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The Science of Jules Verne's Fiction

Dean Regas

Nineteenth-century science and technology shaped two classic tales of imaginary spaceflight.

Under a Floridian sky, three astronauts boarded their metallic spacecraft. As throngs of well-wishers nervously looked on, at the awaited moment the crew blasted up, up into the warm, clear air — soaring toward the Moon. Flying where no human had gone before, they approached the cratered lunar surface, orbited around the silvery orb, and beheld the farside of the Moon. Then the spacecraft returned to Earth and plunged into the Pacific Ocean, where an American naval vessel gathered the intrepid astronauts and carried them safely back to the United States to be welcomed as national heroes.

Apollo 8's recovery

NASA

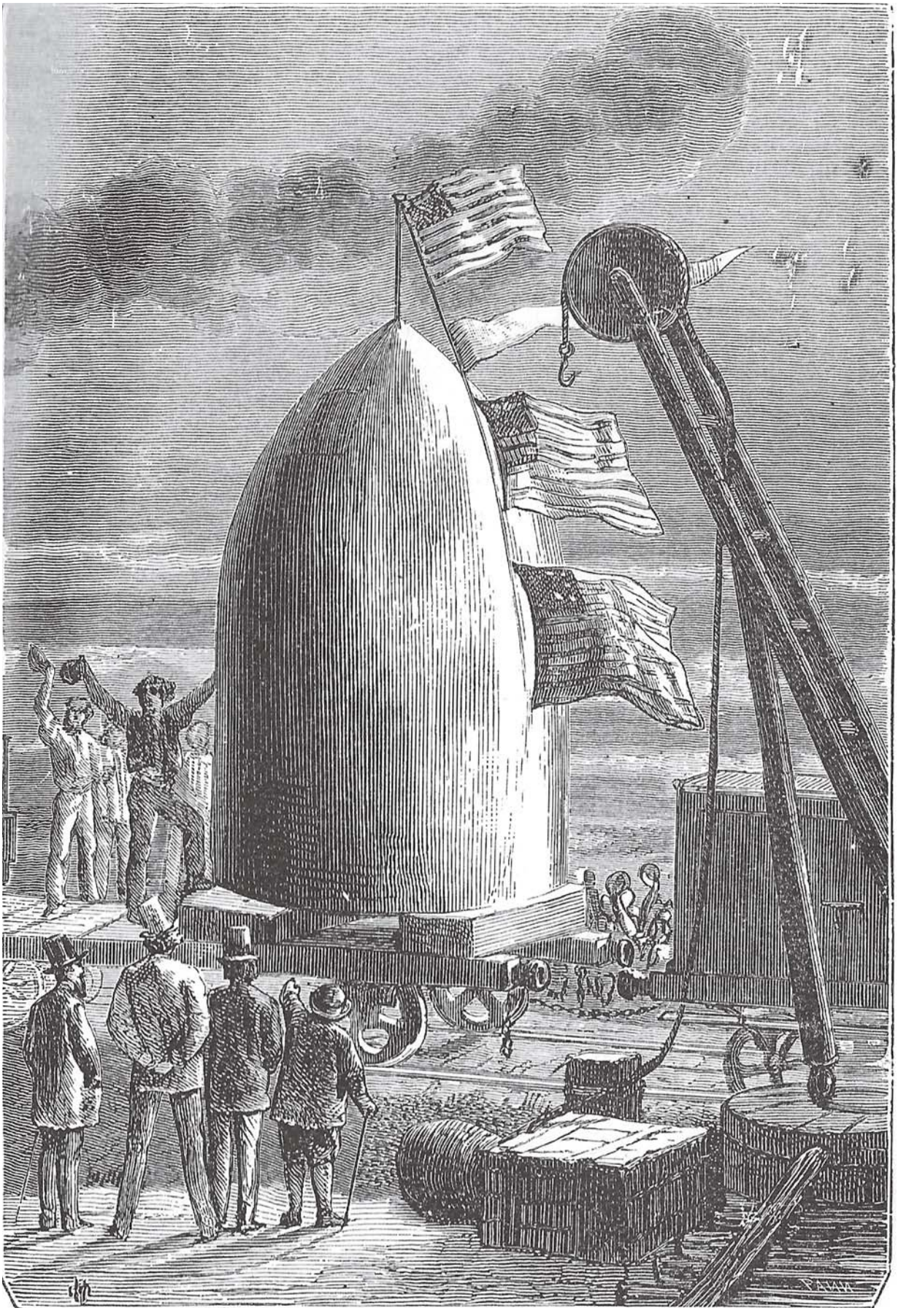
This is the true story of the Apollo 8 mission, during which three American astronauts circumnavigated the Moon in December 1968. It also happens to be the plot of Jules Verne's 1865 science-fiction classic, *From the Earth to the Moon,* and his 1870 sequel, *Around the Moon*. A number of coincidences occur between this fantasy journey and the real-life mission undertaken a century later.

