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NASA'S RETURN TO THE MOON

A LOOK AT THE HISTORY BEHIND THE ARTEMIS PROGRAM

THE 50TH ANNIVERSARY OF THE LAST CREWED MISSION TO THE MOON

↗ A full Moon is in view from Launch Complex 39B at NASA's Kennedy Space Center on 14 June 2022. The Artemis I Space Launch System (SLS) and Orion spacecraft, atop the mobile launcher, are being prepared for a wet dress rehearsal to practice timelines and procedures for launch. (Photo credit: NASA/Cory Huston)

NASA HISTORY DIVISION
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From the Acting Chief Historian

ON 29 AUGUST, thousands gathered at Kennedy Space Center and millions tuned in to see the launch of the Space Launch System (SLS) on its first test flight, known as Artemis I. A problem with one of SLS's four RS-25 engines led NASA to scrub the launch. NASA Administrator Bill Nelson addressed the media, saying that the Agency had no plans to "launch until it's right." A second launch attempt on 3 September met a similar fate, this time because of a hydrogen leak.

Aerospace history is packed with the challenges of first attempts.

Aerospace history is packed with the challenges of first attempts. The initial attempt to launch the uncrewed Mercury Redstone vehicle on 21 November 1960 resulted in a spectacular failure with the rocket lifting 4 to 5 inches off the pad and settling back down again to stand proud as the escape pylon rocketed 4,000 feet into the air. When the smoke settled, the rocket stood where it had started, draped in both its main and reserve parachutes. Not exactly what the designers had intended.

The Space Shuttle struggled with delays of its own as it made the trek from the Vehicle Assembly Building (VAB) to low-Earth orbit. But it is possibly the launch of Apollo 4, the first uncrewed flight of the Saturn V and its many issues, that offers the most instructive parallel. The Apollo 4 mission was intended as an "all-up" test of the Moon rocket designed to bring President John F. Kennedy's goal back within the realm of possibility.

Years of delays resulted as solutions to one technical issue were followed by the discovery of another issue. Each stage of the rocket experienced problems many thought would bring the program to a halt, including combustion instability in the F-1 engine, a litany of problems with the S-II stage, and a "rapid unscheduled disassembly" of a third stage (S-IVB) on the test stand in Sacramento. The tragic loss of the Apollo 1 crew during ground testing on 27 January 1967 also reverberated across all aspects of the program.

As NASA sought to recover from the tragedy of the fire, technical problems continued to mount. As the launch date drew closer, on 26 October Apollo Program Director Major General Sam Phillips put the early delays into perspective, stating that the program was "in a very complex learning process" and that the Agency was "going to take all the time we need on this first launch." Phillips's call for patience was understandable, given the considerable delays in getting the Saturn V to Cape Canaveral.

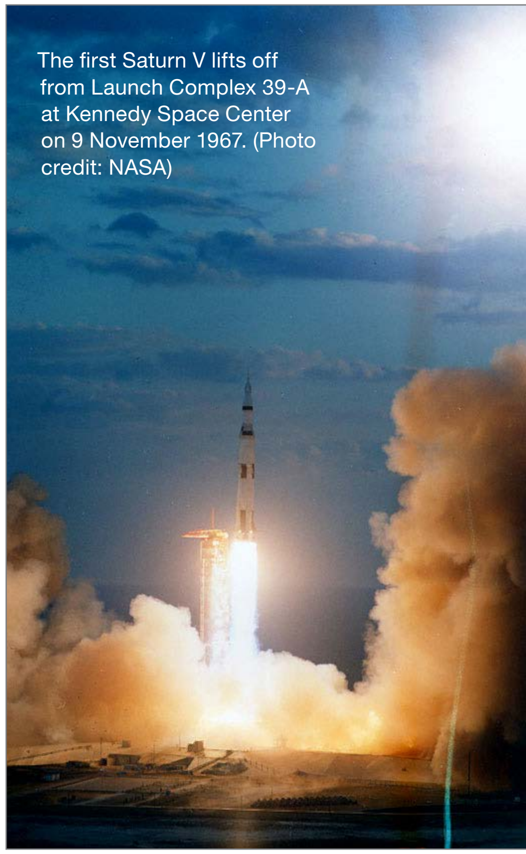
↓ Aerial view of Apollo 4 rollout on 26 August 1967. (Photo credit: NASA)

In March 1967, a mission briefing agenda noted 1,200 problems, which led to 32 discrepancy reports. One interesting problem was the discovery of an errant bolt in an F-1 engine. In June, the launch vehicle had to be unstacked in the VAB after the contractor, North American Rockwell, discovered 80 weld flaws in the second stage (S-II). This discovery led the first stage (S-IC) contractor, Boeing, to conduct a similar investigation, which uncovered similar problems.

Once necessary measures were taken and the vehicle was restacked, Apollo 4 was rolled out to Launch Complex 39A on 26 August 1967. The troubles did not end there. The Countdown Demonstration Test led to, in the words of one program manager, "numerous holds, delays, crew fatigue, scrubs, and recycles." A test that was supposed to take one week wound up taking three. As always, problems were occurring in all stages of the vehicle. In his work *Stages to Saturn*, historian Roger Bilstein recounts how propellant valves in the first stage that were supposed to open in sequence opened simultaneously; components in the second stage were damaged when the liquid oxygen tanks were filled too rapidly; an accumulation of moisture while at the pad caused shorts in the cable connections in the third stage; heating of electronics occurred in the instrument unit; and malfunctions of the ground support equipment prevented proper pressurization of helium bottles. The list became longer at every turn, causing the launch to slip from October to early November. Many inside and outside the Agency questioned whether that date would hold.

Once all the problems were addressed with the Saturn V, a launch date was finally set for November 7. But as the day drew closer, managers at Marshall Space Flight Center remained concerned about potential leaks in the seal rings of the liquid oxygen fill and drain valves due to the vehicle's long sojourn at the pad. This problem, combined with similar anxiety over batteries in the second stage, caused Phillips to move the launch from 7 to 9 November.

Finally, on the morning of 9 November 1967, Apollo 4 lifted off the pad for a nearly flawless flight. The successful flight served to quiet critics, calm the nerves of the workforce, and place President Kennedy's goal back within reach. The "all-up" approach of launching all three live stages at once, for the vehicle's first mission, certainly presented a multitude of challenges. But the success of Apollo 4 pointed toward the brilliance of that bold decision.


The first Saturn V lifts off from Launch Complex 39-A at Kennedy Space Center on 9 November 1967. (Photo credit: NASA)

Knowing the lessons of the past can serve as a calm in the face of the storm.

History teaches us many things. Knowing the lessons of the past can serve as a calm in the face of the storm. The thousands of NASA employees and contractors who have overcome numerous challenges to get Artemis I to this point can take solace in the fact that those obstacles they face today will make the payoff all the more satisfying. The engineers, management, and support personnel who celebrated Apollo 11 on 20 July 1969 were the same ones who lamented the delays getting Apollo 4 off the ground. When the Artemis program does deliver the first woman and person of color to the lunar surface, these early struggles will be relegated to the dustbins of history.

Brian C. Odom
Acting Chief Historian

The Deep Space Network's Critical Role for Artemis I

» By **Laurance Fauconnet**, Jet Propulsion Laboratory

OVER 50 YEARS AGO, NASA captured the world's imagination and inspired generations with the Apollo 11 Moon landing. Back then, NASA's communications networks were crucial to mission success. These days, NASA's Deep Space Network, which is managed and operated by NASA's Jet Propulsion Laboratory (JPL) in Southern California, provides a critical service for supporting the Artemis I mission.

