museo galileo

Istituto
e Museo
di Storia
della Scienza

The Museo Galileo is home to the only surviving instruments designed and built by Galileo himself. The most important are two original telescopes and the objective lens of the telescope with which Galileo discovered Jupiter's moons. More generally, the Museum is the repository for the priceless scientific collections of the two dynasties that once ruled Florence: the Medici and the House of Lorraine. The Museum's international renown makes the inauguration of the Museo Galileo one of the key cultural events in the world this year.
The Museum's subtitle will preserve its earlier name of "Istituto e Museo di Storia della Scienza" (Institute and Museum for the History of Science). But the new designation "Museo Galileo" adopted in 2010 emphasizes the central role of the Galilean heritage in the Florentine institution's activities and cultural profile. The Museum is not only a showcase for an invaluable legacy of instruments and experimental apparatuses. It operates as an institute engaged in research and documentation, offering scholars from around the world the resources of its specialized library, also available online.

The new exhibition layout presents the historical and cultural setting in which the Medici and Lorraine collections were assembled, the places where they were once displayed, the collectors' goals, and the activities of the scientists who played the leading role in this enterprise. On display are more than 1,000 instruments and devices of major scientific importance and exceptional beauty. The focus of the entire exhibit plan is Galileo. The Medici collections bear witness to the scientific culture in which the Tuscan scientist emerged. The instruments and experimental apparatuses acquired by the Lorraines in the 18th and 19th centuries reflect the powerful stimulus provided by Galileo's discoveries to the development of physical and mathematical sciences in the modern age.
The Museo Galileo tells the history of scientific activity in Florence and Tuscany centered on his emblematic figure. In many respects, this history is linked to leading-edge international research conducted in the same periods. Indeed, the Medici and Lorraines offered patronage and support to highly talented scientists responsible for some of the key theoretical and practical advances in modern science.

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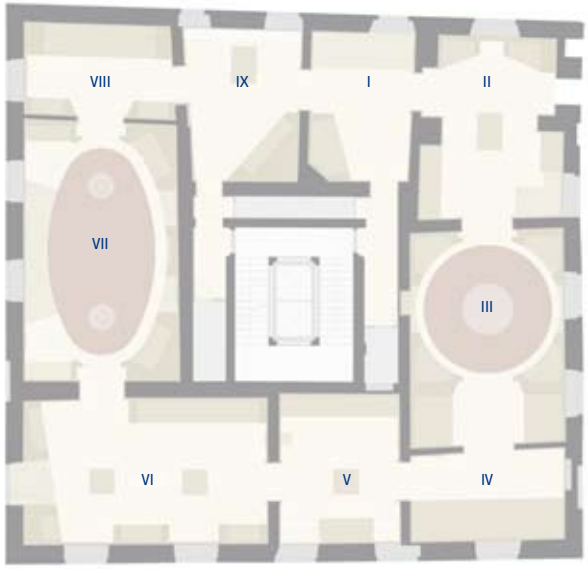
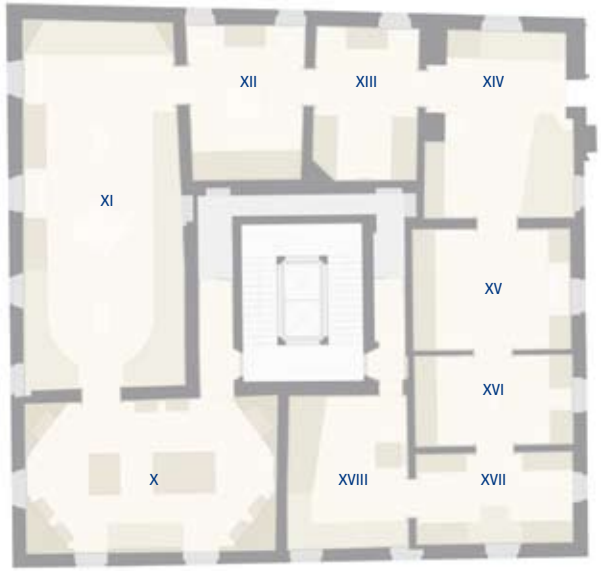
First Floor
The Medici Collections



