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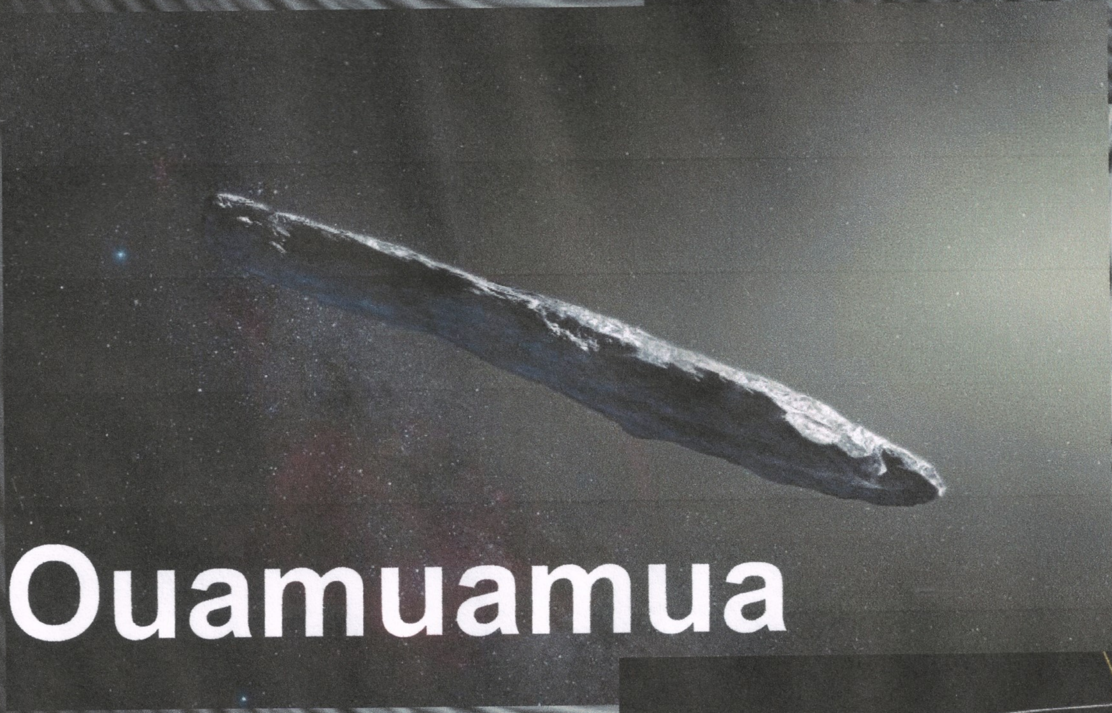

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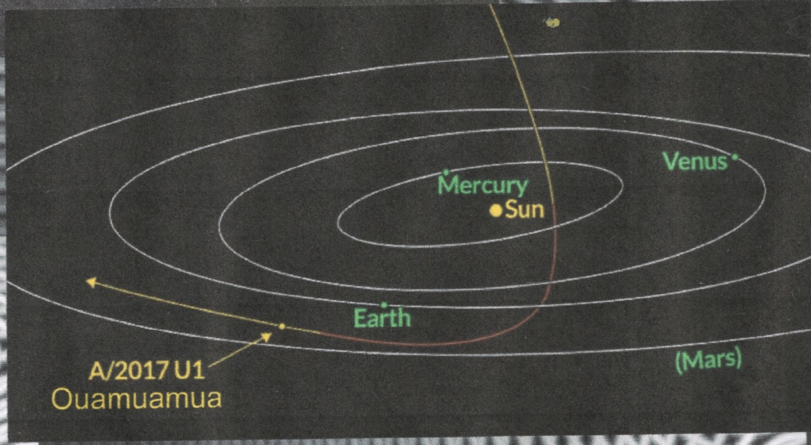