The Deep Space Network handles communications for Artemis I beyond low-Earth orbit. These include the mission's outbound trajectory corrections, outbound powered flyby, return powered flyby burns, and return trajectory corrections. NASA's Near Space Network, which is managed and operated by Goddard Space Flight Center (GSFC) in Greenbelt, Maryland, provides communications data in and below low-Earth orbit.

At the Moon, the Deep Space Network will enable insertion into distant retrograde orbit. Distant retrograde orbit is a highly stable orbit in which Orion travels retrograde, or opposite, from the direction the Moon travels around Earth. The Deep Space Network will maintain communications with Orion over five stages: in distant retrograde orbit; during the burns for departure; during return power flyby; during return transit; and during the final return trajectory correction burn, with a handoff to the Near Space Network's Tracking and Data Relay Satellite (TDRS) constellation.

The Deep Space Network will also help facilitate communications for all three of the Artemis I mission's secondary payload deployment stops. The CubeSats launching with Artemis I are small satellites that will be deployed along Orion's trajectory to provide additional research opportunities for scientists and engineers. After deployment, most of the CubeSats will communicate through the Deep Space Network and pick up tracking data used for their navigation.

A Legacy of Supporting Lunar Exploration

JPL has a rich history of lunar exploration. In the 1960s, JPL began to develop robotic spacecraft to explore other worlds. This effort began with the Ranger and Surveyor missions to the Moon, paving the way for NASA's Apollo piloted lunar landings. Rangers 7, 8, and 9, launched in 1964 and 1965, taking photos of the Moon as they descended toward intentional impacts. From 1966 through 1968, Surveyors 1, 3, 5, 6, and 7 made soft landings on the Moon.

Australian technicians are seen operating and monitoring systems for the 26-meter (85-foot) antenna at the Tidbinbilla Deep Space Instrumentation Facility (now known as the Canberra Deep Space Communications Complex) in this photo from January 1969. (Photo credit: Commonwealth Scientific and Industrial Research Organisation [CSIRO]/NASA)

↑ The Tidbinbilla Deep Space Instrumentation Facility is located in the Paddys River valley, about 12 miles (20 kilometers) from Canberra. In this July 1969 photo, a single 26-meter (85-foot) Deep Space Network antenna can be seen next to the facility. (Photo credit: CSIRO/NASA)

That legacy of lunar exploration also includes the Deep Space Network.

Although primarily tasked with tracking uncrewed spacecraft exploring beyond geosynchronous orbit, the Deep Space Network also has a long history of supporting crewed lunar missions.

On 20 July 1969, NASA astronauts Neil Armstrong and Buzz Aldrin, with Michael Collins orbiting above, became the first humans to land on another world, our Moon. Affixed to the inside of the Eagle lander's door was a small, unconventional TV camera. The extraordinary images it captured showed Armstrong and Aldrin amid what Aldrin described as the "magnificent desolation" of the lunar surface.

Getting this incredible video to hundreds of millions of people back on Earth, gathered around countless television sets in rural homes, on city streets, and in remote villages around the globe, relied on the flexibility and resourcefulness of NASA's Manned Space Flight Network and the Deep Space Network.

The Deep Space Network personnel designed the Manned Space Flight Network, a set of tracking stations built to support the Mercury, Gemini, Apollo, and Skylab space programs. The Manned Space Flight Network sites were constructed near the Deep Space Network complexes, located in Goldstone, California; Madrid, Spain; and Canberra, Australia, so that the Deep Space Network could provide additional support. After Apollo, the Manned Space Flight Network no longer needed the large antennas that had been used for lunar communication, and they were eventually transitioned to the Deep Space Network.

During lunar landing and liftoff, NASA "dishes" in Madrid, Spain, would provide tracking support for Apollo 11. But, at the time of the moonwalk, Madrid was facing away from the Moon and couldn't "see" it. The job of getting those first historic pictures down to the world fell to tracking stations in Australia and here in the United States.

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The Deep Space Network's Critical Role for Artemis I (continued)

When Armstrong finally started descending the Lunar Module ladder 3 hours after the Eagle landed at Tranquility Base, a 64-meter antenna at the Deep Space Network complex in Goldstone, California, received the first downlink and two-way communication from the surface of the Moon.

However, by the time Armstrong reached the foot of the ladder, Mission Control in Houston, Texas, had switched the transmission to NASA's Honeysuckle Creek's 26-meter antenna located outside of Canberra, Australia. The improvement in picture quality was extraordinary. Responsibility for voice communications, however, remained at Goldstone. Those iconic words in history—"That's one small step for (a) man, one giant leap for mankind"—ended their 240,000-mile journey to Earth at one location, while the pictures of Neil Armstrong speaking them came to be seen through another.

After almost 9 minutes into the broadcast, a 64-meter dish at Parkes Observatory, located in Parkes, New South Wales, Australia, provided an even better picture. Television transmission would continue through 23 July 1969.

Interior view of the Mission Operations Control Room in the Mission Control Center during the Apollo 11 lunar extravehicular activity. The television monitor shows astronauts Neil Armstrong and Buzz Aldrin on the surface of the Moon. (Photo credit: NASA)

Since then, the 64-meter antenna at Goldstone has been expanded to 70 meters. It has accumulated a rich legacy during its many years of supporting space exploration. In addition to capturing the words of astronauts on the Apollo Moon missions, the dish has communicated with every one of NASA's major robotic solar system explorers. The antenna enabled the world to see the first-ever close-up images of Jupiter, Saturn, Uranus, and Neptune; their rings; and their myriad moons, courtesy of the Pioneer, Voyager, Galileo, and Cassini missions. The antenna has also communicated with NASA's Mars missions.

NASA has pushed the boundaries of space travel, and the antennas of the Deep Space Network are the indispensable link to explorers venturing beyond Earth. As we continue to explore the Moon and beyond, the Deep Space Network is there to provide the crucial connection for commanding our spacecraft and receiving never-before-seen images and scientific information, propelling our understanding of the universe, our solar system, and, ultimately, our place within it.

Glenn Research Center's 50-Plus Years of Environmental Spacecraft Testing

» By **Bob Arrighi**, Glenn Research Center

↑ In these two photos from 1964, the Centaur upper stage, equipped with two RL-10 engines, is lowered into the SPC's Chamber Number 1 through its domed hatch. (Photo credit: NASA/GRC/Bill Bowles)

NASA'S GLENN Research Center's (GRC's) 2020 qualification testing of the Orion spacecraft was just the latest in a decades-long series of tests of full-scale space vehicles in simulated space conditions. Unlike booster stages, these vehicles operate entirely in outer space and must be tested in an environment that recreates that setting.

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The Center's experience with realistic flight simulation began during World War II with the operation of entire fighter aircraft or wing sections of bombers in the Altitude Wind Tunnel (AWT). The tunnel, which was managed by Abe Silverstein, created the low pressures, cold temperatures, and dry air flow found at high altitudes.

Years later, in his role as NASA's Chief of Space Flight Programs (1958–61), Silverstein learned that spacecraft required a higher level of reliability and that the conditions in space affected electronics and hardware. After witnessing the myriad of complications with the Project Mercury capsules, Silverstein was a key proponent of the construction of a space environmental simulation chamber in late 1960 to subject the entire capsule to simulated spaceflights.

