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The Big Idea That the Earth Revolves Around the Sun and Why It Is Important to Contemporary Science

In this paper I will prove that the concept that the Earth revolves around the Sun, otherwise known as The Heliocentric Model, is important to contemporary science because it gives us a better understanding of the physical world and the rules that help govern it. Firstly, I will summarize and explain the idea of Heliocentrism and the history behind its discovery and scientific adoption. Secondly, I will prove that this concept is of import in contemporary science because it leads to a better understanding of the physical world through the discoveries of Newton and Einstein. Thirdly, I will inspect and analyze both historical and contemporary criticisms of Heliocentrism across physical, astrological, and theological disciplines, in addition to the stance that the concept is no longer of any significance in contemporary science due to the importance of focusing on Terra-centric matters, and the shift of focus throughout the scientific community towards more minute realms such as quantum mechanics. Lastly, I will refute the historical criticisms by explaining the Heliocentric proofs of Galileo, and Kepler, and then prove that the contemporary criticisms are invalid due to the importance for all scientific disciplines in their ability to have accurate representations of the physical world, namely through the manner in which the model assists in giving an accurate picture of gravity.

Heliocentrism is the astronomical model in which the Earth and planets revolve around a relatively stationary Sun at the center of a Solar System. The fundamentals of this idea were first laid out in Copernicus' theory. Copernicus' theory says the following:

1. Around the Sun, in order, are Mercury, Venus, Earth and moon, Mars, Jupiter, Saturn, and the fixed stars.

2. The Earth has three motions: daily rotation, annually revolution, and annual rotation about the axis.

3. Retrograde motion of the planets is explained by the Earth's motion.

4. The distance from the Earth to the Sun is small compared to the distance to the stars. ("Heliocentrism")

Although Copernicus is often credited with the theory of Heliocentrism, he was not the first person to think of it. Aristarchus of Samos first proposed the notion that the Earth revolves around the Sun as early as the third century BCE. ("Heliocentrism") Nicolaus Copernicus, a Renaissance mathematician and astronomer, used this outline and expanded on it as a way to explain the retrograde of the planets. He published his book *de Revolutionibus orbium coelestium* (On the Revolutions of Heavenly Bodies) while he was on his deathbed in 1543. In this book he describes his theories and provides a fully predictive mathematical model of the heliocentric system, but he does not provide any experimental evidence. ("Heliocentrism")

This concept is important to contemporary science because it leads to a better understanding of the physical world through the discoveries of Newton and Einstein. Without a Heliocentric system, Newton's Law of Gravitation would never be created and through it, Einstein's Theories of Relativity. Newton's Law of Gravitation states: "Any two bodies in the universe attract each other with a force that is directly proportional to the product of their masses

and inversely proportional to the square of the distance between them." ("Newton's Laws of Universal Gravitation") This is the reason why the smaller mass, Earth, is able to revolve around the bigger mass, Sun. If this were not true, we would not have a viable theory as to why everything falls downward, or why we stay on the ground. Einstein came up with his Theories of Relativity by trying to explain why the force of gravitation is not instantaneous as Newton said, but instead cannot be faster than the speed of light. Through his work with Eddington and with gravitation and the speed of light, he created the Theories of Relativity.

Tycho Brahe, a famous astronomer and alchemist of the sixteenth century, argued against Copernicus' heliocentric model claiming there were physical, astronomical, and theological errors with it. The Aristotelian physics that was used at the time offered no explanation for the movement of a massive body like the Earth. Brahe claims the Copernican system

> "… expertly and completely circumvents all that is superfluous or discordant in the system of Ptolemy. On no point does it offend the principle of mathematics, Yet it ascribes to the Earth, that hulking, lazy body, unfit for motion, a motion as quick as that of the aethereal torches, and a triple motion at that." (Gingerich)

