From galileo to hubble philosophy essay

The 16th century provided the world with scholars such as Galileo, Kepler, Copernicus, and Lagrange, all of whom helped to advance the scientific phenomenon of space exploration through telescopes with the results of their many experiments. Although over 500 years have passed since these scholars walked the Earth, their discoveries and inventions are still very much used today, and will continue to be used well into the future. From Galileo to Hubble is a great leap in technological advancement. If it were not for Galileo, society would not have today’s level of technology used in space exploration. Everything NASA foresees for future projects is always influenced by past research up to four centuries ago. How the does the discoveries from the 16th century influence tomorrow’s telescopes?

Galileo was not the first person to question whether the Earth was truly at the center of the universe. Nicholas Copernicus first wrote about his theory that the sun was the center of the universe in his book, De Revolutionibus Orbium Coelestium (“ On the Revolutions of the Celestial Orbs”). However, the book was written simply as a hypothetical mathematical problem. Copernicus’s theory proposed that the sun was at the center of the universe and the Earth revolved around it. Copernicus did not continue to explore his theory because, it is speculated, he was distracted by trying to follow Aristotle’s requirement for the law of motion. This law of motion was considered the uniform circular motion of all celestial bodies, which led Copernicus to believe that his theory could only be proven if he went from a geocentric model to a heliocentric model. Galileo then took the Copernican theory and explored it as being the truth. Galileo’s ideas that Earth was not the center of the universe truly sparked the scientific revolution. The people of the time were ready for some real answers, although they never spoke of this because of their loyalty to the Church. The idea that the sun was actually the center of the universe went against many Biblical passages. Galileo pointed out that scripture teaches us how to go to heaven, not how the heavens go. (The Galileo Project).

Before the 16th century, society believed that the earth was at the very center of the universe. Anyone who believed otherwise was condemned by the church and, consequently, society as well. Due to the lack of scientific research, religious ideas were the only ways that people could view the world. They had no scientific evidence to back up any sort of explanations. While there were ideas and theories about the solar system that had yet to be proven, no one at the time had the tool to back up this theory. During the scientific revolution in the 16th century, a scientist named Johannes Kepler proposed three laws of planetary motion. Kepler went on to explain that these accurate descriptions of the motion of any planet and any satellite nearly 400 years ago, and are still by NASA today. Kepler described five different fixed stationary orbits. If it were not for Kelper, society probably would not have the Lagrange points, which are used to give accurate locations of fixed loop hoop orbits in-between the earth and the moon.

Technology then had to catch up with the theory. An early 16th century scientist came up with a tool that would literally change the outlook of how society perceived the world and later, even the universe. Spectacle maker Hans Lippershey is accredited with the earliest record design of the optical telescope. When word actually got out about this new innovative tool, Galileo Galilei made a name for it.

Galileo took the telescope and did what no one else thought of, he courageously pointed it towards the heavens. His theory caused a ripple effect in the scientific community. His unending devotion and determination for discovery led to a better understanding of the universe. He gave other scientists, artists, and philosophers of centuries to come something they can build on.

A telescope perfected from Hans Lippershey invention by the simple arrangement of two lenses in a long, narrow tube allowed Galileo to see objects ten times more clearly. With his primitive telescope, Galileo was able to make a number of remarkable discoveries. At the time, people believed the surface of the moon was smooth and flat. However, Galileo found mountains, valleys, and craters on the surface. Not only was Galileo the first man to see the craters of the moon, but he also went on to discover sunspots, the four large moons of Jupiter, and the rings of Saturn.

This fire of ideas that Galileo created through his discoveries inspired scientists to create telescopes of increasing size and complexity. With the ever-changing shape and form of telescopes, astronomers have been able to see ever farther into the universe with increased clarity. Although telescopes have revealed much over their nearly 400-year history, they are still limited in what they can show us from Earth. Light pollution, cloud cover and the Earth's turbulent atmosphere constantly interfere with telescope views from Earth. No telescope, to date, has been able to overcome these problems. To conquer these problems, scientists decided that a telescope must be placed above the atmosphere, in orbit around the Earth. That is where the Hubble telescope was born.

