

**Galileo Galilei:
Heretic or Scientist?**

**By
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When Galileo looked through his newly expanded telescope in 1609, he stared at the heavens and discovered many things never seen before. He published his findings about the craters on the moon and several planets (Jupiter and Venus, etc.) in a small booklet called “The Starry Messenger” (“Siderius Nuncio,” 1610). In 1613 and 1615 he made observations which supported the Copernican heliocentric theory that the earth revolved around the sun and not, as Ptolemy and Aristotle had declared, vice versa. In other words, the earth was not the center of the universe, as had been prescribed in the Old Testament and by many Christian religious figures including St. Augustine and St. Thomas Aquinas.

By 1616 Galileo had written letters to highly placed individuals about his support for heliocentrism, but when word got around he was almost immediately warned by the Church not to hold or defend the Copernican System. So being a faithful Catholic, Galileo complied---for the time being.

Galileo was born in 1564 in Pisa, the major port for the city of Florence in Italy. His father, Vincenzo, was a lutenist and composer who formulated theories on musical harmonics published in Dialogue format in 1581. Galileo went to the University of Pisa to study medicine but while there, he noticed a chandelier swinging in the breeze in both small and large arcs but completing each of those arcs in the same time period--which he found were similar to those of his beating heart.

In 1585, lacking sufficient funds to help support his family, including his younger brother, he left the University to become a tutor. A year later he invented a hydrostatic balance describing how one could accurately weigh objects in air or water in his work, "La Balancitta." He also studied design (including chiaroscuro) and became an instructor in design and perspective at the Accademia del Disegno in Florence. Then in 1589 he was appointed Professor of Mathematics at the University of Pisa.

Following the death of his father in 1591, Galileo was appointed Professor of Mathematics at the University of Padua where he remained for eighteen years. During that time he fathered three children out of wedlock, two daughters and one son. Because of their illegitimacy and their father's inability to pay a dowry, the daughters became nuns (the eldest was later buried in Galileo's tomb at Santa Croce in Florence). Eventually the son, Vincenzo, was legitimized and named his father's heir.

In 1593 Galileo invented a crude form of a thermometer which he called a “thermoscope.” Two years later he improved a ballistics/military compass which he designed for surveying and making general calculations. Then in 1600 the Roman Inquisition found Giordano Bruno, a supporter of Copernicus, guilty of heresy for holding a number of beliefs like pantheism and the existence of other eternal worlds, and had him burned at the stake.

In 1608 Hans Lippershey in Holland, invented a refracting telescope, but a year later, Galileo designed a much improved version which could actually display the mountains and craters on the moon and the revolutions of several other moons around Jupiter (rather than the Earth). He reported his findings to friends and others in 1610, and in time, astronomers began referring to those moons circling Jupiter as “the Galilean Moons.”

Then, while on a visit to Rome in 1613 he was inducted into the prestigious Lincean Academy, and they in turn published his “Letters on Sunspots” (viewed through the telescope) in which he publicly supported the Copernican System. Thereafter, Galileo would refer to himself as Galileo Galilei, Linceo. By 1615, his earlier writing, “The Starry Messenger” had become such a popular publication that it had been distributed all over Europe and was even brought to China by Jesuit missionaries!

But despite all this public acclaim, in 1616, as stated above, the Roman Inquisition told Galileo to stop supporting the Copernican System and placed Copernicus’ publication, “De

Revolutionibus Orbium Coelestium” on the Index of Forbidden Books. It took a while for Galileo to recover from this blow, but, as one might expect of a man of his argumentative nature, he soon plunged into another controversy, this time about the nature of comets, after three appeared in the sky in 1618.

His ongoing argument with a Professor of Mathematics at the Collegio Romano over these comets led him to publish a brilliant exposition on what came to be known as “the scientific method” under the title of “Il Saggiatore” (The Assayer”) in 1623. “The language of the Universe,” he wrote,

“is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures, without which it is humanly impossible to understand a single word of it.” (Brittanica.com)

Just as this essay was about to be published, a Cardinal who had been a friend and patron of Galileo’s for over a decade, Maffeo Barberini, was named Pope Urban VIII. It was immediately dedicated to the new Pope, and in 1624 Galileo went to Rome to discuss with him other theories he had about tides and movements of the earth. The Pope gave him permission to write a book about his theories of the Universe, but warned him to avoid treating any aspects of the Copernican System other than hypothetically.