He later explained, "[E]very piece of equipment that is taken aboard... [should be] environmentally checked so that it can live in the environment of space, the total environment of space: the vacuum of space, the temperatures of space, the pressures of space; that is, in the fields of other components; that the whole ensemble put together is tested environmentally so as to operate successfully."[1]

When Silverstein returned to Lewis Research Center (today, Glenn) as Center Director in the fall of 1961, work had just begun converting the massive AWT into two test chambers—one to simulate the vacuum of outer space; the other, the conditions of the upper atmosphere. The facility, renamed the Space Power Chambers (SPC), was the largest of only a handful of vacuum tanks in the United States at the time. The use of the tunnel's existing infrastructure accelerated the construction to fill the void until larger facilities such as the Space Environmental

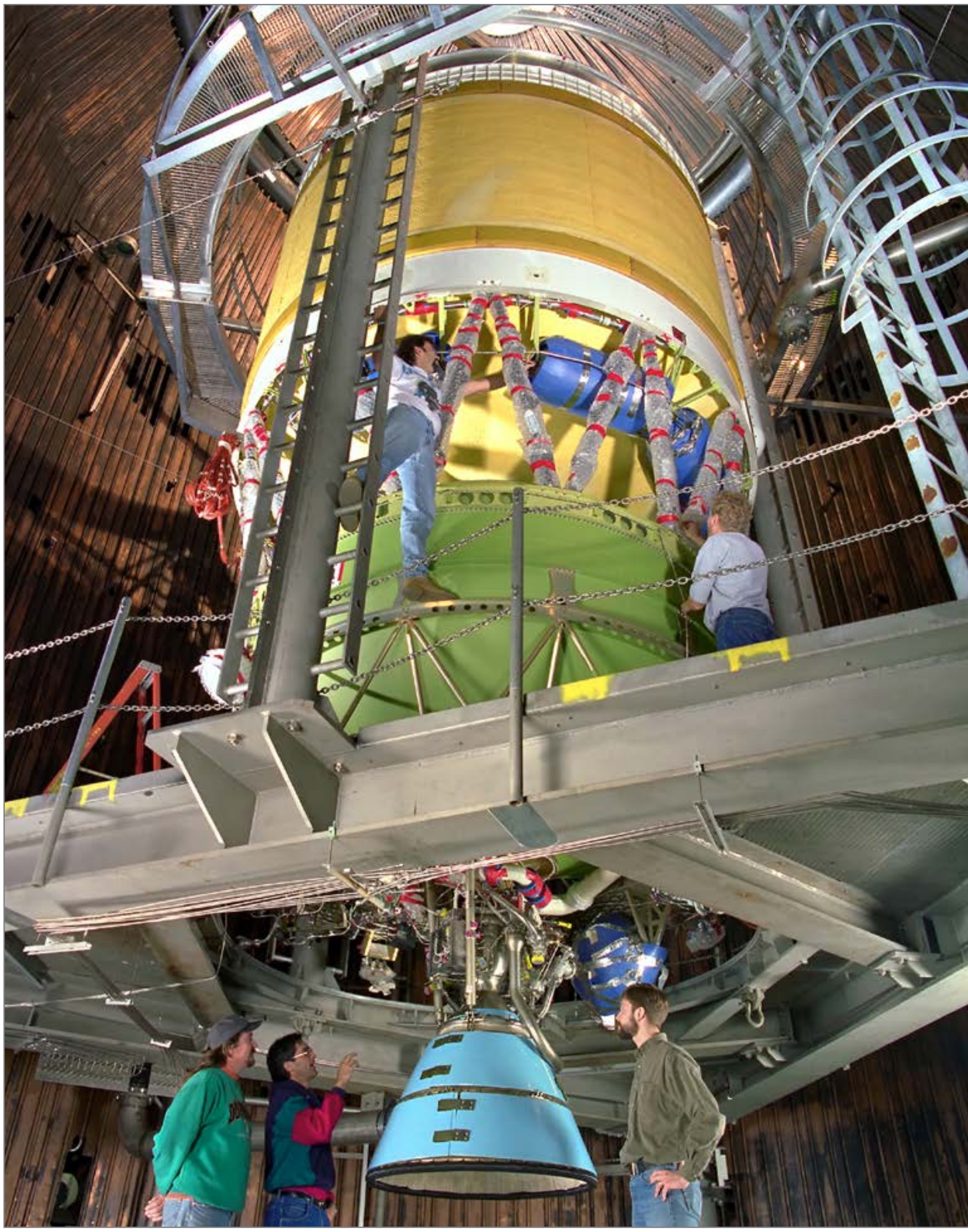
Simulation Laboratory at what is now Johnson Space Center were completed.

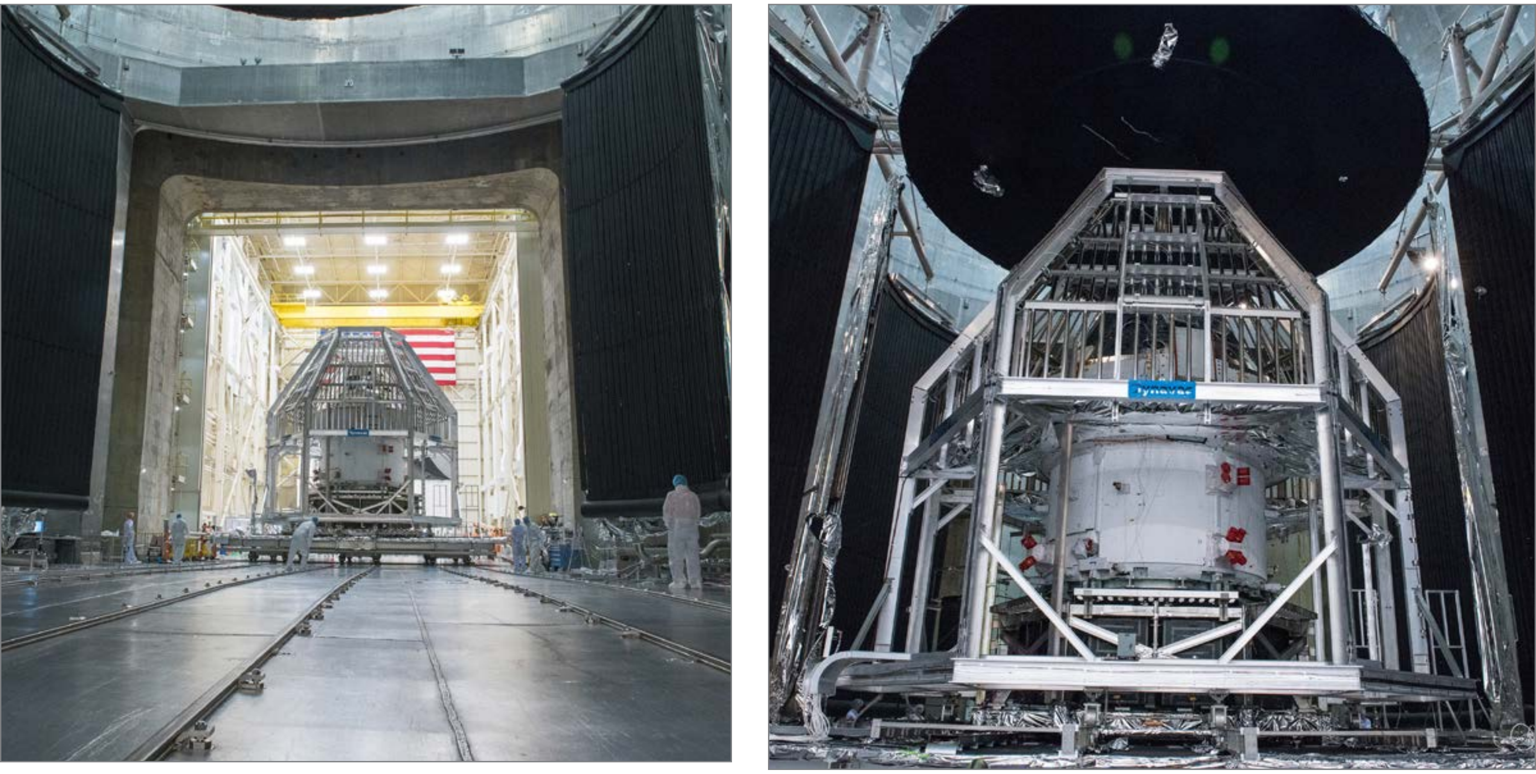
The SPC construction had just been completed when NASA transferred the Centaur upper-stage program to Lewis in the fall of 1962. The Agency had recently decided to use the new, unproven Centaur rocket with an Atlas booster to launch a series of Surveyor spacecraft to the lunar surface to explore landing sites for Apollo. As part of the Center's extensive effort to get the temperamental vehicle ready for its mission, Silverstein decided to add a dome to the new SPC vacuum tank so that the stage could be stood up vertically inside and subjected to the environment found at 100 miles altitude. Quartz lamps simulated solar radiation, and a cryoshroud installed around the vehicle produced the low temperatures of space.