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ASTRO SPACE STAMP SOCIETY

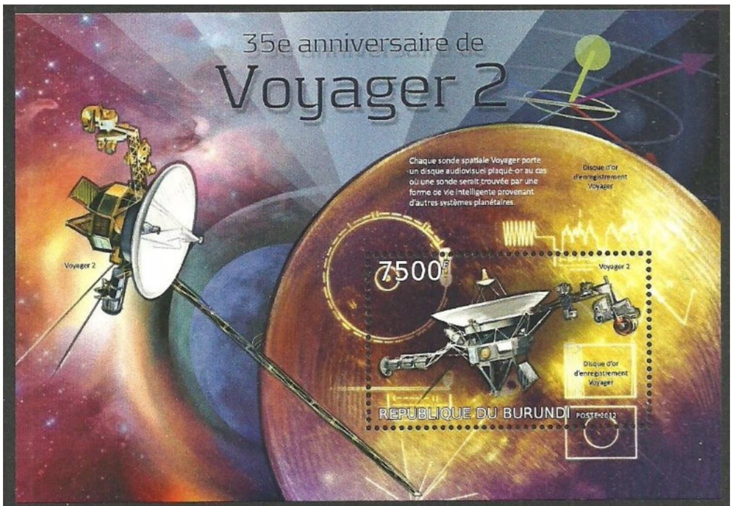
40 years of Voyager, Man's Furthest Travelled Spacecraft

***Umberto Cavallaro**, editor of our Italian sister paper* AdAstra *updates the story of "V-ger"*

The very name "Voyager" could not be more apt for the twin probes that had become the Humanity's longest-lived and farthest spacecraft ever in its travel to infinity, and are described as "the greatest voyages of exploration ever conducted by our species". Their mission was to locate and study the limits of the solar system, including the Kuiper belt and the exploration of nearby interstellar space. *"A bottle thrown into the cosmic ocean"* as defined by the great scientist Carl Sagan.

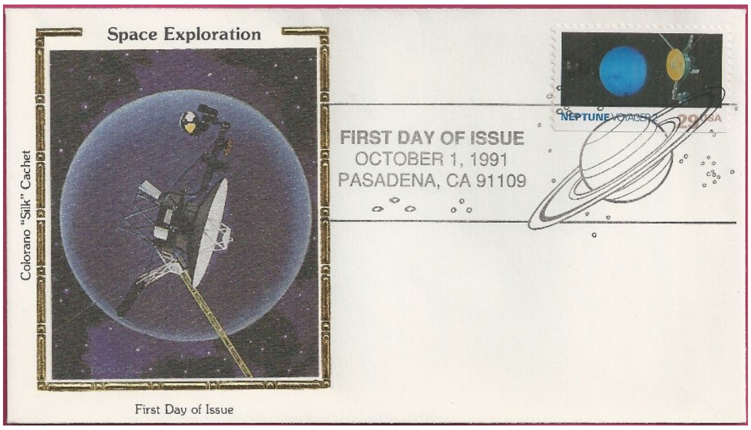
Voyager 1 and 2 have now achieved 40 years of operation and exploration.

Voyager 2 lifted off from the Kennedy Space Center on Aug. 20, 1977, about two weeks before the Sept. 5 launch of Voyager 1. The two probes were sent on different trajectories; despite being launched second, Voyager 1 was put on a path to reach both Jupiter and Saturn, before its sister probe, Voyager 2. Voyager 1 experienced closest approach to Jupiter on March 5, 1979 and Saturn on November 13, 1980. Conversely, Voyager 2 made its closest



approach to Jupiter on July 9, 1979 and Saturn on August 26, 1981.

After visiting the Saturnian system the twin probes said farewell to each other and their roads, so far almost coincident, separated. The Titan flyby in November 1980 impressed upon Voyager 1 a modification of trajectory that took it out of the plane of the Solar System, and directed it towards interstellar space. On August 26, 1981, Voyager 2 continued on its way to Uranus and then Neptune. Closest approach to Uranus occurred on January 24, 1986 and gave



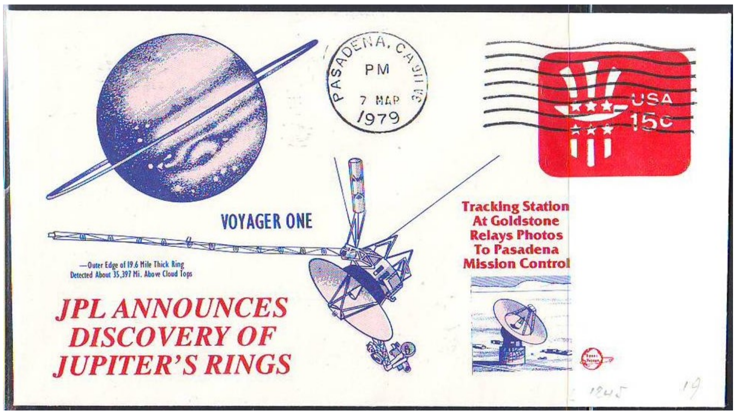
Voyager 2 the honour of being the first, and to date, only spacecraft to explore a planetary body outside the orbital distance of Saturn. On August 25, 1989 it passed above Neptune's north pole, before angling downward and leaving heliosphere in August 2012 and entering interstellar space.