His “Dialogue Concerning the Two Chief World Systems, Ptolomaic and Copernican,” was finished in 1630 when he sent it to the Roman Censor for approval. An outbreak of

the plague interrupted communications between Rome and Florence, so Galileo asked that the censoring be completed in Florence. The Roman Censor complied but sent along a set of serious criticisms, causing Galileo to preface the book with an acknowledgment that what he had written was hypothetical in nature only. With that assurance, the Florentine censors gave their approval and it was published in 1632.

However, in this Dialogue, the three major participants were soon recognized as amusingly representing three hypothetical persons involved in the Copernican controversy: Salviati, being Galileo, Sagredo, an intelligent layman, and Simplicio, a staunch Aristotelian. “Simplicio” in Italian translates as “simpleton.” So, by gathering together all the arguments on the question of Copernicanism and arranging them in three clusters in an ongoing dialogue, he hoped the final version would actually sound like a discussion, and not a doctrine.

Unfortunately, Galileo was unable to help himself when it came to mocking persons with whom he disagreed, and the argument presented by Simplicio actually rephrased some of the same words used by Pope Urban himself!! The result was his immediate order to present himself before a special commission to respond to their conclusion that he had not referred to the Copernican System hypothetically as he had stated in the preface. The commission immediately declared him to be “vehemently suspect of heresy” (Britannica.com) and condemned him to life imprisonment with the order that

he formally “abjure” the doctrine. He complied, but at the same time, was reported to have muttered under his breath, “Eppure, si muove.” (“And yet, it moves.”)

Fortunately for him, by that time he had acquired such acclaim and honor that he was never actually imprisoned. Instead he spent the rest of his life going from the home of one admirer to another, including the Tuscan Ambassador to the Vatican, and the Archbishop of Siena, Ascanio Piccolomini. He was finally permitted to retire to a villa at Arcetri, not far from Florence, where one of his daughters was living in a nunnery. (Wade Rowland, “Galileo’s Mistake.”)

Nevertheless, Galileo continued working on some of his earlier studies which had been interrupted by his work on the telescope. A book was published in Leiden in the Netherlands in 1638 (outside the influence of Rome), with the title: “Discourses concerning Two New Sciences” (including “the Law of Falling Bodies” and the mixing of bodies at two motions in “parabolic arches at constant speed and acceleration.”)

A biography of Galileo by his pupil Vincenzo Viviani, claimed that he had dropped balls of the same material but different masses from the Leaning Tower of Pisa, all landing at the same time and speed, illustrating that the time of their descent was independent of their mass, as later stated in Newton’s First Law of Motion.

