



GALILEO BETWEEN HISTORY AND MYTH: NEW OBSERVATIONS ON THE LIFE AND WORKS OF GALILEO GALILEI



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Summary

The present paper is the result of a joint work between Charles University of Praha, the Catholic University of Ružomberok and the University of Nitra to make known a very famous but unknown personality, Galileo Galilei. The main task of this group of researchers was the Slovak translation of Galileo's last work: *Dialogue around two new sciences related to mechanics and movement of bodies*. The first part of the paper concerns the life of the scientist, with particular regard to the famous process to Galileo Galilei in 1633. The article then examines the Galilean mythos, that image that in the century was created around the Florentine scientist for several reasons and which does not correspond to reality. For example, the famous statement assigned to Galileo "And yet it moves!", which is not recorded in any document, not even in the papers of his process. Finally, this paper recalls some of the steps taken by the Catholic Church that led to an instance of annulment of the process.

Key words: Galileo, the Catholic Church and scientific research, telescope, Ptolemaic solar system, Maria Celeste Galilei.

Introduction

This article is a summary of a five-year work that is still underway. Born from the interest and work of a great professor at Charles University in Prague, Petr Vopienka¹, the work developed in collaboration between Charles University, the Catholic University of Ružomberok, Slovakia and the Institute EURESIS of Milan. Each of these organizations studies at different levels the life and works of Galileo Galilei. The group of the Catholic University of Ružomberok does the

translations of Galileo's works in Slovak (Translated by Stefan Tkacik, Rosangela Libertini, Viktoria Liasuk, 2016) and the use of Galilean methods and discoveries to bring children and young people closer to the study of physics and mathematics.

In particular, Galileo's last work was translated into Slovak: *Discourses and Mathematical Demonstrations Relating to Two New Sciences*.

This work received recognition from the Slovak government, which called it "Scientific Project of National Interest"² and funded the continuation of studies.

Galileo has been said and written a lot about, and is a personality that is still loved and interested in today.

As we will see soon, the myth surrounding Galileo, as a solitary scientist and persecuted by the powerful, starting with the Catholic Church, does not correspond to the truth, as well as the idea of a ruthless and heartless relationship that Galileo would have with his daughters, and what is more important, that Galileo's phrase "And yet it moves!" does not correspond to truth, at least in the way almost all of us know it.

Among the sources used for the present work Vatican Documents of the Vatican Secret Archives of the Vatican concerning Galileo Galilei, which were published in 2009 as volume (Sergio Pagano (with the help of), 2009), are of particular importance; and also the reports of the Pontifical Commission requested by John Paul II, who in the years 1981 to 1992 studied and re-examined all the documents concerning Galileo and the Catholic Church up to the formal annulment of the affair. (Sanches de Tocha Alameda, 2009 [2008]).

The Holy Father John Paul II on the centenary of the birth of Albert Einstein said:

"... I hope that theologians, scientists and historians, inspired by a spirit of sincere collaboration, will deepen the examination of the Galileo case and, in the honest recognition of the wrongs, from whatever part they come, would make disappear the mistrust that this case still in many respects opposes to a fruitful concord between science and faith, between the Church and the world" (John Paul II, 1992)

Galileo and his time

Europe in the mid-16th century had one of the most difficult times³. The Pontifical State was continually attacked by Protestant princes and subjected to the pressure sometimes from France sometimes from Spain, which tended to subjugate it to its hegemony. The princes governing the other regions, such as the Medici in Tuscany, had to continually seek to maintain their independence by supporting sometimes one force and sometimes another one³.

While from the cultural point of view, the importance of Italy was still crucial, economically, the country lost its power, as it was devastated by armies from all over Europe. Many regions lived literally in poverty and hunger.

In this situation Galileo Galilei was born, in Pisa, in Tuscany in 1564, the first of 7 children. His father, Vincenzo, was a musician and traveled for a long time throughout Europe, his mother Giulia, descended from a noble family, but without great economic means, the Ammannati family. (Galilei with the help of Perini, 2011: 234) When he was 19, young Galileo was sent to study medicine as his father wanted, but he was particularly interested in mathematics, astronomy, astrology and physics, and in the cathedral of Pisa he would discover then that the big chandeliers were moving with a constant movement (Galilei with the help of Perini, 2011: 234).