The Centaur's more than two dozen simulated multiphase missions (without firing engines) in the SPC revealed that electronics cannisters did not require pressurization and verified the performance of a new static inverter. On 30 May 1966, an Atlas-Centaur successfully launched the first of seven Surveyor landers to the Moon. Centaur has gone on to launch dozens of probes, satellites, and observatories and remains active today.

Meanwhile, Silverstein made plans for two larger, more powerful environmental test facilities at its remote test site at Plum Brook Station (today known as Armstrong Test Facility). B-2 (currently named the In-Space Propulsion Facility) could not only subject a full-size stage to the simulated vacuum, temperatures, and radiation of space, but also had the one-of-a-kind ability to fire rocket engines without breaking the vacuum. It remains the only facility in the country with this capability. Simultaneously, the world's largest space simulation chamber (known today as the Space Environments Complex) was built at Plum Brook. Simulated altitudes of up to 300 miles can be created in the 122-foot-tall and 100-foot-diameter chamber. Plum Brook's twin giants began operation in late 1969.

The Delta III second stage was prepared for testing at Plum Brook's B-2 Facility in February 1994. (Photo credit: NASA)





↑ In December 2019, the Orion spacecraft was prepared for space environment testing at the Space Environments Complex at Plum Brook Station. (Photo credit: NASA/GRC/Bridget Caswell)

In December 1969, Lewis engineers initiated a multiyear program in the B-2 facility to determine if a later-generation Centaur required boost pumps to start its engines in space. A Centaur without the pumps was successfully tested dozens of times in B-2's simulated space environment. The eventual elimination of the boost pumps simplified the system and reduced vehicle cost. In the early 1970s, B-2 also tested a Centaur vehicle configured for the Titan IV booster. The tests verified that the stage could complete three-burn missions with long periods of coast in between. Titan-Centaurs launched NASA's marquee Viking and Voyager missions in the mid-1970s.

In the mid-1990s, B-2 conducted hot firings of the new cryogenic stage for the Delta III launch vehicle. The vehicle's pumping system underwent engine chilldown and ignition tests in the vacuum chamber in 1996. Then, in 1998, a complete Delta III upper stage was installed in the facility prior to its maiden flight. Like the earlier Centaur tests, the vehicle was subjected to a simulated mission profile, including multiple engine firings. Despite its short career, Delta III was essential to the transition to the successful Delta IV launch vehicle.

B-2 was one of the few vacuum facilities capable of handling SpaceX's large Crew Dragon vehicle. A series of non-propulsive tests in the summer of 2018 verified the spacecraft's ability to withstand the space environment prior to its first uncrewed demonstration flight in March 2019.

In early 2020, Glenn tested the Orion spacecraft for eight weeks in the vacuum, low temperatures, and radiation of space inside the Space Environments Complex. The massive chamber had previously primarily been used to test large components such as solar arrays and power systems. The space environment tests went exceptionally well, and the Orion vehicle was returned to Kennedy Space Center in March 2020 to prepare for its initial launch with Artemis I this fall. ■

Endnote

1 Abe Silverstein, interview by John Sloop, 29 May 1974.

Langley Research Center's Contributions to Artemis

» Adapted by **Rob Wyman**, Langley Research Center, from an article at www.nasa.gov

JUST AS IT DID for the Mercury and Gemini programs, as well as the Apollo missions where it helped tackle many of the fundamental challenges of landing the first humans on the Moon, NASA Langley Research Center in Hampton, Virginia, has made many important contributions to the development of today's Artemis lunar exploration program.

Langley's primary areas of involvement include shaping Artemis mission architecture, refining spacecraft exit and entry aerodynamics, building safety systems for astronauts, crafting electronics for instrumentation, programming robotics for in-space assembly, and developing business approaches for space commerce.

Aerodynamic Testing of the Orion Capsule

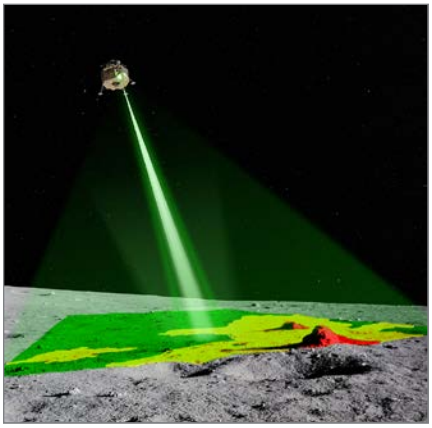
In Langley's National Transonic Facility, which uses supercold nitrogen gas at high pressure to duplicate true-flight aerodynamics, a scale model of Orion is prepared for testing that will show the effects of aerodynamic pressures on the ablated heat shield. (Photo credit: NASA/David C. Bowman)

The Space Launch System Meets the Wind Tunnel

The Space Launch System aerosciences team at Langley worked through a series of wind tunnel tests to better understand the changing pressures and wind loads exerted on the Block 1B version of the rocket during each phase of launch. In the 14- by 22-foot wind tunnel, the research team introduces smoke into the airflow to get a better visualization of the data being collected. (Photo credit: NASA/David C. Bowman)

The Orion Capsule Makes a Big Splash

Tucked under Langley's historic gantry is the Hydro Impact Basin where the Orion capsule's landing integrity was tested for oceanic splashdowns. (Photo credit: NASA/David C. Bowman)



Making Moon Landings Safer

Navigation Doppler Lidar is under development at Langley and will allow for extremely safe and ultra-precise descent and landings of robotic and crewed vehicles on the Moon and on other worlds by creating three-dimensional elevation maps of the terrain. (Image credit: NASA)

Development of the Orion Launch Abort System

As in this image from 1959, in which members of Langley's Pilotless Aircraft Research Division prepared a boilerplate Mercury capsule and production version of the launch escape system for testing of a ground-level abort, today's NASA Langley manages the development of the Launch Abort System for the Orion crew module. (Photo credit: NASA)

To find out more about this research, visit *https://www.nasa.gov/feature/langleys-contributions-to-artemis.*

