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Telescopes, Mankind's Eye into the Universe

Telescopes, Their Creation and the many Discoveries Associated with this Tool.

Chanté R. Burch
Karina Gonzalez

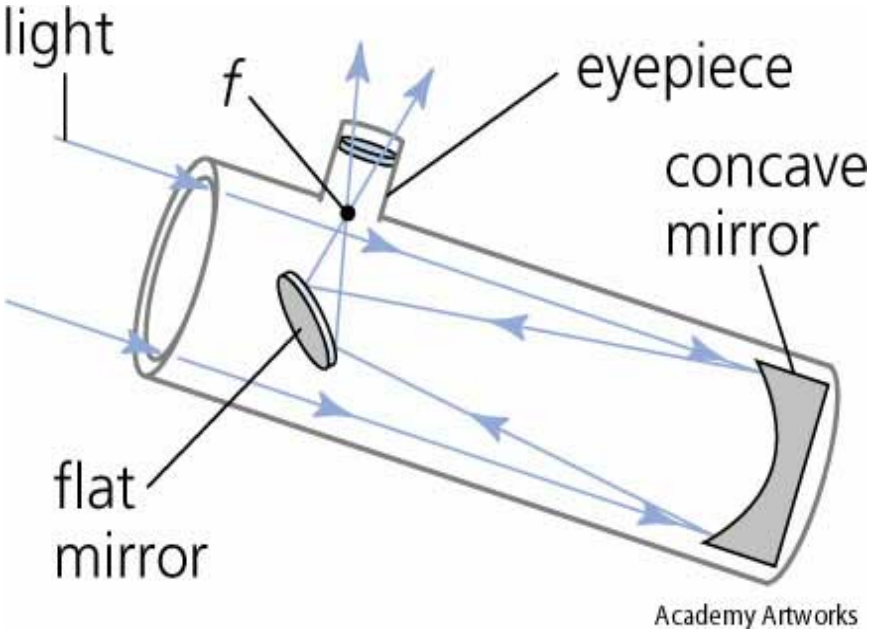
Physics 1010
Salt Lake Community College

Abstract

In 1609 an Italian physicist and astronomer Galileo became the first person to point a telescope skyward. Although that telescope was small and the images fuzzy, Galileo was able to make out mountains and craters on the moon, as well as a ribbon of diffuse light arching across the sky, which would later be identified as our Milky Way galaxy. After Galileo's and, later, Sir Isaac Newton's time, astronomy flourished as a result of larger and more complex telescopes. With advancing technology, astronomers discovered many faint stars and the calculation of stellar distances. In the 19th century, using a new instrument called a spectroscope, astronomers gathered information about the chemical composition and motions of celestial objects.

Introduction

Telescopes have been the center of thousands of great discoveries from the moment mankind gazed through one and they are still making discoveries hundreds of years later. Telescopes have varies ways of being made but they all have the same components which we will be referring to several times during the paper. All telescopes have an objective and an eyepiece. The symbol for the diameter of the objective is the symbol for the exits pupil (where the light leaves the eyepiece. Both the eyepiece and the objective have focal lengths that correspond with them.



Telescopes an optical instrument designed to make distant objects appear nearer, containing an arrangement of lenses, or of curved mirrors and lenses, by which rays of light are collected and focused and as a result this tool lets mankind look beyond earth into the heavens. Therefore telescopes have given us a new understanding of our place in the universe and continue to show us new exciting

discoveries.

The History of the Telescope

The early development of lenses based on Reckoner, Archimedes (d. 212 BCE), discusses how to express very large numbers, the number system in use at that time could express number up to a myriad. As an example he chooses the question as to how many grains of sand there are in the cosmos. The use of telescopes demonstrated that ordinary observes could see things that Greek philosophers had not dream of.

In order to make the problem more difficult, he chooses not the geocentric cosmos generally accepted at the time, which would have to be many times larger because of the lack of observable stellar parallax. We know, therefore, that already in Hellenistic times thinkers were at least toying with this notion, and because of its mention in Archimedes's book Aristarchus's speculation was well-known in Europe beginning in the High Middle Ages but not seriously entertained until Copernicus.