The Hubble telescope, launched in 1990, marks the most significant advance in astronomy since Galileo's telescope. This telescope was the first to be launched into orbit and is therefore at the ultimate mountaintop for viewing the universe. Above the distortion of the atmosphere, above rain clouds and light pollution, Hubble has an unobstructed view of the universe. So what did the new telescope discover? Scientists claim that they have used Hubble to observe the most distant stars and galaxies as well as the planets in our solar system. Even twenty years after its launch, Hubble is still in working order. However, the time has come to improve this situation and create something that will go beyond the Hubble's view. It is also important to have something that we are able to do regular maintenance on. By placing a permanent telescope on the moon, we can explore the universe in even greater capacity than the Hubble telescope did. Even today Galileo's influence is being felt in the development of telescopes and their increasing ability to explore space.

This opportunity to place future space telescopes in superior environments would create a situation where Moon-based crews can easily visit them. It is promising enough that NASA should now begin brainstorming options and opportunities that I will recommend towards them. Telescopes on the Moon, especially instruments capable of feats well beyond the Hubble and Webb, but how can someone demonstrate how to overcome the cons over the pros? Placing telescopes on the moon telescopes could be considered a more stable environment than a telescope in orbit. Thus, placing telescopes within the service range of lunar outposts will have the effect of firming up the future for those outposts, and also receive funding necessary to keep them operational and growing. The biggest question is can you improve on the next telescope by creating one ultimate telescope or developing many with variety of task giving all while keeping within a practical budget?

Galileo's Influence on the Scientific Community

Lance K. Erickson Ph. D., a professor of applied aviation sciences and space studies at Embry Riddle Aeronautical University, agrees that Galileo had a strong influence on the scientific community. However, in our interview on DATE, Dr. Erickson added that even if Galileo had not lived, society would not be that far behind where it is now in space exploration. In addition to Galileo, many other scientists in history were developing their own telescopes. Leonard Digges, for example, invented the reflecting and refracting telescopes, but never capitalized on his invention.

Another professor, however, emphasizes Galileo's importance. In an interview with Dr. Alan R. Pratt, professor of humanities at Embry Riddle Aeronautical University, he stated that if it were not for Galileo, many artists and philosophers would not have been so greatly influenced on the imagination of the universe. Dr. Pratt, stated:

In terms of any other changes that happened in past centuries regarding science, I really do not think [that] any philosopher or artist could have had a bigger impact than Galileo did. In a matter of a few months, Galileo was able to alter the development of science so deeply as those months between the end of 1609 and the beginning of 1610. He now was at the crown rewriting the book of laws, which consisted of raw facts with evidence to back it up. He literally changed physics, which, in turn changed cosmology, and again that changed the way future philosophers and artists imagined the universe. This influenced many poets, mostly because they were stimulated on a sense of anxiety, that Galileo discovered that society is in fact on a small planet.

According to Dr. Pratt, this change in science introduces a big change in religion and anthropology. Figure 1 portrays Galileo trying to convince the Church.

Figure 1: Galileo and his Discoverieshttp://www. chrismadden. co. uk/moon/galileo-telescope-church. gif

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Unlike many revolutions, the scientific revolution changed people's minds, rather than the way society acted. People began to seek scientific answers to things that they before accepted as truth without question. Figure 1, shows that Galileo had a lot of explaining to do, but that it was not easy convincing the church of his discoveries. His theory was very much against religion, and Galileo knew this would change everything. As a result of Galileo's influence, science and mathematics began to be more widely accepted than philosophy when used to explain phenomenon. Today, it is hard for anyone to comprehend that there was a time where claims were not researched scientifically. Galileo developed a more modern concept of researching which scientist still use today.

