Telescopic discovery:
how did it all begin?

United Nations
Educational, Scientific and
Cultural Organization

International
Astronomical
Union

Partners for the International Year of Astronomy 2009

THE UNIVERSE
YOURS TO DISCOVER

INTERNATIONAL YEAR OF
ASTRONOMY
2009

The telescope has revolutionised science and astronomy

From the moment the telescope was turned towards the heavens it has been an instrument to show us our origins and fate.

…but how did it all begin ?

The genesis of the refractor

A refractor telescope is composed of at least two lenses.
Lenses, whose name reflects their shape, have been known since Antiquity.

At that time they were mostly used for decoration, but the Ancients remarked their peculiar properties.

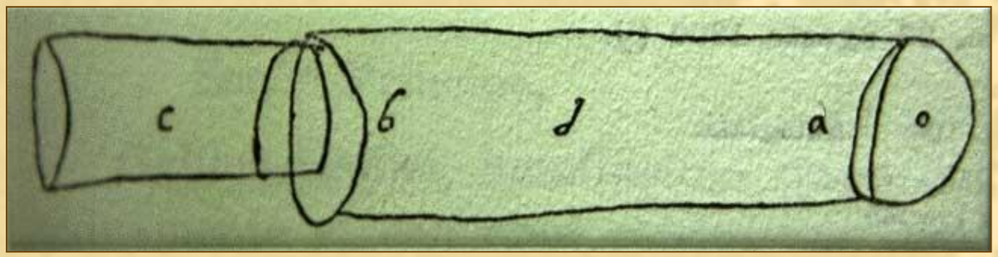
Sénèque (4 BC- 65 AC) mentioned in his Questione naturalis: «*Everything that is seen through water is bigger. The letters, though small and pale, looks larger and clearer [when seen through] a sphere of glass filled with water.*»
One could also set paper on fire by using a small piece of polished glass.

Such observations and studies continued throughout the Middle Ages with people like Alhazen, Grosseteste, and Bacon.

The genesis of the refractor telescope

Some people, like the famous Roger Bacon, imagined incredible uses for these magic lenses: combining them to multiply their enlarging powers, and then observing planets and stars!

One should not forget Giambattista della Porta (1535-1615) who mentions combining lenses in his books *De refractione* and *Magie Naturelle*. He was the first to draw a refractor



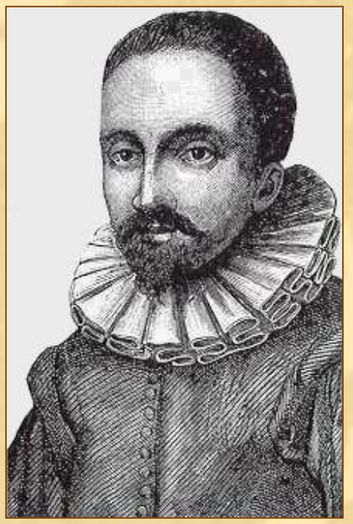
The earliest known illustration of a telescope. Giovanbattista della Porta included this sketch in a letter written in August 1609.

Unfortunately, the glass quality was too poor. At the end of the 13th century, glasses were invented to correct presbytia, and in 1450 to correct myopia. Glass technology slowly began to improve, and the first refracting telescopes were built at the beginning of the 17th century.

Glasses were very popular from the start, as shown by numerous paintings, such as this one from Rothenburg church..
http://fr.wikipedia.org/wiki/Image:Lunettes-Rothenburg-Eglise_St_Jacques.JPG

Hans Lipperhey (1570-1619)