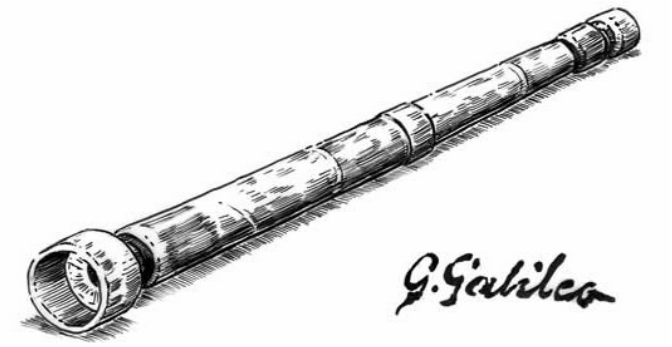
Hans Lippershey

Lippershey on October 2nd 1608 applied for a patent for his first instrument for the looking distance, his instrument consisted of a tube having two lenses at its end. This instrument delivered side and exact pictures, but only delivered a small field of vision at medium enlargements. The telescope became one of the most important scientific instruments of the 17th century. In 1609 Galileo Galilei built a telescope like the one Lipershey had constructed and as generally know he drew a lot of attention with it.

One story relating to the development of the telescope involves Lippershey noticing two children playing with lenses in his shop. The children observed that when they looked through two lenses, a weather vane on a nearby church appeared to be larger and cleaner. According to the story, Lippershey tried it himself and realized the amazing possibilities. He then place a tube between the lenses to make a telescope.

Lippershey's telescope enable to make several observations which finally led to the result that the earth turns round the sun and is not fixed center of the universe.

Galileo



Have you ever been curious about Galileo's Telescope? Where did the idea come from and how did Galileo improve it? What did Galileo see with his telescope? What was it called and how did it work?

In the late summer of 1608, a new invention was all the rage in Europe the spyglass. These low power telescopes were probably made by almost all advanced opticians and the very first was credited to Hans Lippershey of Holland. These primitive telescopes only magnified the view a few times over. Much like our modern times, the manufacturers were quickly trying to corner the market with their invention, but Galileo Galileo's friends convinced his own government to wait because he thought that he could improve the design. When Galileo heard of this new optical instrument he set about engineering and making improved versions, with higher magnification. Galileo's telescope was similar to how a pair of opera glasses work a simple arrangement of glass lenses to magnify objects. His first versions only improved the view to

eighth power, but Galileo's telescope steadily improved. Within a few years, he began grinding his own lenses and changing his arrays. Galileo's telescope was now capable of magnifying about 10 times more than normal vision and but it had a very narrow field of view. However this limited ability didn't stop the Galileo telescope.

What Galileo saw with his telescope one fine fall evening, Galileo pointed his telescope towards the one thing that people thought was perfectly smooth and as polished as a gemstone the Moon. Imagine his surprise to find it "uneven, rough, full of cavities and prominences." Galileo's telescope had its flaws, such as a narrow field of view that could only show about one quarter of the lunar disk without repositioning, but a revolution had begun. Months passed, and Galileo's telescope improved. On January 7, 1610, he turned his new 30 power telescope towards Jupiter, and found three small, bright stars near the planet. One was off to the west, the other two were to the east, all three in a straight line. The following evening, Galileo once again took a look at Jupiter, and found that all three of the "stars" were now west of the planet still in a straight line.

There were more discoveries awaiting Galileo's telescope such as the appearance of bumps next to the planet Saturn (the edges of Saturn's rings). Just like any modern scientist, Galileo Galilei published his findings in 1610 in a small book titled The Starry Messenger." No, he wasn't the first to point a telescope towards the heavens, but Galileo was the first to do it methodically, and this means Galileo had no diagrams to work from, but used only his own system of trial and error for lens placement.

Newton

Newton was a busy man. He was the first to identify and begin to understand gravity. He discovered that white light is made up of colors, and he was among the first to formulate the mathematical discipline of calculus. And in 1668 in England, he created a small but powerful telescope that didn't suffer from chromatic aberration. Astronomers had struggled for years with chromatic aberration, which is also know as "color fringing" or "purple fringing" is a type of distortion in which there is a failure of a lens to focus all colors to the same converge point or the fringes of color that surrounded bright objects seen through a glass lens.

