

AN EXHIBITION
OF WORKS BY
GALILEO GALILEI
(1564–1642)

*M. M. H. Sig: Gabriel Proberera.
Galileo Galilei*

The History of Science
Collections
The University of Oklahoma Libraries
Norman, Oklahoma
1980

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Duane H. D. Roller
Curator

The modern world inherited from the Greeks two distinct approaches in the attempt to comprehend the universe: the non-mathematical, non-quantitative Aristotelian physics; the idealistic mathematics associated with the Platonistic philosophy and exemplified by the work of Greeks such as Euclid, Archimedes and Ptolemy. Knowledge of the Aristotelian philosophy arrived in the West first and became dominant in the universities and, as a result, the Aristotelian natural philosophy—physics—became accepted knowledge among University graduates. Awareness of the mathematical approach to nature reached the West somewhat later and its practitioners tended to be non-academics. The deep division between physics and mathematics, so difficult for moderns to understand, set the stage for a momentous battle, in which the mathematicians mounted a successful attack on Aristotelian physics and replaced it with mathematical physics.

In many ways the patron saint of the movement was Nicolaus Copernicus (1473–1543), whose heliocentric theory attracted mathematically-trained investigators who, in the 17th century, increasingly argued for the physical truth of the Copernican mathematical astronomy and for the use in general of the mathematical approach in physics. Concurrently, mathematicians were increasing their knowledge of Greek mathematical work. Niccolò Tartaglia (1499–1557) published in printed form the works of Archimedes, including his work on floating bodies, and the first edition of Euclid in Italian translation, greatly strengthening the knowledge and tools available to mathematicians interested in physical phenomena. Tartaglia probably taught and certainly influenced Ostilio Ricci (1540–1603), who became court mathematician to the

Grand Duke of Tuscany and taught perspective at the Drawing Academy at Florence and became a channel for transmission of knowledge of both Archimedes and Euclid. Late in the 16th century, Ricci began to teach Galileo Galilei (1564–1642) and, understandably, Galileo displayed in his work knowledge of both Archimedes and the Italian edition of Euclid.

Galileo was the son of Vincenzo Galilei (ca. 1520–1591), a musician of considerable note, who saw to his son's humanistic education, with emphasis on music, painting, and literature, and sent the boy to the University at Pisa to study medicine. However, Galileo became interested in mathematics during his stay in Pisa, through the influence of Ricci. He left the University of Pisa in 1585 without a degree and, after returning for a brief tenure of teaching at Pisa, he was appointed to teach mathematics at Padua, where he began lecturing in December 1592.

Prior to 1606, Galileo had engaged in a considerable amount of scientific work and had produced a good deal of manuscript, although he had not published any printed books. He was supplementing his university salary by private teaching in a variety of subjects and, also, by teaching the use of and selling a drafting instrument of his own design.

At the very beginning of the seventeenth century Galileo began preparing a manual giving instructions for the use—although not the manufacture—of his drafting instrument. Manuscript copies of this manual were made available to purchasers of the instrument from 1601 on. Then in 1606 he had a printer, Pietro Marinelli, come to Galileo's home and print there sixty copies of the manual. The copy exhibited here contains marginal notes by Galileo.

*Le Operazioni del compasso
geometrico, et militare. Di Galileo
Galilei Nobil Fiorentino Lettor delle
Matematiche nello Studio di Padoua.
Dedicato al Sereniss. Principe di
Toscana D. Cosimo Medici. In
Padova, In Casa dell'Autore, Per
Pietro Marinelli. MDCVI. Con
licenza de i Superiori.*

It has been reasonably surmised that at least one of the reasons for preparing the printed version was to enable Galileo to dedicate the book to Cosimo de' Medici, in the hope of getting patronage that would enable him to move back to Florence. Galileo knew that Cosimo's father, the Grand Duke of Tuscany, had employed Ostilio Ricci, on his staff with the title of "mathematician" and that the position had been vacated in 1603 at Ricci's death. If that was Galileo's hope, it was a vain one; no offer was forthcoming from either Cosimo or his father.

