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ABSTRACT

Comparison Between of Kandilli Observatory Museum and Galileo Museum

The objective of this paper is to compare and evaluate worldwide known Kandilli Observatory and Galileo Museums. Bogazici University Kandilli Observatory Museum is the current Kandilli Observatory and Earthquake Research Institute located in the back of Kandilli by director Fatin Hoca in 1911 as the continuation of Observatory-Amire, founded in Beyoğlu in 1868. It is a Turkish observatory, which is also specialized on earthquake research. The museum is retransformed as Kandilli Observatory and Earthquake Research Institute Museum in 2006 to provide information on geophysics instruments for young students. Galileo Galilei Museum was created by the University of Florence in 1972 for the Italian astronomer, physicist, engineer philosopher and mathematician on the banks of the Arno River in Florence. The research was designed to provide contributions to young scientists and museum specialists by investigating similarities and differences between the two museums.

Key Words: Galileo Museum, Kandilli Observatory and Earthquake Research Institute Museum, Exhibition, Research Institution, Mathematics, Science.

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Introduction

Boğaziçi University Kandilli Observatory Museum: Kandilli Observatory Museum includes instruments in the Islamic Era as sextants, quadrants, manuscripts, telescopes, transit instruments, globes, observatory equipment and a wide astronomy collection. Within the Rectorate of Ergün Toğrol and the Observatory Directorate of Ahmet Mete Işıkara, Fethiye Erbay was assigned to establish a museum in Kandilli in 1992. Museum studies initiated within the same year by Cumhure Üçer, Atilla Özgüç, Tahsin Tahaoğlu ve Fethiye Erbay, Mutlu Erbay. Within the context of this Science Museum Project; inventory was defined, collection was recognized and restoration works started at first.

Old instruments, sextants, quadrants, astrolabes and astronomy calendars were collected from the university departments for exhibition purposes. Instruments kept in various places, storages and packages were removed, cleaned, separate pieces were brought together and inventory studies were initiated. Inventory studies performed by Fethiye Erbay and retired museum specialist of Beşiktaş Naval Museum and her student Nuran Tezgel, in 1993.

A specific area in the building was assigned for museum objects. Museum establishment project was prepared by Nuri Özer Erbay and the preliminary project was completed in March 1994. Earthquake simulation rooms, ateliers for training purposes were included in the pro- ject. Fethiye Erbay designed and drew new cabinets appropriate for contemporary exhibition standards. 10 cabinets were constructed. Construction work started to transform this area into a museum. Museum project was supported with an exhibition held on the occasion of Ulug Bey's 600th birthday.
Since 1992, establishment of Kandilli Observatory and Earthquake Research Institute Museum has gained a new perspective. In 2006, Gülay Barbarosoğlu, Head of the Institute, brought the Project of Establishment of Science Museum in Kandilli Observatory and Earthquake Research Institute into the agenda. Barbarosoğlu's attempts to retrieve the objects formerly be long the Institute and not open to public in Rahmi Koç Industrial Museum became successful and those objects were taken back. The seismography lab built in 1934 by the devoted studies of Mustafa Aktar and Tahsin Tahaoğlu was also integrated in museum's exhibition area. 32 of 581 volumes Kandilli manuscripts, including 369 books on astronomy, mathematics and geography and written in Turkish, Arabic and Persian, are exhibiting in the museum. The museum was restorated by Istanbul Metropolitan Municipality in the past.

During the Rectorate of Gülay Barbarosoğlu, the Kandilli Observatory and Earthquake Research Institute Museum was again brought to the agenda to protect the cultural heritage. The studies initiated to establish an official museum.

Galilei Galileo's Galery: Galileo's name was due to a fifteenthcentury ancestor, Galileo Bonaiuti. He was Galileo's greatgreat uncle and had been a wellrespected physician and chief magistrate in Florance. The family changed its surname to Galilei in his honor and Galileo was also given his first name. Galileo's father, Vincenzio Galilei, was born in Florence, Italy in 1520. He had a significant influence on his son. He studied music in Venice and later made his living as a composer, singer, teacher and lute player. Vincenzio published several books on music theory and musical scores for the lute. He also performed several experiments using mathematics to try to explain how musical instruments worked. These experiments had a strong influence on Galileo. Galileo learned how to sing, play the lute and other musical instruments.

