock for calibration and for timing larger intervals. The original apparatus was reconstructed relatively recently and Galileo's original laboratory notes have been interpreted. (The experiment is valid provided all the balls have the same figure, and thus the same ratio of moment of inertia to mass.)

However, the studies of particular interest to the myth were related to astronomy. Because scientific (and other) arguments had moved to the medium of printed publications, we should look briefly at the publications relevant to Galileo's disputes. Principal among these were *The Starry Messenger* (1610), *Sunspots* (1613), *The Assayer* (1623), and *The Dialogue Concerning the Two Chief Systems of the World, the Ptolemaic and the Copernican* (1632).

The Starry Messenger was an immediate success. When Galileo published *Sunspots*, in 1613, the Jesuit Father Christopher Scheiner attacked Galileo's priority in discovery of sunspots. The argument, once opened, took on a life of its own. Galileo's personality was not such as to avoid a fight, nor were his friends willing to let him rest. As the argument raged, Scheiner argued (correctly) that the plea to read "the book of Nature", rather than accepting Aristotle's views, was against official Jesuit philosophy, too much like the reformists who argued for direct reading of the Bible.

Galileo was particularly effective at justifying his own views with Biblical quotations, to the point that he was repeatedly reminded that he was a scientist, not a cleric. In 1615, a complaint was filed to the Holy Office by the Dominican Father N. Lorini against the support of Copernicanism by Galileo, charging Galileo with "wanting to set forth Holy Scripture in his own fashion and contrary to the common interpretation of the Holy Fathers." The issue was referred to a committee of (non-science) cardinals, who provided the advisory opinion that the Copernican model did not agree with Scripture. The issue was quietly put to rest. Bellarmino called Galileo in and informed him that Copernicus' work was in need of revision. (The revision, quickly accomplished, consisted of removing ten lines, from the preface, that dealt with interpretation of Scripture.) He told Galileo not to argue for the "truth" of Copernicanism, although geocentrism had never been declared a matter of faith.[17] This blocked the judicial action on Lorini's complaint. Bellarmino's support of Galileo and *The Starry Messenger* was provided in writing, which led, in turn, to an award to Galileo from the Collegio Romano. In 1616, Galileo was explicitly forbidden by Pope Paul V to partake in exegesis (interpretation of scripture), but Galileo was assured personally that there was no thought of personal sanction against him.

---

[17] Orazio Grassi was a Jesuit mathematician, astronomer, and architect of the Collegio Romano. He was the principal protagonist (writing under the pen name of Lotario Sarsi) of the interpretation of comets as extra-terrestrial travelers of the solar system, and accordingly was attacked, bitingly and effectively, by Galileo in *The Assayer* and thus became a mortal foe of Galileo. As late as 1627, however, in his public response to *The Assayer*, Father Grassi conceded the relative lack of importance of the Copernican viewpoint. In *Ratio ponderum librae et simbellae*, Grassi refers to "the opinion on the Earth's motion, although its immobility is not considered among the fundamental points of our Faith"

Galileo was soon involved in his conflict with Father Grassi,[18] who wrote under the *nom de plume* "Sarsi" on the topic of comets. Grassi had the weight of observational astronomy on his side, but it pricked a raw nerve for Galileo. Grassi's model was borrowed from Brahe, who did not accept Copernicus' model. Galileo accordingly feared the Grassi interpretation of comets would conflict with Copernicus. Lacking an adequate rebuttal to Grassi's advocacy of extraterrestrial bodies, Galileo argued that comets were optical effects within the atmosphere. *The Assayer*, Galileo's response to Grassi (with editing assistance by powerful collaborators), was directed to "Sarsi". It was a literary bombshell that received the seal of the Pope (Urban VIII) and an enthusiastic pre-publication endorsement that ensured wide acceptance. Despite his invalid science concerning comets, Galileo appeared to win this first round of the argument. But the war was just beginning. The striking success came with a hidden high price tag because of the enemies formed and the arguments applied.

