Copernicus, Galileo and the Church

Carla Rita Palmerino

400 years ago

- 24 February 1616: a commission of eleven theologians, appointed by the Holy Office, assessed the two following propositions:

(1)The sun is the center of the world and completely devoid of local motion

Assessment: “This proposition is foolish and absurd in philosophy, and formally heretical since it explicitly contradicts in many places the sense of Holy Scripture.”

(2) The earth is not the center of the world, nor motionless, but it moves as a whole and also with diurnal motion

Assessment: “This proposition receives the same judgement in philosophy and (…) in regard to theological truth it is at least erroneous in faith.”

400 years ago

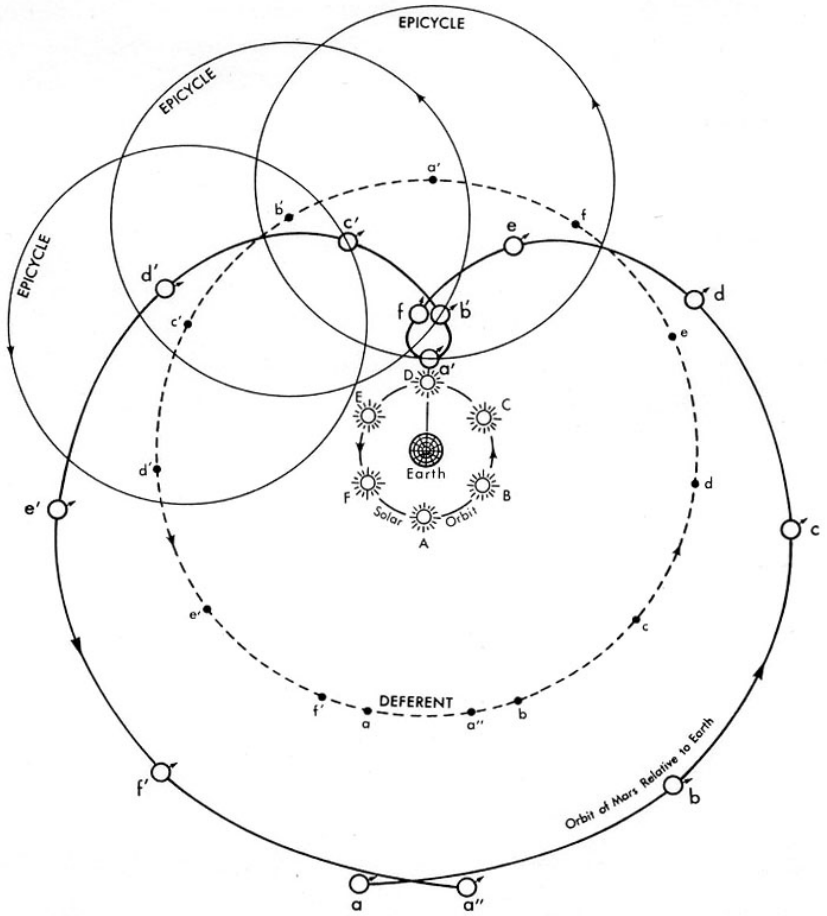
- 26 February 1616: Cardinal Bellarmine warns Galileo not to hold or defend the Copernican opinion
- 5 March 1616: Copernicus' *De revolutionibus orbium coelestium* is placed on the *Index, donec corrigatur*

The subordination of astronomy to philosophy and theology

Gregor Reisch, *Margarita philosophica* (1503)

Claudius Ptolemaeus (ca 90-168)

Andreas Cellarius, *Harmonia Macrocosmica* (1660)



σώζειν τὰ φαινόμενα (Save the phenomena)?

