

Posted on Thu, Apr 2, 2009

Galileo's telescope, here in Philadelphia

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When NASA launched a new space telescope called Kepler this year, mankind took another step in a quest that started 400 years ago with two eyeglass lenses and a piece of lead pipe.

It was in 1609 that mathematician professor Galileo Galilei pointed his homemade telescope skyward and saw what looked like mountains on the moon and other wonders no one had imagined.

His instrument - marginally more powerful than a cheap pair of modern binoculars - enabled him to shatter cosmological dogma as he carefully catalogued the phases of Venus, the moons of Jupiter, and the stars of the Milky Way.

Starting Saturday, visitors to the Franklin Institute in Philadelphia can see one of two surviving original telescopes that allowed Galileo to open the heavens to science - and ultimately led to his house arrest for heresy.

Galileo's revolution continues today, as ever more powerful telescopes keep demoting Earth farther from the center of all creation. The Kepler telescope promises to show whether the universe is sprinkled with other earths.

Historians say Galileo was particularly worried about rivals, especially the formidable astronomer Johannes Kepler, for whom the new NASA telescope is named.

Galileo feared Kepler would get his hands on a telescope and beat him to the cosmic discoveries that awaited. But Kepler apparently lacked Galileo's gift for building instruments.

It was in the summer of 1609 that Galileo, then teaching at the University of Padua, heard about a new magnifying invention that used two lenses and a tube.

These early telescopes magnified by only a factor of three, said Owen Gingerich, a Harvard historian of science. Galileo didn't wait to acquire one. With the concept in his head, he started building much better ones, gradually working from about six power magnification to 20.

"Galileo turned what was essentially a carnival toy into a serious scientific instrument," Gingerich said.

He worked fast, and by fall he had a telescope with enough power to resolve topography on the moon - what we now know as craters.

Back in the early 17th century, respectable, educated Europeans were taught that Earth was the center of the universe, and that the stars, planets, moon, and sun were perfectly spherical and made of a heavenly substance called ether. They rotated around Earth on crystalline shells, according to the book *Galileo's New Universe*.

The more Galileo saw, the more strongly he argued for a cosmos in which Earth and other planets moved around the sun, with the stars much farther away. It was a view that had been suggested more than 50 years earlier in a book by the astronomer Nicholas Copernicus.

It was not just religious dogma that kept the idea from wide acceptance. It was also common intuition, said Gingerich. Earth certainly didn't feel as if it were moving. And people argued that there was no plausible way for the moon to ride around the sun along with the planet.

But Galileo showed that other planets could have their own satellites when he discovered Jupiter's moons and carefully logged their orbits.

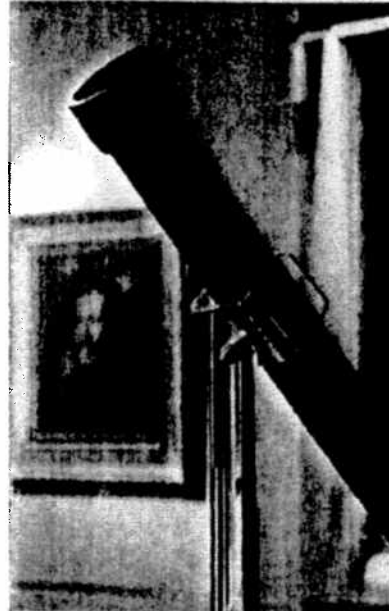
If Jupiter could move through the heavens with four moons in tow, he argued, Earth could move with its one.

Galileo also made a case that the stars were much farther away than the planets - and that they were self-illuminating rather than reflecting sunlight.

No one knows what Galileo thought about the prospect of other inhabited worlds. His silence on that issue may be related to the death of philosopher and teacher Giordano Bruno, who was burned at the stake in 1600 for heresy.

Bruno speculated that the universe was populated by infinite worlds circling infinite suns. (He made many other inflammatory remarks such as the claim that Jesus was not divine but simply a good magician.)

While his visionary picture of the universe wasn't the central reason for Bruno's execution, Gingerich said, people didn't talk too loudly about other worlds for some years.



LISA GODFREY

The Galileo telescope on display. Galileo turned what was essentially a carnival toy into a serious scientific instrument, a Harvard historian said.

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