In some time he left the official medical studies and began studying math taking private lessons. In 1589 he started studying mathematics at the university in Pisa. He was particularly interested in the acceleration of moving bodies, supporting an important correspondence with the greatest mathematicians of his time, the Jesuit Cristoforo Clavio and the Marchese Guidobaldo from Mount Urbino, who always helped and protected him. In 1591 Father Vincenzo died, Galileo became the head of household, and he had to support economically the mother, the three sisters and the younger brother. The obligation to pay the dowry for the sisters' weddings, which had been promised by his father, also fell on his shoulders. In 1592 he left the university of Pisa, where he entered thanks to the help of Guidobaldo, but where he was hated by his older colleagues, and began teaching in Padua, where he worked eighteen years and where he received great affection and enjoyed success among the students, many of whom lived with him. In fact, Galileo, in order to solve the problems of family debts, rented rooms to some of his students for a fee.

In Padua he got to know Venetian Prince Giovanni Francesco Sagrado, who belonged to one of the oldest and noble families in Venice, owned, amongst other things, most of the Venetian naval shipyards, and Galileo began experimenting with the methods of shipbuilding at his shipyards (Galilei with the help of Perini, 2011).

In 1594 he wrote the *Fortification Treaty*, and began teaching military architecture.

Galileo never got married, perhaps because of the fear of having one more family in addition to his own by birth, but for a long time he had a relationship with Maria Gamba, from Venice and recognized all her children as his own (Sanchez di Tocha Alemada, 2009: 131)⁴.

In 1600 the first daughter, the most beloved, called Virginia, was born. Livia was born the following year. Both of them became clergy nuns at the same convent at Arcetri, not far from Florence, probably forced by their father in order not to pay the dowry. It must be said that this was not a particularly cruel thing on the part of the father, as it would be said later, that was one of the most common solutions for girls born outside of marriage and yet belonging to a "good family". Virginia, who took the religious name of Mary Celeste, throughout all her life would remain very attached to her father, helping him as much as possible. Here we see a familiar image that is very different from the image of a vain and ruthless Galileo: he maintained a lifelong relationship with his sons, especially with the first and male one, Vincenzo, who after several years of frictions with the father, passed the last years of them next to him (Riccioni).

As for Maria Celeste, it is enough to say that there are left all of her numerous letters to her father, about 130, which Galileo kept jealously throughout his life, while unfortunately those which Galileo wrote continuously to her were missed. In addition, she arranged the purchase of "Villa Gioiello" the house that Galileo had at Arcetri, in Tuscany, and which was just a few meters from the convent where his daughters lived. The daughter from the convent wrote, cooked, sewed for her father, and he repaid her by buying things that were very different from those of the convents such as various musical instruments, wall clocks etc. We will again talk about her speaking about the relationship between Galileo and the Church.

In 1597 G. built the "geometric and military compass", which immediately became an important tool for engineers and at university he began to describe the Universe according to Copernicus's view. In 1606 he wrote a book about the new instrument, which brought also a remarkable improvement in the economic situation since he began to produce it in series at home, with the help of students who were retired from him. During a visit to Venice Galileo came to know due to Sagredo that Dutch artisans had invented an instrument that allowed them to see distant objects as they were close. It was the "Tube with two lenses". He bought a specimen, and greatly improved it, then presented it to the Doge of Venice as if it were his invention. That is why many people today think that he invented the telescope, although it is not true. For this "discovery" that made Venice much more powerful on the sea, the wage from the University of Padua was doubled, and the University also appointed him as a Lifelong Professor.

But Galileo's greatness is not only in the fact that he improved the telescope, but in his understanding of its usefulness. People of his time thought of the telescope as a tool to use in war, he began to use it to look at the sky.

First, through the telescope, he discovered what the Milky Way was, and discovered the moons of Jupiter, and with them the fact that not all the objects that were in the sky turned around the Earth. From these observations, the text *Sidereus nuntius* was written in Latin (Galilei, with the help of Claudio Perini, 2011: 238).