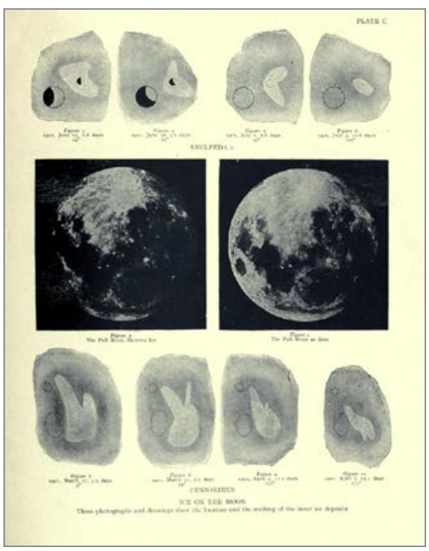
Artemis and Water on the Moon

» By **James Anderson**, Ames Research Center

↑ A data visualization showing the Nobile region at the lunar South Pole. The terrain in the Nobile region is most suitable for the VIPER to navigate, and it will communicate about and characterize potential water and other resources. (Image credit: NASA's Scientific Visualization Studio)

IN THE APOLLO ERA, the Moon was dry. For the Artemis generation, the Moon is wet. No, the amount of water on the Moon has not changed significantly since the 20th century—it's still drier than any desert on Earth—but our understanding of the Moon's history and the nature and distribution of water there has changed significantly. And before the barren Moon of the Apollo era, some astronomers believed the Moon was covered in frost and vegetation.

Admittedly, those astronomers were in the minority in the early 1900s. Even though William Pickering had made serious contributions to astronomy, such as the discovery of Saturn's moon Phoebe as well as a determination for the tenuousness of the Moon's atmosphere, some of his conclusions were not widely embraced. In his book *The Moon: A Summary of the Existing Knowledge of Our Satellite, with a Complete Photographic Atlas*, Pickering wrote that water vapor should be expected on the Moon "in the solid form, as hoar frost, in considerable quantities." In addition to water ice and potential vegetation akin to a lichen on the Moon that Pickering envisioned, he was also an advocate for the theory of canals on Mars, which Percival Lowell famously promoted. Pickering made arguments for preferentially investigating canals on the Moon instead of on Mars, in part because of the Moon's proximity to Earth. The point here is not to champion Pickering for being somehow ahead of his time on the lunar water question. But the question remains: when did humanity discover water on the Moon?



→ A plate from Pickering's book *The Moon*, purporting to show ice on the lunar surface. (Image credit: Internet Archive/Doubleday, Page & Company; public domain)

By the time NASA was preparing maps and atlases of the Moon for Apollo, photography reigned supreme with the Ranger and Lunar Orbiter missions. Concerns about water did not meaningfully factor into the planning for the data being collected. With Artemis, questions about water on the Moon, what water ice and other volatiles can tell us about the Moon's history, and water ice's potential for in situ resource utilization on the Moon motivate many of the instrument payloads being sent to the Moon. What accounts for this shift?

The Moon's history was already an active area of scientific debate prior to

Artemis and Water on the Moon (continued)

In the Lunar Biological Laboratory at Ames Research Center, Apollo 11 samples are studied for possible signs of life in 1969. Researchers certainly did not expect to find anything like the ice or lichen imagined by William Pickering decades before, but the field of exobiology could not pass up the opportunity to study the first material returned to Earth from elsewhere in the solar system that was not a meteorite. Signs of life more than signs of water were the focus. (Photo credit: NASA)

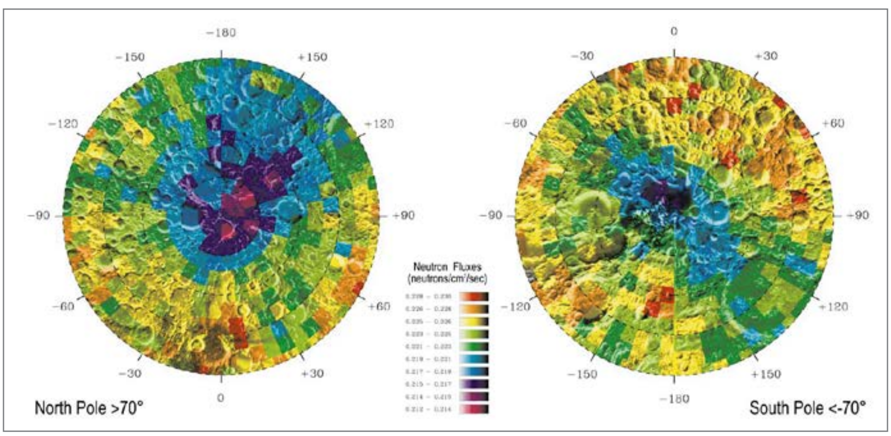
In 2019, NASA scientists at the Lunar Curation Laboratory at the Agency's Johnson Space Center in Houston prepare to open an untouched rock and soil sample from the Moon that was returned to Earth on Apollo 17. This was the first time in more than 40 years that a pristine sample of rock and regolith from the Apollo era had been opened, setting the stage for scientists to practice techniques to study future samples collected on Artemis missions. (Photo credit: NASA/James Blair)

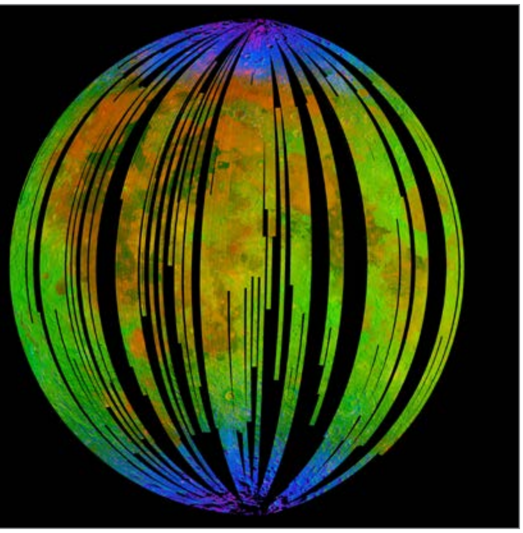
the Space Age. Historian Ron Doel has traced the interdisciplinary nature of the development of solar system research, including the dramatic saga between Gerard Kuiper and Harold Urey in the 1950s that disrupted professional collaborations between astronomers and chemists interested in the origin of the solar system, for which the presence and form of water figures prominently. The terms of that debate—from the theorized thermal evolution of the Moon to the isotopic abundances of protoplanetary matter—are probably more recognizable to lunar scientists today than, say, the claims about canals on Mars that Percival Lowell had advanced a generation earlier.

After Apollo 17, the Moon no longer represented a high-value target for further exploration, given the slate of deep space planetary missions and the development of the Space Shuttle Program. When NASA did return to the Moon in 1994, it was as a partner of the Defense Department on the Clementine mission, for which science was incorporated only in the very late stages of the mission planning. That mission provided a hint that there could be water ice at the poles of the Moon, but it was unclear. A few years later, the first competitively selected mission of the Discovery Program, Lunar Prospector, went to the Moon with lunar science as its primary objective. The least expensive mission of the Discovery program to date, Lunar Prospector returned data showing elevated hydrogen levels at the poles that strongly indicated water. In media reports, the cautious qualifying statements were often dropped, and it was simply reported that water had been discovered on the Moon. A frequent talking point around the time of Lunar Prospector was that 80 percent of the Moon's surface had not been studied by Apollo and that the presence of lunar water could enable a future sustained presence on the Moon.