However, the book produced an unexpected result: a student at Padua, Baldessar Capra (*ca.* 1580–1626) published a plagiarization of Galileo's ideas on the compass, claiming invention of the instrument and thereby labeling Galileo a thief who had dedicated his stolen work to Cosimo de' Medici. Galileo reacted sharply, taking legal action that resulted in the expulsion of Capra from the University and an order to seize all the copies of the book.

LE OPERAZIONI
DEL COMPASSO
GEOMETRICO,
ET MILITARE.

DI
GALILEO GALILEI
NOBIL FIORENTINO
LETTOR DELLE MATEMATICHE
nello Studio di Padoua.

Dedicato
AL SERENISS. PRINCIPE DI TOSCANA
D. COSIMO MEDICI.



IN PADOVA,

In Casa dell'Autore, Per Pietro Marinelli. MDCVI.
Con licenza dei Superiori.

Difesa di Galileo Galilei Nobile Fiorentino, Lettore delle Matematiche nello Studio di Padoua, contro alle calunnie & imposture di Baldessar Capra Milanese, vsategli sì nella considerazione astronomica sopra la nuoua stella del M DC IIII. come (et assai più) nel publicare nuouamente come sua inuentione la fabrica, et gli vsi del compasso geometrico, et militare, sotto il titolo di vsus & fabrica circini cuiusdam proportionis, &c. Cvm privilegio. In Venetia, M DC VII. Presso Tomaso Baglioni.


The seizure of Capra's plagiarization of Galileo's work was incomplete; a number of copies had already been sent abroad. In 1607 Galileo published his *Defense* against Capra, to inform both Cosimo de' Medici and his own colleagues abroad of the legal proceedings and judgment against Capra. The copy exhibited here is inscribed by the author to "Giab.^{ta} Amadori," presumably Giovanni Battista Amadori (1567–1621), a Florentine physician. It also contains handwritten notes by Galileo.

**DIFESA
DI GALILEO GALILEI
NOBILE FIORENTINO.**
Lettore delle Matematiche nello Studio di Padoua.

Contro alle Calunnie & imposture
**DI BALDESSAR CAPRA
MILANESE,**

*Usategli sì nella Considerazione Astronomica sopra la nuoua Stella
del M DC IIII. come (et assai più) nel publicare
nuouamente come sua inuentione la fabrica, et
gli vsi del Compasso Geometrico, et
Militare, sotto il titolo di*

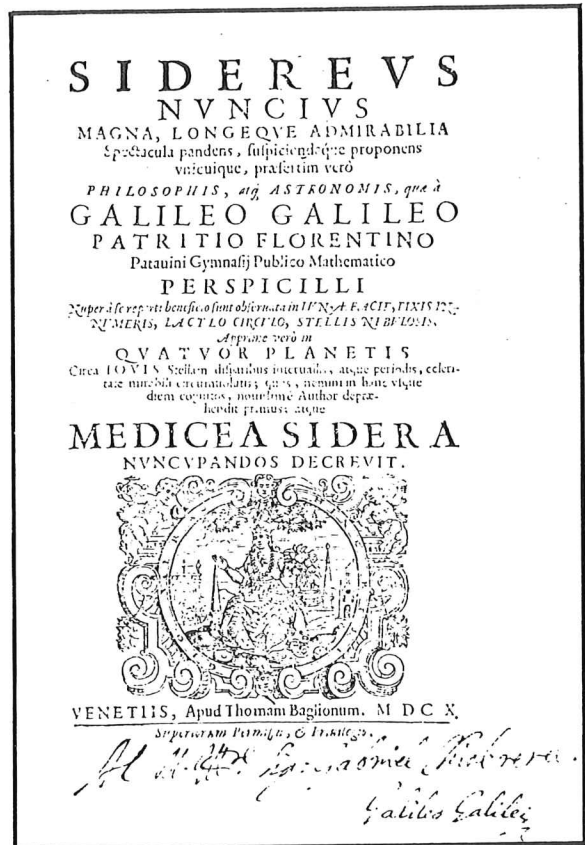
Vfus & fabrica Circini cuiusdam proportionis, &c.
CVM PRIVILEGIO.



IN VENETIA, M DC VII.
Presso Tomaso Baglioni.

