The Works of Galileo
A guided tour

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. "Philosophy [*i.e.*, physics] is written in this grand book—I mean the universe—which stands continually open to our gaze, but it 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 around in a dark labyrinth."

Galileo Galilei, *Il Saggiatore* (*The Asssayer*, 1616)

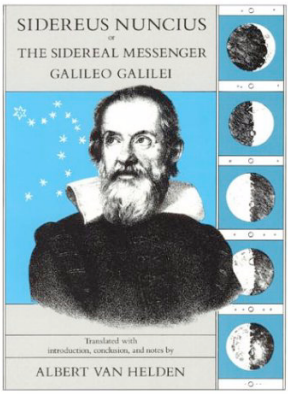
Foundations of Mathematical Physics: a few examples

Mathematics	Astronomy
Euclid, *Elements of Geometry* Latin (Venice, 1476) Arabic (Rome, 1594) English (London, 1570) Archimedes of Syracuse, *Conics* etc. First printing, ed. Niccolò Tartaglia, 1543.	Ptolemy, *Almagest* (ca. 150 AD). Regiomontanus, *Epitome* of *Almagest* (1496) Nicolaus Copernicus, *On the Revolutions of the Heavenly Orbs* (1543) Johann Kepler, *Mysterium Cosmographicum* (1596)

Timeline and Quotations

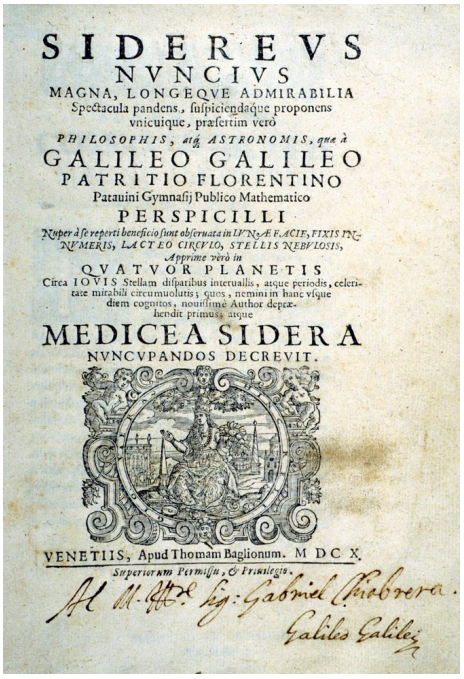
Year	Events
Early Years	
1564	Birth of Galileo Galilei, son of Vincenzio Galilei, in Pisa. February 15.
1574	Vincenzio moved his family back to Florence.
1575-1577	Began education at the Monastery of Vallombrosa. Entered the Vallombrosan Order. Removed by his father before completing his novitiate year.
1581	Entered the University of Pisa to study medicine.
1585	Returned to Florence without a degree.
1588	Circulated a respectable manuscript on the center of gravity. Corresponded with Christoph Clavius, the Jesuit astronomer.
1589	Became lecturer in mathematics at the University of Pisa; 3-year contract.
1592	Resigned from Pisa because of controversies with Aristotelian professors. Spring and summer: Returned to Florence. September: became lecturer in mathematics at the University of Padua, in the Republic of Venice. 4-year contract; remained there until 1610.
1596	Kepler, *Mysterium Cosmographicum* "proving" Copernicanism, sent copy to Galileo. Galileo didn't read it, but wrote Kepler that he had been a Copernican "for several years."