The publication created great amazement among scientists at the time but at the same time, it also became the cause of attacks by his enemies⁵. Galileo, always attentive to his public image, and opposed to what they say, desperate to gain support from other personalities of the scientific world of that time, he prepared a good number of binoculars, which he gifted to scientists and politicians to convince them personally on the truthfulness of his statements.

In 1610 Galilei accepted the proposal of the Prince of the Republic of Tuscany, Cosimo II of the Medici family, to return to Tuscany at the service of the Prince himself. So he was named "first mathematician and philosopher of the grand duchy of Tuscany". Cosimo, for the rest of his life, struggled for his territories to be independent from both Spain and France and for this purpose, he started an important renovation of the port of Livorno. Galileo's work and projects, which he truly admired, were very useful to him.

In the meantime he was increasingly approaching Copernican ideas.

In 1616 the Roman Church condemned the Copernican heliocentric astronomical system, and the Holy Office banned the reading of his work *De Revolutionibus Orbium coelestium*.

In 1623 Galileo went to Rome (Favaro, 1919: 171–187) where he had many friends to try to convince the local scientific world in the truthfulness of Copernican theories (Favaro, 1919: 175). He also had a series of meetings with the Holy Father himself, Urban VIII, Maffeo Barberini, who, despite receiving honors from him (received it six times in six weeks) was not convinced of Copernican doctrines. So, Galileo did not succeed in his intent. He was even advised, as the Pope himself said, not to mention Copernicus's ideas as the proven truth, since in fact there were no demonstrations to eliminate other ideas on the matter, but to present the Copernicus doctrines as one of the possible hypotheses regarding the Earth's movement, which at that time was already recognized.⁶

In 1630, Galileo finished the *Dialogues Concerning the Two Chief World Systems*, in which three characters, Salviati, Sagredo and Simplicio discussed movements of the Earth and neighboring stars as seen by Ptolemy and Copernicus.

Galileo emphasizes in that work that the Earth is not different from the other planets, and supports the Copernican hypothesis that it, together with the other planets, revolves around the Sun.

This work, in addition to its importance for the history of astronomy, brought great innovations into the study of Mechanics. Among the various innovations introduced by Galileo there is the differentiation of the concept of speed and acceleration. The book was immediately presented to Roman censorship and obtained after two years the permission to be published, following some minor changes required.

The output of the work brought great enthusiasm on the one hand, and on the other – so much hatred and envy. A well-known philosopher, Scipione Chiaramonti⁷, took up position against Galileo and along with some professors from the University of Pisa, where they continued to hate him as a former student who had made a career that continued to be the center of Aristotelian philosophy of the time. Probably Chiaramonti is the one who inspired the person of Simplicio⁸, as a philosopher who wanted to know every human science based on the Aristotelian theories. But thanks to the relationships that Chiaramonti had in the Roman Curia, he and others succeeded in convincing Pope Urban VIII that he himself was the Simplicio (Sanches de Tocha Amaleda, Sánchez de Toca, 2009 [2008]), of who spoke Galileo (Smolka, 2000)⁹. The order of the printer of Florence to stop printing and selling the text came from Rome and the order not to distribute the copies in his possession came to Galileo. Galileo was called to Rome to prove the truthfulness of his suppositions before the Inquisition Tribunal (Smolka, 2000: 244).

During his first stay in Rome, he had been advised, probably by the Pope himself, not to present Copernicus's arguments as the absolute truth, so when the book *Dialogues Concerning the Two Chief World Systems* was published and when it obtained the Imprimatur of the Church, some of Galileo's enemies, whom we have already mentioned¹⁰, professors teaching astronomy under the Ptolemaic System, began to accuse him in front of the Pope who called him to Rome. Galileo arrived in Rome in January of that year (Favaro, 1919: 171–187), but the trial only took place in April. Why? Because it was time left for Galileo to present the scientific proofs that Copernican theory was the only possible truth and not just a mathematical theory. Galileo, as it was mentioned, was unable to provide such proofs, and tried to explain the Earth's movement, using the tides of the sea, but was not convincing enough. Newton, 50 years later would show the mistakes of his interpretation¹¹. Galileo was continuously repeating that he did not want to

write a work against religion and tried to explain why his work was not simply a defense of the Copernicus's theories (Sanches de Tocha Alemada, 2009: 136)