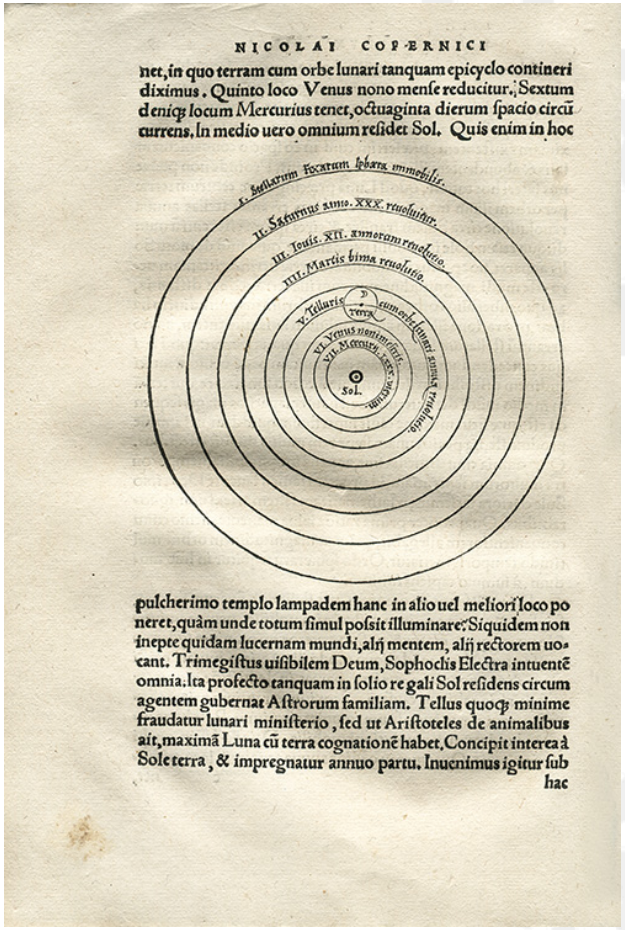
Nicolaus Copernicus
(Torun, 19 February 1473 - Frombork, 24 May 1543)

NICOLAI
COPERNICI TO-
RINENSIS DE REVOLVTIONI-
bus orbium cœlestium,
Libri VI.

IN QVIBVS STELLARVM ET FI-
XARVM ET ERRATICARVM MOTVS, EX VETE-
ribus atq; recentibus observationibus, restituit hic autor.
Præterea tabulas expeditas luculentasq; addidit, ex quibus eosdem motus ad quodlibet tempus Mathe-
matum studiosus facillime calcu-
lare poterit.

ITEM, DE LIBRIS REVOLVTIONVM NICOLAI
Copernici Narratio prima per M. Georgium Ioachi-
mum Rheticum ad D. Ioan. Schone-
rum scripta.

Cum Gratia & Priuilegio Cæs. Maiest.
BASILEAE, EX OFFICINA
HENRICPETRINA.



NICOLAI COPERNICI

net, in quo terram cum orbe lunari tanquam epicyclo contineri diximus. Quinto loco Venus nono mense reducitur. Sextum denique locum Mercurius tenet, octuaginta dierum spacio circũ currens. In medio uero omnium residet Sol. Quis enim in hoc

pulcherimo templo lampadem hanc in alio uel meliori loco po neret, quàm unde totum simul possit illuminare? Siquidem non inepte quidam lucernam mundi, alij mentem, alij rectorem uocant. Trimegistus uisibilem Deum, Sophoclis Electra intuentẽ omnia. Ita profecto tanquam in solio regali Sol residens circum agentem gubernat Astrorum familiam. Tellus quoq; minime fraudatur lunari ministerio, sed ut Aristoteles de animalibus ait, maximã Luna cũ terra cognationẽ habet. Concipit interea à Sole terra, & impregnatur annuo partu. Inuenimus igitur sub hac

Copernicus: save the phenomena?...

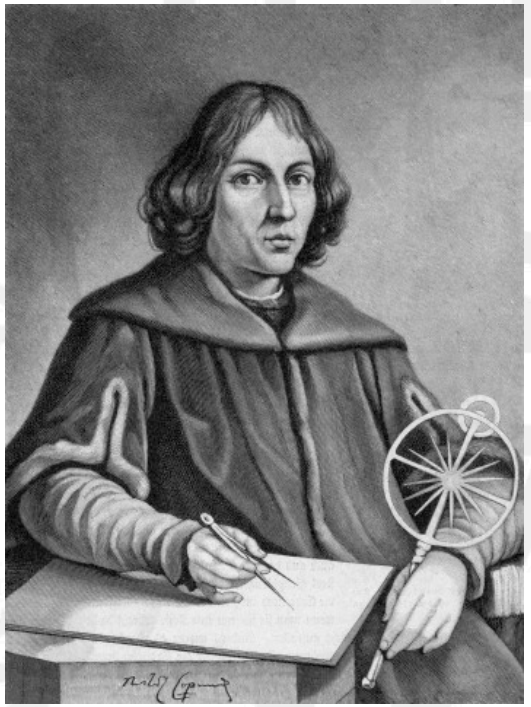
Andreas Osiander's anonymous preface

"It is the duty of an astronomer to compose the history of the celestial motions through careful and expert study. (…). **Since he cannot in any way attain to the true causes, he will adopt whatever suppositions enable the motions to be computed correctly from the principles of geometry for the future as well as for the past**. The present author has performed both these duties excellently. **For these hypotheses need not be true nor even probable**."