Sir Isaac Newton Taking Telescopes to the Next Level

Following Galileo, English physicist, mathematician, astronomer, natural philosopher, alchemist, and theologian, Sir Isaac Newton is considered by many scholars and members of the general public to be one of the more influential people in human history. In 1661, the scientific revolution was at its peak, and many works of basic to modern science had appeared. Astronomers from Copernicus to Kepler had elaborated the heliocentric system of the universe. Galileo had proposed the foundations of a new mechanics built on the principle of inertia. Led by Descartes, philosophers had begun to formulate a new conception of nature as an intricate, impersonal, and inert machine. Newton was about to change the laws of the universe that were backed up by mathematically proven certainty. These laws were physical by nature but were neither sporadic nor limited locally. According to Newton in Principia, laws were universal. There were three laws that would describe universal gravitation. The only limit of these laws of motion was that they could not be applied to the atomic level or on some conditions that would include the speed of light (Cambridge).

Newton's Telescope

In addition to these theories, Newton followed where Galileo left off and made a bigger and better telescope that would yet again change the way the public would view the universe. Figure 2 shows one of Newton's many drawings of his telescope.

Figure 2: Newton's Drawing of a Telescope

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The drawing represents the time when Newton began formulating the idea of optic lenses. An optic lens bends light in order to refract and, therefore, magnify the image. Newton went on to develop what is known as the theory of optics.

Theory of Optics

The theory of optics utilizes a concave mirror to develop a refracting telescope. Newton was able to utilize the visible light spectrum and show that bending it would create a magnifying effect. Understanding refracting telescopes did play a big role in the development of future telescopes. In 1704, Newton published Opticks, which resulted in his victory in the debate of the nature of light. In his publication, he questioned the theories of light, defraction, and the visible spectrum. He developed experiments to test these questions which he reviewed in Opticks. While this controversial debate over the nature of light was tested by many scientists, Newton's theory of optics became generally accepted. This theory led into the law of superposition, consisting of a wave-like property. Superposition opened a new door in physical optics. It wasn't until Sir Isaac Newton developed the next upgrade to the telescope, which he called the reflecting telescope, and later renamed as the Newtonian Reflector. This new optic lens would be revolutionary in terms of seeing deeper into space. Figure 3 depicts one of Newton's large telescopes with a structure to reach the eyepiece. These huge telescopes were the first of their time and were the first to use a pitch lap, a polished optical surface that acts as a mirror. Newton claimed that this reflector would be the heart of the design of the Newtonian telescope. Thus, the optic lens that Newton perfected within his telescope is still used today in the Hubble Space Telescope. Newton's development of the optic lens proved to be the next important step in space exploration. His upgraded development in the telescope was indeed the influence needed to keep the evolution of telescopes going.

Figure 3: A large Newtonian Reflector

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The Hubble Space Telescope

Science has come a long way since the first telescopes were imagined in the minds of their creators. The complexity can range from a ten dollar telescope to multi-million dollar telescopes developed by today's space explorers. The most well-known of today's telescopes is the Hubble space telescope, which is used to capture images of space from Earth's orbit.

Long before the Hubble telescope was launched into orbit in 1990, scientists were developing ideas of sending telescopes into space. In 1946 Lyman Spitzer, a researcher from Yale University, wrote a paper entitled Astronomical Advantages of an Extra-Terrestrial Observatory, in which he discusses how Earth's atmosphere affects the visibility of stars and planets in space. Through his research and development, Spitzer began collaborating with scientists and professionals to move his plan into action. In the 1960s, NASA began to discuss the feasibility of such a project, and in 1971, it was granted permission to further discuss the blueprint for the project. The largest obstacle in the creation of the Hubble telescope was acquiring the funds for the project, which was estimated to cost $400 to $500 million. After revising parts of the telescope to make it more cost-effective, Congress finally the proposal for funding at $200 million and established the Large Space Telescope project funding in 1977. NASA had planned for the telescope to be launched in 1983; however, assembly of the Hubble was delayed through 1985, when it was finally completed. Figure 4 shows the various control systems of the Hubble as it is in orbit. The planned launch had finally been set for October 1986. This launch was interrupted in January, when tragedy struck the Challenger space shuttle as it ascended into the atmosphere and exploded above the Florida skyline. NASA officials began to question whether the telescope would make it safely into orbit. One year later, shuttle launches resumed, but it was not until April 24, 1990 that space shuttle Discovery finally carried the Hubble into orbit.