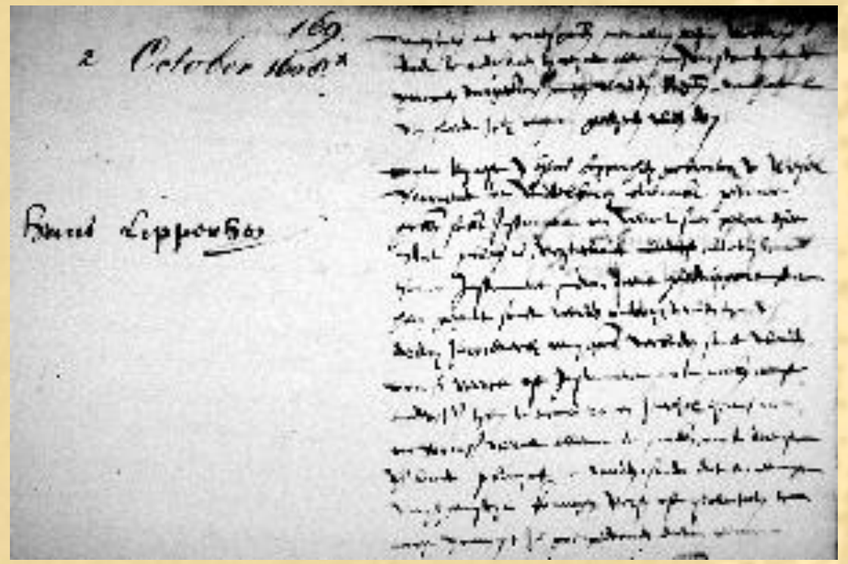
It is Hans Lipperhey who first presented the telescope as we know it today.



Images: Luxorion ezine 2000

Lipperhey (also known as Lippershey) was born in Wesel. He was a gifted spectacle maker based in the Netherlands. On 2 October 1608 he applied for a patent for the telescope that he claimed to have invented. The application was denied, but news of the invention soon spread across Europe. The device indeed appeared quite interesting: “All things at a very great distance can be seen as if they were nearby, by looking through glasses which he claims to be a new invention.”

After Lipperhey’s patent application was made several other people claimed to have invented the telescope, but Lipperhey’s application still stands today as the first recorded design for a telescope.



Lipperhey’s patent request, dated 2 October 1608.
http://galileo.rice.edu/sci/lipperhey.html

Sacharias Janssen (1585 – 1632)

Sacharias Janssen was a spectacle maker in Middelburg, and a colleague and competitor of Lipperhey.

Janssen is one of the possible inventors of the telescope. In the 1630s, his son said that his father built his first telescope years before 1609, following an Italian device dated 1590. However there is no documentary evidence confirming this.