…or true system of the world?

Copernicus' Preface and Dedication to Pope Paul III

"The meditations of a **philosopher** are far removed from the judgment of the laity, because **his endeavor is to seek out the truth in all things, so far as this is permitted by God to the human reason** (…). If perchance there shall be **idle talkers**, who, though they are **ignorant of all mathematical sciences**, **nevertheless assume the right to pass judgment on these things, and if they should dare to criticize and attack this theory of mine because of some passage of Scripture which they have falsely distorted** for their own purpose, I care not at all."

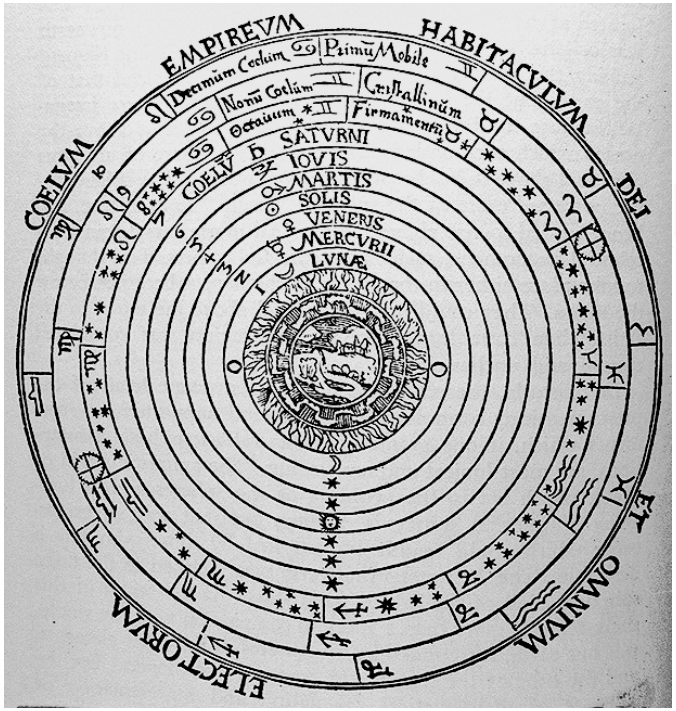


Theological objection to Copernicus' theory

Joshua 10:13: "And the sun stood still, and the moon stayed, until the people had avenged themselves upon their enemies."

Philosophical objection to Copernicus' theory

Violates the sublunar/superlunary dichotomy: the Earth is essentially different from the other planets

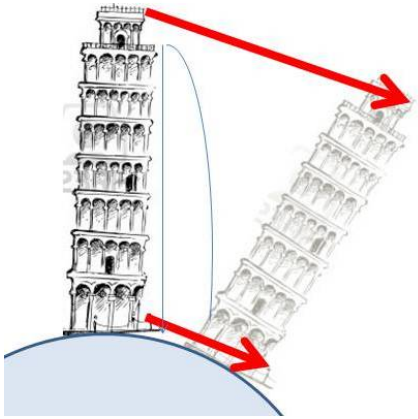


Physical objections to Copernicus' theory

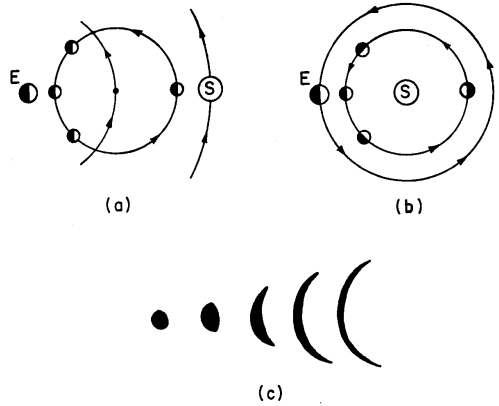
Is incompatible with the Aristotelian theory of motion:

a) the Earth cannot orbit the Sun and carry the Moon along

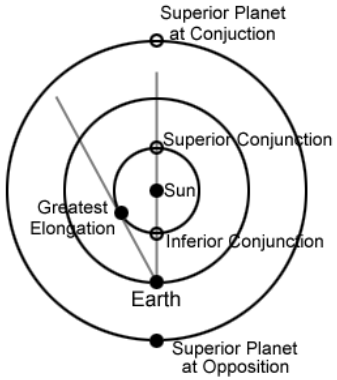
b) the daily motion of the Earth should affect the behavior of terrestrial bodies



