

THE SKY THIS MONTH

NOVEMBER 2009

GALILEO GALILEI'S LEGACY

You have definitely heard of the great astronomer and scientist named Galileo, but have you heard of what he really did for the science of astronomy?



Figure 1: A portrait of Galileo Galilei in crayon drawn by Ottavio Leoni in 1624. Image courtesy of Wikipedia.

Galileo di Vincenzo Bonaiuti de' Galilei was born in Pisa, Italy on February 15, 1564. In his early life, he contemplated becoming a priest and studied medicine, but it was mathematics that finally caught his eye.

In 1589, he was appointed to the chair of mathematics at Pisa. In 1592, he began teaching geometry, mechanics and astronomy and continued to do so until 1610.

The invention that would truly define his legacy came in 1608, when a Dutch lens maker, Hans Lippershey, invented the first practical telescope using two lenses placed within a tube. Galileo is often mistakenly given the credit for inventing the telescope, but it is what he did with the new invention that made him a legend of astronomy.

The telescope was originally used for terrestrial use, mainly for spotting ships miles away from shore. Galileo decided to point the new invention at the sky to discover what he could see.

What he saw would not be boring. He saw dark spots on the Sun, bumps and curves on the Moon, Venus apparently changing its shape, many more stars than could be seen with the eye alone and, most importantly, objects that seemed to orbit Jupiter (instead of the Earth).

Galileo also saw what he thought were "moons" or "ears" on either side of the planet Saturn. Although he did not know it at the time, he actually discovered Saturn's rings.

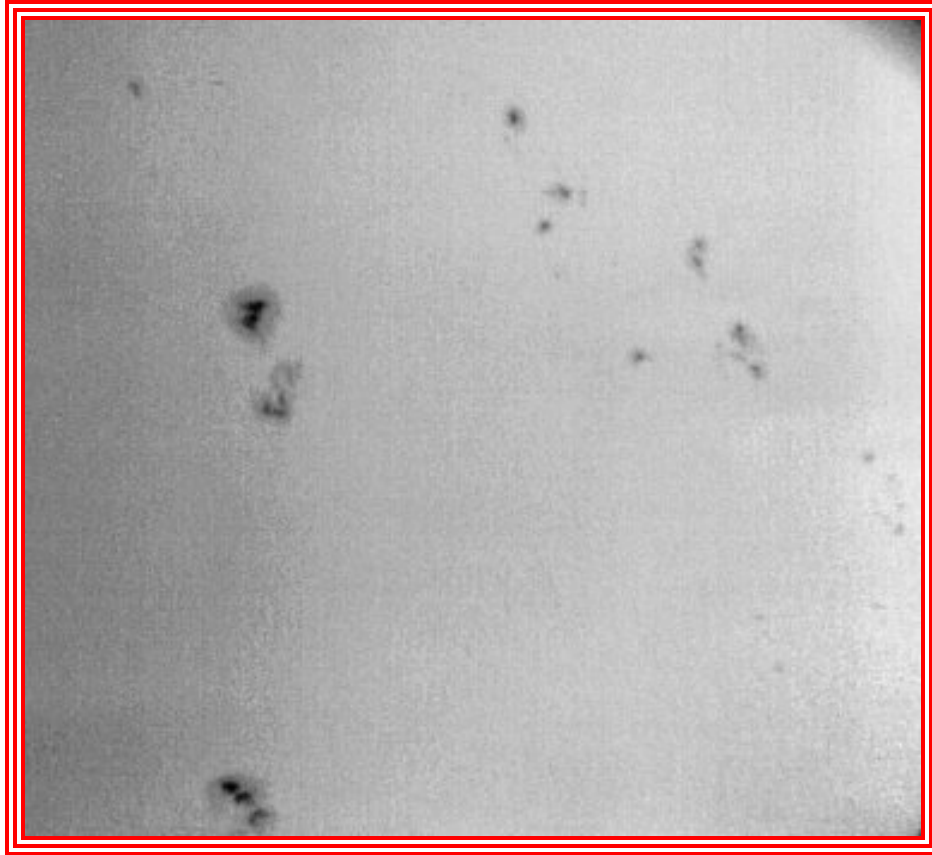


Figure 2: Galileo was the first to see the sunspots; areas of the Sun that are up to 1000 degrees colder than their surroundings. He used the apparent motion of the sunspots to determine our Sun's rotation period, which is on average 27 days. Image by the author.



Figure 3: Galileo was the first to see our Moon as it truly appeared: full of mountains, valleys and craters. Up to that time, the Moon was believed to have been perfectly smooth. Images by the author.



Figure 4: Galileo was the first to view Venus' phases. Images by the author.

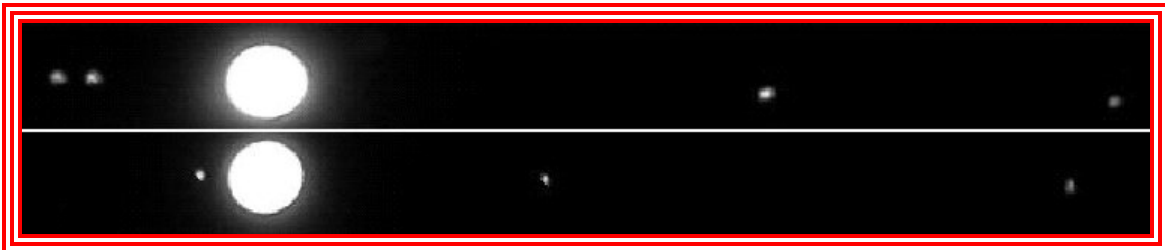


Figure 5: Galileo was the first to view four moons orbiting Jupiter. He noted the positions of the four objects for months at a time. Images by the author.