Figure 4: Important Features of the Hubble Space Telescope

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Most would consider the launch of the Hubble a success; however, one mission of the launch was to gain spectacular images of the cosmos. Within a few weeks of being launched, the images that were sent back to NASA headquarters appeared blurry and out of focus. According to the NASA History Division, " An investigation revealed a spherical aberration in the primary mirror, due to a miscalibrated measuring instrument that caused the edges of the mirror to be ground slightly too flat" (NASA). In December 1993, the first servicing mission was performed with five back-to-back spacewalks, fixing the aberration as well as performing routine maintenance. When the images finally developed into sharp, clear pictures of space, NASA considered the maintenance mission a success. With sustained servicing missions, Hubble has continued to explore the universe from Earth's orbit for the past twenty years.

Additional Telescopes

Although the Hubble space telescope is not the only telescope in orbit, it has remained the only one to operate on visible light wavelengths. Other telescopes, such as the Spitzer space telescope detect infrared radiation, or heat radiation. In addition, Chandra is a telescope that measures X-rays from high-energy regions of the universe, such as exploded stars, according to the Chandra X-ray observatory. Another telescope, the Swift, measures gamma rays. NASA headquarters explains that,

Swift's primary goal is to unravel the mystery of gamma ray bursts. The bursts are random and fleeting explosions, second only to the Big Bang in total energy output. Gamma rays are a type of light millions of times more energetic than light human eyes can detect. Gamma ray bursts last only from a few milliseconds to about one minute. Each burst likely signals the birth of a black hole. (NASA).

As one can see, there are multiple uses for telescopes in space, ranging from visible explorations, to X-ray, to gamma ray, and beyond. As science evolves, so will the applications of telescopes in space.

James Webb Space Telescope

The future of telescopes is rapidly evolving. Within a few years, the Hubble will no longer be the main operating telescope in orbit. In 2014, NASA plans to launch the next telescope into orbit: the James Webb Space Telescope. This large infrared telescope will consist of a 6. 5 meter primary mirror and measure parts of the universe that have never been documented before. As seen in Figure 5, the James Webb Space Telescope's mirror is nearly three times the size of the Hubble mirror. With its four measuring instruments: the Near InfraRed Camera, Near InfraRed Spectograph, Mid-InfraRed Instrument, and the Fine Guidance Sensor Tunable Filter Camera, the Webb will measure infrared waves with some visible range. Figure 6 shows the different parts of the James Webb Telescope and where it will be placed in orbit. According to NASA, “ The Webb has four main science themes: The End of the Dark Ages: First Light and Reionization, The Assembly of Galaxies, The Birth of Stars and Protoplanetary Systems, and Planetary Systems and the Origins of Life.” (NASA). It will explore the development of the first galaxies, and how they have connected to ours.

Figure 5: Mirror Comparison between JWST and Hubble (BBC News)

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Figure 6: The James Webb Space Telescope (BBC News)

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Telescopes and the Moon

The moon is often brought up in forums on the NASA website regarding the possibilities of placing telescopes on the lunar surface. In order to even consider how to fulfill the four W’s of curiosity (what, where, when, and why), scientists must find a valid reason for leaving the practical environment of the Lower Earth Orbit (LEO). The LEO is an ideal place for telescopes to be in the reach of astronauts for routine maintenance. This is an important issue to explore for the future of telescopes. In an interview with Dr. Lance Erickson, he stated that the idea of placing a telescope on surface of the moon is just not practical. The reason for that is simply because the rocket-power to transport the telescope onto the lunar surface is not there. Dr.

Erickson explained that even if NASA decided to assemble the telescope on the surface of the moon rather than transporting it, they would have to do so on the far side of the moon. This would result in requiring a lunar outpost for routine maintenance. Even though the idea of scientists placing telescopes on the moon sounds like an ideal project for future exploration, Dr. Erickson stated that the amount of money needed to budget a project of that magnitude would be beyond practical.