Image: American Physical Society

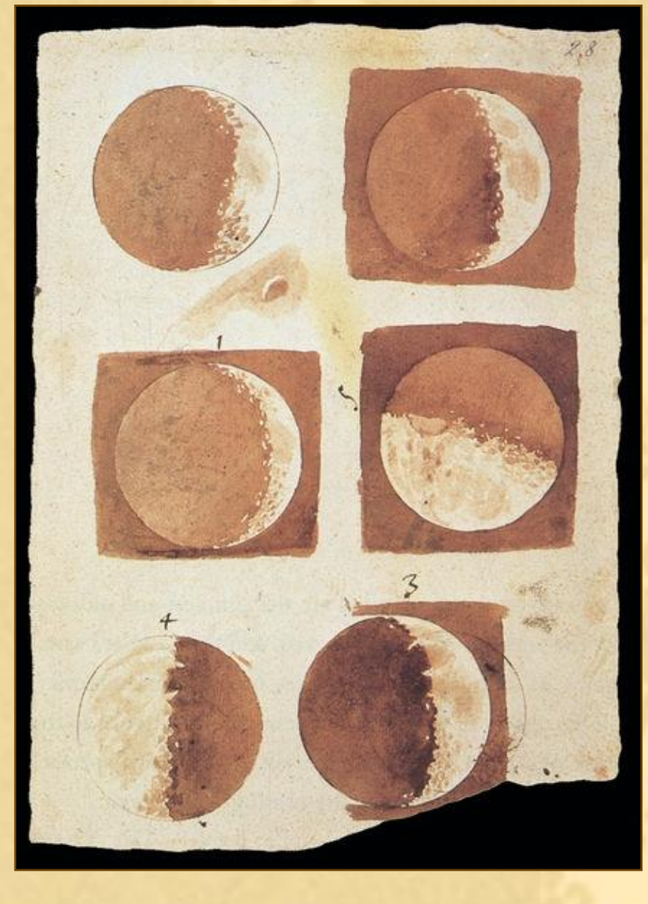
The first observations : the Moon

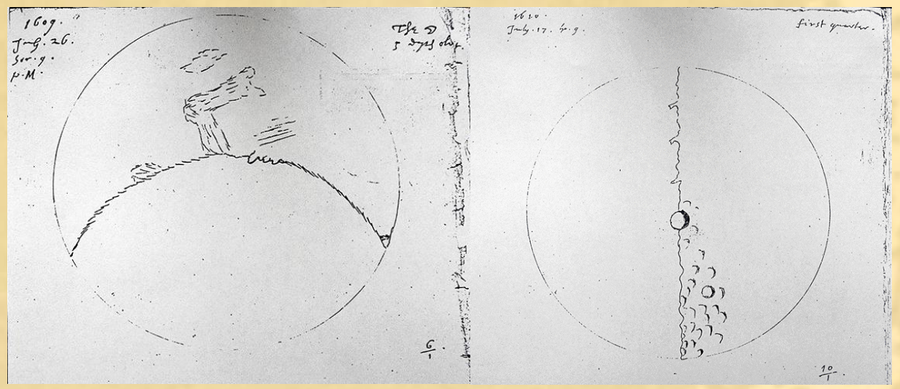
As soon as the refractor was available it was turned towards the sky, as Bacon and others had suggested centuries before. Surprises were numerous, triggering a true scientific revolution.

A Dutch newspaper dated 1608 reports that many stars invisible to the eye could be detected with the new device. Unfortunately, the observer remained anonymous.

In summer 1609, the Moon was the target of Thomas Harriot, followed a few months later by Galileo and others.

They discovered craters and mountains: the celestial bodies were not smooth and perfect!





Images: Wikipedia & The Galileo Project

Thomas Harriot (1560 – 1621)

English man Thomas Harriot was a scientist and astronomer living in Oxford. In one of his many roles he was a cartographer on an expedition organised by Sir Walter Raleigh. He may have been the first person to use a telescope for astronomy.

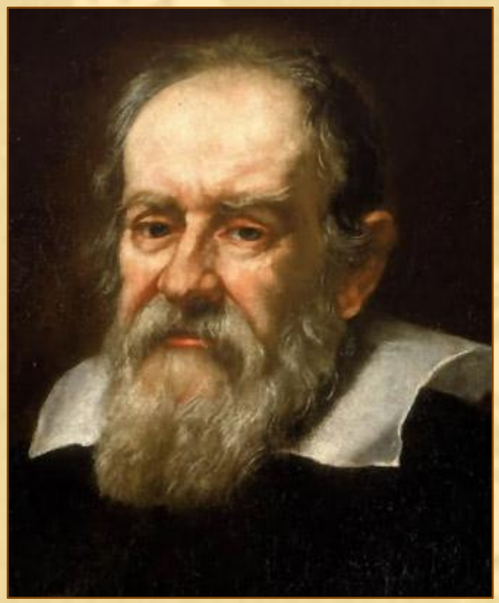
Harriot is not well known throughout the world although some of his observations were advanced for his time.

It is has been shown that Harriot observed and sketched the Moon through a telescope
on 26 July 1609, months before Galileo is known to have done so.

Though hardly as famous as Galileo, Harriot's works in observing and noting sunspots were the first recorded observations of these phenomena.

Image: East Carolina University | http://www.ecu.edu/cs-cas/harriot.cfm

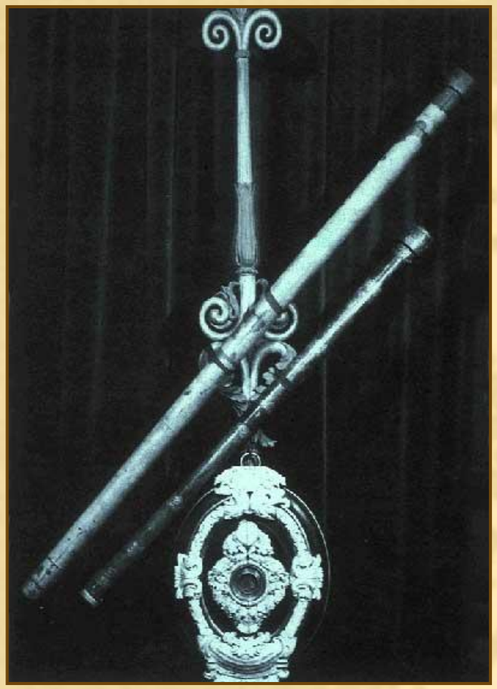
Galileo Galilei (1564 - 1642)



Despite the notable efforts of his contemporaries, the Italian Galileo Galilei is widely regarded as one of the founders of modern astronomy. His concise observations of a range of astronomical objects laid the foundations for centuries of research.