Astronomically, Brahe had issues with Copernicus' assumption of vast distances between the Earth and the stars. The previous model, Ptolemy's geocentric model, assumed the stars also orbited Earth in a sphere just past Saturn. Theologically, the Catholic Church took much offense to the heliocentric theory. In 1616, the Theological Advisory Committee in the Inquisition determined that the heliocentric theory "contradicts the Catholic faith" and declared it officially heretical. They stated its, "Philosophically (i.e., scientifically) foolish and absurd, and is considered official heresy because it explicitly contradicts the meaning of Scripture in many places, in terms of the verbal significance of the words and in terms of the accepted

interpretation and understanding of the Church Fathers and the Doctors of Theology." The claim that the earth revolves around the sun was considered "a mistake of faith". (The Prohibition of the Heliocentric Theory)

Although the Catholic Church revoked their stance on Heliocentrism in 1822, there are still some people today that believe the Scriptures are right. They often quote the Bible with the following verses: "The sun also ariseth, and the sun goeth down, and hasteth to its place where it ariseth again. (Ecclesiastes 1:5)", "He set the Earth on its foundations; it can never be moved. (Psalm 104:5)", and "On the day the Lord gave the Amorites over to Israel, Joshua said to the Lord in the presence of Israel: 'Sun, stand still over Gibeon, and you, moon, over the Valley of Aijalon.' (Joshua 10:12)." (New American Bible)

Some people nowadays also take the stance that the concept is no longer of any significance in contemporary science due to the importance of focusing on Terra-centric matters and the shift of focus throughout the scientific community towards more minute realms such as quantum mechanics. They believe that we shouldn't care about space or our solar system at all. All we have to know is that the sun comes up in the morning and down at night, and outside of that we should just focus on problems that we have on Earth.

Galileo played a huge role in proving Copernicus' theory. He used his refined telescope to discover the four large moons of Jupiter. This provided evidence that the solar system contained bodies that did not orbit Earth. He also discovered the phases of Venus, which is the first observational evidence for Copernicus' theory. And he discovered the rotation of the Sun about a fixed axis as indicated by the apparent annual variation on the motion of sunspots. He published these findings in *Sidereus Nuncius* (Starry Messenger) in 1610. ("Heliocentrism")

Kepler was a firm believer in Copernicus' theory. While studying the orbit of Mars and Brahe's extensive notes on astronomical observations, he realized that the orbits of the planets are not circular as was implicitly assumed by Copernicus, but rather ellipses with the Sun at one focus point. From this concept, Kepler derived the Laws of Planetary Motion. These state,

1. The orbit of every planet is an ellipse with the Sun at one of the two foci.
2. A line joining a planet and the Sun sweeps out equal areas during equal intervals of time.
3. The square of the orbital period of a planet is proportional to the cube of the semi-major axis of its orbit. ("Johannes Kepler")

He published his works in *Mysterium Cosmographicum* (Cosmic Mystery, The Secret of the World). This was the first attempt since Copernicus to say that the theory of Heliocentrism is physically true, and with the observational and experimental data he provided, the concept was accepted. ("Heliocentrism")

In order to explain Kepler's elliptical planetary orbits, Isaac Newton proposed universal gravity and the inverse-square law of gravitational attraction, which is stated above. This explained that the elliptical orbits were due to the Sun's gravitational pull on the planets. Newton's studies of Kepler also lead to Newton's Laws of motion and creation of calculus. These advances in science and mathematics were necessary for society to move forward and expand and would not have been possible without Copernicus' theory.

In conclusion, I proved that the concept that the Earth revolves around the Sun is important to contemporary science because it gives us a better understanding of the physical world and the rules that help govern it. Firstly, I summarized and explained the idea of Heliocentrism and the history behind its discovery and scientific adoption. Secondly, I proved

the concept is important to contemporary science by showing how it lead to scientific discoveries of Newton and Einstein. Thirdly, I analyzed the criticisms of Heliocentrism across physical, astronomical, and theological disciplines by explaining the issues of the lack of ability to measure the motion of an enormous body such as the Earth, the belief that the stars orbited the Earth and were much closer than assumed in the Copernican Theory, and the inconsistencies between the theory and the Scripture. I also analyzed the stance that the concept is not of any significance because societies focus should be on Terra-centric matters. Lastly, I refuted the historical criticisms by explaining Galileo's telescopic observations and Kepler's discovery of an elliptical orbit that supported Copernicus' Theory of Heliocentricity, and then proved the contemporary criticisms were invalid because the theory is important to all scientific disciplines in order to have accurate representations of the physical world.

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