Furthermore, having a variety of telescopes rather than one big expensive telescope could be a more feasible way to do research. Dr. Erickson explains that having a backup plan before the actual plan is exactly how achieve efficiency. With a backup plan, the probability of having a successful outcome for research doubles. NASA Space Center will not look into any suggested projects that do not have a valid contingency plan, insuring that research and development will help with funding. This way if a mistake is made between the launch of the plan and the actual space flight, scientists have something to fall back on. The greatest barrier of getting an idea to machine is having a logical way of overcoming hurtles that scientist have to adapt to. For example, it is necessary to satisfy the needs of the project within the limits of the funds available in order to justify the research with the public. Having the taxpayers agree on research is huge because much of the funding may come from taxpayers' wallets.

In coming up with a logical proposal to NASA about having a lunar-based telescope, which, in-turn would have to be submitted to congress, there are a mix of pros and cons regarding the project.

Dr. Erickson pointed out the cons of placing a telescope on the lunar surface, there are some feasible advantages in fulfilling this idea. Paul Gilster, an author, looks at peer-reviewed research on deep space exploration, with an eye toward interstellar possibilities on his website. For the past five years, this site has coordinated its efforts with the Tau Zero Foundation, and now serves as the Foundation's news forum. Paul Gilster states:

Putting an enormous radio telescope on the far side of the Moon has so many advantages that it's hard to imagine not doing it, once our technology makes such ventures possible. Whatever the time frame, imagine an attenuation of radio noise from Earth many orders of magnitude over what is possible anywhere on the near side, much less on Earth itself. (Tau Zero Foundation)

Due to the dusty environment of the moon, the best type of telescope to utilize would be a radio telescope. Objects on Earth and in space also emit other types of electromagnetic radiation that cannot be seen by the human eye, such as radio waves. The full range of radiation emitted by an object is called its electromagnetic spectrum. This radio astronomy is also known as the study of celestial objects that emit radio waves. Scientists can study astronomical phenomena that are often invisible in other portions of the electromagnetic spectrum. Thus, placing this type of telescope would be a benefit to the environment on the moon for the one big problem not mentioned through NASA website forums on how to deal with the lunar dust. The Apollo astronauts found that no matter how careful one was, the dust went everywhere. Having dust on the mirror or the hardware is not what one wants. With the Construction of a large based mirrored telescope on the lunar surface it would be particularly a problem during construction. Since radio waves penetrate dust, scientists can use radio astronomy techniques to study regions that cannot be seen in visible light, such as the dust-shrouded environments, which are the locations where you find the birth of stars and planets.

Filling the Medium with Future Telescopes

Today, NASA’s budget will not be able to cover telescopes with cost running over in the trillions just in maintaining a lunar outpost. Being able to justify the cost of an improved telescope, while keeping it in the Unites States budget, will require filling the medium between the LEO and the Moon. So in filling this medium so instead of building on joint task telescope, NASA should implement a variety of telescopes at all of the Lagrange points.

Lagrange points are The Lagrangian points (also Lagrange points, L-points, or libration points), the five positions in an orbital configuration where a small object affected only by gravity can theoretically be stationary relative to two larger objects (such as a satellite with respect to the Earth and Moon) (Web Definitions). According to Dr. Erickson, he suggested that there are three justified Lagrange points that can be used effectively for telescopes that can be designed for different task. In order to figure out what Lagrange point will fit a given telescope the job the best, you must consider the locations of each point. Furthermore, it’s important to point out that these Lagrange points follow under what is called the Kepler’s laws The three laws of planetary motion are briefly described below (Physics Classroom):

The path of the planets about the sun is elliptical in shape, with the center of the sun being located at one focus. (The Law of Ellipses)

An imaginary line drawn from the center of the sun to the center of the planet will sweep out equal areas in equal intervals of time. (The Law of Equal Areas)

The ratio of the squares of the periods of any two planets is equal to the ratio of the cubes of their average distances from the sun. (The Law of Harmonies)

With these laws in place, there is a chance of finding a loophole, and that's exactly what the five Lagrange points are. For example, with the L1 point, and given the proper distance of a spacecraft, which is maintained between the earth and the sun so long as it is about a hundredth of the distance to the sun (ESA). The spacecraft will take about one year to go around the Sun. With that, this point can used for monitoring the sun for it's in the direct line between the sun and earth. In the interim, L1 is very unstable, so any spacecraft here will require their own rocket engines. Though, it's a useful point for observing the sun (Dr. Erickson), the antennas which track it from Earth are also aimed at the Sun, which causes the disruptions with radio waves. Corrections are needed regularly (ESA). So the research will be limited to the sun.