Galileo built his telescope in the summer of 1609. He was the first to publish results based on telescopic observations in March 1610.

On 25 August 1609, Galileo demonstrated his first telescope to Venetian lawmakers. This was the first outreach activity with a telescope.



Galilean telescope .

Images: Wikipedia & The Galileo Project

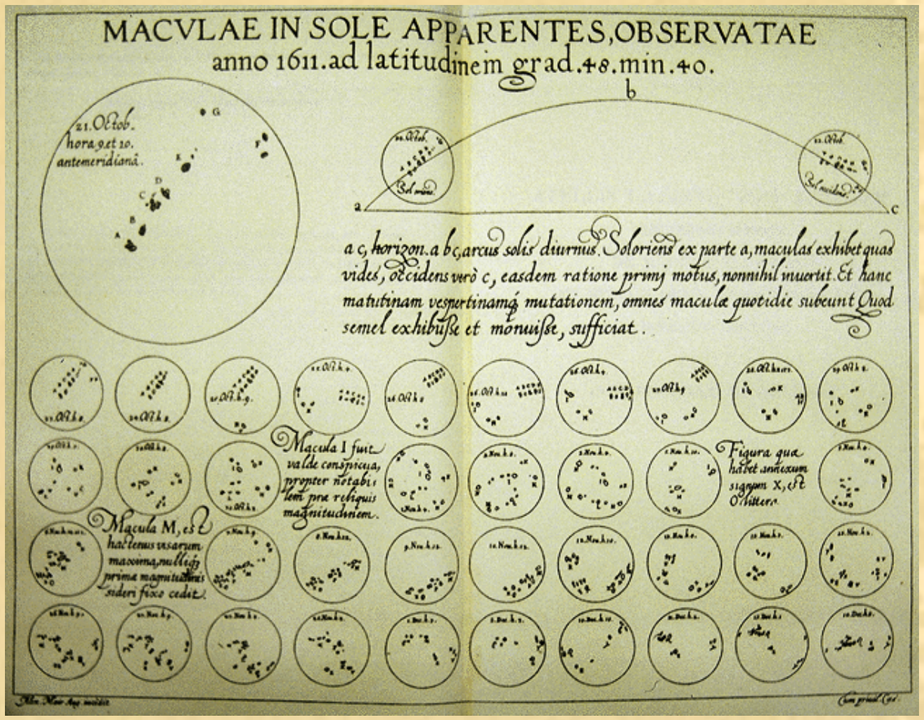
The first observations: the Sun

In 1610, the Sun became the centre of attention.

Harriot, Galileo, Christoph Scheiner, and Johannes Fabricius found dark spots on the Sun.

Some thought that these spots were clouds or close-by satellites, but many astronomers understood that these spots truly belong to the Sun's surface.

The perfection of celestial bodies, advocated by Aristotle, does not reflect reality!



Sunspots drawn by Scheiner day after day.
http://galileo.rice.edu/sci/observations/sunspots.html

The first observations: Jupiter

In January 1610, Galileo (and maybe also Simon Marius) observed Jupiter with a refractor enlarging 20 times. Three faint stars appeared close to the planet.

Night after night, Galileo continued his observations and saw that there were in fact four “stars” following Jupiter throughout the sky.

This meant that they are not stars, but satellites! The discovery was a true revolution. Indeed, in Aristotle’s physics there was only one centre for all motions: the Earth. However, these four satellites do not revolve around our planet.

Again, it seemed that the ancient Greek theories must be revised.