The Dialogue Concerning the Two Chief Systems of the World, the Ptolemaic and the Copernican, was published in February, 1632, in Florence. It carried the endorsement of the Vatican. By May it had reached Rome. A friend of Galileo and insider at the Vatican reported, "The Jesuits will persecute him bitterly." In July the *Dialogue* was secretly banned. But why?

The *Dialogue* dealt, nominally in a hands-off fashion, with the Ptolemaic and Copernican models. It proved to be immensely important, but served as a lightning rod for public attention at a critical moment. Although discussion of the issue is nearly always described in terms of "Copernicanism", there were two primary questions: *a*) Was the early Greek model, casually adopted by the Church and associated with Ptolemy, of "perfect" heavenly structures correct? And *b*) was the geocentric model associated with Ptolemy, or the heliocentric model associated with Nikolas Koppernigk, the Polish astronomer who wrote in Latin under the name Copernicus, correct? Very few even pretended to understand the mathematics of epicycles, eccentrics, and equants, the fundamental building blocks of Ptolemy and Copernicus, so the mathematical models of these authors were not the significant issue.

Some, including Rowland, suggest that "there was no convincing proof of [correctness of the Copernican heliocentric model] in Galileo's time." That challenge demands examination.

At the beginning of the 16th century, it was generally assumed that:

A. The Earth is "corrupt", with mountains, gullies, swamps, and deserts. (Rather than an "ideal" place, it was considered "the pits".)

B. The Earth is at the center of the universe and is unique as the locale for mankind — the children of God — and for all other creatures. (Only on Earth live the sons of Adam, the survivors of the flood — saved by Noah — , and those saved by the coming of Christ.)

C. The heavens are perfect. Therefore:

1. The heavens are eternal and unchanging.
2. The orbits of heavenly bodies are circular.

---

[18] *Libra Astronomica ac Philosophica*, by Lotario Sarsi or Lotharil Sarsii or Lothario Sarsio Sigensano or Lotharius Sarsius Sigensanus = anagram of Horatius Grassius Salonensis or Orazio Grassi.

Galileo and other astronomers could do nothing to improve the Earth, but observations of novae (new stars) indicated change in the universe. Kepler's elliptical orbits were not easily described as a sum of circular components. Sunspots were apparent imperfections on the Sun. Lunar surface irregularities demonstrated imperfections of the Moon. Jupiter's moons were neither heliocentered nor geocentered, but consistent with multiple motions of bodies moving about bodies other than the Earth. Saturn's moons were more problematical, in terms of observations, but supported the interpretation of Jupiter's moons. And the phases of Venus provided perhaps the most obvious and direct support for the heliocentric model.

The only critical evidence that was missing (nearly everyone conceded) was stellar parallax. If the Earth moved, the view of the stars should change with time. Absence of such parallax (not seen until the 19th century) was recognized as evidence *either* of geocentrism or of very great distances to the stars. Probably even this would not have constituted a barrier to acceptance of heliocentrism, except that terrible things happened to Church doctrine when the jump was made from a confined hard-shell universe to an infinite universe (and there were no stop signs along the way of the transition).

Even the early observations (surface of the Moon and Jupiter's moons) were convincing to many in the Church — perhaps a majority in its leadership — including Cardinal Roberto Bellarmino,[19] an amateur science enthusiast, who tended to believe the heliocentric model was self-consistent and could be valid, but should be "considered" false because it violated Church belief. By the second decade of the 17th century, there simply was no rational alternative to heliocentrism.[20] Also, we must keep in mind that Galileo was not criticized so much because of a lack of proof regarding Copernicanism as because he presented too much proof!