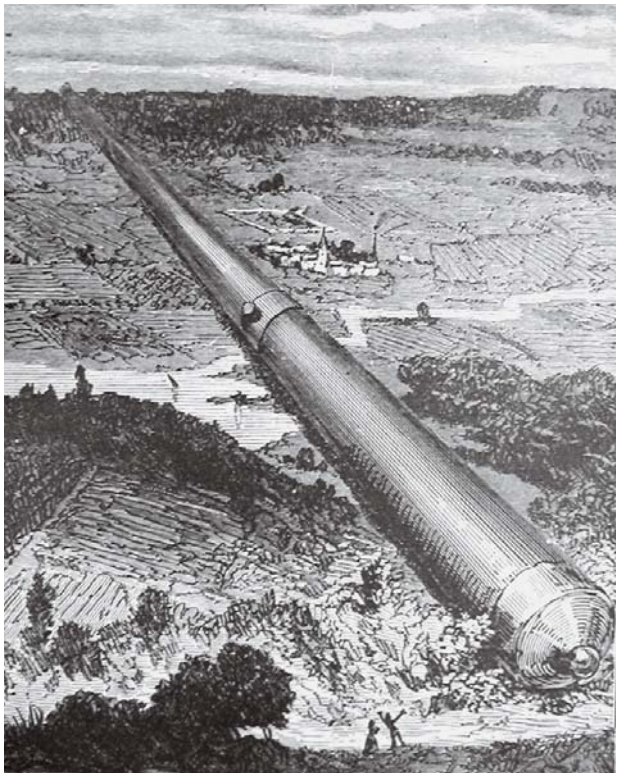
Verne's research on the latest astronomical discoveries, along with his familiarity with cutting-edge technology, allowed him to construct a realistic journey complete with comedy, drama, and education. Like Verne himself, the novels' adventurers were scientifically minded; they hypothesized, explained, and debated math, science, engineering, and astronomy throughout their journey. Today, 150 years later, Verne's science-fiction stories provide an illuminating window into 19th-century scientific knowledge.

The year is 1865, and Verne introduces the Gun Club, a fictional organization in Baltimore. The club's members (who possess, according to one account, "not quite one arm between four persons and exactly two legs between six") are artillery specialists who lament the end of the Civil War. So they must grudgingly turn their efforts to peaceful endeavors. President Impey Barbicane envisions a new course for the club and his country. "It is reserved for the practical genius of Americans to establish a communication with the sidereal world," he says. He proposes to shoot a cannonball at the Moon — and to hit it. After rousing applause he states, "I have the honor, my brave colleagues, to propose a trial of this little experiment."

With worldwide financial, moral, and spiritual support, the experiment begins. In order to reach the Moon, members of the Gun Club must build a monstrous cannon. They intend to fire it when the Moon is closest to Earth and directly overhead — something that can only occur between 28° north and 28° south latitude. After fierce lobbying (and ample name-calling)

Facing page: **The bullet-shaped projectile arrives at Stone's Hill, near Tampa Town in Florida. This and other engravings are reproduced from an 1886 printing of Jules Verne's *From the Earth to the Moon* and *Around the Moon* and provided by Jared Woodfill.**





To accelerate the projectile to high speed, the Gun Club's members build a mammoth cannon, Columbiad, that is 900 feet long.

from residents of Texas and Florida, Barbicane selects Tampa Town, Florida, as the project's base of operations. Soon the artillerymen construct a 900-foot-long cannon, called Columbiad, and load it with a mountain of explosives.

A century later, in 1958, engineers at the nonfictional National Aeronautics and Space Administration (NASA) also determined Texas and Florida to be well suited for America's rocket launches. If a rocket is propelled eastward from close to the equator, the added velocity of the spinning Earth will help it more easily break free of its gravitational pull and require less fuel. NASA managers likewise chose Florida over Texas as its principal launch site for orbiting satellites and for trips to the Moon and beyond.

In Verne's 19th-century rendition, the Gun Club initially plans for an unmanned mission. However, the inclusion of passengers is prompted by an audacious Frenchman named Michel Ardan, who arrives in Tampa Town demanding to fly in the projectile. In a typical Vernian twist, Barbicane and his rival, Captain Nicholl (an armor-plate magnate and foil to the Gun Club), agree to put aside their differences and join Ardan in a well-furnished bullet to be shot at the Moon. How they will return home is not fully discussed or detailed until they are en route.

