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The Grand Tour

Though out our existence mankind has made great strides in understanding the universe in which we live in, applying logic and ingenuity in the quest for knowledge of our existence in time and space. Most of what we know about our sun and solar system has been learned through means of observing the skies and astronomical bodies that surround us. From ancient times we have been able to map the position of stars and planets that appear in our skies with basic scientific and mathematical innovations. However with the advancements in science and technology of the twenty first century, humankind has been able to observe the planets and our solar system like never before with the Voyager 1 and 2 missions launched by NASA in 1977. From these missions we have uncovered a wealth of knowledge regarding our solar system and beyond the neighborhood of the outer planets to the outer limits of the Sun's sphere of influence. These findings have reshaped the study of astronomy, as we know it today.

During the 1960's, astronomers and technicians at NASA were presented with a rare opportunity for launching a spacecraft that would traverse the outer limits of our solar system. With the alignment of the giant planets nearing, astronomers devised a mission where a spacecraft would be able to use a "gravitational slingshot" effect to fly by the giant planets, study the sun's sphere of influence, and finally reach interstellar space. This method allowed the spacecraft to require a minimal amount of propellant and

also have shorter transit durations between the planets. So work began on Voyager in the year 1970, challenging technicians and astronomers alike to perfect the mission in order to be able to reach the outer solar system. It took more than a decade of planning and anticipation before the so-called “Grand Mission” would finally be launched.

The mission consisted of two twin satellites launched one after the other en route to the gas giants Jupiter and Saturn from which they would use the gravity assist as a one way ticket out of the solar system. NASA’s Jet Propulsion Laboratory constructed voyagers 1& 2, including the most sophisticated forms of imaging and radar technology on the satellites. Both spacecraft were equipped with a parabolic dish high-gain antenna that allow radio waves to be transmitted back to earth, and radioisotope thermoelectric generators that will power most of their systems until the year 2025. The satellites were also equipped with a two-camera system consisting of a narrow lens and a wide lens that provided astounding images of the planets and earth as the craft flew further away from us. But among all these components on the crafts one was by far the most crucial in mankind’s quest for reaching life in the cosmos; the Golden Record. Aboard Voyager 1 & 2 are 12-inch gold platted copper phonographic records containing information about the spacecraft’s origin and the planet from which it came from.

Renowned U.S. astronomer Carl Sagan was selected by NASA to compile “timeline” of humanity and its existence on planet earth. Sagan, an extraterrestrial life enthusiast, included 116 images of Earth, it’s life forms, and various natural sounds such as those made by surf, wind, animals and humans. Along with these sounds musical selections from different cultures and eras, spoken greetings in fifty-five languages, and printed messages from President Carter and U.N. Secretary General Waldheim were also

included. Atop of the disc is an engraving in binary of instructions on playing and viewing the content of the record, the coordinates of our sun, and an illustration of the two lowest states of hydrogen. The original engraving was supposed to include an image of a man and woman in the nude portraying the anatomy of humankind, but due to negative feedback from the public NASA opted to include only the silhouettes. Although it would take forty thousand years before the voyager crafts made it to any other planetary system, Sagan was adamant on making the information on the disc as simple to interpret at any corner of the universe. Like he once stated, "the spacecraft will be encountered and the record played only if there are advanced spacefaring civilizations in interstellar space. But the launching of this bottle into the cosmic ocean says something very hopeful about life on this planet" (Carl Sagan, 1977).

On August 20th, 1977 Voyager 2 was launched into space aboard a Titan-Centaur rocket from Cape Canaveral Florida on its mission to study the outer reaches of the solar system and our suns sphere of influence. Preceding its twin Voyager 1 was later launched from Cape Canaveral on September 5th, 1977. Although Voyager 1 was launched after its sister, it surpassed it and reached the gas giant Jupiter on March 5th, 1979 followed by Voyager 2 on July9th, 1979. During this rendezvous both satellites collected never before seen images of Jupiter and its stormy surface along with its four biggest moons. From the data received back at Earth, astronomers discovered high levels of volcanism on Io, which was not believed to occur so far from the sun. They were also able to capture astounding images of Europa and its striated surface leading to the hypothesis that a liquid ocean might exist underneath its frozen surface. Both of these discoveries elated

astronomers and Sagan because it meant that life had a higher chance of existing elsewhere in the solar system.

After their rendezvous with Jupiter, both voyagers continued to their next destination, Saturn. On November 21st, 1980 Voyager 1 made it to the ringed giant to begin its observational phase followed by Voyager 2 almost a year later on August 25, 1981. During their observation of Saturn, both satellites compiled masses of data on its atmosphere, magnetic fields and its ring system. From this observational period astronomers were able to study planetary formation on a smaller scale and apply it to the formation of our solar system. They also were able to study Saturn's largest moon Titan and its thick gaseous atmosphere and discovered ice geysers shooting up miles into the moons atmosphere. While observing Titan Voyager 1 experienced an extra gravitational deflection that sent it closer to the moon, shifting it out of the plane of the ecliptic. Although the gravitational assist from Saturn would send Voyager 1 en route to Pluto, NASA decided to end its planetary mission and send it out into space to continue it interstellar mission. As for Voyager 2, it continued to fly by to the last giants of the solar system.

On January 24th, 1986 Voyager 2 reached Uranus commencing its observation of a world very strange to us. During this period it discovered many satellites and even a ring system surrounding the planet that was not visible from Earth. Astronomers were allowed to study the planet's perpendicular rotation of axis and its corkscrew-like magnetic field. In addition, the satellite revealed high-resolution pictures of its largest moon Miranda and the huge faults running across its surface suggesting that it was probably shattered by a catastrophic impact before and coalesced again. After its Uranus

flyby Voyager 2 reached Neptune on August 25th, 1989 before traversing into interstellar space. Upon arrival, the satellite conducted a close flyby of Neptune's larger moon Triton taking numerous mosaic photographs of the moon and the planet. It also discovered the "Great Dark Spot" on the planet that was thought to be a cloud itself, but instead is hypothesized to be a hole on the planet's visible cloud deck. After completing its mission on Neptune, Voyager 2 was sent of into empty space where it, along with its sister companion, would continue to fly away into interstellar space.

Three decades later both Voyager 1 & 2 continue to transmit data to earth occasionally taking hours to reach home. As of March 2012 Voyager 1 is 119.9 AU away from earth travelling at 3.6 AU per year while Voyager 2 is at about 98.3 AU from Earth and travelling at 3.3 AU per year. Currently both satellites continue to fly out into interstellar space transmitting data about our sun's heliosphere and heliopause back home. Through pure ingenuity, luck and creative thinking, astronomers and technicians at NASA were able to launch one of the most ambitious missions ever proposed by man. Thanks to the brilliant minds of yesteryear, mankind has been able to learn about our solar system and further contemplate our existence in the beautifully complex web of space, time, energy and matter that is our universe.

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