The next useful point will be Lagrange point 2. This point is located roughly around 1. 5 million kilometers behind the earth (as viewed from the sun). To give a physical reference, it is estimated to be about four times the distance of the moon and earth (Figure 7).

Figure 7: Lagrange Point 1

http://www. unexplainable. net/brainbox/uploads/1/21. jpg

According to Dr. Erickson, this point will be the best for observing the larger universe which is observing deep space. The telescope would be free from the earth's shadow, which distorts the observing views of the telescope mostly from the heat changes (correlation between day and night) (ESA). Most importantly, this point will be more stable than L1 and provide a more stable viewpoint.

Figure 8: Lagrange Point 2 (Scientific Web)

http://www. scientific-web. com/en/Astronomy/CelestialMechanics/images/LagrangePoints03. jpg

Furthermore, L3 Lagrange point is the best for observing the galaxy according to Dr. Erickson. This Lagrange point lies behind the Sun, and any objects which may be orbiting there cannot be seen from Earth. The orbiting speed would equal earth and place the telescope just outside the orbital period of earth and as well the telescope would be on the opposite side of the sun which would block out sun light pollution (ESA).

The reason Lagrange point 4 and 5 could not be used is mostly because of debris. Debris gathers at these locations interferes with the stability of these points as well as the resistance to gravitational perturbations lets objects such as small asteroids and a lot of dust to gather around these locations (ESA).

In recognizing the best locations for future telescopes, it is important to understand the future designs for each task that the telescope will be fulfilling beyond all telescopes land based or present space telescopes. Scientists must find the medium of fulfilling both areas of the given mission. Finding the balance between fixed orbit positions within any lagrange points is not rounding off to what scientists think is the closest position for the fix in orbit, but rather being precise within feet of accuracy. These loopholes are very temperamental. That one of the major flaws with dealing with fixed orbits beyond human control. Gravity, like anything else in space, either works strongly in the favor of positive results for research as well as negative outcomes. The success of the mission for the space telescope will be greatly affected by where the telescope is located. Scientists will be faced with the greatest challenge of placing these telescopes not just in these point orbits but maintaining these telescopes in the point orbits.

Conclusions

While it may seem like a simple history lesson about Galileo and Newton but if it wasn't for their influence in the science community, society would not be where it is now in regards to space exploration. From Galileo to Hubble, much of the tools that helped Newton are still helping us today with telescopes. From retaining the laws of Kepler, to the Lagrange points, everything used in NASA has something to represent scientist of the 16th century today.

Only a few settings are ideal for space telescopes. The best telescope design will resemble the Hubble. Like Galileo to Newton, the telescope of tomorrow will be perfected and increased in size and complexity as scientists learn from past mistakes. The James Webb telescope will be the next generation, but even though it is the most modern telescope, scientists are still looking beyond the Webb on what and where to place the next telescope. The future of telescopes will be satellite based on Lagrange points 1, 2 and 3. With a given purpose for each point, the observation will be different from one another; this will open up a variety of experiments for NASA.

The best place to observe the Sun will be at Lagrange point 1, for it is in the direct line between the Sun and the Earth. Though it falls in the criteria of being in a loop hole, being a fix orbit is exactly what a satellite telescope needs. It will require some rocket power to maintain its position in orbit. Given the circumstances of it position, it will only be able to observe the Sun, which scientist are still learning about today. With the only flaw of this point being the radio interference because of the Sun, there is still much to learn from the L1 point that a telescope will be an asset to better this research.

The next best position for future telescopes would be L2, as it is an ideal place to observe the larger Universe, which is observing deep space. The reason for this is because the telescope would be free of the Earth’s shadow. This is very important when it come to exploring space in the means of using a telescope. Every astronomer knows that light is a major influence on telescope imagery. Light is what creates an imbalance in heat in space. Out of all the Lagrange points, L2 is the best. It is the most stable of the three points and it can increase the distance we can explore into deep sp