Fig 1-2. Museum Objects in the Kandilli Observatory and Earthquake Research Institute (F.Erbay; 1994)

Fig 3. Documentation of Museum Objects in Kandilli Observatory and Earthquake Research Institute, (F.Erbay; 1994)

He learnt musical measure of time or rhythm. Vincenzio Galilei wrote "Dialogue on Ancient and Modern Music". He discovered and published a new tuning rule for lute. This work was against the traditional music model and a challenge for former music teacher of him, hence Vincen zio's former teacher prevented him to publish the book in Venice, and this book was published three years later. Galileo's experimental and theoretical works on mass movement were independent from the works of Keppler and Descartes. His inventions were prototypes of classical mechanical instruments developed by Sir Isaac Newton. Galileo conducted various experiments on pendulums. These experiments originated from a sermon in the Cathedral of Pisa when he became interested in the cathedral's chandelier. As it swung in the breeze, the chandelier traced part of the circumference of a circle, or an arc. Galileo noticed that the time for a complete swing appeared to stay the same whether the arc was small or large. He used his pulse to measure the time and counted how many beats each swing took.

He studied Medicine for two years at the University of Pisa before his interest
in Physics.

Galileo's quote: *''Philosophy [nature] is written in that great book whichever is before our eyes -- I mean the universe* –''but we cannot understand it if we do not first learn the language and grasp the symbols in which it is written. The book is written in mathematical language,

Fig 4-5 Exhibition of Museum Objects in Kandilli Observatory and Earthquake Research Institute (F.Erbay; 1994)


Fig 6-7. An astrolabe and a quadrant (F.Erbay; 1994)

and the symbols are triangles, circles and other geometrical figures, without whose help it is impossible to comprehend a single word of it; without which one wanders in vain through a dark labyrinth."

Galileo questioned the strict, dogmatic and traditional views of the Church with philosophical views and ideas of the Enlightenment. Galileo made his own telescope and tried to discover the mysteries of the universe. This was the physical basis for theoretical assumptions of today's astronomy. Galileo observed the surface of the Moon, discovered the phases of Venus and discovered Jupiter's satellites, observed Saturn's ring, Orion and the star groups and the Milky Way, and discovered the sunspots on the Sun. Galileo's observations strengthened his belief in Copernicus' theory that Earth and all other planets revolve around the Sun. Most people in Galileo's time believed that the Earth was the center of the universe and that the Sun and planets revolved around it. The Catholic Church, which was very powerful and influential in Galileo's day, strongly supported the theory of a geocentric, or Earth- centered, universe. He was accused of being a heretic by the Church and people.

"Starry Messenger" was criticized by traditionalist scientists and ecclesiastics. The Church thought that this was a serious threat for its holy structure since the Renaissance. This perception indicated that the strict rules and actions of the Church were getting more restricted. Galileo proved the validity of the Copernican system, the Sun was the center of the universe and the Earth had a motion around this center.

Galileo Museum: Galileo had also valuable contributions in engineering such as physics. Between 1595 and 1598, he invented and developed geometric and military compass which was appropriate for the use of soldiers and architects. This instrument was a developed version of the former instrument designed by Niccolo Tartaglia and Guidobaldo Del Monte. Marc Antronio Mazzoleni produced over 100 of these compasses with Galileo's order and Galileo sold at 50 lire a piece. He also received 120 lire for the lectures to teach how to use of this instrument. In 1593, Galileo Galilei invented a rudimentary water thermoscope, which for the first time, allowed temperature variations to be measured. These objects are the most valuable instruments in the museum and symbolize the first technological improvements.

GMAİLG

Galileo Museum has various awards like 2010 ICOM Italy Award, 2010 British Scientific Curator Award and 2011 European Museum Academy Award.