Galileo lost two friends in 1621: Pope Paul died in January and Bellarmino died in September, but after a short interval (1621-1623) with Gregory XV, Maffeo Barberini became Pope Urban VIII, which delighted Galileo and his friends. It was considered a "marvelous

---

[19] Saint Roberto Bellarmino, 1542-1621, is generally identified in this country as Robert Bellarmine. The Holy Office of the Congregation of the Supreme and Universal Inquisition (called the "Holy Office" or the "Inquisition") consisted of Cardinals, presided over by the Pope. In the early 17th century, it was under the management of the Jesuit Cardinal Bellarmino, a friend of Galileo. Through a misreading of the chronology of history, he has often been depicted as an enemy and persecutor of Galileo.

[20] In one sense, no observations or calculations could prove the validity of the heliocentric model, although the observation of phases of Venus effectively disproved the Ptolemaic model. The entire discussion was phrased in terms of kinematics, rather than dynamics, because Newton had not yet provided the key to understanding the dynamics. More realistically, however, any investigation of motion must carry some concept of simplicity and regularity in the absence of chaotic intervention. Outside the geographical realm of the doctrinal arguments, heliocentrism had little trouble catching on among scientists.

conjunction" to have a Florentine friend in the office.

Difficulties with the Standard Myth

According to the standard myth, the case against Galileo was quite straightforward. He advocated the heresy of Copernicanism, even after being warned not to do so. Thus he had to be brought to account. Why are questions still asked about this?

Opinion was shifting between 1610 and 1620 in favor of non-Aristotelian interpretations as they related to astronomy and physics.[21] Father Grassi did not hesitate to interpret comets in contradiction to Aristotle.[22] Church authorities went to great lengths to avoid taking sides on the scientific question, pending definitive evidence one way or the other. Nevertheless, Galileo was extremely cautious, both before and after the conversations of 1616. Every publication by Galileo was sent to the high authorities for approval before printing (as late as 1632).

At no point (other than, perhaps, 1632-33) were problems of astronomy and motion of the Earth of major consequence for Church beliefs. It appeared the Church leaders were as aware as Galileo of the problem of declaring a belief to be a matter of faith when the possibility existed that the matter might be definitely settled otherwise by future observations. Geocentrism was never declared a matter of faith. Bellarmino stated (not "If" but) "When there shall be a real demonstration that the Sun stands in the center of the universe, and that the Earth revolves around it, it will then be necessary to proceed with great caution in exploring those passages of Scripture which appear contrary to this." Pope Paul V told Galileo to "put away all care, because [he] was held in so much esteem both by [the pope] and the whole congregation of cardinals. They would never lend their ears lightly to calumnious reports." He added that as long as Paul lived, Galileo was safe (which proved to be true). Cardinal Maffeo Barberini apparently concurred, and was instrumental in the gentle admonishment of Galileo and mild "correction" of Copernicus in 1616,[23] explaining later (as Urban VIII) that the Church had neither "condemned nor ever would condemn the doctrine of Copernicanism as heretical, but only as rash."

By contrast, Urban VIII declared in 1632-33 that Galileo was guilty of (unspecified) ideas "perverse in the extreme," "... these things which might bring religion very great prejudice, of the worst that has ever been invented," and "...a question of the most perverse business that could ever be handled".[24] Galileo was told his heresies were more serious than those of Luther and

---

[21] Brooke and Cantor, *op. cit.* p. 111; Rowland, *op. cit* p. 5

[22] Reston, *op. cit.*, pp. 180-90.

[23] See especially Brooke and Cantor, *op. cit.*, p. 109; Rowland, *op. cit.*, p. 149.

[24] Rowland, *op. cit.* p. 202.

Calvin. Surely this is inconsistent with simply advocating an unproven, but typically favorably regarded, Copernican model.[25] Yet, despite these charges (made to Ambassador Niccolino and probably others), Galileo was not charged with a significant heresy, nor was he excommunicated, or imprisoned, before or during the trial, in any accommodations unfit for high nobility.