Timeline and Quotations

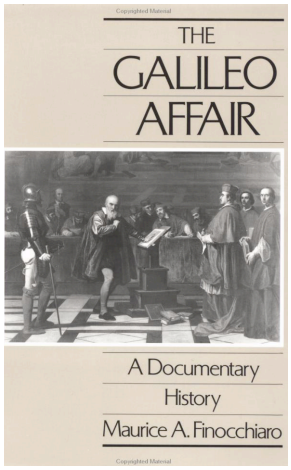
Year	Events
1600	Daughter Virginia (later Sister Maria Celeste) born to Galileo and his Venetian mistress, Marina Gamba. Two other children would follow: Livia (1601) and Vincenzio (1606). Dava Sobel, *Galileo's Daughter* (Penguin, 2000). NOVA, "Galileo and the Battle for the Heavens" (2002)
1604	Supernova, described by Kepler. Heavens may change, contrary to Aristotle.
1605	G. returned to Florence for summer to tutor Cosimo II, son of the Grand Duke of Tuscany.
1606	Galileo, *Le operazioni del compasso geometrico, et militare* (Padua, 1606). Instrument crafted in Galileo's home and sold to his students. Manual established Galileo's priority. Only 60 copies printed. Basis for tutoring on which Galileo's income depended; intended only for owners of instrument (not depicted in manual). Pleased Cosimo, to whom it was dedicated. Solved problems such as estimating altitudes, topographical and fortification surveying, "making the caliber" of cannonballs of different materials, estimating cannon angle for given target distance, etc.
	English translation Stillman Drake, *Operations of the Geometrical and Military Compass* (Dibner Library Publication, Smithsonian Institution, 1978). "The opportunity of dealing with many great gentlemen in this most noble University of Padua, introducing them to the mathematical sciences, has by long experience taught me that not entirely improper was the request of that royal pupil who sought from Archimedes, as his teacher of geometry, an easier and more open road that would lead him to its possession; for even in our age very few can patiently travel the steep and thorny path along which one must first pass before acquiring the precious fruits of this science.... Hence I excuse them [who cannot take the long path] together with that young King of Syracuse, and desiring that they should not remain deprived of knowledge so necessary to noble gentlemen by reason of the length and difficulty of ordinary roads, I fell to trying to open this truly royal road—for with the aid of my Compass I do that in a few days, teaching everything derived from geometry and arithmetic for civil and military use that is ordinarily received only by very long studies."
1607	Baldassar Capra, *Usus et fabrica circini cuiusdam proportionis*. This was a translation of Galileo (1606) from Italian into Latin, perhaps done by Simon Mayr. It implied that Galileo stole the invention. Galileo mobilized support. Hearings in Venice resulted in a court judgment against Capra and remaining copies of the book were confiscated. 30 copies escaped, so Galileo published his *Difesa contro alle calunnie & imposture di Baldessar Capra* (1607).
The Telescope and Starry Messenger	
1609	Galileo improved the telescope, constructed his own, and demonstrated its military utility to Senators of the Republic of Venice from San Marco's belltower. Then he began observing the heavens.
1610	*Sidereus Nuncius* (Venice, 1610). March, hastily published. Galileo, *Sidereus Nuncius*, trans. Albert Van Helden (University of Chicago, 1989). A. Demonstrated lunar topography; launched 17th-century race for the Moon. Moon and the Earth are similar kinds of bodies: both have mountains, seas, atmosphere, and shine by reflected light. Do these analogies suggest that the Earth is also a wandering planet? "When the Moon displays herself to us with brilliant horns, the boundary dividing the bright from the dark part does not form a uniformly oval line, as would happen in a perfectly shaped spherical solid, but is marked by an uneven, rough, and very sinuous line, as the figure shows.... what causes even greater wonder is that very many bright points appear within the dark part of the Moon... gradually these are increased in size and brightness [and...] joined with the rest of the bright part.... Now, on Earth, before sunrise, aren't the peaks of the highest mountains illuminated by the Sun's rays while shadows still cover the plain?" 