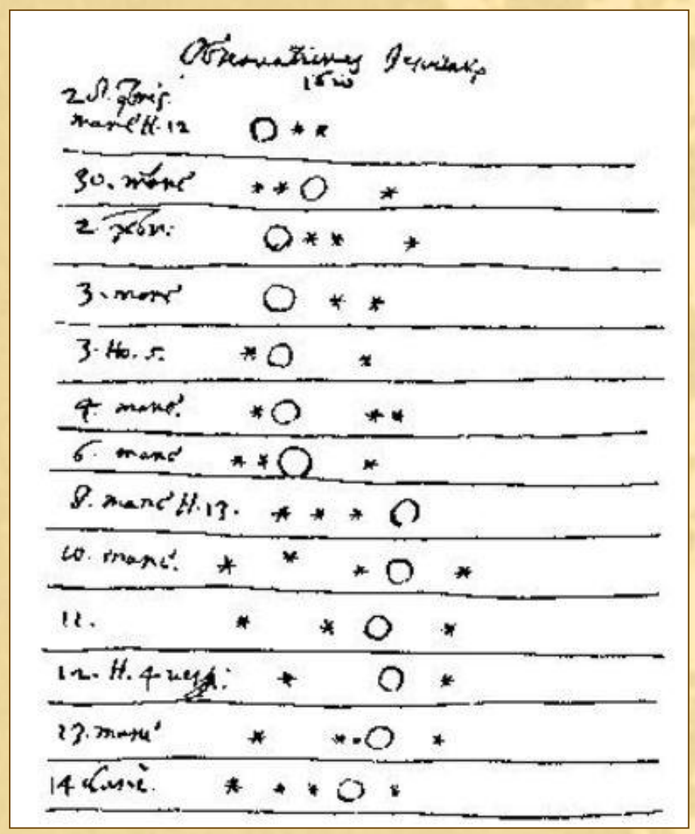


Image: Galileo Project

The first observations: Venus and Saturn

Venus was also observed in 1610. Phases were soon discovered and although Greek models predicted phases, the exact change in shape can only be explained if Venus revolves around the Sun. With the four Jovian satellites, this makes at least 5 celestial bodies not orbiting the Earth!

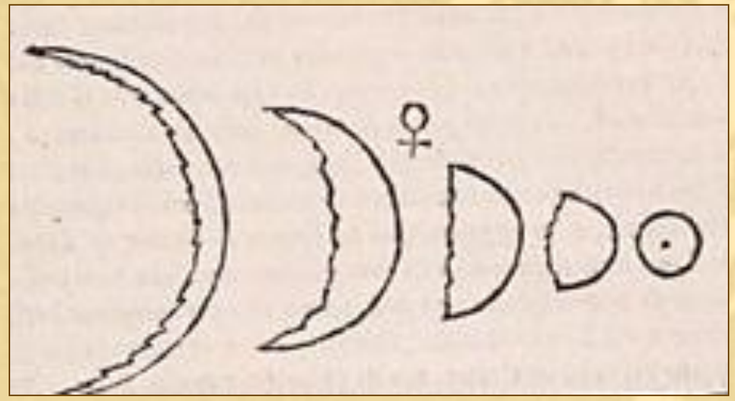
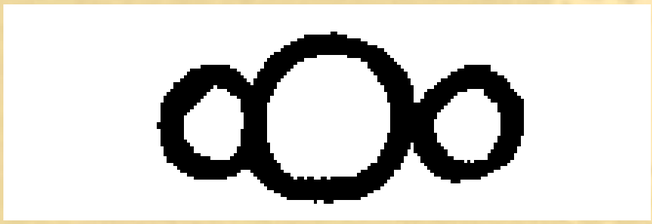


Image: Il Saggiatore (1613)

Saturn displayed a peculiar shape in these primitive telescopes, a shape described by Galileo three-fold, or oOo. In addition, this shape evolves over the years. This remained a mystery until 1659, when Christiaan Huygens explained the phenomenon with the presence of a ring surrounding the planet.



Reflecting telescopes come onto the scene

Glass is not the only thing with peculiar properties. The story goes that Archimedes used mirrors to set enemy ships on fire.

Instead of combining lenses, mirrors can be used. The first experiments were probably tried in the 16th century by Leonard Digges and his friends. Some historians used the nickname “Elizabethan telescope”.

In the 17th century, Nicolas Zucchi, Marin Mersenne, James Gregory, and Laurent Cassegrain imagined various possibilities of reflectors.

Finally, Isaac Newton built the first reflector in 1668.