One place to look is at the previous publication, *The Assayer*. Vincenzo Viviani, Galileo's final student and his biographer, wrote that "all the misfortunes to which, from that hour until his last days, Signor Galileo was subjected via relentless persecution for his every deed and word" stemmed directly from the publication of *The Assayer*, which was devoted to comets and light, rather than the Copernican model. There was a verbal report of an attack on *The Assayer* for endorsement of Copernicanism, and historians have often accepted the implication that *The Assayer* advocated Copernicanism, though it did not. On this point Galileo had been scrupulously careful. Some have suggested the major heresy was solely a creation of Urban VIII, who took personal offense to a small section of Galileo's writings, but there is no evidence of such extreme pettiness in other actions, and specific contrary evidence of his friendly concern for Galileo before and during the trial.

New thoughts were an irritant, but two points seem more important. First, in the background of Church doctrine, starting with the second millennium, the issue of the Eucharist and its interpretation had become so dominant that it pervaded and controlled consideration of the nature of matter and its transformations. Indeed, the Church dictated the language that could be applied to the study of matter, beginning with Berengarius at Chartres, Angers, and Tours, in the early 11th century. This prevented any meaningful study of chemistry, or the physics of matter, until science broke free of the Church in the late 17th and the 18th centuries.[26]

Second was the immediate political situation. Pope Urban VIII was coming under increasing pressure, primarily for allowing "free thought". He was the first to have been selected by secret ballot and was opposed by the more conservative branch of the Church, led by Spain.

The antagonism was not limited to cloak-room grumbling. After simmering for years, it flared up in 1631-2, aided, no doubt, by catastrophes the Pope did not manage to avoid, specifically the plague, an eruption of Vesuvius, and Swedish military successes — by Gustavus Adolphus' Protestant invaders during the 30-year War. An inflammatory sermon by Father Grassi on Good Friday, April 18, 1632 was correlated with continuous pressure by Spain, culminating in an open denunciation of Urban VIII by Cardinal Borgia, Spanish ambassador and protector of Spain, and by the cardinals of his party, in a secret council of state of the Church on March 8, 1632, followed by an open threat by Cardinal Ludovisi to depose Urban VIII as a protector of heresy. At this point, imminent threat of invasion of Italy by the Swedes weakened the position of the Pope, forcing him into "reconciliation" with Spain and a promise of greater protection of

---

[25] By the time of the trial, Bellarmino and Paul V were dead, and thus did not contribute. Urban VIII, a friend of Galileo, had endorsed his publications.

[26] See Redondi, *op. cit*. Chapter 7.

orthodoxy. By May, the Renaissance, and its acceptance of new thoughts on science and philosophy, had come to an end in Italy. Urban VIII was forced to concede to the Spanish and Hapsburg pressures, promising new diligence in upholding the Faith as understood by the Jesuits and the conservative Spanish.[27]

An Alternative View

An investigation by Pietro Redondi of the life and times of Galileo is based on correspondence and other writings of the time and on records newly uncovered in the archives of the Vatican. Redondi notes that "books that have been written on the trial of Galileo would fill several shelves." But there were reasons to believe documents were in the Vatican vaults that had not been publically released. With very limited permission of access, he delved into the official records to examine original documents. The story that developed at the very least provides an alternative view that appears logical and persuasive from this distant perspective. Briefly, Redondi argues that the heresies charged to Galileo had nothing to do with Copernicanism, but much to do with atomism, and their importance was tied to timing and political pressures on the Pope

After the discussions of 1615-16, Galileo largely steered clear of heliocentrism for several years, waiting for the climate to change. He maintained his strong interest in the heliocentric model, and wrote on the subject, but not for general publication. Galileo was scrupulously careful not to deal with Copernicanism in *The Assayer*. But Galileo was insufficiently aware of the dangerous trap behind him as he retreated. He reverted to earlier interests in the structure of matter, light, and heat. In 1611 Galileo had presented an argument for corpuscular light. His exhibition of the "Bologna rock", a piece of BaS that exhibited phosphorescence, amazed friends and colleagues, for the "cold light" separated light and heat (previously not distinguished). His explanation was based on light as particles. Similarly, his *Discourse on Floating Bodies* argued for an atomistic model of matter and heat.