Al' onore di Giab.^{ta} Amadori

Siderevs nuncivs magna, longeqve admirabilia spectacula pandens, suspiciendâque proponens vnicuique, praesertim verò Philosophis, atque astronomis, quae à Galileo Galileo Patritio Florentino Patauini Gymnasij Publico Mathematico perspicilli nuper à se reperti beneficio sunt obseruata in Lvnæ facie, fixis innomeris, lacteo circulo, stellis nebulosis, apprime verò in quatuor planetis circa Iovis stellam disparibus interuallis, atque periodis, celeritate mirabili circumuolutis; quos, nemini in hanc vsque diem cognitos, nouissimè Author depraehendit primus; atque Medicea Sidera nuncupandos Decrevit. Venetiis, Apud Thomam Baglionum. MDC X. Superiorum Permissu, & Privilegio.



The precise origins of the telescope are not well-known; it seems likely that it was invented in the Lowlands. Whatever its origins, by 1608 information about this new invention was circulating in Europe. Galileo learned about it in the summer of 1609 and promptly set about designing and manufacturing such instruments and exploring their uses. Before the end of the year he had begun to observe the heavens with these "perspective glasses." By March, 1610, he had published a book on his discoveries, which included details of the Moon's surface, many previously unseen stars, and four satellites of Jupiter. The copy exhibited

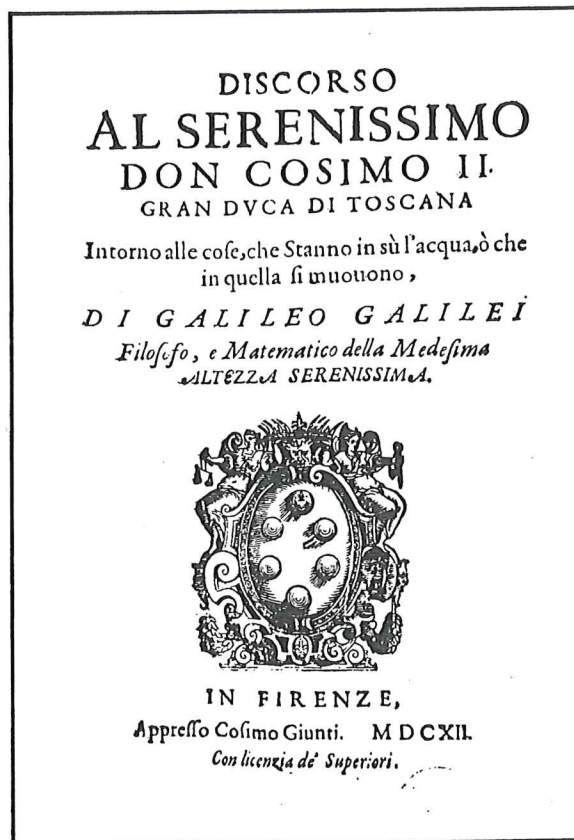
here is inscribed by Galileo to the lyric poet Gabriello Chiabrera (1552–1637).

Again the book was dedicated to Cosimo de' Medici, who had become Grand Duke of Tuscany the previous year, and Galileo named the satellites of Jupiter "The Medicean Stars." These events led to Galileo's appointment to a special chair of mathematics at the University at Pisa and as mathematician and philosopher (physicist) to the Grand Duke of Tuscany. He returned home and took up permanent residence in Florence.

Discorso al Serenissimo Don Cosimo II. Gran Duca de Toscana intorno alle cose, che stanno in sù l'acqua, ò che in quella si muouono, di Galileo Galilei Filosofo, e Matematico della Medesima Altezza Serenissima. In Firenze, Appresso Cosimo Giunti. MDCXII. Con licenzia de' Superiori.

From his safe base of operations on the Grand Duke's staff, Galileo pursued his telescopic observations, his scientific work, and steadily increasing attacks against the Aristotelian physics. He became embroiled in arguments with a number of physicists on the question of why ice floats, and extended some earlier work of his own on the general subject of floating bodies into a book.