Timeline and Quotations

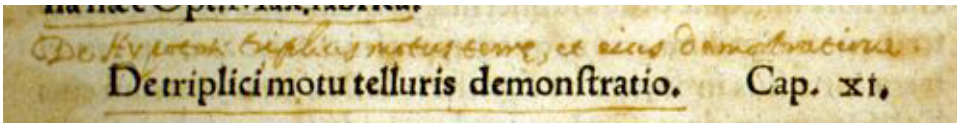
Year	Events
	B. Detected vast numbers of unsuspected stars. Stars remain small pinpoints of light, not enlarged globes like planets. Therefore all stars may be much farther away than previously believed, and the absence of stellar parallax is no longer an objection to Copernicus. How plausible then that the now vastly-thick sphere of stars rotates every 24 hours around a central, stationary Earth? "For the Galaxy is nothing else than a congeries of innumerable stars distributed in clusters. To whatever region of it you direct your spyglass, an immense number of stars immediately offer themselves to view, of which very many appear rather large and very conspicuous but the multitude of small ones is truly unfathomable." C. Discovered satellites of Jupiter, proving that more than one center of revolution exists in the universe, and that a moving planet will not leave its Moon behind. Jovian system a miniature Copernican system, and also a ticket to return to Tuscany ("Medicean stars" dedicated to Cosimo II). Affirmed that planets move around the Sun, and that the Earth is a planet (the latter distinguished his views from Tycho and marked him as a Copernican). "We have moreover an excellent and splendid argument for taking away the scruples of those who, while tolerating with equanimity the revolution of planets around the Sun in the Copernican system, are so disturbed by the attendance of one Moon around the Earth while the two together complete the annual orb around the Sun that they conclude that this constitution of the universe is impossible. For ... our vision offers us four stars wandering around Jupiter like the Moon around the Earth."
1610	Giulio Libri, an Aristotelian physicist at the University of Pisa, refused to look through his telescope. When Libri died shortly thereafter, Galileo quipped that he would be able to see Jupiter's satellites on his way to heaven. June: Galileo resigned from University of Padua. July–September: Galileo returned to Florence as chief Mathematician *and Philosopher* (i.e., physicist) to Cosimo II de Medici, Grand Duke of Tuscany.
Triumph in Rome, Sunspots, and Floating Bodies	
1611	March: Visit to Rome. Telescopic observations confirmed by Clavius and other Jesuit astronomers, who certified them to Cardinal Bellarmine (interpreted as consistent with Tychonic system). Galileo was feasted, honored, celebrated by these mathematicians. Ludovico Cigoli, "Assumption of the Virgin," Santa Maria Maggiore (Rome).
1611	Inducted into *Accademia dei Lincei* by Federico Cesi, along with Giovanni Baptista Della Porta. Other members included Francesco Stelluti, and the German Mark Welser.
1611	General of Jesuit order commanded the defense of Aristotle in physics, and of Thomas Aquinas in theology. This order was repeated in 1613.
1612	*Discorso... che Stanno in sú l'acqua* (*Discourse on Floating Bodies*). Galileo's first published work on a topic in physics where Galileo opposed Lodovico delle Columbe using Archimedes' principles rather than Aristotle's; mathematical vs. qualitative approach to physics. Printed treatise based on a public debate held by Grand Duke at a dinner where Cardinal Maffeo Barbarini also spoke in support of Galileo. Mentions sunspots; periods of Jupiter's satellites; phases of Venus; and the peculiar shape of Saturn. Galileo, *Discourse on Bodies in Water* (Urbana, 1960), trans. Stillman Drake.
1611	Apelles [Christoph Scheiner], *Three Letters on Sunspots* (published by Mark Welser).


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, nouissime Author deprę-
hendit primus atque
MEDICEA SIDERA
NVNCVPANDOS DECREVIT.
VENETIIS, Apud Thomam Baglionum. M D C X.
Superiorum Permissu, & Priuilegio.
Galileo Galilei