Room I	*The Medici Collections*
Room II	*Astronomy and Time*
Room III	*The Representation of the World*
Room IV	*Vincenzo Coronelli's Globes*
Room V	*The Science of Navigation*
Room VI	*The Science of Warfare*
Room VII	*Galileo's New World*
Room VIII	*The Accademia del Cimento: Art and Science of Experimentation*
Room IX	*After Galileo: Exploring the Physical and Biological World*

Second Floor
The Lorraine Collections



Room X	*The Lorraine Collections*
Room XI	*The Spectacle of Science*
Room XII	*Teaching and Popularizing Science: Mechanics*
Room XIII	*Teaching and Popularizing Science: Optics, Pneumatics, Electromagnetism*
Room XIV	*The Precision Instrument Industry*
Room XV	*Measuring Natural Phenomena: Atmosphere and Light*
Room XVI	*Measuring Natural Phenomena: Electricity and Electromagnetism*
Room XVII	*Chemistry and the Public Usefulness of Science*
Room XVIII	*Science in the Home*

Room I
The Medici Collections

Over the years the Medici Family, patrons of the arts and science, formed a superb collection of scientific instruments that was housed for about two centuries in the Uffizi Gallery alongside masterpieces of ancient and modern art. The collection, begun by the founder of the Grand Duchy of Tuscany, Cosimo I de' Medici (1519-1574), was further enriched by his successors: Francesco I (1541-1587), interested mainly in natural-history collections and alchemy, and Ferdinando I (1549-1609), who acquired a great number of mathematical, nautical and cosmographical instruments. Cosimo II (1590-1621) had the unique privilege of adding to the collection the original instruments of Galileo (1564-1642) – the geometric and military compasses and the telescopes. Other instruments, including the ingenious glass thermometers, were made for the Accademia del Cimento, founded by Grand Duke Ferdinando II (1610-1670) and Prince Leopoldo de' Medici (1617-1675). Cosimo III (1642-1723) supported the mathematician Vincenzo Viviani (1622-1703), Galileo's disciple, and his project to commemorate the great scientist that was to continue throughout the 19th century.

Room II
Astronomy and Time

Since antiquity mankind has been fascinated by time, viewed as an enigma on both the philosophical and the physical level. Without succeeding in explaining what time is, astronomy has always contributed to defining its units (year, month, day and hour), on the basis of the observation of celestial phenomena, developing precise time-keeping instruments. The need to control time is mirrored in the two main goals pursued by astronomy until the 17th century: establishing a calendar to fix the correct dates of religious festivities and recurrent events in civil life; and predicting the positions of the stars and planets to formulate astrological predictions.

Before the advent of the telescope – opening new horizons for exploring the nature of the celestial bodies – astronomical instruments, portable ones in particular, were used mainly for measuring time. The Medici collection hosts a large number of the most refined time-keeping instruments.

Room III
The Representation of the World

The cultural value of cosmography in Medici Tuscany is shown by the enthusiastic reception of Ptolemy's *Geography* (2nd century A.D.), one of the founding texts of modern geographical studies rediscovered in Florence in the late 14th century. The ambitious project for the New Wardrobe in Palazzo Vecchio, conceived by Cosimo de' Medici (1519-1574) as a grandiose *theatrum mundi*, can also be considered as an attempt to assimilate and update Ptolemy's *Geography*.

This project was emulated later in the Uffizi Gallery by Ferdinando I (1549-1609), who conceived a Cosmographic Room containing representations of the Medicean domains and a great Ptolemaic model of the universe created by the cosmographer Antonio Santucci († 1613). The Palazzo Vecchio and the Uffizi projects form a continuum designed as a *summa* of 16th-century cosmology to celebrate the Prince's power.