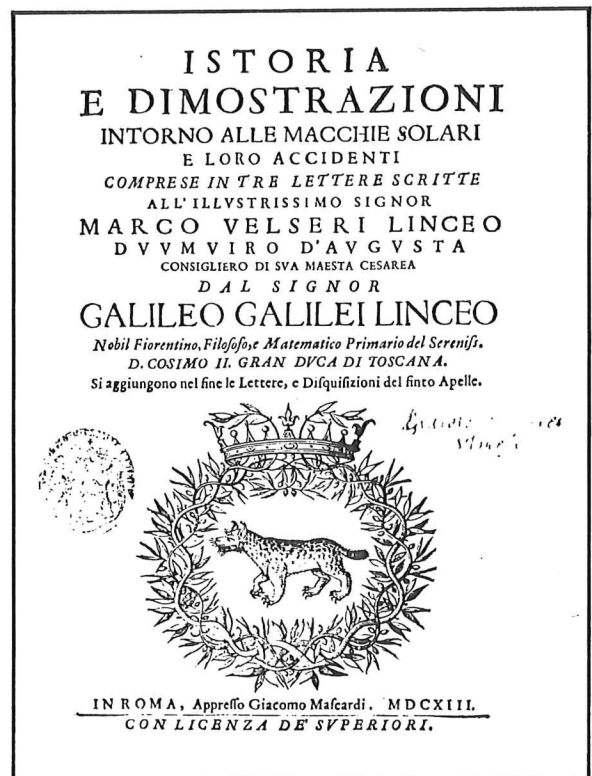
In particular Galileo brought to bear on the problem both mathematical attitudes and information on the subject, stemming from Archimedes, that were largely unknown to the physicists of his day. His book on floating bodies, published in 1612, also contained a report of further observations of Jupiter's satellites and some comments on the recently discovered sunspots.



Istoria e dimostrazioni intorno alle macchie solari e loro accidenti comprese in tre lettere scritte all' Illvstrissimo Signor Marco Velseri Linceo Dvumviro D' Avgvsta Consigliero di sva Maesta Cesarea dal Signor Galileo Galilei Linceo Nobil Fiorentino, Filosofo, e Matematico Primario del Sereniss. D. Cosimo II. Gran Dvca di Toscana. Si aggiungono nel fine le lettere, e disquisizioni del finto Apelle. In Roma, Appresso Giacomo Mascardi. MDCXIII. Con licenza de' Svperiori.

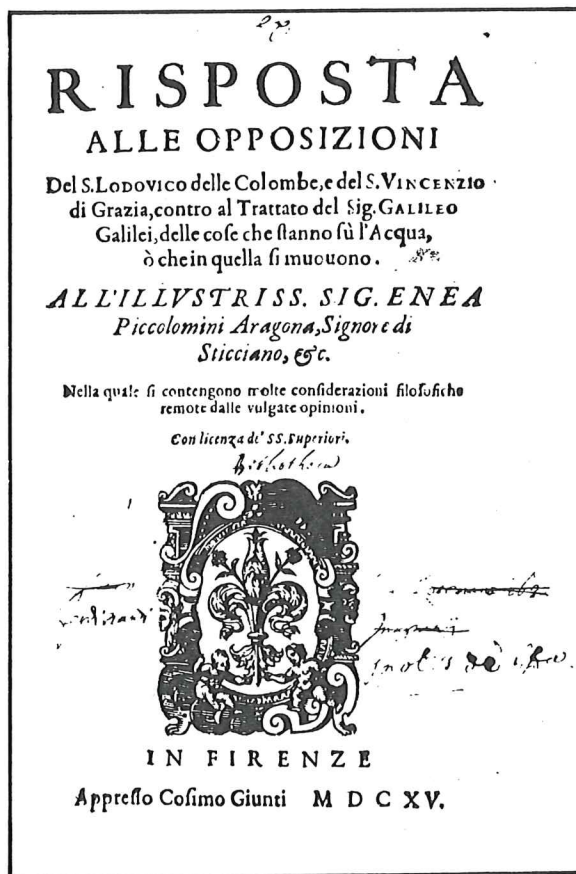
In 1613 a book by Galileo on the sunspots was published in Rome under the auspices of the *Accademia dei Lincei*. This was one of the earliest organizations of scientists, founded and led by Federico Cesi (1585–1630). Galileo had been made a member in 1611 and was identified as such on the title page of this work, which also carries the symbol of the organization, a picture of a lynx.