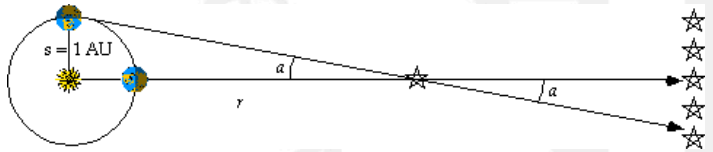
Astronomical objections to the Copernican system



Phases of Venus



Superior planets at opposition and conjunction

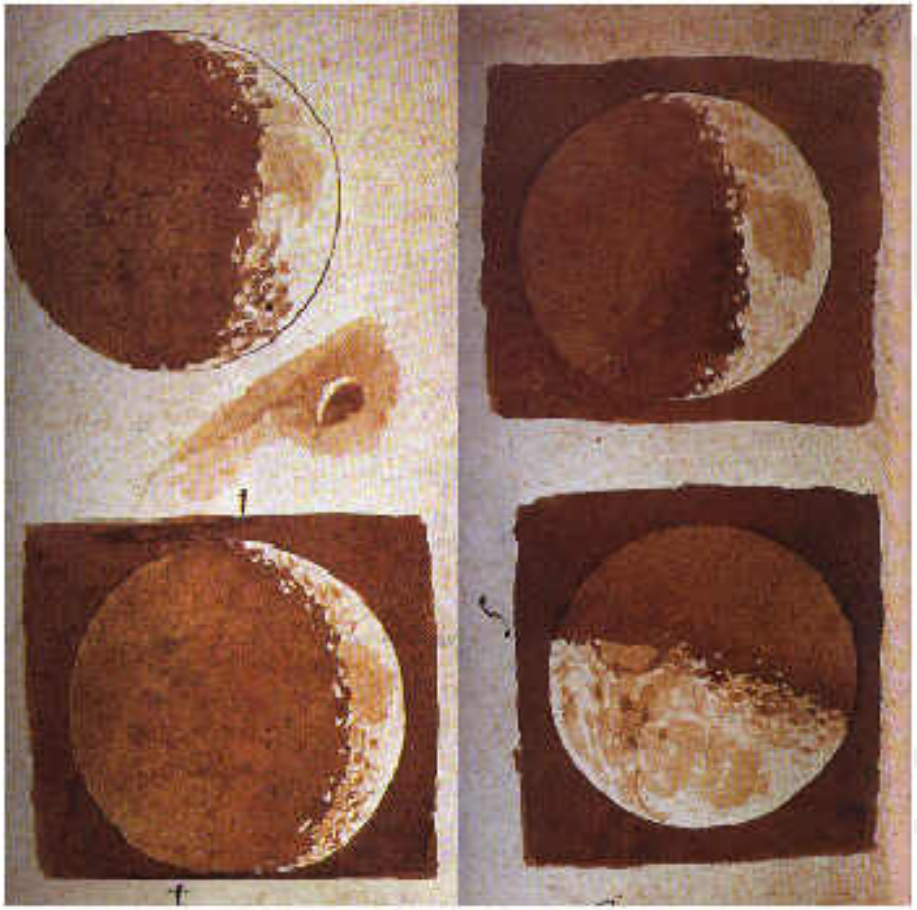