Room IV
Vincenzo Coronelli's Globes

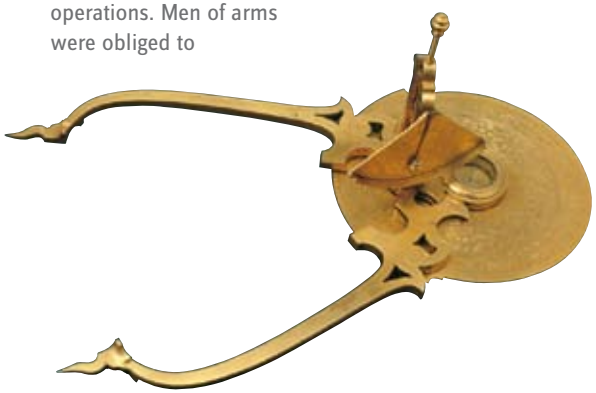
Four globes made by the Venetian cosmographer Vincenzo Maria Coronelli (1650-1718), famous for the great size of his creations, such as the globes nearly four meters in diameter built for Louis XIV, King of France, are present in the Medici collections. The Museo Galileo's globes belong to the series made by Coronelli at the cosmographic Accademia degli Argonauti founded by him in Venice in 1684. These globes are medium- and small-sized (about one meter and about fifty centimetres in diameter). In 1693 Coronelli described his globe-making techniques in the *Epitome cosmografica*. Hand-written or printed sheets of paper, called gores, were glued onto a large ball made of wood and papier-mâché and finished with plaster. The twenty-six sheets displayed in this room (twenty-four half-gores and two polar caps) were printed in the 20th century from the original copper plates kept at the Bibliothèque Nationale in Paris. These plates were prepared for the second edition (Paris 1693) of Coronelli's celestial globe.

Room V
The Science of Navigation

Having consolidated their power over Tuscany, the Medici turned their gaze toward the sea, hoping to win a place in oceanic navigation and develop trade with the East and West Indies. These ambitions favoured the development of maritime science effectively contributing to making Leghorn in the Great Duchy a major centre in the Mediterranean. It was equipped with arsenals, naval shipyards, nautical schools and workshops which produced nautical instruments and cartography, mainly for the captains of the Medicean fleet, the Knights of St. Stephen. In 1606 the English Admiral, Sir Robert Dudley (1573-1649) entered into the service of Ferdinando I (1549-1609), marking the reinforcement of the program of nautical science at the Medicean Court. In 1646-1647, Dudley published in Florence an imposing treatise on the art of navigation, *Dell'arcano del mare*, dedicating it to Ferdinando II (1610-1670). After Dudley's death his important group of nautical instruments became part of the Medicean collection.

Room VI
The Science of Warfare

In 1599 Ferdinando I (1549-1609) had the mathematical instruments moved from Palazzo Vecchio to a room dedicated to military architecture in the Uffizi Gallery. The new display explicitly celebrated the "science of warfare" which, with the spread of firearms, had transformed battlefields into a theatre of geometric studies. Mortars compelled modifying the geometry of fortresses. Moreover, a suitable knowledge of the ratio between the weight and range of cannonballs was now required, calling for precise measurement and computation operations. Men of arms were obliged to



acquire basic mathematical principles for the perfect management of military operations. As stated by Galileo (1564-1642) for the noblemen who attended his lessons in mathematics, a soldier should have a basic knowledge of arithmetic, geometry, surveying, perspective, mechanics and military architecture. This new approach to war favoured a vogue for collecting scientific instruments at court that swept through Europe as an intellectual celebration of the art of war.

Room VII
Galileo's New World

The Summer of 1609 marks the beginning of the revolutionary telescopic exploration of the skies that led to the sensational discoveries of Galileo Galilei (1564-1642): the surface of the Moon appeared grooved by mountains and valleys like those of the Earth; the constellations displayed a multitude of stars invisible to the naked eye; Jupiter was surrounded by satellites (called the Medicean Stars by Galileo); Venus showed cyclic phases like those of the Moon; the Sun's surface was marred by dark spots; Saturn bulged strangely at the sides.
These astronomical discoveries heralded a revolution destined to demolish an image of the universe that had lasted for two thousand years. The profound shock of that revolution, undermining faith in man's privileged position in the universe, aroused violent antagonism that was to claim Galileo himself as victim.

Room VIII
The Accademia del Cimento: Art and Science of Experimentation

Founded in 1657 by Grand Duke Ferdinando II (1610-1670) and Prince Leopoldo de' Medici (1617-1675), the Accademia del Cimento was the first European society exclusively devoted to science, preceding the foundation of the Royal Society in London (1660) and the Académie Royale des Sciences in Paris (1666).
Following in the footsteps of Galileo, the Cimento conducted experiments to verify some principles of natural philosophy hitherto universally accepted on the basis of Aristotle's authority. The Academy concluded its work in 1667 by publishing the *Essays on natural experiments*, in which some of its activities were described. Significant results were achieved by the Academy in thermometry, barometry and the observation of Saturn. Numerous experiments were designed to verify the possibility of creating a vacuum, and to observe its effects on animals and objects. The Accademia del Cimento played an important role in demolishing the traditional belief that nature abhors the vacuum.