Newton’s telescope.

http://amazing-space.stsci.edu/resources/explorations/groundup/lesson/scopes/newton/scope.php

Timeline of the birth of the telescope

The first eyeglasses are made by a lay person in Pisa, Italy

c. 1286

Hans Lipperhey approaches the government of the Netherlands with a patent for the telescope

Images: Wikipedia

1608

Images: Wikipedia

Detail of portrait of Hugh de Provence, 1352

c. 1350

Spectacles invented and glass lenses developed

Timeline of the birth of the telescope

1609

First half of 1609

Telescopes could be bought in spectacle shops in Paris, Milano, Napoli,…

July

Thomas Harriot observed the Moon through a telescope

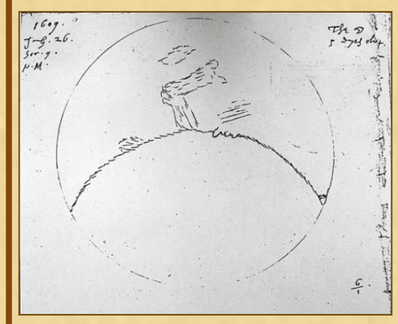


Image: Galileo Project

August

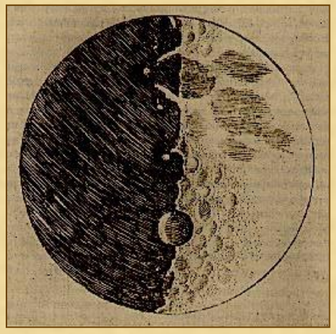
Galileo demonstrated his first telescope to Venetian lawmakers

Image: Universe Review

1610

September – October (?)

Galileo turns his telescope to the Moon



January

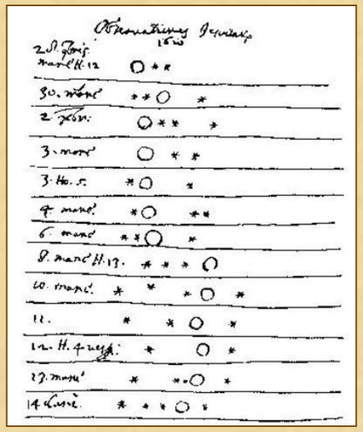


Image: Galileo Project

Galileo turns his telescope to the sky to see Jupiter's moons

1611

September

The phases of Venus observed by Galileo and others

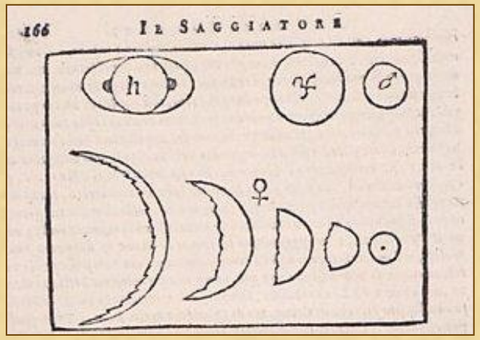


Image: Il Saggiatore (1613)

Johannes Kepler describes the optics of lenses, including a new kind of astronomical telescope with two convex lenses (the "Keplerian" telescope)

Bibliography

In French :

Danjon A., Couder A., Lunettes & télescopes, 1979, Librairie Scientifique et Technique A. Blanchard

Nazé Y., Histoire du télescope – la contemplation de l'Univers des premiers instruments aux actuelles machines célestes, 2009, Vuibert

In English :

Chapman A., A new perceived reality – Thomas Harriot's Moon maps, Astronomy & Geophysics, vol 50, p1.27 (2009)

King H.C., History of telescope, 1955, Sky Publishing Corp.

Ronan C.A., The origins of the reflecting telescope, Journal of the British Astronomical Association, vol 101, p335 (1991)

Rosen E., Did Roger Bacon invent eyeglasses ?, Archives Internationales d'Histoire des Sciences, vol 26, p 3 (1954)

Rosen E., Did Galileo claim he invented the telescope ?, Proceedings of the American Philosophical Society, vol 98, p304 (1954)

Rosen E., The invention of eyeglasses, Journal of the History of Medicine, vol 11, p13 & p183 (1956)

Rosen E., The naming of the telescope, http://homepages.tscnet.com/omard1/jportat3b.html

Van Helden A., The invention of the telescope, Transactions of the American Philosophical Society, vol 67, #4 (1977)