The trial was held in 1633. Galileo was 70 years old. The sentence of conviction was signed by 7 cardinals of 10 (Sanches de Tocha Alemada, 2009: 132)¹². The author was condemned to the forced domicile and to the recitation of the seven penitential psalms to be praised daily for the Holy Father, if he would recognize the error of his statements and to be imprisoned if he would insist on presenting Copernican doctrines as truth. Galileo immediately agreed to retract his ideas. He was also banned from publishing other books on astronomy. The *Dialogues Concerning the Two Chief World Systems* was banned, and the following year was put on the list of forbidden literature.

He passed the home prison sentence, first at Palazzo Medici in Rome, then at Cardinal Piccolomini in Siena, and then from December of the same year in his own home at Arcetri in the house near the convent where his clarified daughters lived, especially his beloved Maria Celeste, who unfortunately died the following year. Galileo did not recover anymore from the death of his daughter, losing gradually his eyesight.

At the end of 1636, he finished *the Dialogue around two new sciences related to mechanics and movement of bodies*. It was published in Leiden in Holland in 1638 probably without the consent of the author himself. Because of the blindness, this last work was written with the help of his two disciples Evangelist Torricelli and Vincenzo Viviani and his son Vincenzo. He died on January 6, 1642 (Sanches de Tocha Alemada, 2009: 246).

Let us now look at some particular aspect of the figure of Galileo Galilei.

The "Galileo Myth"¹³

The figure of Galileo as an imperturbable scientist often showed opposed to the Church, who even after firm utterance "And yet it moves," is far from reality, and is born by the literature that appeared in the following centuries.

Many literary works, rather than historical ones, have contributed to this image, here we will mention only a few, returning to some troublesome aspects of his life.

We start from one of the most famous legends, perhaps the best-known one: the famous phrase assigned to Galileo "And yet it moves!" that would be pronounced after the end of the 1633 trial.

Galileo, after the trial, which in fact was a defeat for him, human and scientific, since he had failed to demonstrate the truthfulness of Copernicus's statements, he

avoided the prison in exchange for the abjuration, that is, the recognition that he was wrong .

Why to risk in order to have new problems just for a simple phrase? Neither the documents relating to the trial (AAVV with the help of Sergio Pagano, 2009) nor the letters written by Galileo Galileo after the trial (del Lungo and Favaro, 1915) mention this famous phrase.

The first one to assign this sentence to Galileo Galilei relating to the trial is an enlightener Giuseppe Baretta¹⁴, (17) who in the book *The Italian Library* (Baretta, 1957: 150), makes a gallery of the main Italian personalities, and speaking of Galileo, assigns this phrase to him, though not having been personally in Rome and having had no access to materials related to the Galilean affair.

The force expressed by the phrase itself suggested Bertold Brecht to cite it in his theatrical work *The Life of Galileo*.

Even a few years ago, a scientific book like that of Jozef Smolka, *Galileo Galilei, legenda moderní vědy* (Smolka, 2000), continued to assert that Galileo, after the trial, said, "And yet it moves!" (Smolka, 2000).

This is a very nice phrase, but there is no evidence that Galileo ever said it, at least in that context and at that moment.

The Church and the person and the works of Galileo Galilei (Sanches de Tocha Alameda, 2009)

Let us now go to another point where the figure of Galileo appears absolutely mythical and not completely corresponds to the reality.

There has been much talk of the relationship between Galileo and the Church and of the persecution and torture that Galileo suffered. In several historical periods, the event itself has been used to oppose the "Church's obscurantism" against the "freedom and truthfulness of science".

But when you take the documents of this affair, it seems clear to you that the trial has not been announced because of Galileo's controversy against the Church, not even based on Galileo's personal hatred towards the Church.

The main enemies of Galileo, and those who spoke against him were mostly personalities from the Florentine nobility and all the physics and astronomy professors who fought their whole life against him, because with his discoveries, Galileo strongly called into question their teachings.