This work, although principally on sunspots, brought the record up to date on Galileo's astronomical observations, including observations of the satellites of Jupiter and the phases of Venus. And, at the end, Galileo clearly expressed his support of the Copernican theory of astronomy.



Risposta alle opposizioni del S. Lodovico delle Colombe, e del S. Vincenzio di Grazia, contro al trattato del Sig. Galileo Galilei delle cose che stanno sù l'acqua, ò che in quella si muouono. All' Illvstriss. Sig. Enea Piccolomini Aragona, Signore di Sticciano, etc. Nella quale si contengono molte considerazioni filosofiche remote dalle vulgate opinioni. Con licenza de' SS. Superiori. In Firenze. Appresso Cosimo Giunti. MDCXV.


Benedetto Castelli (1578–1643) had been a pupil of Galileo's in Padua and had moved to Tuscany to become a colleague of Galileo's. He had acquired an appointment to teach mathematics at Pisa and became an active and ardent supporter of Galileo's views. In 1615, a book appeared without any given author but with a preface signed by Castelli. The work was a strong attack on Galileo's opponents, and it was and is widely believed that Galileo and Castelli wrote it together.



Nov-Antiqua Sanctissimorum Patrum, et probatorum theologorum doctrina, de Sacrae Scripturae testimoniis, in conclusionibus mere naturalibus, quae sensatâ experientiâ, & necessariis demonstrationibus evinci possunt, temere non usurpandis: In gratiam Serenissimae Christinae Lotharingae, Magnae-Ducis Hetruriae, privatim ante complures annos, italico idiomate conscripta à Galileo Galilaeo, Nobili Florentino, Primario Serenitatis ejus Philosopho & Mathematico: Nunc vero juris publici facta, cum latina versione italico textui simul adjuncta. Augustae Treboc. Impensis Elzeviriorvm, typis Davidis Havtti. M. DC. XXXVI.

Galileo's overt and increasing support for the Copernican theory produced a growing opposition, not only among the physics professors but also among some priests, preachers, and professors of theology. In late 1613, theological objections to the theory were voiced at the dinner table of the Grand Duke of Tuscany that the devout and influential Grand Duchess Christina found very disturbing. Galileo was perfectly willing to take on the professors of theology as well as the physics professors and began to write on the relations between science and scripture. His views were widely circulated in manuscript in the next few years. Exhibited here is the first printed edition of this work, issued some 20 years later.

NOV. ANTIQUA
*Sanctissimorum Patrum, & Probatorum
 Theologorum Doctrina,*
 De
SACRÆ SCRIPTURÆ
 TESTIMONIIS, IN CONCLUSIONI-
 BUS MERE NATURALIBUS, QUÆ SEN-
 SATÂ EXPERIENTIÂ, & NECESSARIIS DEMONSTRATIONI-
 BUS EVINCI POSSUNT, TEMERE NON USURPANDIS:
In gratiam
Serenissimæ CHRISTINÆ Lotharingæ,
Magnæ-Ducis Hetruriae, privatim ante complures
annos, Italico idiomate conscripta
 à
 GALILAEO GALILAEO, Nobili
 Florentino, Primario Serenitatis Ejus Phi-
 losopho & Mathematico:
Nunc vero juris publici facta, cum Latina versione
italico textui simul adjuncta.



Augustæ Treboc.
 Impensis ELZEVIORVM,
 Typis DAVIDIS HAVTTI.
 M. DC. XXXVI.

Il Saggiatore nel quale con bilancia esquisita e giusta si ponderano le cose contenute nella Libra Astronomica e Filosofica di Lotario Sarsi Sigensano. Scritto in forma di lettera all' Ill.^{mo} et Reuer.^{mo} Mons.^{re} D. Virginio Cesarini Acc.^o Linceo M.^o di Camera di N. S. dal Sig. Galileo Galilei Acc.^o Linceo Nobile Fiorentino Filosofo e Matematico Primario del Ser.^{mo} Gran Duca di Toscana. In Roma. MDCXXIII. Appresso Giacomo Mascardi.