Comets excited relatively little public interest in 1623, several years after the last appearance of a comet in the heavens. Why then did *The Assayer* attract such great attention, and why was it important in the conflict between Galileo and the Jesuits? The answer lies in the philosophy developed in that publication. While demolishing "Sarsi" with wit and satire, *The Assayer* undertook a totally new look at the language and style of science. Not only did it speak of really indivisible atoms, referring to light, but it applied equivalent terms (fiery particles, fiery minims, very thin minims, and the smallest quanta) in describing heat and material bodies, while attacking

---

[27] Lest we think we are imagining a conspiracy, within months a cardinal and two monks were burned as a result of accusations and conviction of attempted assassination of Pope Urban VIII. There surely was a belief in the Vatican that the pope had mortal enemies who would like to see him replaced (with no suggestion that any of the conspirators were Copernicans). On the other side, Friar Paolo Sarpi, who strongly antagonized Rome but was "safe" in Venice, was subjected to two assassination attempts that were generally attributed to the Vatican. They played for keeps.

the very structure of Aristotelian science.

The traditional "paradox", "is there sound when a tree falls in the forest when no one is there to hear?", relies entirely on the ambiguity of defining what is meant by "sound". (As we would express it today, do we mean a physical wave or a physiological or a psychological sensation?) One could similarly ask, is there color, is there odor, is there taste when no observer is there to detect these qualities? From the 17th century perspective, Galileo separated the *qualities* from the *object*. By contrast, properties such as size, shape, and motion, considered ephemeral by Aristotle (and Grassi), were associated directly with the object by Galileo. This was a near mirror image of Aristotelian thought, and was the substance of the attack on Grassi's monograph and of Grassi's response.[28]

To a modern physicist, "anti-Aristotelian" suggests a Galilean interpretation of bodies falling with a common acceleration in a gravitational field. To the 17th century theologian, at least after the eruption of the 1620's, an anti-Aristotelian scientist implied one who considered light, matter, and heat to be corpuscular, and therefore inevitably in conflict with the Tridentine dogma of the Eucharist. Even at this early date there was recognition that a change in substance would be far more difficult to reconcile with a model of the substance consisting of enduring atoms. (Philosophers and theologians tied themselves and each other in knots with terminology to "clarify" their interpretations of transubstantiation.) On the other hand, we now recognize that Galileo's endorsement of atomism was little more than a stab in the dark, of little or no enduring significance.

At the Council of Trent, a major doctrinal decision was affirmation of transubstantiation, the repeatable miracle[29] of changing the bread and wine of the Eucharist to the body and blood of Christ. As Redondi has noted, "One could perhaps be Catholic and Copernican, but one could not be Catholic without respecting the Tridentine postulate of the Eucharist." Bellarmino had employed the doctrine of transubstantiation in sending Bruno to the stake, and it remains a major point of theological dissension today between the Roman Church and Protestants.

In 1623, when the first copies of *The Assayer* became available, Grassi stated clearly, and

---

[28] The modern reader will note that with better instrumentation, we have swung back toward the Aristotelian association of perceptive properties — color, odor, *etc.* — with the object, rather than the observer, but have interpreted these in the Galilean sense. In the meantime, the assumption that color, density, and such were inherent attributes fed the extensive alchemical searches for understanding of matter and for transmutation. If gold has certain inherent properties — hardness, color, density — then mixing materials to achieve those properties should yield gold.