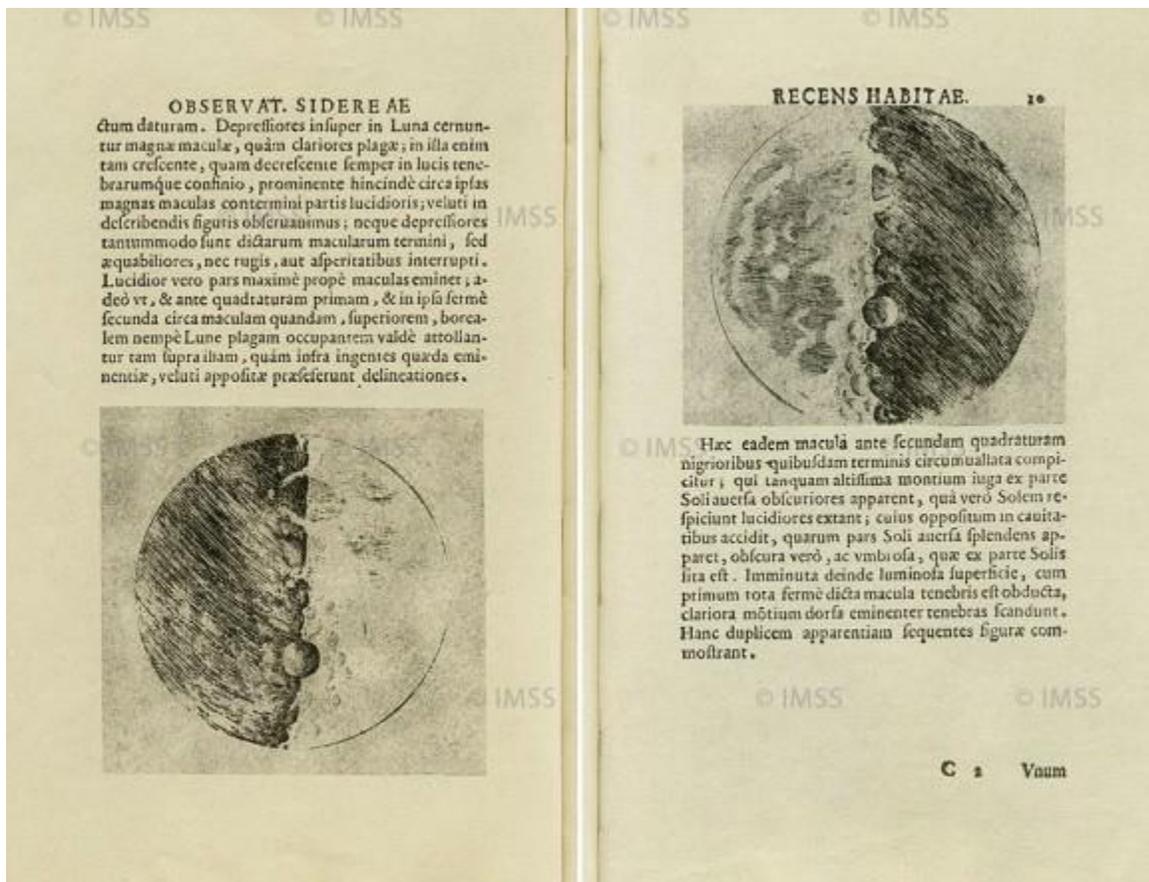
Amazingly, in 1971 Astronaut David Scott during the Apollo 15 Mission, proved that Galileo's (and Newton's) theory was right about all bodies accelerating at the same speed no matter what their weight when subject to the same force (gravity in this instance), as he dropped a hammer and a feather from the same height onto the surface of the moon! Many other scientists from Newton to Descartes, and even Albert Einstein, also highly praised Galileo's work, especially when he stated that the laws of physics are the same in any system moving at a constant speed in a straight line regardless of its particular speed or direction. Einstein called this the "Special Theory of Relativity."

During the last years of his life Galileo became blind (from staring at the sun through his telescope?) and died on January 8, 1642, never to be forgotten as "the father of observational astronomy", "the father of modern physics", "the father of the scientific method," and "the father of science." (Britannica.com) It was Stephen Hawking who claimed him to be more responsible for the birth of modern science than anyone else, and finally, Albert Einstein who called him "The Father of Modern Science."

Nevertheless, it took the Church over two centuries to change its views of Galileo and Copernicus, when their works were dropped from the Index of Forbidden Books in 1758. And almost two centuries later in 1939, Pope Pius XII, in his first speech to the Pontifical Academy of Sciences, praised Galileo as being one of the "most audacious heroes of research." In 1992 Pope John Paul II went even further

and expressed regret for how the issue of Galileo was handled by acknowledging the errors of the Catholic Church in this matter. Then, on the 400th anniversary of Galileo's earliest observations through the telescope, Pope Benedict XVI praised his contributions to astronomy.

What a remarkable heritage for a man who was born poor and died blind! Thank you, Galileo Galilei, Linceo!!



Craters on the Moon from "The Starry Messenger."