Timeline and Quotations

Year	Events
1613	*Alle macchie solari* (Letters on Sunspots). Tracks motion of sunspots with diagrams. Argued that they are contiguous with solar surface, contrary to the Jesuit Christoph Scheiner's view that they are planets circling the Sun like Venus. Not planets because: they move together, and slowly (about a month). They are irregular in shape. They form and disappear with irregular timing. Foreshortening of the spots as they approach the edge of the solar disk proves they're contiguous with the solar surface. Discovery suggests corruptibility of the heavens, contrary to Aristotle but accepted by many, e.g. Bellarmine. Diagrams of periods of Jupiter, phases of Venus. Explicit affirmation of Copernicanism. Priority dispute, and witty, patronizing invective alienated Scheiner (*Rosa Ursina*, 1630). Galileo 1613 *etc*. excerpted in Stillman Drake, *Discoveries and Opinions of Galileo* (1957). Galileo began to formulate a geometrical argument for Copernicanism, never published in full. See Mark Smith, "Galileo's Proof for the Earth's Motion from the Movement of Sunspots," *Isis*, 1985, 76: 543-551.
Scripture and Copernicanism	
1612	Niccolò Lorini, a 70 year old Dominican who was on good terms with the Grand Duke, attacked the "opinion of Ipernicus, or whatever his name is," as contrary to Scripture.
1613	Galileo's friend Benedetto Castelli defended Copernicus to Cosimo's mother, the Grand Duchess Christina, when the question whether it contradicts Scripture arose during a banquet. Galileo wrote "Letter to Castelli," circulated in manuscript to reconcile the two.
1614	Dominican Tommaso Caccini preached a sermon from the pulpit of Santa Maria Novella in Florence, December 21, on the text "Ye men of Galilee, why stand ye gazing up into heaven?" (Acts 1.11; raised issue of how the "Sun stood still" in the book of Joshua.)
1615	Lorini denounced the "Letter to Castelli" to Inquisition as an incursion upon theology. Galileo prepared revised version as "Letter to Grand Duchess Christina," which circulated in manuscript. Galileo argued that the purpose of Scripture is to tell us how to go to heaven, not how the heavens go; Scripture never errs, but its interpreters do err; and read rightly, Scripture and Science will never conflict (unity of truth). That which is obscure (figurative language) should be explained by means of that which is clear (mathematics). To show the traditional basis of his exegesis, he cited St. Augustine throughout. While theologians were not impressed by a mathematician trying his hand at exegesis, Galileo actually did exegesis better than the theologians did physics. Pope John Paul II used Galilean language to affirm similar hermeneutical principles in 1992.  English translations of Galileo's "Letter to Castelli" and "Letter to the Grand Duchess Christina," are in Maurice Finocchiaro, *The Galileo Affair* (Berkeley: University of California Press, 1989). Galileo: "In disputes about natural phenomena one must begin not with the authority of Scriptural passages but with sensory experience and necessary demonstrations." Quoting Augustine: "If, against the most manifest and reliable testimony of reason, anything be set up claiming to have the authority of Holy Scriptures, he who does this does it through a misapprehension of what he has read and is setting up against the truth not the real meaning of Scripture, which he has failed to discover, but an opinion of his own; he alleges not what he has found in the Scriptures, but what he has found in himself as their interpreter." Caccini made a deposition before the Congregation of the Index in Rome against Galileo for holding two propositions: "the Earth moves as a whole as well as with diurnal motion; the Sun is motionless." (For Caccini's deposition, see Finocchiaro.) Paolo Foscarini published a treatise reinterpreting Scripture consistent with Copernicus. Cardinal Bellarmine wrote "Letter to Foscarini" instructing him to regard Copernicanism as hypothetical (i.e, keep mathematics in its place). Galileo visited Rome to advocate Copernicanism both as physically true and as consistent with Scripture. Foscarini's work and Bellarmine's letter are in Richard Blackwell, *Galileo, Bellarmine and the Bible* (1991).