In order to test the projectile, the Gun Club team practices with two small passengers: a cat and a squirrel. However, after the cannon fires and the ball falls back to Earth, only one emerges — the cat had feasted on the squirrel during the journey.

NASA engineers likewise tested their rockets with animals, specifically monkeys and mice, prior to launching human passengers. By then the space race was well under way, and in September 1968 (three months before Apollo 8) the Soviet Union's Zond 5 mission successfully flew a unique combination of tortoises, mealworms, flies, bacteria, plants, and seeds around the Moon and returned them safely to Earth.

Back in Tampa Town, it's launch day. Five million visitors have flooded into central Florida to witness the momentous event, which has to occur precisely at 10:48:40 p.m. The three explorers descend into the cannon and board their projectile. As the blastoff approaches, some in the crowd count *up*: ". . . thirty-eight! – thirty-nine! – forty! FIRE!!!"

Frankly, anyone shot out of such a cannon would be instantly killed. Verne knew this, and so he explains how the shock would be dampened with compartments of

NASA

Far left: **The projectile's interior is well appointed, with room for its crew of three and several animals. A bed of water under a wooden floor cushions the passengers during launch.** ***Left:*** **The liftoffs of Verne's fictional spaceship and of Apollo 8 both occurred in Florida.**

water. In truth, this would not have protected the astronauts. However, in the novel, the abrupt liftoff merely knocks the trio unconscious — though it kills one of the two dogs aboard (yes, they brought dogs).

When the crew regains consciousness, they reorganize their vessel and risk opening a porthole to dispose of the unlucky canine — which then tragically drifts next to them throughout the journey. In the novel, this open-door gamble works tremendously well, but in reality the extremely low pressure of space would vacuum the crew from the projectile.

Earth's Second Moon

Once above Earth's atmosphere, the crew faces a new crisis: a giant boulder hurtles into view. It narrowly misses their tiny craft but leaves the crew shaken. What *was* that thing? Barbicane concludes that it was Earth's second Moon.

In the mid-19th century, planet hunting had become all the rage. Neptune's discovery in 1846 let loose a mob of astronomers claiming the existence of new, unseen celestial bodies. Also in 1846, French astronomer Frédéric Petit claimed that two of his countrymen had observed Earth's second moon. Based on their accounts, Petit calculated its orbit and published his findings in 1861. Verne read this theory and seized upon it as a plot device in this novel. Barbicane even cites Petit as his source! (With 150 years of hindsight, however, Earth's second moon remains pure fiction.)

As Barbicane, Nicholl, and Ardan approach "the" Moon, they describe their observations of the lunar landscape in great detail. They spy deep craters and towering mountain peaks, radiating rays of debris, dark seas of rock, and deep rifts. The travelers then notice something is amiss: the projectile will not land on the lunar surface as planned but instead carry them to within a few miles of the Moon's north pole.

What had gone wrong — their math, aim, or velocity? It was that wayward rock, that "second moon," whose proximity and gravitational pull perturbed the course of the projectile. As the explorers realize this failure, they pass over the pole and are plunged into utter darkness.

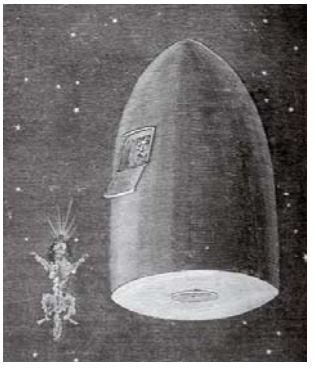
The Farside (and Dark Side) of the Moon

The Moon is tidally locked to Earth. Therefore, from here we can only ever view one hemisphere of its surface. Not until 1959 did a robotic Soviet spacecraft, Luna 3, provide the first crude images of the unseen farside.

So what spectacular images would Verne dream up about the farside of the Moon — visions that would not be challenged for almost 100 years? Until this point of the story, Verne's descriptions were based on known science; however, the lunar farside was a great unknown in the 19th century.

The projectile reaches the Moon when it appears full from Earth, so the farside is almost pitch black. Ardan expresses his disappointment: "Here is, however, a good opportunity lost of observing the other side of the moon." Yet it is not a complete loss. The warm glow from an erupting volcano illuminates its surroundings and gives the travelers tantalizing views of this *terra incognita*.