Room IX
After Galileo: Exploring the Physical and Biological World

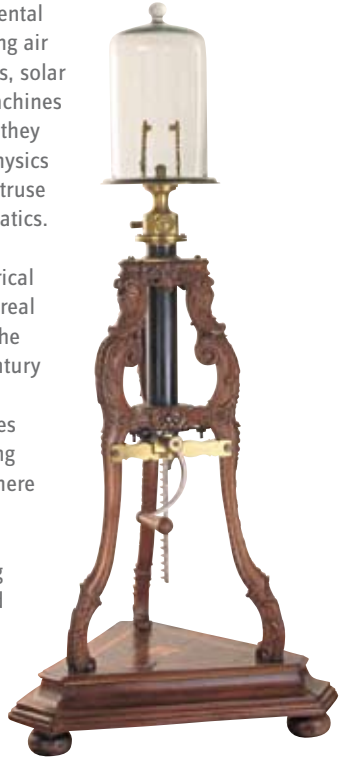
In the second half of the 17th century, meteorology developed at a fast pace, thanks to increasingly perfected instrumentation for measuring thermometric, barometric and hygrometric variations.
The systematic utilization of improved microscopes yielded important results in the fields of biology and entomology. Francesco Redi (1626-1698), a leading figure in these fields of research, brilliantly combined refined strategies of experimentation with scrupulous microscopic observations. Telescopes of ever-greater size and more complex optical systems were also built at this time by expert instrument makers. With such progress in telescopic instrumentation, astronomical observations led to important new discoveries.

Room X
The Lorraine Collections

At the death of Gian Gastone de' Medici (1671-1737), the Habsburg-Lorraine family became the sovereigns of Tuscany. At the initiative of Grand Duke Peter Leopold (1747-1792) the scientific collections were rearranged. In 1769 they were moved from the Uffizi Gallery to Palazzo Torrigiani, the premises of the Imperial and Royal Museum of Physics and Natural History (today's "La Specola" Museum) inaugurated in 1775. Equipped with laboratories and workshops, the Museum was directed by the scientist Felice Fontana (1730-1805). To the collection from the Medicean legacy were added, over the years, apparatus built in the Museum's workshops, such as machines or lathes, various instruments for research in physics (some invented by Fontana himself), wax anatomical models, workbenches, and precision instruments imported from abroad. The Museum also had an astronomical observatory. Among its directors was the celebrated astronomer and optician Giovanni Battista Amici (1786-1863). In 1841, under the direction of Vincenzo Antinori (1792-1865), the most important part of the collection was displayed in the Galileo Tribune. The collection grew until 1859, when the last Grand Duke, Leopold II (1797-1870), left Tuscany.

Room XI
The Spectacle of Science

Spectacular effects were a typical feature of many aspects of 18th-century science. The high society of the time, avid for innovation and entertainment, was fascinated by the phenomena of experimental physics. In salons and courts the laws of nature were illustrated by itinerant lecturers who taught science through spectacular experimental demonstrations. Using air pumps, planetariums, solar microscopes and machines for studying impact, they offered courses in physics that avoided the abstruse language of mathematics. Their lectures, often presented like theatrical performances, were real social events. Over the course of the 18th century the newly invented electrostatic machines were used in amusing "electric soirées," where the demonstrators staged spectacular performances during which the ladies and gentlemen present experienced, on their own bodies, the phenomena of electric attraction, repulsion, shocks and sparks.



Room XII
Teaching and Popularizing Science: Mechanics

In the 18th century, the cultural vogue for presenting science thanks to spectacular experiments among the upper classes stimulated the demand for new educational instruments. They included models of simple and complex machines to demonstrate the practical applications of scientific principles. Educational apparatus were frequently derived from research instruments that had become obsolete. Numerous instruments described in 18th-century treatises, highly ingeniousand efficacious, remained in use in scientific cabinets, with few modifications, up to the first decades of the 20th century. The instruments in the Lorraine collection are perfect replicas of those described in the treatises of famous 18th-century scientists and demonstrators such as Willem Jacob's Gravesande (1688-1742) in Holland and Jean-Antoine Nollet (1700-1770) in France.