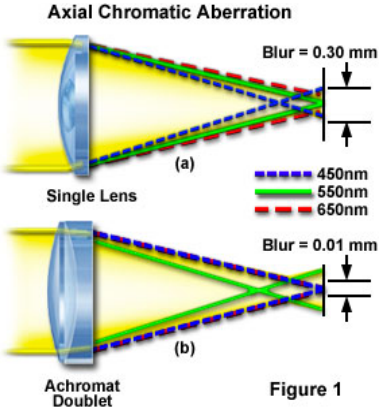


Figure 1

As light passes through a lens, it breaks up into various colors because the glass bends the colors by different amounts. Newton's solution was simple: He took the lens out of the telescope. Newton replaced the primary lens with a polished, rounded, metal mirror. He experimented with different mixtures of metal and decided on one that was six parts copper to two parts tin. It was almost as bright as expensive, quick-to-corrode silver and would reflect a lot of light.

The more light the mirror reflected, the better view the telescope would provide of the sky. The light rays no longer passed through glass, so bright images were no longer surrounded by a colorful halo. Unfortunately, Newton couldn't eliminate another common problem: spherical aberration, or the blurry view caused by the spherical shape of his primary mirror. To keep his head from getting in the way of the reflected light. Newton added an extra mirror, the second mirror that bounced the light out the side of the telescope, into the eyepiece.

Newton made two reflecting telescopes, but neither was used much. Their purpose was more to prove his ideas about telescopes than to view the sky. Although other scientists would have to improve Newton's design before these types of telescopes became popular, today we still call them Newtonian reflectors, after their creator.

Newton explained the workings of the universe through mathematics. He formulated laws of motion and gravitation. These laws are math formulas that explain how objects move when a

force acts on them. Isaac Newton explained three basic laws that govern the way objects move. He then described his idea, or theory, about gravity. Gravity is the force that causes things to fall down. If a pencil falls off a desk, it will land on the floor, not the ceiling. In his book Isaac also used his laws to show that the planets revolve around the suns in orbits that are oval, not round. Newton used three laws to explain the way objects move. They are often call Newton's Laws.

How Telescopes Work

In the simplest terms a telescope magnifies far away objects by gathering light at a point. This gives the illusion that the source of the light is closer than it actually is. There is a few ways this can been done. A refracting telescope uses to convex lenses. These lenses have sides that bend with an outward curve. The first is a larger lens, the objective and the second is a smaller lens, the eyepiece. The telescope works by gathering light through the objective and bending to the focal point (the focus). The light then goes through the eyepiece bending it again so the eye can see a clear image.

A reflecting telescope works much the same way as the refracting telescope. The reflecting telescope uses mirrors instead of lenses. The larger mirror is still the objective, the smaller mirror is called the secondary mirror and there is a lens as the eyepiece. In this telescope the objective is located at the back of the telescope rather than at the front. Light enters the telescope, hits the objective focusing the light and reflects back to then hit the secondary mirror, which then bends the light to a focus. The focused light then goes through the eyepiece just as in the refracting telescope.

The smaller the objective, the longer the telescope and the grater the magnification. This is shown by the equation for magnification. The equation for magnification is M = fO/ fe. If the fo is 30 times longer than fe the magnification equals 30. Which means whatever you are viewing with the telescope appears 30 times as big.
Telescopes also have the capability to record data in more than just visible light. Telescope are now built with lenses to view x-rays or inferred radiation. This allows us to see things that are hidden from view by the lack of visible light.

Telescopes Today

When looking at the incredible images that appear every month from the Hubble Space telescope, it takes genuine creative genius to invent a tool where none existed before. We sometimes forget the history of telescope and how much technology has improved.

The Hubble was behind schedule and over budget when it was launched in 1990. The entire project was the combination of many smaller projects that fit neatly together for a sucessul launch. However, after it was in orbit they found a catastrophic mistake. The Hubble Telescope was out of focus. A tiny miscalculation during the critical grinding of the main mirror caused a minor imperfection. Even though it was miniscule, it was enough to not make the mirror focus properly. Billions of dollars and decades of work seemed to be all for naught. It required new ingenuity, and patience.