In the 19th century, scientists believed that volcanoes had formed the craters on the Moon. Earth's volcanoes



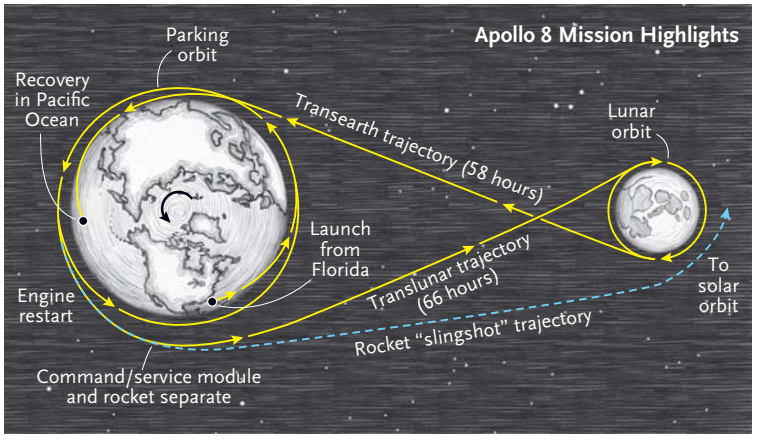
The force of the launch kills Satellite, one of two dogs aboard. So the passengers open a hatch to dispose of it. But the carcass floats alongside the craft en route to the Moon.

Freed of Earth's gravity, the three passengers and assorted animals float freely as the spacecraft coasts toward the Moon.

While coasting in darkness over the lunar farside *(left)*, the passengers endure extreme cold inside their capsule. But they warm quickly *(right)* once the capsule returns to sunlight.

resembled the lunar surface from afar, and therefore geologists imagined innumerable volcanoes as the source of lunar craters. Verne's knowledge of current geological theories surely satisfied his science-minded followers.

The Apollo missions ultimately dashed any lingering faith in the volcano theory. Samples collected by its astronauts, along with spectrographic data from orbiting craft, prove that high-velocity impacts formed the vast majority of lunar craters. There are no active volcanoes on the Moon, though eruptions shaped the topography in the distant past. The large, dark, characteristically circular maria are in fact vast lava plains that partially filled basins excavated by titanic impacts. Billions of years later, these lava "seas" made ideal landing pads for the six Apollo missions that reached the lunar surface.



S&T: LEAH TISCIONE; SOURCE: NASA

Apollo 8's December 1968 flight to the Moon and back took 6 days. Its three-man crew orbited the Moon for 20 hours at an average altitude of 69 miles.

As Verne's astronauts continue around the farside of the Moon, a meteor streaks below them and explodes above the surface. The fireball brightens the lunar landscape momentarily, and the travelers are able to decipher what appear to be clouds, continents, seas, and forests. During the journey, Verne cites many scientists of the day who debated the existence of a lunar atmosphere. The three astronauts continue that debate and wonder if it was merely an illusion.

As it rounds the south pole, the projectile emerges into daylight. The travelers then observe the bleak, scarred landscape of the Moon's southern hemisphere. They see, "Nothing belonging to a living world — everything to a dead world, where avalanches, rolling from the summits of the mountains, would disperse noiselessly at the bottom of the abyss. . . . In any case it was the image of death, without its being possible to even say that life had ever existed there."

Buzz Aldrin, who in July 1969 became the second astronaut to walk on the Moon, expressed his awe and wonder about the beautiful but barren lunar landscape, calling it "magnificent desolation."

The inertia of Columbiad's projectile then carries the crew away from the Moon and returns them to Earth. The projectile streaks through the atmosphere like a shooting star and splashes into the Pacific Ocean. The Gun Club frantically scours the seafloor but later simply finds the projectile bobbing atop the waves, an American flag flapping from the top of its cone. The astronauts have returned safely!

Future Vision

The exciting circumlunar journey not only brings fame to the three explorers but also emboldens American scientists and engineers. Verne writes, "Since Barbicane's attempt, nothing seemed impossible to the Americans." The Gun Club helps to create the National Company of Interstellary Communication (NCIC) — a fictional forerunner of NASA — with a mandate to facilitate travel between the Earth and Moon, as well as to the planets and stars.

When founded in 1958, NASA likewise employed many former military scientists and engineers for the purely peaceful exploration of space. A decade later, NASA's Apollo team accomplished the herculean endeavor of sending astronauts first around the Moon and then, just months later, down to its surface. It was a golden age for American science and technology.