Parallax

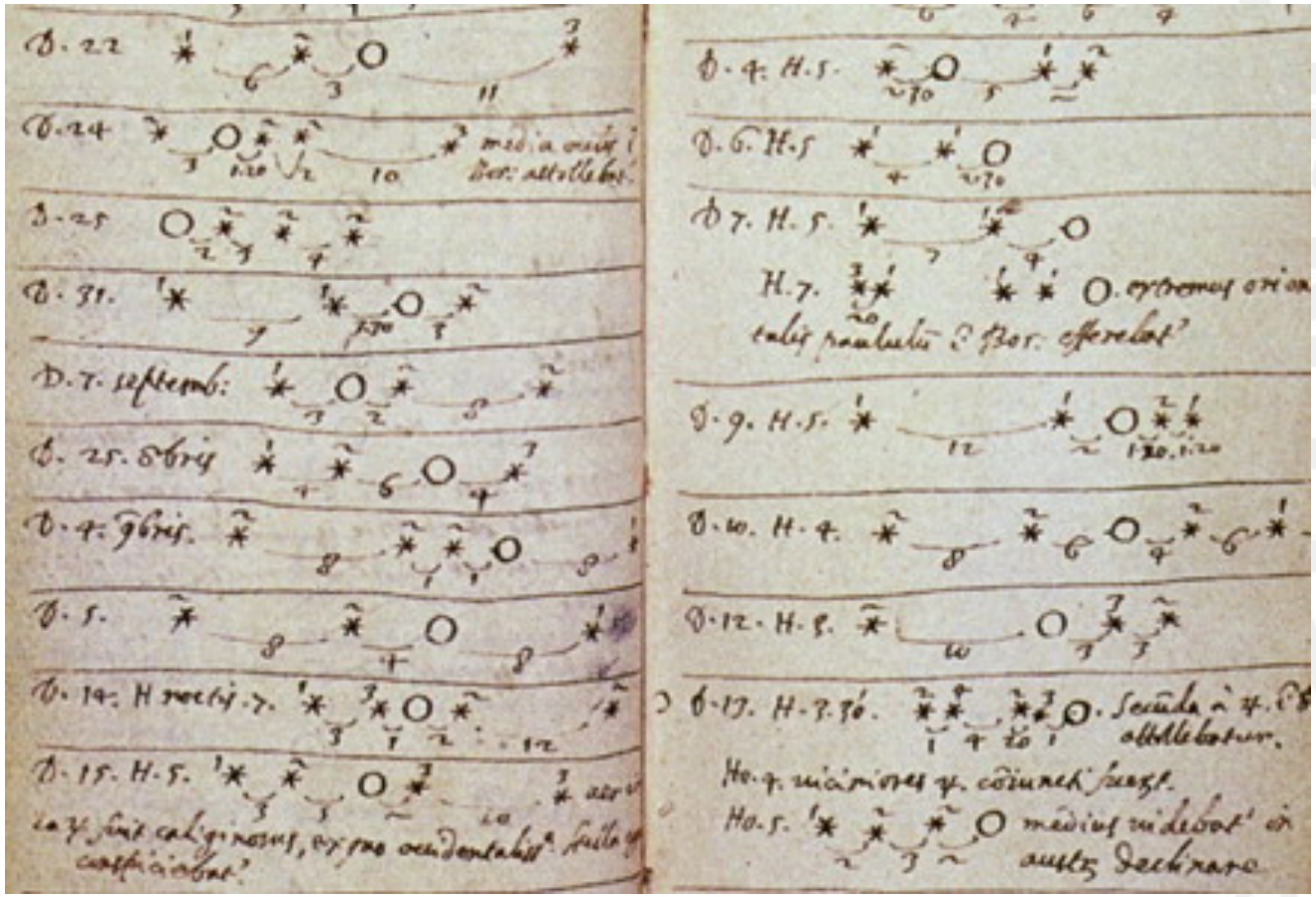
Galileo Galilei
(Pisa, 15 February 1564 – Arcetri, 8 January 1642)

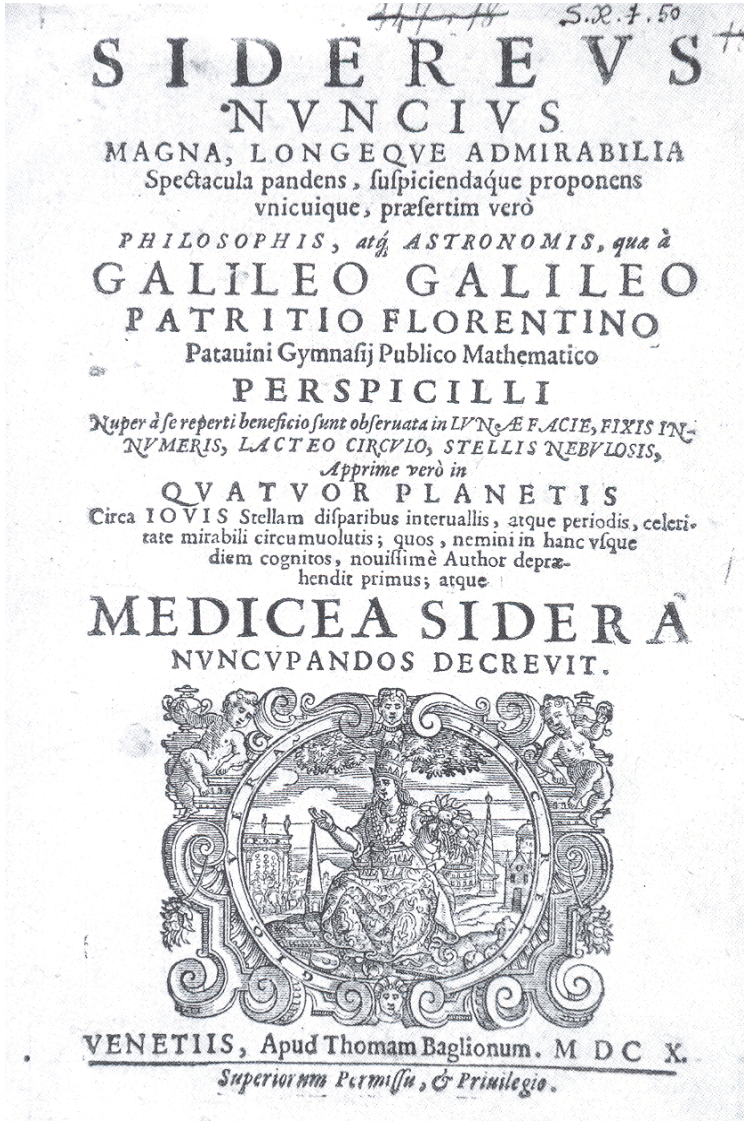
The telescope as an astronomical instrument (1609)

