Our Conceptualization Of The Solar System Essay, Research Paper

The human conceptualization of the solar system dates back to the beginning of time. The early Egyptians worshipped the sun as a source of life and then the area called space was becoming a curiosity to humans. Throughout history, our knowledge of the solar system has increased and there is still much to learn. Through the research and studies of Brahmagupta, Ptolemy, Kepler, Brahe, Copernicus, Galileo, Newton, and Einstein. With this knowledge, laws and equations for physical science have been developed and they have been useful to analyze many tangible aspects of science.

The earliest astronomers were Ptolemy (90-168 AD) and Brahmagupta (590-678 AD). Ptolemy extended the observations and conclusions of Hipparchus, to form his geocentric theory, which is popularly known as the Ptolemaic system. He described his geocentric system and gave various arguments to prove that, in its position at the center of the universe, the Earth must be immovable. Ptolemy argued that since all bodies fall to the center of the universe, the Earth must be fixed there at the center, otherwise falling objects would not be seen to drop toward the center of the Earth.

In Brahmagupta?s book, Brahma- sphuta- siddhanta (The Opening of the Universe), he discussed solar and lunar eclipses and positions of the planets. He believed in a static Earth and he gave the length of the year as 365 days 6 hours 5 minutes 19 seconds in the first work, changing the value to 365 days 6 hours 12 minutes 36 seconds in the second book. Quoting Brahmagupta, ?As the sun eclipses the stars by its brilliancy, so the man of knowledge will eclipse the fame of others in assemblies of the people if he proposes algebraic problems, and still more if he solves them.?, he foreshadowed the increase in knowledge about the solar system.

In about 1513, Copernicus, a Polish astronomer, wrote the Copernican theory, stating that the Sun was at rest in the center of the Universe. A full account of the theory was not published until the very end of Copernicus’s life, under the title On the revolutions of the heavenly spheres. Along with these discoveries, he said ?Mathemata mathematicis scribuntu? which means mathematics is written for mathematicians. This would be the basic theory that Kepler accepted in order to formulate his three laws of planetary motion.

Tycho Brahe’s stated that heavy bodies fall to their natural place, the Earth, which is the center of the universe. If the Earth were not the center of the universe, the study of physics would be useless. He developed a system kept the Earth in the center of the universe, so that he could retain Aristotelian physics and the Moon and Sun revolved about the Earth, and the shell of the fixed stars was centered on the Earth. But Mercury, Venus, Mars, Jupiter, and Saturn revolved about the Sun. He put the (circular) path of the comet of 1577 between Venus and Mars. This Tychonic world system (Figure 1) became popular early in the seventeenth century.

Kepler formulated and verified three laws of planetary motion, now known as Kepler’s laws. Under the basis of the Copernican Theory, he produced a hypothesis to account for distances between planetary orbits. In 1609, he published a thesis containing statements of two of his laws of planetary motion: that planets move in ellipses, and that planets move faster as they near the sun. In 1619 he published another discovery about planetary motion: that the time of each planet’s revolution around the sun is proportional to its distance from the sun, this proportion being the same for all the planets. The first law says that the planets orbit in elliptical paths, with the sun at one focus of the ellipse. The second law states that the areas described by the straight line joining the center of the planet and the center of the sun are equal for equal times; the closer a planet comes to the sun, the faster it moves. The third law states that the ratio of the cube of a planet’s mean distance from the sun to the square of its orbital period is a constant, the same for all planets. He was devoted to his work as stated, ?Nam et nobis Jupiter, ut et Mars, et mane Mercurius, et Sirius apparuerunt quadranguli. Alter enim diametrorum angulosorum caeruleus erat, alter puniceus, in medio corpus flavum fulgore admirabil.?i (And to us Jupiter, like Mars, and in the morning Mercury and Sirius, appeared four-cornered. And one of the diameters running between the corners was blue, the other red, in the middle the body was yellow, and amazingly bright.). This allowed for the ability to have information about planetary orbits. Along with his colleague, Galilei Galileo, this opened the door to greater enlightenment about the solar system.

Galileo was an Italian physicist and astronomer, who, with German astronomer Kepler, started the scientific revolution. His most valuable scientific contribution was his founding of physics on precise measurements instead of using metaphysical principles and formal logic. In late 1609, he had built a telescope of 20 times magnification, with which he observed the mountains and craters on Earth’s moon. He also saw that the Milky Way was composed of stars, and he discovered the four largest satellites of Jupiter. By 1610, he had observed the phases of Venus, which proved the Copernican system, that the Earth revolved around the sun, and disproved the Aristotelian and Ptolemaic assumptions that the planets circled a fixed Earth.

In the late 1680s, Sir Issac Newton devised his three laws of motion. When Newton applied these laws to the laws of orbital motion formulated by the German astronomer Kepler, he derived the law of universal gravitation. This law explained that all objects in space and on earth are affected by the force called gravity. Through the works of the early scientists, Kepler was able to formulate laws of planetary motion and he posed a question. Why did the planets move faster when they were nearer to the sun? This was answered by Newton?s derivation of Kepler?s laws, which was universal gravitation. Through this, he was able to state that the planets moved faster due to the force of gravity on the sun. We now use Newton?s 2nd and 3rd laws to find the force of gravity of planetary bodies.

In early 1905, Albert Einstein developed a theory based on two assumptions: the principle of relativity, that physical laws are the same in all inertial reference systems, and the principle of the invariance of the speed of light, that the speed of light in a vacuum is a universal constant. He was able to provide a consistent and correct description of physical events in different inertial frames of reference without making special assumptions about the nature of matter, radiation, or their interaction. He accounted for previously unexplained variations in the orbital motion of the planets and predicted the bending of starlight in the vicinity of a massive body such as the sun. The confirmation of this prediction during a solar eclipse in 1919 became a media event, and Einstein’s fame spread worldwide.

Through the works of these astronomers, the field of physics was improved and the status of our abstraction of the solar system has grown greatly. We still use the laws and theories formulated by early astronomers in order to help us in our research. Since our research is extensively growing, the laws can now be used to derive new hypotheses and help us to solve the enigma we know as the solar system.