The Palazzo Castellani, site of the Istituto e Museo di Storia della Scienza since 1930, nowadays Museo Galileo, is a building of very ancient origin, dating from the late 11th century. Today, it hosts the Galileo Museum of University of Florence, the Institute and Museum of the History of Science.

Interior Design and collection of Galileo Museum:

Medici and Lorraine collections were transferred into a small room in the Uffizi Gallery which became known as the "stanzino delle matematiche" and the museum was established. In 1775, the instruments were moved from the Pitti Palace to the Royal Museum of Physics and Natural History founded by Grand Duke Peter Leopold Habsburg-Lorraine. In 1929, the First National Exhibition of the History of Science was organized in Florence. Main remark of this exhibition was Italy's scientific heritage and following the show, in 1930, the University of Florence opened to the public in Palazzo Castellani and the permanent exhibition of the Istituto di Storia della Scienza, to which the Medici-Lorraine collection of instruments had been conferred. The museum is open to public since 1930 and an affiliation of the University of Florence. After the damage caused by the bombings that destroyed the bridges of the Lungarno at the end of the Second World War, another hard blow was dealt to the collection by the flood of 1966. The instruments were

Fig 8. Galileo Museum, University of Florence, Institute and Museum of the History of Science
http://www. visitmuseums.com/museum/galileo-museum-of-science-florence-italy-343.(çevrimiçi; Mart 2016)

stored in the basement; ground floor of the Museo wasserious damaged. Thanks to the efforts of Maria Luisa Righini Bonelli, the director of the Museum later, it was possible to carry out the instruments, reopen the exposition rooms to the public and return energies towards library collecting and research activities. Building of the museum was renovated between 2002 and 2003. Goppion made 80 display cases and cabinets for Galileo Museum, objects are still exhibited on these cabinets today. Basement is used for the seminars, conferences, temporary exhibitions, cultural events.

Book sales, restoration studies are conducted in the Entrance Floor. Medici Collections are included in the First Floor. Second Floor is designed for Lorraine Collections. Third Floor includes Galileo Museum, offices and a library belongs to University of Florence, Institute and Museum of the History of Science and a project area for the team work.

Galileo Museum includes Medici and Lorraine Collections. The First Floor Temporary Exhibition includes Medici Collections, Science Academy Collections in 1657, Leopold Medici Collections, a thermometer, a barometer and objects found in Pitti Palace. The Medici Wardrobe from 1562, the wardrobe in Vecchio Palace, the house of Cosimo Medici, maps, solar system and globes.

In 1600 the collection was transferred to a small room in the Uffizi Gallery which became known as the "stanzino delle matematiche". Lorraine Family Collections include microscopes, telescopes, micrometers and spectroscopes as well as thermoelectric instruments. There was a room including Lorraine Colections:

These collections, Galileo Tribune, as statue of Galileo, a military compass, and telescope were brought together with the documents on Galilean discoveries in 1841.
Two fingers and a tooth removed from Galileo Galilei's corpse in a Florentine basilica in the 18th century. The vertebra, tooth and three fingers have been kept at the University of Padua, where Galileo taught for years. But the tooth and two fingers from the scientist's right hand - the thumb and middle finger - were kept by one of the admirers, an Italian marquis, and later enclosed in a container that was passed on from generation to generation in the same family. Museum authorities found detailed historical records and documentation regarding to these families and gave them back to the museum in 2014.

A geometrical and military compass was designed by Galileo in 1604. Galileo's military compass offered gunners a new and safer way of elevating cannons accurately and enabled them to quickly compute the charge of gunpowder for cannonballs of different sizes, materials. He published Operations of the Geometric and Military Compass in 1603. In the preface, it was stated that the book was written in the writer's house. The preface also included a lens and two telescopes developed by Galileo with the contributions of Don Cosimo, the Grand Duke of Tuscany, to discover Jupiter's satellites. Galileo heard of a Dutch invention that allowed distant objects to be seen as distinctly as if they were nearby. He noticed the military importance of this instrument. He built his own telescope, and then gradually improved the power of his telescope, grinding lenses himself, and he introduced his invention to the Venetian Senate. He was quick to spot the potential military application of an instrument which would enable the holder to see ships' approaching Venice two hours before they were visible to the naked eye. He made the Senate a present of a telescope. time, allowed temperature variations to be measured. In 1714, Gabriel Fahrenheit invented the first mercury thermometer, the modern thermometer.