Room XIII
Teaching and Popularizing Science: Optics, Pneumatics, Electromagnetism

In the 19th century, with the enormous development of the educational system thanks to the foundation of new schools, universities and polytechnic institutes, the demand for didactic tools grew. To meet these new needs both 18th-century instruments with a few modifications, and new apparatus demonstrating the fast-paced scientific discoveries being made in the fields of acoustics, thermology, optics and electricity were utilized. The educational instrumentation industry expanded rapidly, with its centres of excellence in London, Paris, and as from the late 19th century, in various German cities. In Italy the production of scientific tools for teaching purposes was limited. Thus the Italian collections were equipped mainly with instruments made abroad.

Room XIV
The Precision Instrument Industry

In the 18th and 19th centuries the making of precision instruments for astronomy, geodetics, surveying and navigation was concentrated mainly in Britain, France and Germany. The British instrument maker

Jesse Ramsden (1735-1800) invented the first machine for precisely dividing graduated scales, while in Bavaria Joseph von Fraunhofer (1787-1826) produced the finest optical-quality glass. In Italy, only Giovanni Battista Amici (1786-1863) was able to design original optical instruments, including excellent microscopes that could compete with foreign production. The astronomical observatories founded in Italy, starting from the first decades of the 18th century, exploited the continuous improvements in instrumentation. The Florence Observatory (1780-1789), annexed to the Museum of Physics and Natural History, aspiring to compete with the great astronomical centres at Greenwich and in Paris, was equipped with mainly British instrumentation.

Room XV
Measuring Natural Phenomena: Atmosphere and Light

The affirmation of the experimental method in the 17th century and the development of new instruments stimulated significant progress in the investigation of natural processes, helping to discover the laws that governed them and to unveil invisible phenomena. The barometer was used to reveal the effects of atmospheric pressure and to measure variations in it caused by changes in the weather. The graduated thermometer was used to measure temperature objectively and ever more precisely. The microscope and the telescope enormously enhanced the powers of eyesight, revealing hitherto unknown phenomena of the microcosm and macrocosm. Lastly, combination of lenses, prisms and mirrors led to progress in the science of optics.

Room XVI
Measuring Natural Phenomena: Electricity and Electromagnetism

In the 18th century new instruments were invented, not only to observe nature, but also to act on it, creating new phenomena. Air pumps were used to study the effects of vacuum; electrostatic machines generating electric shock attracted enormous interest and opened new perspectives in scientific research. In 1800 the invention of the electric battery heralded the age of electrodynamics and electrochemistry. Within a few decades, the study of electric current and its effects led to crucial discoveries, giving birth to electromagnetism, whose practical applications triggered a new industrial revolution.

Room XVII
Chemistry and the Public Usefulness of Science

From the second half of the 15th century, the Medici Court had attracted many alchemists to Florence. Very little of the immense Medicean collection of alchemists' instruments has survived. Among them, a few glass vessels used by the Accademia del Cimento (1657-1667), and the great burning lens donated in 1697 to Cosimo III (1642-1723) to experiment with the effects of combustion on gemstones in the Grand-ducal collection. Much better documented is the Lorraine collection of pharmaceutical chemistry – emblematically represented by the "table of chemical affinities" that hung in the Grand-ducal pharmaceutical workshop – and of apparatus of theoretical and experimental chemistry. The discovery of hydrogen and the method for determining the amounts of oxygen and other gases present in the atmosphere favoured the development of new measuring instruments, such as the electric pistol and the hydrogen lamp of Alessandro Volta (1745-1827), the *evaerometro* of Felice Fontana (1730-1805), and the eudiometer of Marsilio Landriani (1751-1815).

Room XVIII
Science in the Home

In the 18th century, the vogue for experimental science among the upper classes created a new market for instrument makers who, along with one-of-a-kind pieces produced for collectors, introduced a series of standard instruments, furnished with accessories, often sold in kits. Compound microscopes, reflecting telescopes and electrostatic machines were usually employed by the wealthy classes for cultural entertainment and self-learning. Some instruments – splendid table clocks, elegant globes, beautifully decorated barometers and thermometers – became furnishing items, displayed along with precious ornaments as symbols of high cultural and social status. Some extravagant objects, such as telescopes for ladies equipped with ivory cosmetic boxes and telescopes for gentlemen disguised as walking sticks, could also be found in upper-class homes.