

## Galileo viewpoint: foundation of modern physics

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Galileo's point-of-view has become the foundation of modern physics, it brought him into conflict with the Catholic Church. It led to a unified theory of physics. But in recent times – the foundation of modern physics (Galileo's viewpoint) has become submerged in confusions of people with differing opinions who do not stick to the foundational view of what modern physics is.

### Introduction

From an article on Galileo—I want to raise the following points-

Regarding two different viewpoints: Bellarmine viewpoint A and Galileo viewpoint B.

1. Cardinal Robert Bellarmine, the chief theologian of the Church, was unable to appreciate the importance of the new theories and clung to the time-honoured belief that mathematical hypotheses have nothing to do with physical reality.
2. Galileo was the first man who perceived that mathematics and physics, previously kept in separate compartments, were going to join forces. He was thus able to unify celestial and terrestrial phenomena into one theory
3. The Jesuits (a part of the Catholic Church priesthood) insisted that it (2<sup>nd</sup> viewpoint) could have worse consequences on the established system of teaching "than Luther and Calvin put together."

Two points-of-view A and B and 2<sup>nd</sup> being correct, then point (3) the Church deciding viewpoint B was dangerous.

Of course – viewpoint B led to Boscovich's theory, applying maths to physical reality is maths modelling and from this Galileo's relativity that there was no absolute rest.

It is sad that some people have difficulties with this.

## The Life of Galileo and his viewpoint

Britannica article on Galileo [1], says Galileo was: “Italian mathematician, astronomer, and physicist, made several significant contributions to modern scientific thought.”

The story should be familiar that Galileo was gathering evidence to show that the Earth moves around the sun and was not the centre of the universe.

Britannica continues: “His position represented such a radical departure from accepted thought that he was tried by the Inquisition in Rome, ordered to recant, and forced to spend the last eight years of his life under house arrest.”

And on the science: “He informally stated the principles later embodied in Newton's first two laws of motion. Because of his pioneer work in gravitation and motion and in combining mathematical analysis with experimentation, Galileo often is referred to as the founder of modern mechanics and experimental physics. Perhaps the most far reaching of his achievements was his re-establishment of mathematical rationalism against Aristotle's logico-verbal approach and his insistence that the "Book of Nature is . . . written in mathematical characters." From this base, he was able to found the modern experimental method.”

On the Copernican theory he initially kept silent because of fear of ridicule as Britannica points out: “Galileo became convinced early in life of the truth of the Copernican theory (i.e., that the planets revolve about the Sun) but was deterred from avowing his opinions--as shown in his letter of April 4, 1597, to Kepler--because of fear of ridicule.”

Then later Galileo learnt about the invention of the telescope and built one to look at the night sky.

Britannica says: “As the first person to apply the telescope to a study of the skies, Galileo in late 1609 and early 1610 announced a series of astronomical discoveries. He found that the surface of the Moon was irregular and not smooth, as had been supposed; he observed that the Milky Way system was composed of a collection of stars; he discovered the satellites of Jupiter and named them *Sidera Medicea* (Medicean Stars) in honour of his former pupil and future employer, Cosimo II, grand duke of Tuscany. He also observed Saturn, spots on the Sun, and the phases of Venus . His first decisive astronomical observations were published in 1610 in *Sidereus Nuncius* ("The Starry Messenger").”

Galileo found a good reception in Rome: “In 1611 Galileo visited Rome and demonstrated his telescope to the most eminent personages at the pontifical court. Encouraged by the flattering reception accorded to him, he ventured, in three letters on the sunspots printed at Rome in 1613 under the title *Istoria e dimostrazioni intorno alle macchie solari e loro accidenti . . .*, to take up a more definite position on the Copernican theory. Movement of the spots across the face of the Sun, Galileo maintained, proved Copernicus was right and Ptolemy wrong.”

Galileo's ideas became popular: “His great expository gifts and his choice of Italian, in which he was an acknowledged master of style, made his thoughts popular beyond the confines of the universities and created a powerful movement of opinion.”

Then came the backlash because he was going against what was being taught: “The Aristotelian professors, seeing their vested interests threatened, united against him. They strove to cast suspicion upon him in the eyes of ecclesiastical authorities because of contradictions between the Copernican theory and the Scriptures.” Academia set people against Galileo's ideas on religious grounds.