[29] There is necessarily a fine line in theology in defining a miracle. By definition, a miracle must be an exceptional occurrence, not a "ho-hum" everyday expectation, but there are certain events that are classified as "repeatable miracles". Transubstantiation, or the miracle of turning the bread and wine into the flesh and blood of Christ, is deemed such a repeatable miracle, known as the Eucharist.

repeatedly, that he would respond vigorously, within a few months, although he recognized he could not publish a book that quickly. Soon after the end of the year, a secret charge was filed with the Holy Office. Pretrial information was (and is) highly protected (like modern grand jury testimony). Revealing pretrial information was punishable by excommunication. The nature and source of the charge therefore remained hidden until recently. The document (labeled G3) explicitly charged Galileo with support of atomism and thus with heresy by conflicting with the current interpretation of transubstantiation. The distinctive handwriting, and also the language, appears to match that of Grassi. Urban VIII passed the charge to a cardinal who called in Father Giovanni de Guevara as an expert. Guevara indicated he had read *The Assayer* and found it interesting and inoffensive. (His written report is not available.) On the basis of this evaluation, the charge was shelved. This was Galileo's second escape from formal charges.

Grassi was not at all satisfied. By 1626 he had published his response (*Ratio*) to *The Assayer*, seeking to try in public the case he had not won in secret. The accusation of atomist heresy and its specific link to the Eucharist was spelled out in much the same language as in the charge (G3).

In August, 1632, immediately after the appearance of the *Dialogue*, the Jesuits reopened the issue raised by Grassi, sending out a broadside proscription of atomism. Galileo had been very careful with respect to support of Copernicanism and had avoided any mention of the Eucharist or even the term atomism, but he had necessarily included arguments equivalent to atomism in the context of natural phenomena. Urban VIII, with his nephew Cardinal Francesco Barberini, attempted to intercept copies at the printer, in Florence, and in Rome, but too late. Copies had not only been sent out, but were in the hands of important friends in Rome and of the Jesuits.

Secret charges were again filed against Galileo in the summer of 1632. When asked the nature and source of the charges, Father Riccardi, a close friend of Galileo at the right hand of the Pope, offered only false pretenses, but confirmed that the Jesuits were behind the charges. Whether it was again Father Grassi or Father Scheiner (both of whom had publically made threats against Galileo) or someone else is not known. To this day, there is no open record concerning the nature of the charges. Subsequent events suggest, without proof, that the charges mention the *Dialogue* and mention problems of atomism and the Eucharist.

The Pope recognized quickly the implications of the charge. He seemed to have two choices. *a*) He could support Galileo and fight the charges, becoming involved as a defendant in a likely hopeless cause. Or *b*) he could concur in the denunciation, abandoning his good friend and the official scientist of the Church and thereby open himself to the charge (already made) of having harbored a heretic. Neither offered a desirable outcome. Given such a choice, and the papacy to protect, what would you do? Urban VIII clearly had a solution in mind. He told several friends of Galileo that "trial cannot be avoided".

As many have noted, the charges were not treated in routine fashion, which would have been to send them directly to the Inquisition, where the defendant is considered guilty unless exonerated (which was unlikely).[30] The Pope responded to the charges against Galileo in an

---

[30] "In matters before the Holy Office, the procedure is to arrive at censure and then call upon the defendant to recant." Urban VIII quoted by Reston, *op. cit.* p. 236. There are,

unusual manner by creating a commission of three persons to investigate the charges. Two of the commission members, Agostino Oreggi and Zaccaria Pasqualigo, were close friends of the Pope, basically anti-Jesuit, experts on the Eucharist, who could be trusted to handle the problem quietly and expeditiously. The third, Melchior Inchofer, was a Jesuit with moderate strength in mathematics and astronomy who was "ferociously anti-Copernican". He was, himself, at the time under investigation by the Congregation of the Index. The commission was officially asked to serve as a grand jury — *i.e.*, to decide whether the charges should be referred to the Holy Office. Many (now and then) considered it scandalous that no member of the commission was prepared to consider the merits of Copernicanism. (Inchofer has not been widely recognized as a mathematician.) During the process of consideration of charges, by the commission and then by the Holy Office, both Cardinal Francesco Barberini and Urban VIII assured friends of Galileo that he was being given special consideration (not very consistent with the revenge motive often attributed to the Vatican).

