

## Galileo Galilei

Galileo Galilei was born in 1564 at Pisa. Galileo began his studies in medicine at the University of Pisa, but soon dropped out, preferring to study mathematics with Ostilio Ricci. In 1592 he obtained the chair of mathematics at Padua, and began working on the inclined plane and the pendulum. By 1598, Galileo believed in the truth of the Copernican theory, as he wrote to Kepler. Around 1604, he began working on astronomy in order to lecture on the new star that had appeared that year.

In 1609, Galileo heard of the telescope while in Venice, and on his return, constructed one for himself. In 1610, Galileo published his telescopic discoveries in *The Starry Messenger*, and dedicated the four satellites of Jupiter that he had discovered to Cosimo II, Grand Duke of Tuscany, naming them 'the Medicean stars'.

In *The Starry Messenger*, in addition to the satellites of Jupiter, Galileo reported that the milky-way was a collection of stars and how the moon in fact had a ragged surface like earth. *The Starry Messenger* was a sensational success, and Galileo became well known throughout Europe. In 1611, Galileo traveled to Rome, where the Collegio Romano, at the behest of Robert Bellarmino, confirmed Galileo's findings. Frederico Cesi hosted a banquet in honour of Galileo, and was elected to Cesi's 'Accademia dei Lincei' (Academy of the Lynxes). In Rome, Galileo also met Cardinal Maffeo Barberini, who later sided with him on the controversy over floating bodies at a court dinner in Florence.

Picture of Jupiter's satellites from the *Sidereus Nuncius*.

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Large image (89K).

Very large image (1M).

One morning in 1613, at breakfast, Cosimo de' Medici and his mother, the Grand Duchess Christina began discussing the truth of Jupiter's satellites. Benedetto Castelli, Galileo's student, who was present, asked Galileo to comment on the central point of that conversation – the conflict between the Bible and the heliocentric doctrine. The reply was the famous 'Letter to Grand Duchess Christina' which circulated widely in manuscript form at the time. In it, Galileo famously declared that the Bible teaches how to go to heaven, not how the heavens go. Galileo's belief in the truth of the Copernican hypothesis alarmed Dominicans such as Tommaso Caccini and Niccolo Lorini, and the Inquisition examined Galileo's letter to Christina. Thus began Galileo's trouble with the Catholic Church.

Galileo's run-in with the Church is famous to this day, though often over-romanticized or misunderstood. For instance, his declaration in the wake of the condemnation: 'And yet the earth still moves!' is apocryphal. It is therefore important to appreciate the precise nature of the affair.

There were two occasions (1616 and 1632) when Galileo was called to Rome over the truth of Copernicus' theory. As a result of inspecting Galileo's letter, in February 1616, it was agreed by the Inquisition that 1) the immobility of the Sun at the centre of the universe was absurd in philosophy and formally heretical, and that 2) the mobility of Earth was absurd in philosophy and at least erroneous in theology.

At the order of the Pope, Galileo was then summoned (February 1616) by Robert Bellarmino to be cautioned against speaking out on behalf of the Copernican claim. Rumours, however, quickly began to circulate that Galileo had been condemned and prosecuted. In defence, Galileo secured from

Bellarmino a letter stating that this was not the case but that he had had been notified of the Papal decision to censor Copernicus' *De Revolutionibus* because a heliostatic claim was contrary to the literal meaning of Scripture.

Galileo duly kept away from writing on cosmological matters, concentrating instead, on applying his discovery of Jupiter's satellites for determining longitude at sea. In 1623 he wrote the *Assayer*, published by the Academy of the Lynxes and dedicated to Barberini. There, Galileo famously wrote:

Philosophy is written in this grand book - the universe - which stands continuously open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and interpret the characters in which it is written. It is written in the language of mathematics, and its characters are triangles, circles, and other geometrical figures, without which it is humanly impossible to understand a single word of it; without these one is wandering about in a dark labyrinth. (As quoted by Machamer in *The Cambridge Companion to Galileo*, pp.64f.)

His sympathizer and patron Barberini had just been elected Pope, as Urban VIII. In 1624 Galileo had an audience with the Pope, who favourably received the *Assayer*. In the meetings he had with the Pope, Galileo believed he was encouraged to discuss the Copernican theory so long as it was treated as an hypothesis and began to compose the *Dialogue on the Two Chief World Systems*, which was published in 1632 and dedicated to the Grand Duke. The work caused a furore because Galileo seemed to have gone against the injunction not to advocate the physical truth of Copernicus' claim. The sale of the book was suspended six months after its publication.

In September 1632, Galileo was summoned to Rome, where he arrived in January 1633. First the inquisitors tried to get Galileo to admit that he had earlier been officially banned from teaching Copernicus' theory as true, but Galileo produced Bellarmine's letter to contradict this. By then, both Bellarmine (1621) and Cesi (1630) were dead, and Galileo had few powerful patrons left to defend him. A plea bargain to plead guilty to a lesser charge was scuppered, however, when Urban VIII decided in June that Galileo should be imprisoned for life. Galileo was then interrogated under threat of torture, and made to abjure the 'vehement suspicion of heresy'. He was sentenced to life imprisonment. Galileo spent the rest of his life at his home at Arcetri, under house arrest with the archbishop of Siena. Pleas for pardons or for medical treatment were refused.