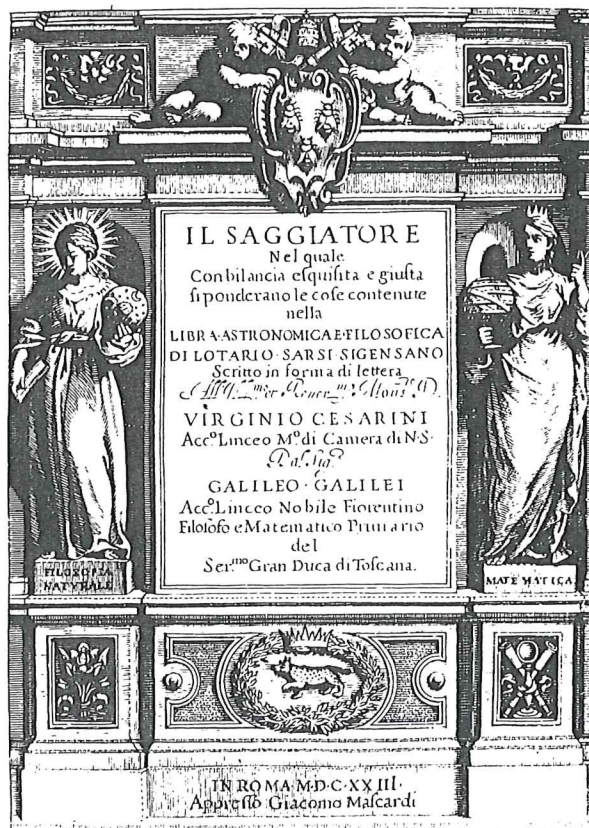
Through the efforts of Galileo, his supporters, and his opponents, the question of the Copernican cosmology (in which the Earth moves) was forced upon the Vatican. A decree of 1616 forbade the teaching of the *physical* motion of the Earth as being both physically false and having the *form* of heresy (but not actually heretical). Galileo found it prudent to desist from direct propagandizing for the physical truth of the Copernican theory but seems to have decided that he could safely continue to attack the views of others, including Jesuit writers in Rome. It earned him their undying enmity.

In 1619 a work attacking Galileo appeared, published at Perugia under the pseudonym Lothario Sarsi, entitled the *Libra astronomica*. It was by a Jesuit, Orazio Grassi (ca. 1590–1654), a mathematician at the Collegio Romano who had been diverted from supporting Galileo probably both

by his own objections to Galileo's attacks on the Jesuits and by pressure from some of his more violently anti-Galilean colleagues. The title of the work suggested that it was intended to weigh Galileo's opinions whereas in fact it was a severe attack on them.

Galileo's reply came four years later in *The Assayer*—that is, the person who uses the finest scales of all for weighing. It also continued his general attack on the Aristotelian physics.

The book was also published by the Lincei, in Rome. While it was being printed, Pope Gregory XV died and a Florentine friend of Galileo's, Maffeo Barberini (1568–1644), became Pope Urban VIII. The Lincei promptly decided that Galileo's book should be dedicated to the new Pope and a new title page was designed, displaying symbols of the Barberini family, the Papacy, and the Lincei.