Galileo was never in a cell. While awaiting trial, he was housed in palatial quarters in the Villa Medici. After the trial got underway, Galileo was moved from the Villa Medici to the Vatican,[31] taking the luxurious suite of three rooms normally occupied by his prosecutor, Father Carlo Sincero. The rooms were appointed with priceless icons and outfitted for every comfort. The prisoner had the run of the spacious corridors outside his suite, as well as the Vatican garden in which to walk and ponder his situation....A servant stayed with the prisoner to look after his every need. "... The pope himself ... reminded the ambassador [from Florence, who was speaking on Galileo's behalf] that such gentle treatment was unique in the four-hundred-year history of the Inquisition."

The charge of atomism, which would have been serious heresy, was never passed on to the Holy Office by the commission. As anticipated, Inchofer went along with a substitute charge against Galileo of supporting Copernicanism. But "supporting Copernicanism" would have been an ineffective charge, given the ambiguous attitudes toward that model. Instead, an unsigned letter by Bellarmino (who had died in 1621) purporting to state the decision of the May, 1616 meeting with Galileo, was "found in the files" that enjoined Galileo, with respect to the recently banned ideas of Copernicus, "not to hold, teach, or defend it in any way whatever, either orally or in writing." There is no trace of any such letter indexed in the files, and no other record of its existence![32] In the *Dialogue*, Galileo had scrupulously refrained from defending Copernicanism,

---

however, ample examples of modifications of this procedure, at the discretion of the highest authorities.

[31] Reston, *op. cit.*, p. 250.

[32] It was clearly the custom of the time (and since) to keep copies of official correspondence. Yet the critical document, on which the entire charge and trial hinged, was apparently uncovered immediately before the trial in the Vatican archives, and was unsigned. (Some have described the absence of authentication to this critical document as nothing more

but he had certainly dealt with the subject. The charge, as transmitted, was a charge of "disobedience". This constituted "inquisitional heresy", much less serious than doctrinal heresy. Other "venial crimes". were added, but all except the "disobedience" were capable of correction. It is significant that the "disobedience" infraction was plainly visible in the *Dialogue* (given the new Bellarmino letter) and thus could scarcely have required 5 meetings of a special commission.

In response to the charge, at the first session of the trial, Galileo produced his own statement from Bellarmino, highly favorable to Galileo's position. Even today, given the written evidence and Galileo's verbal facility, it appears to most readers that Galileo had an excellent chance of refuting the charge if given any pretense of a fair trial, as was expected. The judge called a recess of the trial and held a (highly unusual) secret meeting with Galileo, without witnesses. It seems apparent that the judge explained why the chosen charge was (relatively) favorable to Galileo (compared to the alternative), a point Galileo was well prepared to grasp. At the following session of the trial, Galileo swung to the other side, apologizing for his grievous error. (The famous quotation, "Still it moves", first appeared in 1757.) Thus Galileo was found guilty, by his own statement, not of atomism (which at that time could have meant the stake) or Copernicanism, but of violating an order from Bellarmino. Galileo was required to abjure the Copernican model, which was by no means original to him nor significantly influenced, at that point, by what Galileo said.

Evaluation

The outcome provides some of the strongest support for Redondi's findings and interpretations. Galileo returned to the Villa Medici and then, by way of an archbishop's palace in Siena, to his own home, "The Jewel", at Arcetri "under life sentence", "not authorized to speak in any way about the reasons for his sentence". There he abandoned his speculations on atomism, as well as his limited efforts in astronomy, although he was substantially more willing to discuss questions related to Copernicanism than to discuss or accept any responsibility for atomism.