Resulting in: “They obtained the cooperation of the Dominican preachers, who fulminated from the pulpit against the new impiety of "mathematicians" and secretly denounced Galileo to the Inquisition for blasphemous utterances, which, they said, he had freely invented.”

This scared Galileo as Britannica notes: “Gravely alarmed, Galileo agreed with one of his pupils, B. Castelli, a Benedictine monk, that something should be done to forestall a crisis. He accordingly wrote letters meant for the Grand Duke and for the Roman authorities (letters to Castelli, to the Grand Duchess Dowager, to Monsignor Dini) in which he pointed out the danger, reminding the church of its standing practice of interpreting Scripture allegorically whenever it came into conflict with scientific truth, quoting patristic authorities and warning that it would be "a terrible detriment for the souls if people found themselves convinced by proof of something that it was made then a sin to believe." He even went to Rome in person to beg the authorities to leave the way open for a change. A number of ecclesiastical experts were on his side.”

So, Academia sets religion against Galileo, he tries to get out of that problem, and has part of the Church agreeing with him that his science is not a religious matter.

Then comes – the unfortunately: “Unfortunately, Cardinal Robert Bellarmine, the chief theologian of the church, was unable to appreciate the importance of the new theories and clung to the time-honoured belief that mathematical hypotheses have nothing to do with physical reality.” That is point (1).

We have a clash now between how Galileo thinks about things and how Cardinal Robert Bellarmine thinks about things. And Cardinal Robert Bellarmine is too important a person to ignore and his point-of-view matters in the hierarchy of power.

The religious problem at the time was the fight between Catholicism and Protestantism, and Cardinal Robert Bellarmine: “He only saw the danger of a scandal, which might undermine Catholicity in its fight with Protestantism.” Galileo's science was now on the wrong side in the religious war.

Cardinal Robert Bellarmine response was: “ He accordingly decided that the best thing would be to check the whole issue by having Copernicanism declared "false and erroneous" and the book of Copernicus suspended by the congregation of the Index.”

i.e. the science now became Banned for religious reasons.

Before Banning it, on February 26, 1616 Cardinal Robert Bellarmine warned Galileo: “Cardinal Bellarmine had granted an audience to Galileo and informed him of the forthcoming decree, warning him that he must henceforth neither "hold nor defend" the doctrine, although it could still be discussed as a mere "mathematical supposition.””

The conflict now between viewpoints:

Cardinal Bellarmine declared the theory false and Banned it and looked upon it as mere mathematical speculation, with that speculation having no relationship to physical reality.

But Galileo looking upon the maths being true meaning that made the theory true.

Later Galileo tried to get the Ban lifted: “In 1624 Galileo again went to Rome, hoping to obtain a revocation of the decree of 1616. This he did not get, but he obtained permission from the Pope to write about "the systems of the world," both Ptolemaic and Copernican, as long as he discussed them noncommittally and came to the conclusion dictated to him in advance by the pontiff--that is, that man cannot presume to know how the world is really made because God could have brought about the same effects in ways unimagined by him, and he must not restrict God's omnipotence. These instructions were confirmed in writing by the head censor, Monsignor Niccol Riccardi.”

Galileo then went to work on his book “Dialogue Concerning the Two Chief World Systems--Ptolemaic and Copernican” and it received a good reception: “As soon as it came out, in the year 1632, with the full and complete imprimatur of the censors, it was greeted with a tumult of applause and cries of praise from every part of the European continent as a literary and philosophical masterpiece.”

Then came the crisis and what Britannica calls “inferences” as to what happened next, i.e. guesses as to what happened.

It was guessed that what happened next was: “It was pointed out to the Pope that despite its noncommittal title, the work was a compelling and unabashed plea for the Copernican system.”

i.e. it was a very strong argument for the Copernican theory. Not what they wanted of the Copernican theory being treated as mere speculation.

Then came the religious fall-out.

Britannica: “The Jesuits insisted that it could have worse consequences on the established system of teaching "than Luther and Calvin put together." The Pope, in anger, ordered a prosecution.”

This is point (3)

However, the book had been given permission to be published by a licence:

“The author being covered by license, the only legal measures would be to disavow the licensers and prohibit the book.”

i.e. the Church wanted to revoke the licence.