November 1609: The “uneven, rough and crowded” surface of the Moon



January 1610: Jupiter has satellites like the Earth



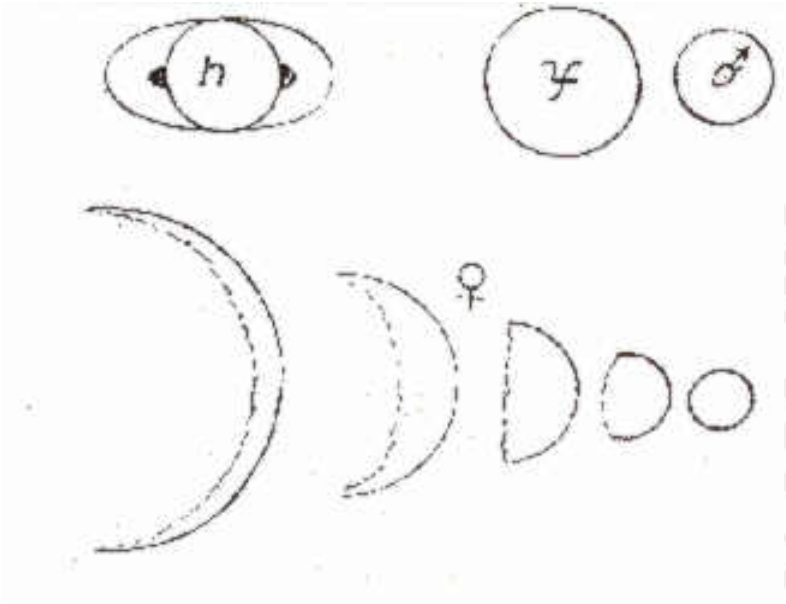


SIDEREVS
NVNCIVS
MAGNA, LONGEQVE ADMIRABILIA
Spectacula pandens, suspiciendaque proponens
vnicuique, præsertim verò
PHILOSOPHIS, atq; ASTRONOMIS, quæ à
GALILEO GALILEO
PATRITIO FLORENTINO
Patauini Gymnasij Publico Mathematico
PERSPICILLI
Nuper à se reperti beneficio sunt obseruata in LVNÆ FACIE, FIXIS IN-
NVMERIS, LACTEO CIRCVLO, STELLIS NEBVLOSIS,
Apprime verò in
QVATVOR PLANETIS
Circa IOVIS Stellam disparibus interuallis, atque periodis, celeri-
tate mirabili circumuolutis; quos, nemini in hanc vsque
diem cognitos, nouissimè Author depræ-
hendit primus; atque
MEDICEA SIDERA
NVNCVPANDOS DECREVIT.

VENETIIS, Apud Thomam Baglionum. M DC X.
Superiorum Permissu, & Priuilegio.