He abandoned his fruitless investigations of atomism, turning back to experimental studies of "practical" physics. He completed work undertaken during his 18 years at Padua, compiling *The Dialogue on Two New Sciences*, which was successfully transmitted abroad and published in 1638, where the Inquisition had no reach and science was blossoming. This work "contains practically all that Galileo has to say on the subject of physics", or in Galileo's words, these dialogues "contain results which I consider the most important of all my studies." Galileo died in 1642 at age 77.

Is Redondi's interpretation believable? Certainly we must ask, if Galileo was considered the

---

sinister than a bureaucratic oversight.) By contrast, no file copy was found in the official archives of a document that *was* clearly authentic, requested by Galileo, treasured and produced by him, and signed by Bellarmino, which conflicted in significant ways from the unsigned document. There is possibly a nice touch of irony here, for those who like to view battles as "good guys *vs.* bad guys". Through this letter, fraudulent or otherwise, the Jesuit Bellarmino may well have been used, post-mortem, to save the Dominican papacy from the Jesuits.

evil being who incited the Pope to violent wrath, why was he treated so exceptionally in his imprisonment? Why did he escape excommunication (quite apart from torture or typical imprisonment)? And what happened to the charge of atomism?

Father Grassi, at age 50, was removed from all teaching responsibilities, including his professorship at the Collegio Romano, removed from his supervision of the St. Ignatius Church of the Collegio Romano, for which he was the architect, and was sent out of Rome to Savona, with only priestly duties, until after Urban's death. He never published again, as Grassi or as Sarsi, and no further references appeared to his written works. Others involved in the intellectual ferment in Rome, including Niccolo Ridolfi and Father Guevara (previously slated to be named a cardinal) and Monsignor Ciampoli, were also banished.

On the other hand, Father Oreggi, a member of the commission who believed in separation of physics, mathematics, and metaphysics, and was the personal theologian of the pope, was named Cardinal following the trial. Urban VIII remained in office til his death (in 1645).

Officially, the Church had found Galileo guilty of disobeying Bellarmino's order (or more precisely, he admitted his "guilt"). For more than 300 years the Church, for public information purposes, stuck with the story that the action had nothing to do with whether the Earth moved but only with following orders, even though, in another case, near the end of the century, it was officially established that Galileo and his followers were condemned primarily not for Copernicanism but for atomism, interpreted from the point of view of the Jesuits as against the Tridentine interpretation of the Eucharist.[33] Unfortunately, common perception has been that the Church had insisted the Copernican model was wrong. Only in 1992 was the condemnation of Galileo overturned and the heliocentric model specifically acknowledged by the Church as correct, with no acknowledgment of the deeper motives of 1633.

In summary,

a. Urban VIII was publicly threatened at the highest levels of Church authority before the trial.

b. After the trial, Urban VIII was no longer threatened. Whatever he did appeared to satisfy his critics.

c. Urban VIII accused Galileo of heresies more serious than those of Luther, but he never revealed what those charges were. The principal "hot button" issue of the day was atomism, because it tied in directly with the doctrine of transubstantiation.

d. The "nominal" charge of advocating Copernicanism was never declared a heresy, before, during, or after the trial.

e. Before and during the trial, Galileo was treated "royally", and after the trial he was sent home, whereas those who had been publically accusing him were exiled.

f. No public mention was made by the Holy Office, at the time of the trial, of the charges of "atomic" heresy, which normally at that time would have demanded a trial and excommunication, if not death.

---

[33] Viviani was informed about "the incrimination of Galileo, for reasons that had nothing to do with Copernicus". Redondi, *op. cit.* pp. 318-319.

g. At the end of the century, one brief but official statement disassociated Galileo and charges related to Copernicanism.

It seems unlikely that a more definitive answer can be obtained on what transpired until more of the secrecy is removed from the Vatican files. At this point, Redondi has raised serious issues concerning the standard myth and offered an alternative that appears to have a logical and compelling foundation, which cannot be dismissed by hand waving arguments about handwriting or bureaucratic oversight. Readers may wish to judge for themselves which interpretation of the history is more likely to be sustained.