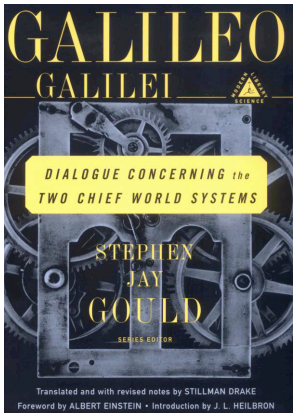
Timeline and Quotations

Year	Events
1615	Tomaso Campanella defended Galileo's scriptural arguments with *Apologia pro Galileo*, written at the request of Cardinal Caetani. Thomas Campanella, *Defense of Galileo*, trans. Richard Blackwell (Notre Dame, 1994).
1616	February 24: Theological consultants agreed that the two propositions detailed by Caccini are absurd and foolish according to natural philosophy, and heretical or at least erroneous according to Faith. Cardinal Maffeo Barbini intervened with the Pope on Galileo's behalf.
	Feb. 25: Cardinal Bellarmine instructed by Pope Paul V to tell Galileo about the impending decree. Three steps: admonition/injunction/imprison for three responses: acquiesence/objection/obstinacy. "His holiness ordered the Most Illustrious Cardinal Bellarmine to call Galileo before himself and warn him to abandon these opinions; and if he should refuse to obey, the Father Commissary, in the presence of a notary and witnesses, is to issue him an injunction to abstain completely from teaching or defending this doctrine and opinion or from discussing it; and further, if he should not acquiesce, he is to be imprisoned."
	Feb. 26: Galileo met with Bellarmine and Segizzi, the Dominican Commissary.
	Feb. 26: A crucial report in Galileo's file at the Inquisition alleges that Segizzi, the Dominican Commissary who was present at the meeting, issued Galileo an injunction not to discuss Copernicanism in any way. This report is anomalous, and its official validity is often rejected: Segizzi's alleged action irregular because Galileo did not have sufficient opportunity to acquiesce to Bellarmine's lighter admonition; no signatures; witnesses not officials of Inquisition or properly qualified; report not original copy but written on blank sides of other pages. Santillana suggests that the report was maliciously fabricated by Segizzi. However, Fantoli reports that a handwritten note on the minutes of Feb 25 written hastily, in Italian, by Segizzi's secretary, also alleges the injunction. Perhaps Galileo initially hesitated to acquiesce to the decree, and the Commissary jumped in prematurely with the injunction, which Bellarmine then overruled and refused to sign?
	March 3: In Inquisition minutes, Bellarmine officially reported that Galileo acquiesced when admonished to abandon Copernicanism (except hypothetically).
	March 5: *Congregation of the Index* suspended Copernicus, *De revolutionibus* (1543) "until corrected." Not prohibited as heretical. Galileo not mentioned; his works not suspended or prohibited. *Index* prohibited Paolo Foscarini's *Letter*.
	March 11: Paul V granted a friendly audience with Galileo.
	Cardinal del Monte wrote the Grand Duke that Galileo "has come out of this in excellent position," and that "his enemies have not reached their intentions in this way."
	May 26: Bellarmine gave Galileo a letter stating that Galileo had not been asked to abjure.
	For English translations of all these 1616 documents see Finocchiaro, *Galileo Affair*.
1620	 Congregation of the Index published corrections to Copernicus, interpreting cosmological assertions hypothetically, making Copernicus permissable to read again.
1621	Grand Duke Cosimo II, Cardinal Bellarmine, and Pope Paul V died.
A New Pope and a New Dialogue	
1623	Cardinal Maffeo Barbarini elected Pope Urban VIII.
1623	Galileo, *Il Saggiatore* (*The Assayer*). Dedicated to Urban VIII. Edited and published by members of the Lincei. Magnificent polemic for mathematical physics, ironically ridiculing a mathematical astronomer. Galileo's target was the theory of comets of a Jesuit astronomer, Orazio Grassi, who argued from parallax that comets move above the Moon (Galileo countered that they were an optical illusion). Sealed opposition of Jesuits to Galileo. Read with delight by Urban VIII, who had written a poem lauding Galileo's polemics.
	English trans. Stillman Drake and C. D. O'Malley, in *The Controversy on the Comets of 1618* (University of Pennsylvania Press, 1960). Quoted at the beginning of this handout.