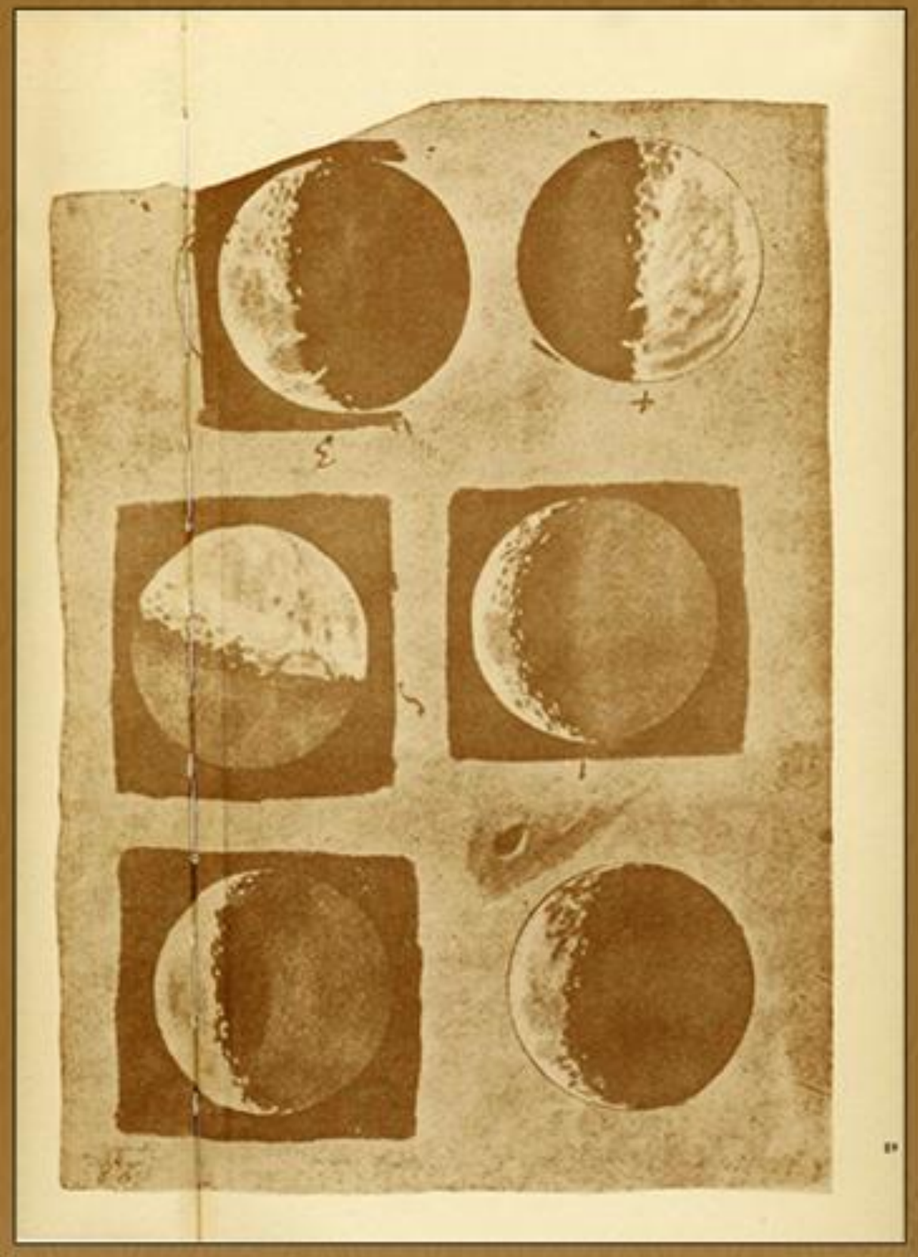
Wilson R., Reflecting Telescope Optics I & II, 1996 & 1999, Springer

Websites:

Telescopes from the Ground Up : http://amazing-space.stsci.edu/resources/explorations/groundup/

AIP hystory of Cosmology : http://www.aip.org/history/cosmology/

Galileo project : http://galileo.rice.edu/



www.astronomy2009.org

IYA2009 Secretariat
ESO education and Public Outreach Department
Karl-Schwarzschild-Strasse 2
D-85748 Garching bei München
Germany

Contact:
Pedro Russo
prusso@eso.org
p. +49 (0) 89 320 06 195

Global Sponsors

Organisational Associates