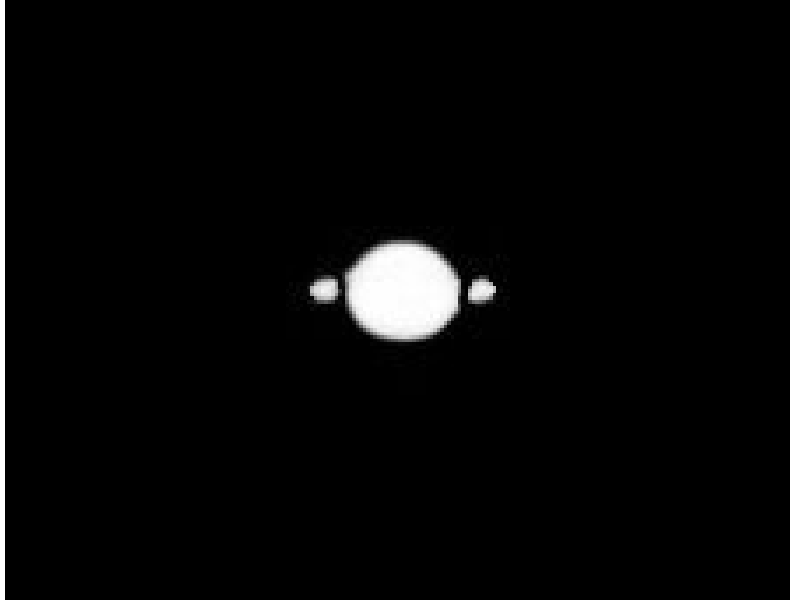


Figure 6: Without the luxury of a large aperture and excellent resolution, Saturn's rings would look something like this. Is this what Galileo saw when he first looked at Saturn through his new telescope? Image by the author.

On January 7, 1610, he first observed three of the four largest moons of Jupiter, which he named Io, Europa and Callisto at the request of his friend: the great German astronomer Johannes Kepler. Several days later, on January 13, 1610, he discovered the fourth, which he named Ganymede.

Galileo then made a startling discovery. He suddenly realized that these four objects were not orbiting Earth, but orbiting Jupiter instead! What he was observing was literally contradicting the beliefs of his time: that the Earth was at the center of the universe and that everything orbited the Earth. Over the next 18 months he would determine the individual periods of each of the moons' orbits.

In 1632, Galileo published his observations of the heavens in a book called "Dialogue Concerning the Two Chief World Systems". This book centered chiefly on the discussion between the Earth-centered (geocentric) solar system and the Sun-centered (heliocentric) solar system. Although the book was given formal authorization by the powers of the day (the Inquisition and the Roman Catholic Pope), his ideas began to spark much controversy.

Galileo was ordered to appear before the Inquisition in Rome in 1633 on the suspicion of heresy. He was specifically charged with having the opinion that the Sun was at the center of the known universe and not the Earth. He was found guilty of being "suspect of heresy" for holding and publishing an opinion contrary to Holy Scripture. Galileo was forced to abjure (recant) all statements he had made concerning the heliocentric universe. Although originally sentenced to

imprisonment, Galileo was placed under house arrest where he remained until his death on January 8, 1642, nearly 32 years to the day when he first observed Jupiter's moons.

Galileo's publications were subsequently banned by the Inquisition until 1718. From 1718 to 1835, the church increasingly allowed reprinting of his works (with some editing included), along with Nicolas Copernicus' heliocentric theories.

Finally, on October 31, 1992, Pope John Paul II exonerated Galileo and expressed regret at how the Inquisition had judged him and his published works. In December 2008, nearly 400 years after Galileo first spotted Jupiter's moons, Pope Benedict XVI praised Galileo for his contributions to both astronomy and science.

Today, the moons of Jupiter are called the Galilean satellites in honour of the man who first spotted them through a small telescope that magnified at a power of only 22x. The International Year of Astronomy (IYA) is a celebration of Galileo's achievements and all achievements in astronomy for the past 400 years.

You can see all four moons of Jupiter just as Galileo did in the 17th century! All you need are steadily held binoculars or a small telescope. Jupiter can easily be spotted in November as a bright white "star" occupying the southern sky just after sunset. All you need to do is point your magnifying device of choice to it and spot the dimmer "stars" nearby. From day to day you should be able to see these objects change position as they orbit the planet.

The IYA should also have an underlying message that is equally important. Galileo was originally doubted and scorned by the authorities of his day for observing and sharing real evidence that the "heliocentric universe", as they called it, was indeed a reality. The IYA should remind us all of the dangers of allowing positions of authority to repress new ideas, whether in science or in any discipline. Today, new discoveries and theories based on real observation are being offered every day, however, there are still those who wish to discredit real evidence as fantasy in order to force their own beliefs on others. Galileo's experiences with the Inquisition should be a warning to everyone that this can still happen in the 21st century just as easily as it did in the 17th.

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