Since Lunar Prospector, the Moon's surface has been mapped many times

Data from the Lunar Prospector mission were used to create these images with dark blue and purple areas at the Moon's poles indicating neutron emissions consistent with hydrogen-rich deposits. These hydrogen signatures provided stronger indications of water in the form of ice or hydrated minerals than evidence from the Clementine mission did earlier in the decade. (Image credit: NASA/USGS/Los Alamos National Laboratory. Source: Feldmann et al., *Science*, 281, 1496, 1998.)





This image of the Moon from NASA's Moon Mineralogy Mapper on the Indian Space Research Organisation's (ISRO's) Chandrayaan-1 mission shows a three-color composite of reflected near-infrared radiation from the Sun, illustrating the extent to which different materials are mapped across the side of the Moon that faces Earth. Small amounts of water and hydroxyl (blue) were detected on the surface of the Moon at various locations. This image illustrates their distribution at high latitudes toward the poles. The South Pole of the Moon is of particular interest to the Artemis Program. (Image credit: ISRO/NASA/JPL-Caltech/Brown University/U.S. Geological Survey)

over with a variety of instruments on multiple lunar missions, including the Lunar Reconnaissance Orbiter (LRO), still in operation since its launch in 2009. Piggybacking on the LRO launch was an inexpensive and innovative mission, the Lunar Crater Observation and Sensing Satellite (LCROSS), which advanced the search for more definitive information about water ice at the lunar poles by sending the empty upper stage of the rocket into a lunar crater at the South Pole, kicking up a vast plume of ejecta that the LCROSS spacecraft observed and flew through on its way to impact. A few months before LCROSS, the first Indian lunar mission, Chandrayaan-1, also sent an impactor into a crater at the South Pole and returned data that further built upon what Lunar Prospector had collected. Aboard Chandrayaan-1 was a NASA-funded instrument, the Moon Mineralogy Mapper, which returned compelling data that strengthened the case for water ice distributed across the poles in multiple forms, not just bound up in minerals in the way that a saltine cracker could be said to have water. Even the sunlit regions of the Moon have water molecules, as recently confirmed by the Stratospheric Observatory for Infrared Astronomy (SOFIA). The Moon is still incredibly dry compared to Earth, but the amount of water that seems to be at the poles—depending upon its form and how it is specifically distributed—could be significant for future exploration. And unlike during the space race of the Apollo era—a geopolitical race between the United States and the Soviet Union with few examples of participation by other nations—present-day NASA is developing Artemis with a clear emphasis on international collaboration, from developing the Artemis Accords to fostering international partnerships with entities like the European Space Agency, which is developing the service module for the Orion crew capsule.

In this Artemis generation, missions that are preparing to launch, many of them part of the Commercial Lunar Payload Services (CLPS) initiative, will continue to build humanity's presence on the Moon before any humans return. Instruments on the Volatiles Investigating Polar Exploration Rover (VIPER) and other CLPS missions planned to be sent to the Moon in coming years will begin to verify the presence of lunar water in ways not even contemplated during Apollo. Water will undoubtedly be "discovered" on the Moon again, but what it looks like up close and whether it might reasonably be extracted, refined, bottled, and commodified remains to be seen. ■

An artist's concept of the completed design of NASA's VIPER. VIPER will get a close-up view of the location and concentration of ice and other resources at the Moon's South Pole, bringing us a significant step closer to NASA's ultimate goal of a long-term presence on the Moon—making it possible to eventually explore Mars and beyond. (Image credit: NASA/Daniel Rutter)

Precious Mementos of Apollo 17

» By **Jennifer Ross-Nazzal**,
Johnson Space Center

↑ Apollo 17 astronaut Ron Evans poses with his wife, Jan, in November 1972. (Photo credit: NASA)

JAN EVANS climbed aboard a "Jolly Green Giant" helicopter on the night of 6 December 1972 for a chance at a better view of the rocket that NASA would soon launch to the Moon carrying her husband, Ronald E. Evans, one of three men who would be on board later that night. As the helicopter circled the Saturn V that evening, the vehicle stood out against the dark sky. Seeing the red, white, and blue flag on the rocket along with the words "United States" was a meaningful, patriotic moment for Jan: one that still brings tears to her eyes years later.[1] She had been excited about Ron's assignment and his selection to the Apollo 17 crew but recognized that this flight was larger than a single mission. The success of this last landing on the Moon belonged to all Americans and symbolized what citizens had done and could continue to accomplish by working together, united behind a single goal.

> As Commander Eugene A. Cernan said, this was "not the end. It's the end of the beginning."

As Commander Eugene A. Cernan said, this was "not the end. It's the end of the beginning."[2]

Ron had been selected as an astronaut six years earlier. When Jan learned that he met the qualifications for the elite group, her husband was on the U.S.S. Ticonderoga flying missions over Vietnam and would miss the application deadline. So Jan, his biggest supporter, placed a call to the head of Flight Crew Operations, Deke Slayton. Ron was interested—would he accept a late application? Slayton assured her he would.[3] Ron ended up being selected as part of the fifth group of astronauts, known as the Original Nineteen: some of whom, like Ron, flew to the Moon, while others flew on Skylab and the Space Shuttle.

At an Apollo 17 crew press conference, Ron, the Command Module pilot, mused on his desire to be an astronaut. He realized he wanted to do something for his country and asked himself, "What can I do in this day and age?" He could not explore as Lewis and Clark had, but "Apollo 17 is going to fill that possibility," he told reporters sitting in the Apollo News Center.[4]

The Apollo 17 crew exuded pride in their country and its achievements in space, eventually selecting America as the name of the Command Module. Wanting the designation "to mean something," the crew purposefully named its spacecraft for the people and country who made the program possible through their courage, sacrifice, and dedication.[5]

↑ Jan Evans's pendant and moonstone ring, which were flown aboard Apollo 17. Designed by jeweler Mike Koven, the jewelry symbolized the crew and their family's excitement about the mission. (Photo courtesy of Jan Evans)

Over the course of their training, Ron became known as "Captain America" for not only piloting their spacecraft, America, but for his recognized patriotism. Ron was "ecstatic" about his title—you might say he was over the Moon about it—and the media took to calling him by the moniker for his visible support of the country, frequently demonstrated by his red, white, and blue outfits.[6]

When they were first selected to the flight, the Evans and Cernan families considered how they might capture the excitement of Apollo 17, and their assignment triggered a desire to preserve the spirit of the historic flight through a somewhat unique medium, jewelry. To celebrate the crew's accomplishments, their wives and a few family members would receive specially designed pieces that symbolized the crowning achievement of their careers. The pieces would be especially meaningful because they would also be flown to the Moon.

Gene and Ron began working with a longtime family friend of the Evanses at Larson's Jeweler in Scottsdale, Arizona, jeweler Mike Koven. Jan and Ron wanted three pendants made, one for her and two smaller ones for their mothers. Jan also wanted a moonstone ring. Gene requested a pendant necklace for his wife, Barbara, and another for his daughter, Tracy. Koven set about designing the pieces and corresponded with the astronauts and their wives by mail. Both astronauts approved the final designs in July 1972.[7]

Jan's pendant symbolized the excitement of the mission and Ron's contributions. She told Koven that she wanted the pendant to resemble the shape of the Command Module and to include Ron's naval aviator wings. The final design also includes an etching of the lunar terrain of Taurus-Littrow, where the Apollo Lunar Module would take off from the Moon for the last time. (Koven said he sketched the site from a photograph.) On the left-hand side of the pendant sits a large diamond, along with Ron's wings and a modern-looking "17" made of 10 smaller diamonds. The pendant is 1¾ inches long and 1½ inches wide.[8] The smaller pendants featured similar designs without the diamonds. Barbara Cernan's pendant also featured a "17" created out of 11 diamonds, topped with a 1-carat diamond. Tracy's included a moonstone with the "17" finished in black enamel.