Now comes the controversy of a forged document that forbade Galileo from publishing on Copernican theory making the licence invalid:

“ But at that point a document was "discovered" in the file, to the effect that during his audience with Bellarmine on February 26, 1616, Galileo had been specifically enjoined from "teaching or discussing Copernicanism in any way," under the penalties of the Holy Office. His license, it was concluded, had therefore been "extorted" under false pretenses.”

Britannica says: “The consensus of historians, based on evidence made available when the file was published in 1877, has been that the document had been planted and that Galileo was never so enjoined.”

I.e. the opinion was that the document was forged. But I think the controversy still rages over whether the document was forgery or not.

A toned-down account of the document [2] has it: “..he [Galileo] was admonished by Robert Cardinal Bellarmine (1542–1621) not to “hold or defend” the Copernican theory. An improperly prepared document placed in the Inquisition files at this time states that Galileo was admonished “not to hold, teach, or defend” the Copernican theory “in any way whatever, either orally or in writing.””

But the document whether forged or not allowed reason to prosecute Galileo:

“The church authorities, on the strength of the "new" document, were able to prosecute him for "vehement suspicion of heresy.””

Galileo in ill-health was then forced to stand trial in Rome in February 1633.

“The sentence was read to him on June 21: he was guilty of having "held and taught" the Copernican doctrine and was ordered to recant. Galileo recited a formula in which he "abjured, cursed and detested" his past errors. The sentence carried imprisonment, but this portion of the penalty was immediately commuted by the Pope into house arrest and seclusion on his little estate at Arcetri near Florence, where he returned in December 1633. The sentence of house arrest remained in effect throughout the last eight years of his life.”

Galileo under house arrest carried on his scientific work until he died.

His science contributions included: “A most substantial part of his work consisted undoubtedly of his contributions toward the establishment of mechanics as a science. Some valuable but isolated facts and theorems had previously been discovered and proved, but it was Galileo who first clearly grasped the idea of force as a mechanical agent. Although he did not formulate the interdependence of motion and force into laws, his writings on dynamics are everywhere suggestive of those laws, and his

solutions of dynamical problems involve their recognition. In this branch of science, he paved the way for the English physicist and mathematician Isaac Newton later in the century. The extraordinary advances made by him were due to his application of mathematical analysis to physical problems.”

“Galileo was the first man who perceived that mathematics and physics, previously kept in separate compartments, were going to join forces. He was thus able to unify celestial and terrestrial phenomena into one theory, destroying the traditional division between the world above and the world below the Moon. The method that was peculiarly his consisted in the combination of experiment with calculation--in the transformation of the concrete into the abstract and the assiduous comparison of results. He created the modern idea of experiment, which he called *cimento* ("ordeal"). This method was applied to check theoretical deductions in the investigation of the laws of falling bodies, of equilibrium and motion on an inclined plane, and of the motion of a projectile.” That is point (2).

The part of the book of the book “Dialogue Concerning the Two Chief World Systems” by Galileo dealing with people talking about geocentricism and heliocentricism that particularly seemed to upset the Pope was [3]: “But in giving Simplicio the final word, that God could have made the universe any way he wanted to and still made it appear to us the way it does, he put Pope Urban VIII’s favourite argument in the mouth of the person who had been ridiculed throughout the dialogue.”

So, Galileo had his viewpoint B and he was ridiculing viewpoint A. Viewpoint A being that God could do whatever he liked. While viewpoint B being that universe/nature was limited to obeying certain mathematical rules, so if there were a God then such a God would similarly be limited and not unlimited as Pope wanted to believe. So, Galileo's science clashed with what certain people want to believe from a certain type of religious viewpoint.

We have the viewpoint of Galileo becoming the basis of modern physics. Continuation of work on this basis led to Boscovich's theory. Boscovich being dealt with in my other articles.

Any rejection of this viewpoint of Galileo is a rejection of basis of modern physics. And of course, in 1905 onwards the physics community went crazy as to its philosophising.

## References

[1] Britannica <http://abyss.uoregon.edu/~js/glossary/galileo.html>

[2] <http://www.britannica.com/EBchecked/topic/224058/Galileo>

[3] <http://www.britannica.com/EBchecked/topic/224058/Galileo/8441/GalileosCopernicanism>

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