November 2014

Galileo: 'Sidereus Nuncius (Starry Messenger)'

Reflections on the various works in the exhibit

Imprints and Impressions: Milestones in Human Progress

Highlights from the Rose Rare Book Collection, Sept. 29-Nov. 9, 2014
Roesch Library, University of Dayton

Galileo Galilei
Sidereus Nuncius (Starry Messenger)

- 1610
- One of only two known copies of earliest issue of the first edition

Reflection 1

One of the most remarkable events that can occur in a scientist's life is to be the first person in history to literally see the natural world in a completely new way. In the early seventeenth century, the invention of the microscope and telescope opened the microcosmos and the heavens to human discovery. The principles of optics needed to explain how these instruments worked were as yet poorly understood (and waiting in part for Newton's *Opticks).* However, it quickly became clear that for the first time in history, aids to human vision had been found that went beyond correcting the blurry eyesight of a monk copying manuscripts and truly opened up new aspects of the world.

Galileo was the first to systematically train the newly obtained telescope on the sky. Therefore, by definition, everything he saw and recorded was a new discovery (and worthy of rapid publication, to put it in the language of modern-day academics).

First, Galileo could look at the moon and realize that the details just out of range of bare human vision are definitely described as craters (blemishes) on the face of the moon—one of those supposedly perfect heavenly bodies. Furthermore, Galileo could make out signs of mountains on the moon, making it seem very much earth-like.

He then turned his telescope on the Milky Way, a fuzzy band of light in the sky. He quickly discerned that the Milky Way was no more than a huge collection of individual stars, too faint and close together to be resolved by the naked eye. He also examined the Pleiades, a small group of six or seven stars in the constellation of Taurus and at the sword and belt of Orion. In each case, he also found that there were many more stars visible with the telescope than could be seen without.

Most spectacular of all came over the course of eight weeks in early 1610 during which Galileo recorded the graceful dance of four spots of light about the planet Jupiter. To a scientist, a set of observations

such as these is most exciting. Putting ourselves in his place, we can think about the first night's observation: "I noticed … that three little stars, small but very bright, were near the planet; and although I believed them to belong to the number of the fixed stars, yet they made me somewhat wonder, because they seemed to be arranged exactly in a straight line." A telescope will always reveal more stars than the naked eye, so that first night might not have been too surprising. However, the next night, "When I turned again to look at the same part of the heavens, I found a very different state of things, for there were three little stars all west of Jupiter and nearer together than on the previous night."

According to his narrative, Galileo viewed only two accompanying stars for the few nights he continued the observations, but within a week, he had figured out that there were four bodies in total and that they were orbiting about Jupiter.

Galileo himself points out at the very end of the *Sidereus Nuncius* the importance of his observations of the "four Medicean planets, recently discovered for the first time by me." The quote serves as its own clear explanation: "Besides, we have a notable and splendid argument to remove the scruples of those who can tolerate the revolution of the planets round the Sun in the Copernican system, yet are so disturbed by the motion of one Moon about the Earth … that they consider that this theory of the constitution of the universe must be upset as impossible; for now … our sense of sight presents to us four stars circling about Jupiter, like the Moon about the Earth."

—Robert Brecha, PhD, Professor, Physics

Reflection 2

The traditional translation of the title *Sidereus Nuncius* is "Starry Messenger." However, there is some controversy surrounding this interpretation. Allegations of hubris surfaced saying this title implied that Galileo considered himself a messenger of heaven. In response to this criticism, Galileo observed that "nuncius" could also be translated as "message." He insisted that this less arrogant sense of the term was the meaning he had intended. This book is a revolutionary contribution to astronomy and physics. It was arguably the first written work that resulted from the use of a telescope in the observation of astronomical phenomena. Galileo's observations and arguments in *Sidereus Nuncius* were instrumental in disproving important aspects of the dominant physics of the time. This copy, published by Tommaso Baglioni, contains woodcut diagrams, three star maps, and ornamentation.