Jan gave Koven free rein over the design of her moonstone ring. The 19-carat stone includes three small diamonds. Instead of a single band, the jeweler chose to include several bands to give the piece a spherical appearance and to capture "the feeling of space."[9]

In November, Koven shipped the pieces to Cape Canaveral so they could be included on the flight. Ron's pieces made it into his personal preference kit, along with the couple's wedding bands. Koven, a guest of the crew, traveled to the Cape to witness the launch in person, and the pendant and moonstone ring he had designed for Jan traveled to the lunar surface with Commander Cernan and Lunar Module Pilot Harrison H. "Jack" Schmitt.[10]

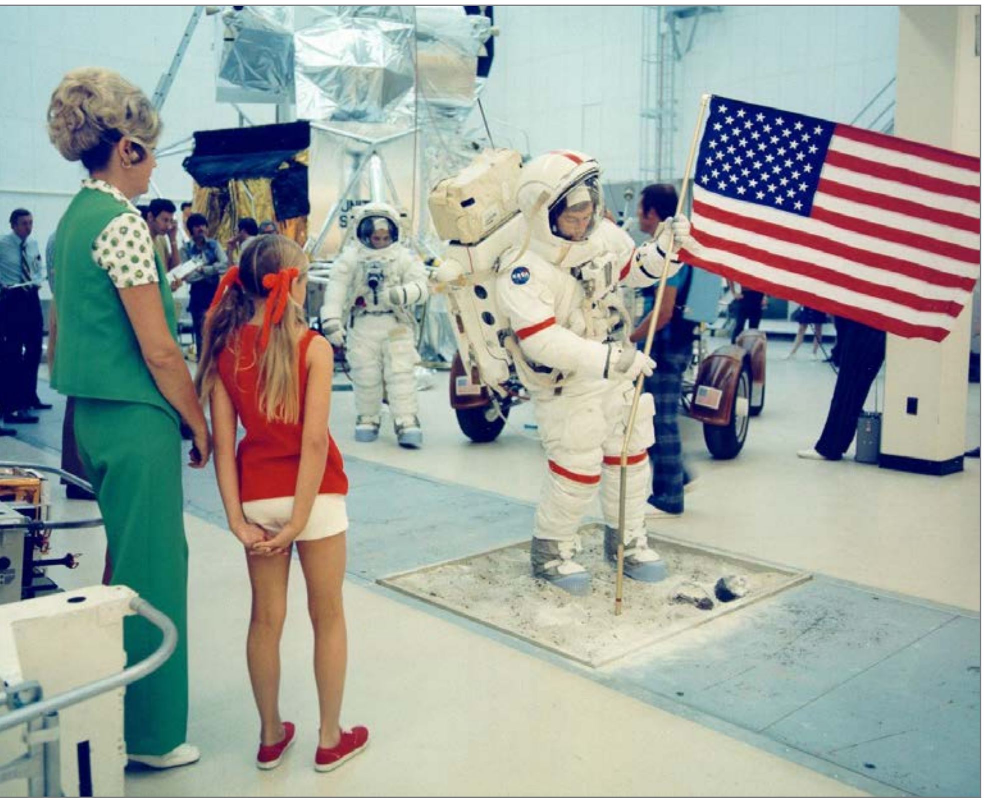
When the crew returned home to Houston, Captain America and his family drove from Ellington Air Force Base and turned down Lake Shore Drive, the main entrance into their neighborhood, where they were greeted by hundreds of American flags lining both sides of the entire street. People carried flags on horseback, and young children decorated their bikes and tricycles with red, white, and blue. Like the Evanses, their neighbors and friends were proud of what the crew, NASA, and America had accomplished.[11] Jan wore the one-of-a-kind

The Evanses' jewelry, flown aboard Apollo 17 and publicly shown here for the first time, reflects one of the ways in which the Apollo crews and their families commemorated their flights.

mementos they had commissioned, but, she admits, they are not everyday pieces. Today, she regularly dons a silver crew medallion that Koven also made for her. She also wears a cross that Koven crafted from Ron's wedding band after he passed away in 1990.[12]

This December, with the 50th anniversary of the Apollo 17 flight, NASA will celebrate the final mission of this historic program. But there are other reasons to contemplate the flight, including the impact the flight had upon the crew and its family members, how they saw the mission, and how they demonstrated their passion for spaceflight. The Evanses' jewelry, flown aboard Apollo 17 and publicly shown here for the first time, reflects one of the ways in which the Apollo crews and their families commemorated their flights. The symbolism of the pendants and the ring captures the patriotism felt by the astronauts and their wives and illustrates their belief in the promise of the Apollo program. While Apollo is a well-documented engineering accomplishment, there is still much more to learn about the cultural and social influence of these flights. ■

↓ Apollo 17 astronaut Gene Cernan trains for a lunar extravehicular activity in August 1972 while his wife, Barbara, and daughter, Tracy, watch. (Photo credit: NASA)



Endnotes

1 The crew officially lifted off the pad on 7 December at 12:33 a.m. EST. Geoffrey Bowman, *A Long Voyage to the Moon: The Life of Naval Aviator and Apollo 17 Astronaut Ron Evans* (Lincoln: University of Nebraska Press, 2021), p. 238.

2 Andrew Chaikin, *A Man on the Moon: The Voyages of the Apollo Astronauts* (New York: Penguin Books, 1994), p. 505.

3 The U.S.S. Ticonderoga, on which Ron served, also recovered the crew and their capsule. Chaikin, *A Man on the Moon*, pp. 499–500.

4 Apollo 17 Press Conference, 10 November 1972, transcript, p. 3, Johnson Space Center (JSC) History Office, Houston, TX.

5 Ibid., p. 2.

6 Bowman, *A Long Voyage to the Moon*, p. 236; "Cmdr. Ron Evans—The First KU Alumnus in Space," University of Kansas, https://union.ku.edu/fly-us-moon (accessed 6 September 2022).

7 Jan Evans, phone conversation with author, 28 August 2022; Jerry McElfresh to John McLeaish, "Jewelry Made for Apollo 17 Crew," *Scottsdale Daily Progress* (26 December 1972), Apollo Series, 074-31, JSC History Collection, UHCL, Houston, TX.

8 Jan Evans, e-mail message to author, 29 August 2022.

9 McElfresh to McLeaish, "Jewelry Made for Apollo 17 Crew"; phone conversation with Evans.

10 Ibid.

11 Jan Evans, oral history with author, 7 August 2003, transcript, JSC Oral History Project, https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/oral_histories/EvansJM/EvansJM_8-7-03.htm (accessed 26 September 2022).