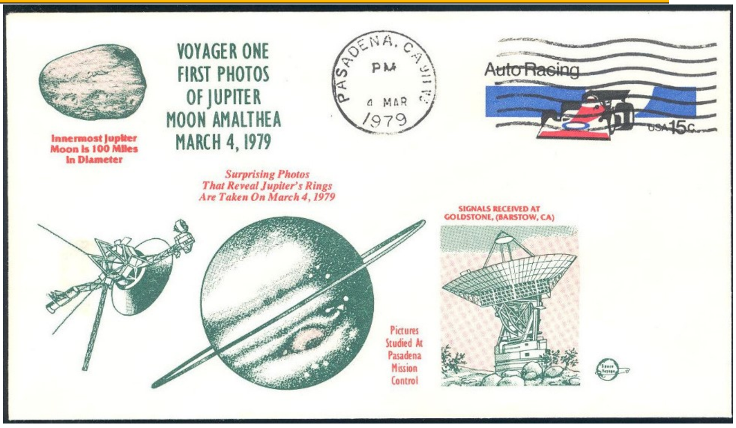
The Voyagers have set numerous records in their unparalleled interstellar journeys. In 2012, Voyager 1 became, as mentioned, the only human-made object to have entered interstellar space. Voyager 2 is the only spacecraft to have flown by all four outer planets – Jupiter, Saturn, Uranus and Neptune. Their numerous planetary encounters include, among others, discovering on Jupiter's satellite Io active volcanoes, formerly found only on Earth, and discovery of icy-cold geysers on Neptune's moon Triton, where nitrogen geysers were observed erupting at less than -230°C (40 Kelvin degrees).

The prospect of a "grand tour" of the outer planets emerged in 1965 from the calculations of a Caltech graduate student named Gary Flandro, then working part-time at NASA's JPL. He was assigned the task of coming up with feasible trajectories for missions to the outer planets and discovered that Jupiter, Saturn, Uranus and Neptune would all be on the same side of the Solar System in the late 1970s.

Based on the musings of Michael Minovitch – another summer intern who three years before, in 1962, had solved the hardest problem in celestial mechanics: the "three body problem" which astronomers including Isaac Newton had been pondering for at least 300 years, without finding a solution – he discovered that a single mission, launched from Earth in 1977, by exploiting the "gravity assist" could visit all four planets within 12 years: an opportunity that would not recur again for another 176 years.

The Grand Tour outer planets missions were nearly cancelled because of not uncommon NASA budget constraints with many expensive priorities. In the early 1970s, NASA was faced with the expense of the final Apollo missions, ASTP, the Viking programme, Skylab, and the beginnings of the Space Shuttle Programme. NASA proposed a grand tour mission anyway but Congress rejected it, and approved instead a cheaper version that would venture out no farther than Saturn.





JPL agreed to the plan but quietly went to work designing and building two tough, smart spacecraft capable of going all the way to Neptune. "We just did it and didn't talk about it," recalled William Pickering, JPL's director at the time.

After several gravitational accelerations Voyager I is currently about 21 billion kilometres from Earth, but despite its vast distance, it continues to communicate with NASA daily, and it continues its journey in the interstellar medium, pointing northward out of the solar system, while Voyager 2 moves southward and, within a few years, it should also enter the interstellar medium. Though the spacecraft have left the planets far behind – and neither will come remotely close to another star for 40,000 years – the two probes, which move at over 48,000 kilometres per hour, and continue to send data, and their different position already allows scientists to compare two different areas of the space where our Sun's influence diminishes and interstellar space begins.

The probe has informed researchers that cosmic rays are as much as four times more abundant in interstellar space than in the vicinity of Earth. This means the heliosphere (the bubble-like volume containing our solar system's planets and solar wind) effectively acts as a radiation shield for the planets.

With the velocity the probe is currently maintaining, *Voyager 1* is traveling about 325 million miles per year (520 million kilometers per year).

Each Voyager carries three radioisotope thermoelectric generators (RTG), devices that use the heat energy generated from the decay of plutonium-238.