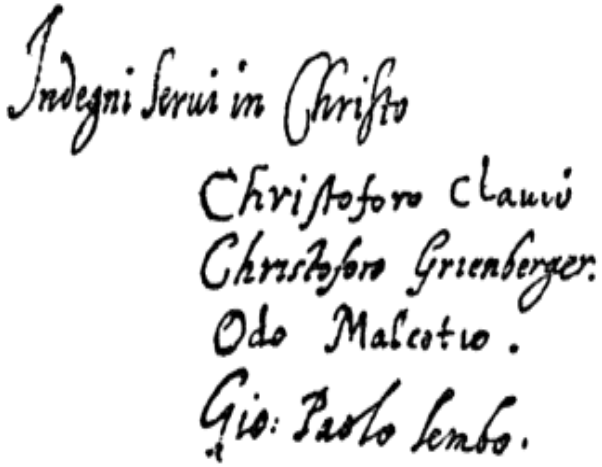
June 1610: First philosopher and mathematician to the Grand Duke of Tuscany

October-December 1610: The phases of Venus

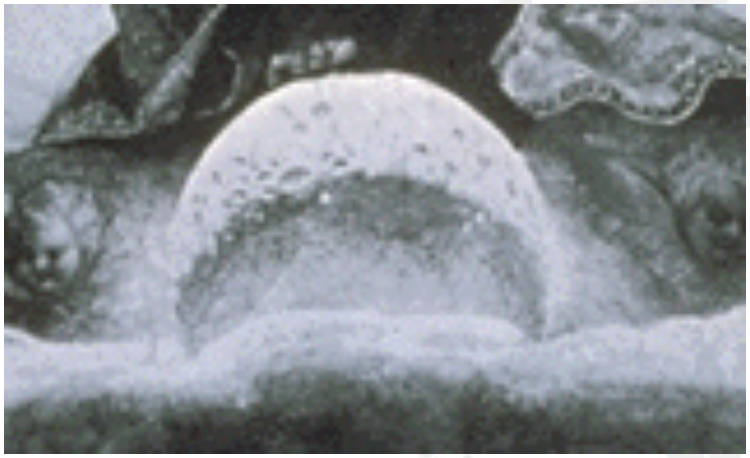


Jesuit mathematicians endorse Galileo's discoveries

24 April 1611: Four mathematicians of the Collegio Romano confirm, in a letter to Cardinal Bellarmine, the validity of Galileo's telescopic observations



The Virgin Mary on a Galilean Moon



Cigoli, *The Immaculate Conception* (1612), Santa Maria Maggiore, Rome

Faith and Reason: Galileo's Copernican Letters (1613-1615)

NOV-ANTIQUA

Sanctißimorum Patrum, & Probatorum Theologorum Doctrina,

De

SACRÆ SCRIPTURÆ TESTIMONIIS, IN CONCLUSIONIBUS MERE NATURALIBUS, QUÆ SENSATÂ experientiâ, & neceſſariis demonſtrationibus evinci poſſunt, temere non uſurpandis:

In gratiam

Sereniſſimæ CHRISTINÆ *Lotharingæ, Magnæ-Ducis Hetruriæ, privatim ante complures annos, Italico idiomate conſcripta*

à

GALILAEO GALILAEO, Nobili Florentino, Primario Serenitatis Ejus Philoſopho & Mathematico:

Nunc vero juris publici facta, cum Latina verſione Italico textui ſimul adjuncta.

Auguſtæ Treboc.

Impenſis ELZEVIRIORVM,

Typis DAVIDIS HAVTTI.

M. DC. XXXVI.

God's two books

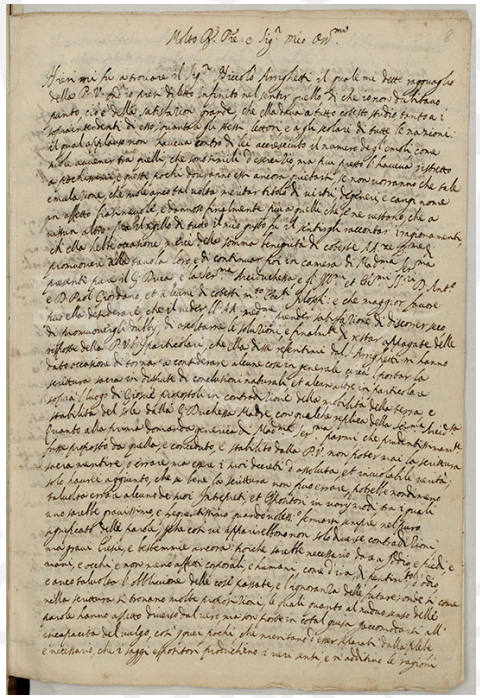
"I recall having heard a great mind say that God's omnipotence composed once two volumes. In the one, *dixit, et facta sunt,* and this was the Universe. In the other, *dixit, et scripta sunt,* and this was the Holy Scripture." (Torricelli, *Academic Lessons*)