Timeline and Quotations

Year	Events
1623	*Apiarium*, by Francesco Stelluti and Federico Cesi. Dedicated to Urban VIII.
1624	Galileo visited Rome to seek revocation of Copernican censure. Six visits with Urban VIII, who cautioned Galileo that divine omnipotence mandated humility in scientific knowledge. Obtained permission to write an even-handed treatise treating Copernicus hypothetically.
1625-1630	Began the "Dialogo" in 1625; progress delayed by illness and other matters; edited by Sister Maria Celeste; completed in 1629 or early 1630.
1630	In Rome, promise of Imprimatur given by Riccardi, but printing arrangements fell through upon death of Prince Cesi, 1630.
1630	Oratio Morandi, a friend of an associate of Galileo's, used astrology to predict an early death of the Pope. Morandi was involved in hermetism and a follower of Della Porta's natural magic. The following year Urban VIII issued a papal bull forbidding astrological predictions of the health or demise of popes, kings, dukes or their families.
1631	Cardinal Borgia (who would later refuse to sign Galileo's sentence) led a group of cardinals who openly criticized Urban VIII for his political alliances with French and Swedish forces against Spain and the Holy Roman Emperor. Sweden was Protestant. Urban VIII appeared both politically and doctrinally vulnerable. Associates of the critical cardinals included some of Galileo's visible supporters.
1632	February: Imprimaturs transferred to allow printing in Florence. Italian. Best-seller. Dialogue format. Three speakers: Salviati (Galileo), Sagredo (open-minded reader), and Simplicio ("Simplikios" a well-known ancient Aristotelian commentator). Four days: (1) Critique of the celestial/terrestrial dichotomy; (2) relativity of motion in the heavens; (3) annual motion of the Earth, sunspots; (4) tides. "Hypothetical" in name only. Concludes with a *physical* proof of Copernicanism based on the tides, as if caused by the combination of the Earth's two motions; its daily axial rotation and annual solar revolution. A mathematician trespassing upon the ground of physics (natural philosophy). *Astronomical* arguments for Copernicanism in the *Dialogo*: •Phases of Venus prove that it orbits the Sun. •Variation in motion of the sunspots, consistent with annual motion of Earth plus rotation of the Sun (evidence by analogy for rotation of the Earth as well). •Similarity between surfaces of Earth and Moon. •Satellites of Jupiter prove more than one center of revolution in the universe. •Discovery of new stars, sufficiently distant to explain the absence of parallax, without requiring them to be illuminated by the Sun. The *Dialogo* made these arguments persuasively for the rest of the century. Noel Swerdlow, ch. in *Cambridge Companion to Galileo* (1998).
	English trans. Stillman Drake, *Dialogue on the Two Chief World Systems* (Modern Library, 2001). Salviati: "Is it possible for you to doubt that if Aristotle should see the new discoveries in the sky he would change his opinions and correct his books and embrace the most sensible doctrines, casting away from himself those people so weak-minded as to ... go on abjectly maintaining everything he ever said?"

Timeline and Quotations

Year	Events
	 Simplicio: "The crucial thing is being able to move the Earth without causing a thousand inconveniences." Salviati: [You say...] "Drop a lead ball from the top of the mast of a boat at rest, noting the place where it hits, which is close to the mast; but if the same ball is dropped from the same place when the boat is moving, it will strike at that distance from the foot of the mast which the boat will have run during the time of fall.... [BUT] anyone who... [actually performs that experiment] will find that the experiment shows exactly the opposite of what is written; ... the stone always falls in the same place on the ship, whether the ship is standing still or moving." Salviati: "Without recourse to experiment, I am sure that the effect will happen as I tell you, because it must happen that way..." Simplicio: "These mathematical subtleties do very well in the abstract, but they do not work out when applied to sensible and physical matters." Salviati: "Take note, Simplicio, just how far one may go without geometry...!" Salviati: "The acceleration of straight motion in heavy bodies proceeds according to odd numbers beginning from one. That is, marking off whatever equal times you wish, and as many of them, then if the moving body leaving a state of rest shall have passed during the first time a space as, say, an ell, then in the second time it will go three ells; in the third, five; .... this is the same as to say that the spaces passed over by the body starting from rest have to each other the ratios of the squares of the times...." Salviati: "we Italians are making ourselves look like ignoramuses..." Salviati: "Nor can I ever sufficiently admire the outstanding acumen of those who have taken hold of [the Copernican] opinion and accepted it as true; they have through sheer force of intellect done such violence to their own senses as to prefer what reason told them over that which sensible experience plainly showed them to the contrary." Simplicio: "keeping always before my mind's eye a most solid doctrine that I once heard from a most eminent and learned person, and before which one must fall silent, I know that if asked whether God in His infinite power and wisdom could have conferred upon the watery element its observed reciprocating motion using some other means than moving its containing vessels, both of you would reply that He could have, and that He would have known how to do this in many ways which are unthinkable to our minds."
The Trial of Galileo	
1632	August: sales halted and copies confiscated by Inquisition. October: Galileo summoned to Rome.
1633	February-April: Galileo stayed at Tuscan embassy in Rome. April 12: Trial began, continued for several weeks. Galileo moved to quarters in Inquisition building, accompanied by servants. Questioned by Inquisition. Chief issue a legal technicality: Despite having received a private papal permission and a public official license to print the *Dialogue*, Galileo was accused of violating a 1616 injunction not to hold, defend or teach in any way the Copernician theory (according to the anomalous Segizzi report). The case became complicated when Galileo produced his letter from Bellarmine. April 17: A panel of Cardinals concluded that the *Dialogue* did indeed teach Copernicanism as physically true, not just hypothetically, contrary to Bellarmine's 1616 instruction and Galileo's own testimony of his intentions. April 27-30: Unofficial negotiations (instigated by Cardinal Francesco Barbarini, likely with approval of Urban VIII) resulted in a compromise where Galileo formally confessed that in writing the *Dialogue* he was carried away by enthusiasm and vainglorious ambition. The compromise seemed to assure Galileo of leniency, and to leave open the possibility that the *Dialogue* could be corrected rather than prohibited. There was never any credible threat of torture. Galileo returned to the Tuscan embassy to await the final disposition.