In 1610, Western physics was dominated by a revised variation of Aristotelian thinking. Among other features, this paradigm held a geocentric view of the universe. In response to problems including the inability to explain retrograde motion of certain planets, Ptolemy had offered certain amendments in his *Almagest*. These

corrections appeared to satisfy mainstream practitioners of natural philosophy for more than 1,400 years. By the sixteenth century, other thinkers were beginning to offer alternative models for the universe and the solar system. In 1543, Copernicus argued for a heliocentric solar system in *De Revolutionibus.* In 1609, Kepler had offered an upgraded variation of this model that replaced Copernicus's circular orbits with elliptical orbits. Yet Kepler's *Astronomia Nova* was not widely read until much later. When Galileo embarked on his observations that would yield*Sidereus Nuncius,* he was not familiar with Kepler's contribution.

Galileo's observations and arguments were made possible and circulated by his use of cutting-edge technology. The technologies in question were the printing press and the telescope. The printing press allowed for rapid distribution of copies his book. The telescope enabled him to observe distant details of the solar system. He had heard of this new optical device in 1609.

"About ten months ago a report reached my ears that a certain Fleming had constructed a spyglass by means of which visible objects, though very distant from the eye of the observer, were distinctly seen as if nearby."

Galileo was able to reinvent a better version of this instrument.

> "Finally, sparing neither labor nor expense, I succeeded in constructing for myself so excellent an instrument that objects seen by means of it appeared nearly one thousand times larger than and over thirty times closer than when regarded with our natural vision."

Sidereus Nuncius is the earliest known publication utilizing this invention for extraterrestrial observations. Galileo was well aware of the potential uses for this device.

> "It would be superfluous to enumerate the number and importance of the advantages of such an instrument at sea as well as on land. But forsaking terrestrial observations, I turned to celestial ones."

He would later use this technology to build a microscope for the Academy of Lynxes, a group of natural philosophy enthusiasts to which he belonged. This salon was founded by Federico Cesi and included Galileo and Maffeo Barberini. Barberini would become Pope Urban VIII in 1623. Under Urban, Galileo would be accused of heresy. Yet, for years following the publication of *Sidereus Nuncius,* Galileo still enjoyed the support of Barberini and a number of Jesuits.

With his telescope, Galileo was able to turn his attention to the so-called "fixed stars" and the constellations of Orion and Taurus. He was able to resolve an old debate concerning the constitution of the Milky Way. At first he thought that certain objects he observed while viewing Jupiter were "fixed stars." When he viewed them again over time through his "very excellent instrument," he noticed that they appeared in different locations at different times. From

the evidence he gathered, he reasoned that these were moons orbiting Jupiter.

His observations of the moon and his reasoning from these observations were arguably the most shocking elements of the book. He was able to argue that the moon had certain geological features (mountains and valleys) similar to what we observe on Earth. Concerning a large crater, he noted:

> "As to light and shade, it offers the same appearance as would a region like Bohemia if that were enclosed on all sides by very lofty mountains arranged exactly on a circle."

This conclusion was a powerful refutation of the Aristotelian/Ptolemaic paradigm that held the position that the moon and planets were perfectly round spheres orbiting the Earth.

—Bill Marvin, MA, Lecturer, Philosophy

*All quotations in the above reflection are from *The Starry Messenger* in *Discoveries and Opinions of Galileo*, translated by Stillman Drake. First Anchor Books. 1957. Print.

For further reading

The Structure of Scientific Revolutions by Thomas Kuhn. The University of Chicago Press,1962, 1970,1996. Print.

The Lying Stones of Marrakech; Penultimate Reflections in Natural History by Stephen Jay Gould. Harmony Books, 2000. Print.

Eye of the Lynx: Galileo, His Friends and the Beginnings of Modern Natural History by David Freedberg. The University of Chicago Press, 2003.