Galileo's thermometer, thermoskope was invented in 1597. The Galilean thermoscope comprises a small glass jar fitted with a very thin tube about 50 centimeters long. You warm the jar in your hands and immerse it upside down in a vessel filled with water. When the jar loses the warmth from your hands, you observe that the water rises in the tube.

The experiment demonstrates the changes in air density caused by changes in temperature.
When the jar is warmed again, the air inside expands, lowering the level of water in the tube. Conversely, when the air cools, its volume shrinks, enabling the water to rise back from the lower vessel into the tube of the jar. He also researched on the areas of Mass and Gravitational

Force. Galileo was the first to study the simple pendulum. He conducted experimental and theoretical research on mass movement. Unlike Kepler, he found that even when a pendulum swings through a small angle, the time of each swing (the period) remains the same as if it swung through a large angle. Galileo performed the experiments at the Leaning Tower of Pisa with the balls of different weights.

During the reign of Ferdinando II, the Grand Duke of Tuscany, a plague swept through Florence. As a scientist, Galileo had an interesting comment on the plea that he analyzed on the microscope: "awful"…They were analyzing them through lenses, however they were unable to define that these microorganisms are real microbes. The "Microbe" would be defined in 1894 by a French bacteriologist Alexandre Yersin, from the Pasteur Institute.

Inclined Plane and Mass Research are also very important. He published the books *"Of Things that Float on Water"* (1612) and The Discourses and Mathematical De- monstrations Relating to Two New Sciences (1638). He calculated the rolling periods and the initial velocity/ time of bronze cannon balls in Venice.

He used a pot filled with water and hanging above. He added a small scale pipe at the bottom of the pot. He measured the discharged water during the each fall of the ball. These measures gave the differences and proportions, hence the mass and the velocity of fall could be calculated.

Inclined Plane Experiment indicated that the weight of an object mathematically related to the component of the weight directed parallel to the inclined plane. The mass of the object doesn't matter; the mass was parallel to the velocity. This development was very helpful for cannon casting ateliers in Venice.

Galileo Museum Library: The library –which has been a part of the institute since its foundation– was completely remodeled in 2002, when it was moved to the third floor of Palazzo Castellani. The new architectural design was awarded the "Bibliocom Biblioteche in vetrina" prize. The library houses about 150,000 works concerning the history of science.
The antique book collection consists of nearly 5,000 works. It includes the Medici-Lorraine Collection, made of scientific books mostly about physics and mathematics, gathered by Tuscan dynasties over five centuries. The library is also home to several archival collections from 18th.to 20th. century and has a photo archive related to the history of the museum's collections, ancient instruments and places of scientific interest. All the materials of the library can be searched from the online catalogue. Museo Galileo started its own Multimedia Lab in 1991. The Lab produces offline and online interactive applications related to the dissemination and documentation of both permanent collections and temporary exhibitions. It also creates digital archives for historical scientific research.

Research and Documentation: Museo Galileo carries out research and documentation in the history of science and technology, as well as in the field of preservation and improvement of museum collections. The Library's book collection and a number of online resources are available to scholars. The museum is a partner to the important institutions, such as the Royal Swedish Academy of Sciences, the Nobel Foundation, the Max Planck Society's institutes and the Harvard University, and co-sponsors several research projects. It also organizes and takes part in many conferences on scientific museology and the history of science and technology.