God's two books: The letter to Benedetto Castelli

"It seems to me that in disputes about natural phenomena the Scripture should be reserved to the last place. For the Holy Scripture and nature both equally derive from the divine Word, the former as the dictation of the Holy Spirit, the latter as the most obedient executrix of God's commands (…). Therefore, whatever (…) necessary demonstrations prove to us concerning natural effects should not in any way be called into question on account of scriptural passages whose words appear to have a different meaning, since not every statement of the Scripture is bound to obligations as severely as each effect of nature." (Galileo to Benedetto Castelli, 21 December 1613)

Some Dominicans attack Galileo

- 21 December 1614: The Dominican friar Tommaso Caccini attacks Galileo during a sermon in Santa Maria Novella
- 7 February 1615: The Dominican friar Niccolò Lorini sends to the Inquisition a complaint against Galileo, together with a copy of the letter to Castelli



Bellarmine' letter to the Copernican Foscarini, 12 April 1615

" I say that it seems to me that Your Paternity and Mr. Galileo should limit yourselves to speaking **hypothetically** (*ex suppositione*) and **not absolutely** (…). For there is no danger in saying that, by assuming that the earth moves and the sun stands still, one saves all the appearances better than by postulating eccentrics and epicycles; and that is sufficient for the mathematician. However, it is different to want to affirm that in reality the sun is at the centre of the world (…) This is a very dangerous thing, likely (…) to harm the Holy Faith by rendering the Scripture false (…) As you know, the Council prohibits interpreting the Scripture against the common consensus of the Holy Fathers."

1616: The prohibition of heliocentrism

- 24 February 1616: Theologians report on Copernicanism
- 26 February 1616: Cardinal Bellarmine warns Galileo not to defend the Copernican opinion
- 5 March 1616: Foscarini's and Copernicus' books are placed on the *Index*
- 1619: Kepler's *Epitome of Copernican Astronomy* (1618) is placed on the *Index*

1623: new hope for Galileo

- 1623: Cardinal Maffeo Barberini elected Pope Urban VIII
- Spring 1624: Galileo has six auditions with the Pope

The *Dialogue concerning the two chief world systems* (1632)

Day 1: Critique of the Aristotelian cosmos

Day 2: Daily motion of the Earth

Day 3: Annual motion of the Earth

Day 4: The tides

The *Dialogue* (1632)

Answer to the empirical-astronomical arguments against Copernicus:
- Phases of Venus
- Moons of Jupiter
- Mars at opposition 60 times as large than at conjunction
- Absence of parallax

Answer to physical arguments against Copernicus:
- Law of inertia
- Principle of relativity of motion
- Principle of the composition of motions

The double message of the *Dialogue* (1632)

To the Discerning Reader: “To this end I have taken the Copernican side in the discourse, proceeding *as with a pure mathematical hypothesis* and striving by every artifice to represent it as superior to supposing the earth motionless – not indeed absolutely, but as against the arguments of some Peripatetics.”

Dedication to the Grand Duke of Tuscany: “Turning over the great book of nature (which is the proper object of philosophy) is the way to elevate one’s gaze (…). The constitution of the universe I believe may be set in the first place among all natural things that can be known.”

“The principal activity of pure astronomers is to give reasons just for the appearances of celestial bodies (…) so that calculated motions correspond with those same appearances (…). However well the astronomer might be satisfied merely as a calculator, there is no satisfaction and peace for the astronomer as a philosopher.” (*Dialogue,* Third Day)

The trial (1633)

The Galilean argument in Johannes Paulus II, *Fides et Ratio* (1998)

Chapter III, *Intellego ut credam*

"This truth, which God reveals to us in Jesus Christ, is not opposed to the truths which philosophy perceives. (…) It is the one and the same God who establishes and guarantees the intelligibility and reasonableness of the natural order of things upon which scientists confidently depend."

Footnote: "[Galileo] declared explicitly that the two truths, of faith and of science, can never contradict each other, 'Sacred Scripture and the natural world proceeding equally from the divine Word, the first as dictated by the Holy Spirit, the second as a very faithful executor of the commands of God', as he wrote in his letter to Father Benedetto Castelli on 21 December 1613. The Second Vatican Council says the same thing, even adopting similar language in its teaching: "Methodical research, in all realms of knowledge, if it respects... moral norms, will never be genuinely opposed to faith: the reality of the world and of faith have their origin in the same God."