Surely for an old scientist who until recently had been considered the star and the greatest scientific personality of his time, it must have been incredibly difficult and cruel to acknowledge publicly that he was wrong, to recognize Copernican

doctrines on the Earth's movement as a false and to see a copy of *Dialogues Concerning the Two Chief World Systems* burning in his face (With the help of Sergio Pagano, 2009: 574). Likewise, it must have been incredibly painful, like no form of torture that had ever existed, the public ban to publish and read the *Dialogues Concerning the Two Chief World Systems*, especially since he had always tried to have a good relationship with the authorities and support from other scientists.¹⁵

But these punishments did not last long. As we have already said, the main condemnation for Galileo was the obligatory stay, first in the palace of the Medici Family in Rome, then in Siena at the house of his friend Archbishop, and then at Villa Gioiello, the house he had at Arcetri and who had been bought because of its proximity to the convent where the daughter, Maria Celeste lived. Moreover, the other commuted punishment, the weekly recital of the seven penitential psalms¹⁶, was acquitted as long as he lived at his daughter's place.

In this regard, it is worth reading the letter his daughter wrote to him:

"I obtained and got the grace of seeing your sentence, the reading of which, although on the one hand it gave me some trouble, on the other hand it was worth have seen it, to find there the stuff that can benefit to V.S. — , which is by letting me know that you have to recite the Seven Psalms once a week. And I do so with pleasure, first because I am persuaded that the prayer accompanied by such a grade of obedience to the Church is very effective, and besides to bring this thought to V.S" (Frugoni, 1967: 8).

It was neither forbidden to visit him, nor the studies he did until the end, together with his young students Viviani and Torricelli, and his son Vincenzo.

In the following centuries the Church has not put aside the relationship with Galileo.

Thirty years after the trial at Galileo, Pope Alexander VII canceled the sentence of censorship that were on the works of Copernicus, and in 1734 Clement XII rehabilitated the memory of Galileo, allowing him to be buried in the Cathedral of Florence.

In 1992, Giovanni Paolo II canceled the Galileo's affair officially.

Conclusion

To conclude, we can ask, what else does Galileo Galilei, his studies, his life say nowadays?

Few historical figures like him were loved and hated.

We, from the Galileo Study Group, think that there are two lessons that remain for us and that make this figure so memorable today:

The first thing is the need to make science out of observation, without prejudice, The second is infinite curiosity and openness to every question and answer that comes from the world of the observed nature, as in the explanations that he gives to such a childish question like why a drop on a leaf (in his case of cabbage) (Galilei with the help of Perini, 2011: 71) keeps its shape, or what it means to gild the silver (Galilei with the help of Perini, 2011: 57 e seguenti)

We also think regarding the Galileo myth, that sometimes it is necessary to think not in the way everyone normally thinks, because sometimes, what everyone knows, as in the case of the phrase "And yet it moves" does not correspond to the truth ...

¹ Petr Vopěnka (16 May 1935 – 20 March 2015) was a Czech mathematician. In the early seventies, he developed alternative set theory (i.e. alternative to the classical Cantor theory), which he subsequently developed in a series of articles and monographs. Vopěnka's name is associated with many mathematical achievements.

² Project KEGA n. **003KU-4/2013**. *Využitie pôvodných matematických demonštrácií a fyzikálnych pokusov, ktoré použil Galileo Galilei v mechanike a pohybe telies vo vyučovaní na základných a stredných školách*. (Teaching at elementary and upper secondary schools the mathematical demonstrations and physics experiments used by Galileo Galilei in mechanics and body motion)

³ You can have a synthetic look at these events in AAVV.(2006). *Atlante Storico Garzanti (Garzanti Historical Atlas)* Milan: RCS Quotidiani. pp. 240-250.

⁴ Baldini claims, however, that Galileo recognized only his son Vincenzo, see. Baldini, U. Galileo Galilei. In: *Dizionario Biografico degli italiani, Enciclopedia Treccani*.