Timeline and Quotations

Year	Events
	May: Summary prepared, heavily tilted against Galileo, with out-of-context quotations. June 16: The compromise fell through. Urban VIII & the Inquisition decreed that the *Dialogo* should be prohibited, and that Galileo must abjure Copernicanism as an error of the faith. Galileo was sentenced as one "vehemently suspected of heresy," which required the humiliating act of public abjuration. Galileo's condemnation was signed by 7 of the 10 Inquisitors, with Francesco Barbarini among those abstaining. The sentence was distributed widely, and read aloud to mathematicians in Florence. The *Dialogue* was prohibited. June 22: Galileo knelt before a plenary session of Cardinals at the Dominican convent of Minerva in Rome, and recited from the prescribed statement: "with sincere heart and unfeigned faith I abjure, curse and detest the aforesaid errors and heresies...." Galileo was released in the custody of the Archbishop of Siena. December: Returned to villa at Arcetri, near Florence, where he lived under house arrest. For important accounts of Galileo's trial, see Fantoli, McMullin and Langford. Many of the documents are translated in Finocchiaro, *The Galileo Affair*.
Last Years	
1634	Sister Maria Celeste died at Convent of San Mateo near Arcetri.
1637	Galileo lost sight in both eyes (glaucoma and inflammation, not from observing the Sun).
1638	July: *Discorsi* (*Discourse on Two New Sciences*) published in Leiden. Two sciences: Tensile strength and motion. Projectile motion parabolic. Inclined plane experiment. Law of falling bodies. English trans. Stillman Drake, *Two New Sciences* (Wall & Thompson, 1989). See Stillman Drake, *Galileo at Work* (Chicago, 1978). Medieval antecedants: Nicole Oresme, *et al.*, Mean Speed Theorem. See Marshall Clagett, *The Science of Mechanics in the Middle Ages* (Wisconsin, 1959).
1638	September: Galileo visited by John Milton, who looked through his telescope.
1642	January 8, Galileo died. Buried in Church of Santa Croce, in Florence.

Reading suggestions

Anthony Fantoli, *Galileo: For Copernicanism and for the Church,* 2d ed. (Chicago, 1996)
Maurice Finocchiaro, *The Galileo Affair* (Berkeley, 1989)
Stillman Drake, *Galileo at Work: His Scientific Biography* (Chicago, 1978)
Richard Blackwell, *Galileo, Bellarmine, and the Bible* (Notre Dame, 1991)
Kenneth Howell, *God's Two Books* (Notre Dame, 2002)
Ernan McMullin, ed, *The Church and Galileo* (Notre Dame, 2005)
Jerome Langford, *Galileo, Science and the Church* (Michigan, 1971)
Peter Machamer, ed, *Cambridge Companion to Galileo* (Cambridge, 1998)
William Wallace, *Galileo and His Sources* (Princeton, 1984)
Mario Biagioli, *Galileo Courtier* (Chicago, 1993)
Michael H. Shank, critique, *Early Science and Medicine*, 1996, 1: 106-150.
Michael Segre, *In the Wake of Galileo* (Rutgers, 1991)
Eileen Reeves, *Painting the Heavens* (Princeton, 1997)
David Freedberg, *The Eye of the Lynx* (Chicago, 2002)

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