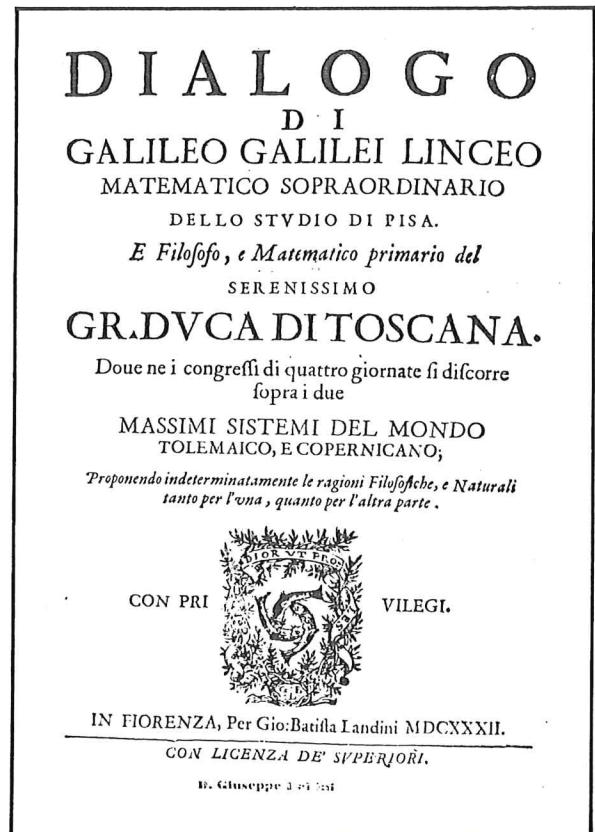


Dialogo di Galileo Galilei Linceo Matematico Sopraordinario dello Studio di Pisa. E Filosofo, e Matematico Primario del Serenissimo Gr. Duca Di Toscana. Doue ne i congressi di quattro giornate si discorre sopra i due massimi sistemi del mondo Tolemaico, e Copernicano; proponendo indeterminatamente le ragioni filosofiche, e naturali tanto per l'vna, quanto per l'altra parte. Con Privilegi. In Fiorenza, per Gio: Batista Landini MDCXXXII. Con Licenza de' Superiori.

The election of Maffeo Barberini to the Papacy seemed to assure Galileo of support at the highest level in the Church. A visit to Rome confirmed this, particularly the freeing of Galileo from any limitation on his writings. He resuscitated a manuscript he had prepared in 1616, on "the flux and reflux of the seas," and began to extend this work on the tides into a general argument for the physical, cosmological truth of the Copernican heliocentric astronomy. Initially he had considerable support in this work from almost every level in the Vatican, including Urban. However, he used both his liberty and support to go a good deal further than the intellectual climate of his day would permit. The *Dialogues* appeared in 1632 and is in the form of a Platonic dialogue. Violent reaction set in after publication of the book, leading to Galileo's trial and conviction for having violated a (never-issued) order from Cardinal Robert Bellarmine (1542–1621) in 1616 not to hold, defend or teach in

any way the Copernican theory. He was condemned to life imprisonment but never imprisoned, the sentence being commuted to house arrest. He ultimately returned home and continued work there. The circumstances provided by the arrest were annoying but did not inhibit his work.

The copy of the *Dialogo* exhibited here contains the changes for the second edition, entered in Galileo's own hand.





Galileo della Bella. f.

Discorsi e dimostrazioni matematiche, intorno à due nuoue scienze attenenti alla meccanica & i movimenti locali, del Signor Galileo Galilei Linceo, Filosofo e Matematico Primario del Serenissimo Grand Duca di Toscana. Con vna appendice del centro di grauità d'alcuni solidi. In Leida, Appresso gli Elsevirii. M. D. C. XXXVIII.

Turning his attention to a number of topics that had long interested him, Galileo began preparation of another book. As arrangements were undertaken for its publication in Venice, it gradually became clear that no church censor in Italy would permit the publication of anything by Galileo. The book was finally published in Holland, in 1638.

This *Two new sciences* is also in the form of a Platonic dialogue, with the same disputants as in the work of 1632. But there is nothing of cosmology in this, the last book of Galileo's books to be published in his lifetime. This is a work on mechanics and its most famous portion is on kinematics. It represents the culmination of a long line of mathematical investigations of motion, extending from 300 years earlier to Galileo's day. It inevitably represents a continuing attack on Aristotelian physics.

DISCORSI
E
DIMOSTRAZIONI
MATEMATICHE,
intorno à due nuoue scienze

Attenenti alla
MECANICA & i MOVIMENTI LOCALI,
del Signor
GALILEO GALILEI LINCEO,
Filosofo e Matematico primario del Serenissimo
Grand Duca di Toscana.

Con vna Appendice del centro di gravità d'alcuni Solidi.



IN LEIDA,
Appresso gli Elsevirii. M. D. C. XXXVIII.