In his exciting and human book, "The Universe in a Mirror: The Saga of the Hubble Telescope and the Visionaries Who Built It," Robert Zimmerman gives us the story behind the press releases and received wisdom about Hubble. We learn about the dreamers who first imagined an orbiting telescope and the scientists and government bureaucrats who helped build it and nearly killed it. It is an exciting to know about the history of telescope and a must-read for space enthusiasts.

If any one man can be credited as the father of the Hubble, it would most likely be astronomer Lyman Spitzer. He was a moving force in American astronomy for decades and was one of the first to propose a space telescope. Like those of many innovators, his ideas faced scorn and

ridicule for years before the technical aspects were worked out. But he dreamed big, and the stunning images that we see nearly every week are a direct result. But imagine a world before the modern computer chip, before the Internet, before DVDs, and you begin to understand the technological challenges these scientists were up against.

The reason why so many people were so excited, if skeptical, about the idea of an orbiting telescope is that the Earth's atmosphere produces turbulence that's what makes stars "twinkle." It looks great, but if you are trying to take very detailed pictures of something very far away, this atmospheric disturbance is a big problem. If you get above the atmosphere, the problem is solved. Which is why so many devoted their lives to this project, and we finally get to learn some of their names and stories. As interesting as the scientific and technical challenges are, to read about the human drama of these outsized personalities is what truly brings this story to life. Hubble was close to death several times as the NASA budget ax swung. But dedicated administrators and scientists managed to save it each time.

No story about Hubble would be complete without the famous mirror story. As the large main mirror of the space telescope was being ground, a minute measuring error meant that the mirror was not perfectly shaped so the light it reflected was slightly off, in layman's terms. This was not discovered until the telescope was hundreds of miles above Earth. The story of this wonderful tool is that Hubble faces toward space. It takes pictures of planets, stars, galaxies that are billions of light years away. Hubble has also seen comet pieces crash into the atmosphere above Jupiter.

Hubble is named after an astronomer. His name was Edwin P. Hubble who made important discoveries in the early 1990s. He found many galaxies in the universe, and helped scientist understand how planets and galaxies form.

Discoveries

Around the time telescopes where invented people believed in the geocentric model of the universe. This was a model that put earth in the center of the solar system and everything else in orbit around it. Then Galileo took a look through one of his telescopes. He discovered that Venus would go from crescent to full and back just as the moon did with earth. This was an amazing discovery to prove the fact that our solar system was not geocentric but was in fact heliocentric. The planets orbit the sun. Another discovery to further prove this fact as was mentioned above was Jupiter’s moons. These points of light as Galileo saw them where orbiting Jupiter instead of earth which but doubt in the geocentric model.

In 1929 Edwin Hubble worked as an astronomer in an observatory on Mount Wilson. Here he did work on measuring galaxies. He also made some discoveries that where based off of an astromer’s earlier work, Vesto Slipher. Vestor knew that elements would give off certain light patters. These pattern depending on the direction the elements where moving would be shifted to the red spectrum or the blue spectrum. Edwin used this knowledge to discover that the red shift of the galaxies in the universe was directly proportional to their distance from earth. This showed that the further away a galaxy was from earth the faster it was moving away.

Telescopes are responsible for the discovery of thousands of objects including: exoplanets (planets not in our solar system), Neutron stars and black holes. It has been the tool that has let us discover the universe in which we live.

The Future

Because it happened so long ago we often think of the moon landing to me dull, when in fact it was a great achievement in the advancement of our space technology. Having actual humans on the moon gave much more insight on it then just looking at it could tell us. This is also true for Mars. The achievement of the mars rover is also over looked. We have been able to learn much

more through pictures and samples on the planet's surface then by viewing it from a telescope. As remarkable the Telescope has been for science it has some obvious setbacks. Telescopes can only see so far. There are still things beyond what we see. As technology advices the Telescope may become obsolete. We have put humans on the moon and rovers on mars. We are even in the process sending humans too mars. Who's to say we will not be able to send humans all across our galaxy and into the universe?

Conclusion

Telescopes will forever have their mark in the scientific community even if their technology becomes obsolete. With their rich history and simple design they have become mankind's eye to view into to the universe and help us little by little discover the universe around us.

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