⁵ One of the first was Ludovico delle Colombe, who wrote a work titled Against the Earth's Motion. Ludovico delle Colombe belonged to the nobility of Florence. See Muccillo, M. Ludovico delle Colombe. In: *Dizionario Biografico degli italiani, Enciclopedia Treccani*. (*Italian Biographical Dictionary, Treccani Encyclopedia*)

⁶ Eugen F.Chabot, in the book *Galileo a ine udajne prestreklky papierskej neomilnosti*, claims that it was the same Card.Barmarmino who suggested to the scientist Foscarini that he and Galileo wrote of Copernican theories "not as truths but as possibilities". See Chabot, E. (1929 [1928]). *Galileo a iné udajne prestreklky pápežskej neomylnosti*. (*Galileo and Other Alleged Failures of Infallibility*) Zvolen.

⁷ On Chiaramonti's enmity towards Galileo cf. eg Francesco Niccolini's letter to Andrea Cioni, 16 August 1632, in which Niccolini, Ambassador of Florence in Rome, expresses to his friend the concern for the presence of Chiaramonte in Rome. In: Isidoro Del Lungo, Favaro Andrea (with the help of) (1915). *Dal Carteggio e dai documenti, pagine di vita di Galileo*. (*From the Cartography and Documents, Galileo's Life Pages*) Florence: Sansoni.

⁸ In fact, it is known that Simplicio is not named by a simple stupid but by Simplicius of Cilicia, a Byzantine philosopher born in 490 AD. who had tried to adapt Platonic ideas to Aristotelian ideas.

⁹ Probably there were also political pressure on the pope by the Habsburgs, supported by Card. Richelieu, who sought every opportunity to go against the state of Florence. Since Galileo devoted his work to Cosimo II Medici, who had devoted so much attention to him and had filled him with favors, Galileo probably found himself in the midst of political games that had nothing to do with science. See, for example, Smolka, J. (2000). *Galileo Galilei, legenda moderní vedy*. (*Galileo Galilei, a legend of modern science*) Praha: Prometheus.

¹⁰ The names of some are known: the Dominicans of the convent of Florence Nicolo Lorini and Tommaso Caccini, who had already publicly stated in 1612 that Galileo opposed the Holy Bible (see Galilei, G., with the help of Claudio Perini (2011). *Discorsi e dimostrazioni matematiche intorno a due nuove scienze. (Discourses and Mathematical Demonstrations Relating to Two New Sciences)* Verona: Editions Simeoni. op.cit. pp. 240). His other enemy was Bolognese astronomer Antonio Magini, who was repeatedly admitted as his opposers among the university professors, first in Pisa and then in Padua, and also the German Jesuit Christof Sheiner. See Galilei, G., with the help... op.cit. pp. 83. See also Baldini, U. Gallileo Galilei. In: *Dizionario Biografico degli italiani, Enciclopedia Treccani. (Italian Biographical Dictionary, Treccani Encyclopedia)*

¹¹ The condemned part is on the 4th day of the "Dialogue Concerning the Two Chief World Systems".

¹² Card.Gasparo Borgia, Cardinal Ludovico Zacchia, and Cardinal Francesco Barberini, cousin of Pope Urban VIII did not sign. See Sanches de Tocha Alameda, M. (2009). *Galileo e la Chiesa*. In: Ponzio, P. (with the help of) (2009). *Cose mai Viste (Things never seen)* in Euresis. Milan: Mondadori Universities. op.cit. pp. 132.

¹³ One of the first who defined some deformations of historical facts about Galileo as a "myth" was John Paul II. (1992) *Discorso ai partecipanti alla sessione plenaria della Pontificia accademia delle scienze. (Speech to participants at the plenary session of the Pontifical Academy of Science)*

¹⁴ Baretti, having created the magazine "La Frusta Literaria" in Venice, had emigrated to London where he spent much of his life. Here he lived in teaching Italian, in which in 1775 he published one of the first Italian language manuals for foreigners.

¹⁵ For example, he always maintained contact with the Jesuit Christopher Clavio, who had been one of his first masters, with the demand to express his thoughts. See Ponzio, P. *Galileo, il Barnabita e la teologia patristica (Galileo, Barnabit and patristic theology.)* In: Ponzio, P. (with the help of) (2009). *Cose mai Viste. (Things never seen)* in Euresis. Milan: Mondadori Universities.

¹⁶ This definition comes from Sant'Agostino: are the Psalms 6, 32, 38, 51, 102, 130, 143.

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