Galileo Galilei (1564 – 1642), was an Italian astronomer, physicist, engineer, philosopher, and mathematician who played a major role in the scientific revolution during the Renaissance. He changed the mind and logic of his era. Galileo has been called the "father of observational astronomy", the *"father of modern physics"*, and the *"father of science"*. His contributions to observational astronomy include the telescopic confirmation of the phases of Venus, the discovery of the four largest satellites of Jupiter, and the observation and analysis of sunspots. He got blind in 1936 because of naked sunlight and he lost his life in 1642. Through the end of his life, Galileo stated following words for his own life: "I would prefer to discover only one fact in the life, even a small one instead of not discover anything and explain the large and wide things. These small things are as important as many fundaments of the inventions are kept in their prototypes"

Galileo's Dialogue Concerning the Two Chief World Systems was published in 1632 and some months after the book's publication, Pope Urban III and Barbarine banned its sale and expelled him from the Science Committees and intellectual bodies. The Inquisition blamed him for heresy, he was forced to give up his minds and he was sentenced to life imprisonment, which was fortunately later reduced to permanent house arrest. He published *"The Discourses and Mathematical Demonstrations Relating to Two New Sciences"* in 1638. 366 years after the Roman Catholic Church condemned Galileo; Pope John Paul II is poised to rectify one of the Church's most infamous wrongs the persecution of the Italian astronomer and physicist for proving the Earth moves around the Sun.

In 1737, 95 years after his death, his corpse was moved from a storage place to a monumental tomb in Santa Croce Basilica in Florence. Galileo Museum Project for restoration and exhibition were designed by Guicciardini& Magni architect studio associate (2007-2010)

The Director of the Vatican's Observatory in Italy, Fr. José Gabriel Funes said in an interview with the Vatican daily, L'Osservatore Romano, it is the 400 th anniversary of Galileo's first celestial observations, so 2009 declared as the astronomy year by the United Nations and the UNESCO and celebrated as Galileo year in Italy. The memory coin is pressed for this year honour.

How does the Kandilli Observatory Museum become a worldwide known museum as Galileo Museum?

The Kandilli Observatory Museum has the advantages of its institutional building, location and has a safe, sheltered area within the campus. It is open to researchers

and reminds the Galileo Museum with these features. The Kandilli Museum has its own janitors, researchers and a manager. However, this museum employs fewer researchers than the Galileo Museum. Inventories of the Museum were recorded and their restorations were completed. The objects and artifacts are always under maintenance, and many instruments are in working order. The Museum may cooperate with various research insti- tutions. The artifacts may be shared in the digital media.

Conclusion

The museum may be represented through a master program or by the Institute. The Galileo Museum is a subsidiary of an Institute, therefore has various sources and funds. The Galileo Museum buys artifacts outside and accepts various objects to exhibit.
However, the Kandilli Museum is not allowed to receive

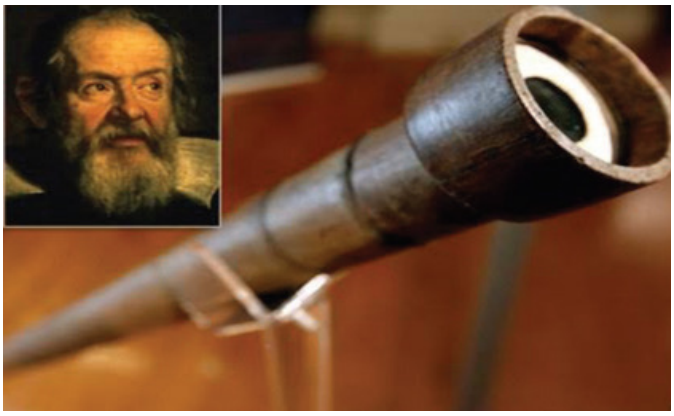

Fig 9. Galileo Museum Galileo's telescope., http://www.museumsinflorence.com/musei/History_of_Science_museum.html(Çevrim içi:7.07.2018)

any donations. Youth generation should be attracted and kept awake through social media. Some researches and conferences may be organized. Swot and feasibility works on museum development still continue. We are in the belief that the Museum will serve as a worldwide known institution as the Galileo Museum in a short period of time

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