There exists an object in the night sky that has simultaneously induced awe and perplexed humanity, an object that has spawned a plethora of myths and stories. The closest celestial body to our Earth, the Moon, has intrigued and inspired mankind for ages; we wish to understand its purpose, but also how, exactly, this orb could have arrived in our terrestrial sky in the first place.

Aside from looking upwards with naked eyes, no one had actually observed the Moon until Galileo Galilei in 1610, who was the first to survey its surface with his "spyglass." The terrain he saw was not flawless and smooth, as believed, but rather full of valleys and ridges – not exactly what he expected, given the reigning Ptolemaic explanation that the Moon was a perfect heavenly sphere.[1] He and other proto-astronomers after him observed its motions and tracked its passage across the sky, but it was not until the 19th century that anyone set out to establish a scientific theory as to how the Earth acquired its companion. The first theory proffered was that of George Darwin (son of Charles Darwin) in the 19th century, who proposed that the when the Earth was still forming, it spun so fast that the Sun's gravity was so strong that eventually a block broke off from the molten Earth which then became our Moon.[2] This is known as the fission hypothesis and has since been discredited; scientists cannot mathematically prove the necessary speed at which the Earth would turn in order create the conditions to birth our Moon in this way. In addition, when the lunar rocks were brought back from the Apollo missions, they were analyzed and found to lack iron, an element very plentiful in the Earth. This effectually debunked Darwin's theory and confirmed the moon is not just a smaller portion of the Earth.

Other models were developed along the way to explain this same conundrum, including the capture and co-accretion hypotheses, fostered by T.J.J. See and Edouard Roche respectively, amongst others. The former theory postulates the moon was a free floating body whose path was slowed and trapped into Earth's orbit and has remained there ever since. This, however, does not square with what scientists know about planetary dynamics, specifically how it would be possible for the moon to align into orbit with the Earth without crashing into it. Again the lunar rocks disproved this idea when they were revealed to have a nearly identical oxygen isotope condition as that of the Earth.[3] The latter theory, co-accretion, speculated that the Earth and Moon formed together simultaneously, from the abundant material that formed the other objects in our solar system. If they had formed together, the Earth and the Moon would share similar properties, such as density and iron in their core; from the lunar rocks, we know this not to be the case.[4]

Then in 1972, after these theories were invalidated, two scientists, William Hartmann and Donald Davis, hypothesized that perhaps the moon was formed after an object collided with the Earth causing a part of it to break off and begin to orbit around the young Earth. This became known as the Giant Impact Hypothesis.[5] This theory effectually explained why the moon has no iron, because it was partly from a foreign object, as well as the similarity in oxygen isotopes, because it was partly from Earth. Basically, when the outside body hit the Earth, the Earth would have absorbed its iron and mantle, but parts of the Earth's mantle material would have been thrust into orbit and coalesced with the foreign material into the Moon. Yet, this hypothesis unfortunately still does not yet explain the whole story, and there are still questions left that are not fully explained. For one, scientists cannot agree on the mass of the impact object, named Theia, after the

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1 http://www.atnf.csiro.au/outreach/education/senior/astrophysics/galileo.html
2 http://www.pbs.org/wgbh/nova/tothemoon/origins.html
[3] http://rationalwiki.org/wiki/Origin_of_the_Moon
[4] http://cloe.boulder.swri.edu/aboutTheMoon/alternateTheories.html
[5] http://rationalwiki.org/wiki/Origin_of_the_Moon
[6] http://en.wikipedia.org/wiki/Giant_impact_hypothesis

Greek titan who gave birth to Selene, the moon goddess. In addition, there are compositional discrepancies between the Earth and the Moon that have yet to be explained, and there is still no agreed-upon angle of impact of Theia.

Despite not offering a definitive explanation for the formation of the Moon, the Giant Impact Hypothesis is still the most widely accepted, and has yet to be completely disproven in favor of a more comprehensive theory.[6] Scientists, in the meantime, continue to find more questions springing from this hypothesis leading us to believe if there is another undiscovered component to it. Until that part of the puzzle is discovered, citizens of Earth can still gaze up at the moon in wonder until we fully understand how our celestial next door neighbor arrived on our doorstep for such a prolonged visit.