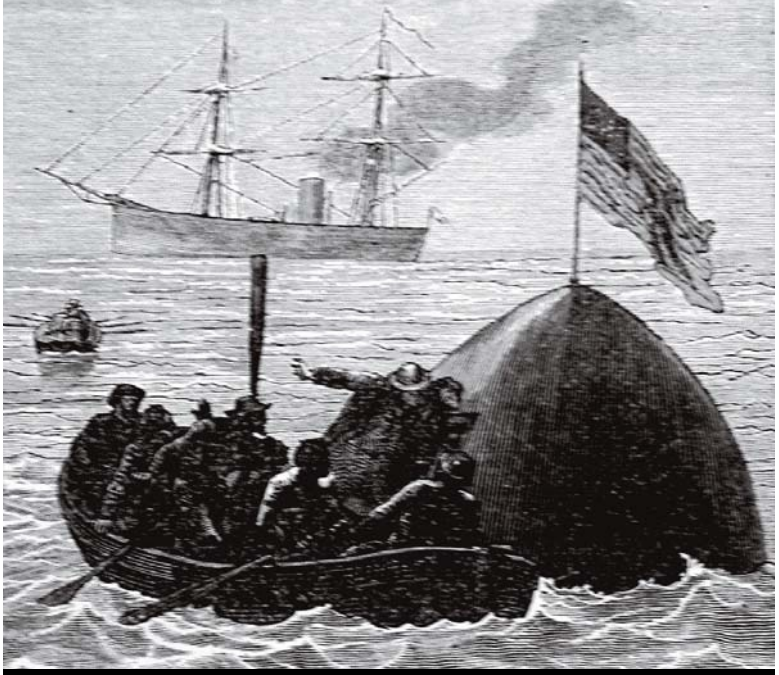
It's difficult to measure what impact the fictional writing of Jules Verne had on the real NASA missions that would follow. Surely many of the space agency's scientists, engineers, and astronauts nurtured their enthusiasm for space travel as children dreaming of what must lie beyond our Earth.

Neil Armstrong certainly felt a connection to Verne's adventure story. On July 23, 1969, returning home after he and Buzz Aldrin had completed their history-making moonwalks, Armstrong began his broadcast to Earth with these words:

> "A hundred years ago, Jules Verne wrote a book about a voyage to the Moon. His spaceship, Columbia [Columbiad], took off from Florida and landed in the Pacific Ocean after completing a trip to the Moon. It seems appropriate to us to share with you some of the reflections of the crew as the modern-day Columbia completes its rendezvous with the planet Earth and the same Pacific Ocean tomorrow."

Often the lines between science fiction and science fact become blurred. But, more interestingly and prosperously, they inspire each other. All new scientific discoveries are born in the imagination of dreamers. On this 150th anniversary of Jules Verne' epic journey, pick up a copy and see what you discover. ✦

Dean Regas *is the outreach astronomer for Cincinnati Observatory and co-host of the bite-sized PBS astronomy program* Star Gazers.

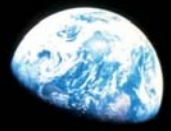


Apollo 8: Life Imitates Art

Verne's 1865 fictional trip around the Moon had several startling similarities to Apollo 8's circumlunar trip in December 1968. Both missions had a crew of three: Ardan, Barbicane, and Nicholl in the novel; Anders, Borman, and Lovell aboard Apollo 8. Verne's fictional projectile blasted off from Tampa Town, only 132 miles from NASA's site at Cape Canaveral. Verne's Columbiad fired its projectile at 24,545 miles per hour. Apollo 8 initially orbited Earth, and then rockets accelerated the capsule to 24,194 miles per hour toward the Moon. Neither craft had enough velocity to break free of Earth's gravitational pull; instead, both reached a point at which the Moon's gravity attracted them the rest of the way.

Verne's projectile then skimmed the lunar surface during a full Moon, which meant that Ardan, Barbicane, and Nicholl could hardly see anything when looking back at the "new" Earth. But Anders, Borman, and Lovell arrived during a waxing crescent phase. Consequently, after rounding the Moon, they were able to capture the timeless image of a "gibbous" Earth rising over the lunar landscape.

Verne's craft ultimately landed in the Pacific Ocean and was recovered by the *Susquehanna*, a vessel from the U.S. Navy. Apollo 8's capsule likewise dropped into the Pacific Ocean (5,000 miles from Verne's landing spot) and was recovered by the aircraft carrier *USS Yorktown*. Both capsules were constructed of aluminum — and both floated.



As the crew of Apollo 8 emerged onto the Moon's nearside, they saw a gemlike gibbous Earth rising over the bleak lunar terrain below them.

NASA