The initial output of the RTGs was approximately 470 W of 30 V DC power at launch and had fallen off to approximately 335 W by the beginning of 1997 and 270 W in 2011. Because the Voyagers' power decreases by four watts per year, engineers are learning how to operate the spacecraft under ever-tighter power constraints. The technology is many generations old and, to maximize the Voyagers' life spans, they also have to consult documents written decades earlier describing commands and software,

It is expected that around 2025 the power could be at its limit and it will be necessary to turn off all the instruments still active. So then the Voyagers may continue to transmit telemetry to Earth, but without providing scientific data anymore. Finally, between 2026 and 2027, every signal will cease. Considering the most optimistic life estimates, until about 2027, 50 years after Voyagers' launch, this will be a true success. Obviously when the last drop of energy is exhausted, the probes will stop transmitting their signal, but their journey will not end. In about 40,000 years, (elision) Voyager 1 will transit about 1.6 light years away from AC + 79 3888, a star placed in the constellation of the Giraffe. Approximately in the same period of time the Voyager 2 will pass at 1.7 light years from the star Ross 248 and in about 296,000 years it will pass at 4.3 light years from Sirio, the brightest star in the sky.

A very special cargo is carried onboard each of the two Voyagers: a "Golden Record". It is a record, similar to a "33 rpm" vinyl disc, entitled "The sounds of Earth" which contains – as wanted by the astronomer Carl Sagan – a collection of multimedia information (images, sounds and music) suitable to describe the whole of humanity in the event of contacts with an extraterrestrial civilization, transforming the probes into cosmic ambassadors. Who knows if by then humankind will still exist or be extinct?

References

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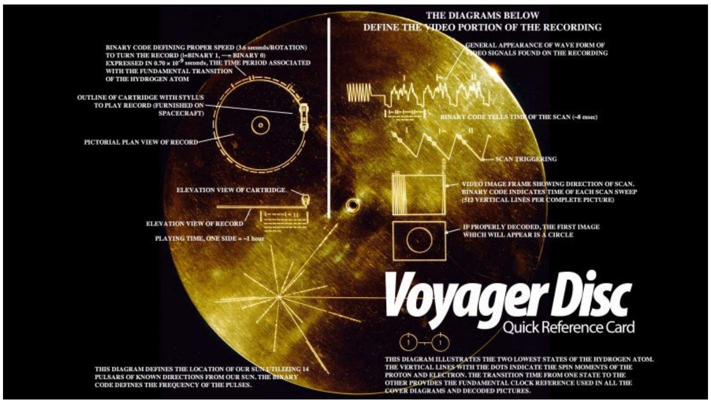

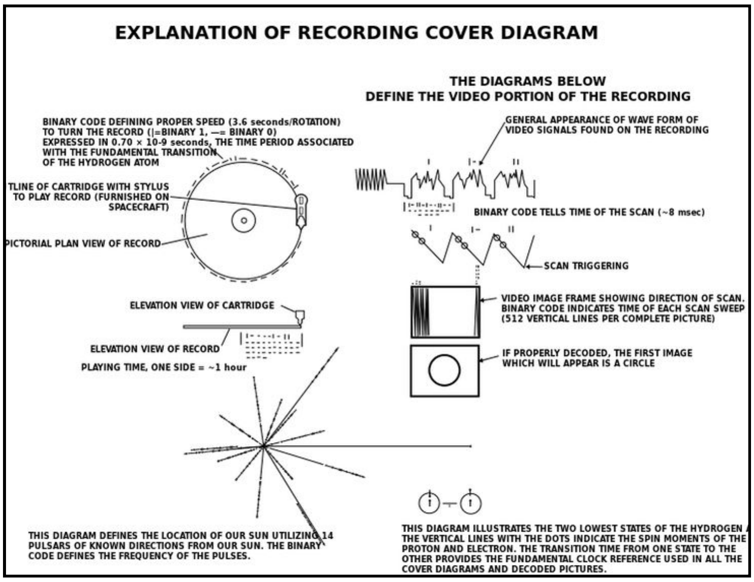

However see this article: ***Who The Hell can Understand The Voyager Disc's user Manual ?***

https://gizmodo.com/5981913/this-is-how-aliens-will-read-our-first-space-greeting-card

Veteran Astronauts

Before you turn the page, can you tell what the four astronauts adjacent have in common, apart from being very experienced spacefarers ?.