12 Phone conversation with Evans.

Mississippi Test Facility's Transition to the Post-Apollo Era

» By **Jessica Herr**, Stennis Space Center

NEARLY 50 YEARS AGO, on 7 December 1972, Apollo 17, the final mission of the Apollo program, was launched. In the background of finishing the Apollo-era testing, the Mississippi Test Facility (MTF, now known as NASA's Stennis Space Center [SSC]) was working on the next thing. Roy Estess, an engineer at MTF, was assigned to put together a presentation to convince NASA to select the facility for the Space Shuttle Program's engine testing. In December 1970, Estess went into NASA Headquarters and gave his presentation to a board of NASA managers and spoke of the low cost of facility modifications that would be needed for the Space Shuttle main engine tests, the test experience already at the facility because of Apollo testing, and the local communities' willingness to support the program. Jerry Hlass, a student at George Washington University working on his master's thesis, also had the ear of the NASA Site Evaluation Board. His thesis titled "Search for a Role for a Large Government Facility," focused on the Space Shuttle Program and the use of the MTF. When asked his opinion, Hlass, who later led the Mississippi facility as its director, gave his case for MTF. On 1 March 1971, it was announced that the Mississippi Test Facility had been selected for the "sea-level testing of the rocket engines to power the Space Shuttle."

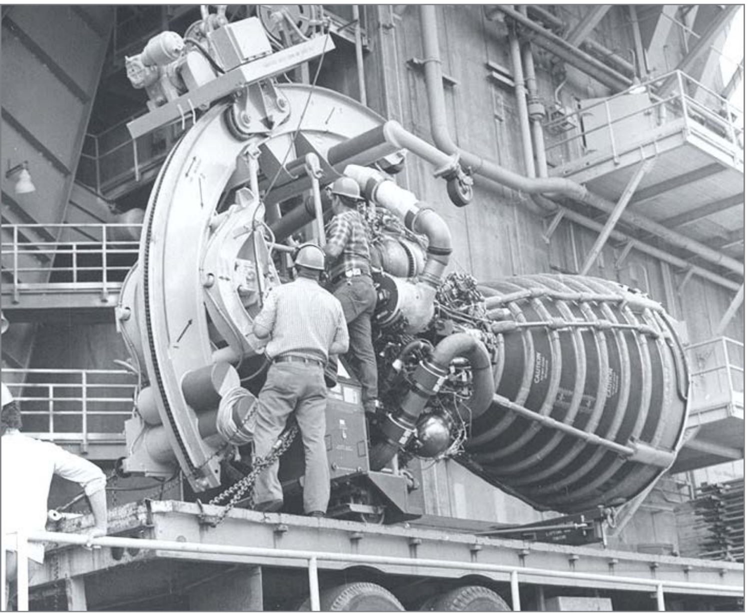
MTF jumped at the chance to test the engines that would power the Shuttle fleet. An effort to have Shuttle engines manufactured at Michoud Assembly Facility (MAF) in nearby New Orleans and tested at MTF went into motion. One of the companies entering bids for the project was the Lockheed Propulsion Company, which embraced the idea of using MAF and MTF to perform the work. Other companies putting in bids for the work were Thiokol Chemical Corporation, Aerojet Solid Propulsion Company, and United Technology Center.

Apollo 17 launches shortly after midnight on 7 December 1972. (Photo credit: NASA)

With bids submitted, a delegation of elected officials, community leaders, and businesspeople from Louisiana and Mississippi began lobbying for the work to come to their states. In late 1973, the award was given to Thiokol Chemical Corporation. The local community around MAF and MTF were angered by the choice since just a few years earlier, MTF had been named "the nation's foremost propulsion test site."

The announcement set off a series of events that would shape the future of MTF: the protest of the solid rocket motor contract award to Thiokol; calls for "full utilization of MTF" by U.S. Senator John C. Stennis, U.S. Representative Trent Lott, and other Mississippi and Louisiana officials; and a campaign for renaming the facility and establishing it as an independent NASA installation no longer under the direction of Marshall Space Flight Center in Huntsville, Alabama.

Senator Stennis spearheaded the movement, and on 14 June 1974, the Mississippi Test Facility was renamed the National Space Technology Laboratories (NSTL) and became an independent installation of NASA, reporting to NASA Headquarters. Stennis said the "efforts to increase the use of NSTL by NASA and other federal agencies [would] now be more successful than ever before." Site Director Jackson Balch was pleased with the changes, saying "it will be kind of nice to be a member of the club."



Just a year later, on 24 June 1975, a brief, but very important event occurred at the newly independent site, the first ignition test of a Space Shuttle main engine. Lasting just a second, it marked the return to propulsion testing for NSTL and opened the door for testing projects to follow, including the current engine tests that will eventually carry humans farther into space than ever before.

Source information for this article comes from *Way Station to Space: A History of the John C. Stennis Space Center*, by Mack R. Herring.

← Technicians install Space Shuttle flight engine 2007 into the A-1 test stand on 13 April 1979. (Photo credit: NASA/SSC)

News from NASA's Centers

NASA Headquarters

Washington, DC

» By **Michele Ostovar**

This summer, the History Office at NASA Headquarters benefited from the efforts of four interns working remotely from their homes: undergraduates Sedrick Billups, Priscilla Foreman, and Madelyn Pollock, as well as Columbia University graduate student Aneka Kazlyna. While we were sorry to say goodbye to Sedrick as he returned to his studies at the University of West Alabama, we are pleased to welcome the remaining three of our summer interns back this fall. Priscilla and Madelyn are continuing their work part-time, while Aneka returns as a full-time intern working with both History and the NASA Astrobiology Program. Speaking of astrobiology, our newest intern, Olivia Reste, will also be exploring the topic for her internship this fall. Olivia, a junior at Rutgers University in New Brunswick, New Jersey, is a biochemistry major with minors in astrobiology and physics. Olivia, Priscilla, and Madelyn are working hard to generate engaging content for NASA History's social media presence on Twitter and Facebook, and we look forward to including their research articles in the next edition of *News & Notes*.

Johnson Space Center (JSC)

Houston, TX

» By **John Uri**, **Jennifer Ross-Nazzal**, **Sandra Johnson**, and **Jessica Kelly**

Jennifer Ross-Nazzal's book *Making Space for Women: Stories from Trailblazing Women of NASA's Johnson Space Center*, published in January 2022 by Texas A&M University Press, continues to receive much interest. The book explores how careers for women at JSC have changed over the years, as told by the women themselves through oral history narratives. Jennifer has had the opportunity to speak about her book at several invited venues both inside and outside NASA. The book is featured in the fall 2022 edition of the NASA Libraries newsletter, and a write-up is included in the July issue of Stennis Space Center's newspaper, the *Lagniappe*.

The JSC History Office continues to participate in oral history projects to capture the history of NASA's Discovery Program for its upcoming 30th anniversary. Sandra Johnson

News from NASA's Centers (continued)

↑ Jennifer Ross-Nazzal's book *Making Space for Women* is featured in the current edition of the *NASA Libraries* newsletter. (Image credit: NASA/Michael Pritz)

and Erik Conway, the Jet Propulsion Laboratory (JPL) historian, are conducting interviews that will serve as material for a comprehensive website that will celebrate the program's milestone. Thus far, the interviews conducted have been with Discovery Program management, project and science managers, and principal investigators involved in the Discovery Program missions. The interviews will continue into FY 2023.

Sandra and James Anderson, the Ames Research Center (ARC) Historian, kicked off a new project to capture oral histories from the Volatiles Investigating Polar Exploration Rover (VIPER) resource mapping mission project team. On its planned 100-day mission on the Moon, the robot will use a specialized drill and spectrometers on board to look for concentrations of water ice that could be harvested on future exploration missions to sustain a human presence on the Moon and potentially other celestial bodies. Once the robot is transported to the Moon's South Pole region by commercial partners through the Commercial Lunar Payload Services (CLPS) initiative, the mission will represent the largest payload delivered so far by that cooperative program. The oral histories are expected to continue into the next fiscal year and include sessions with team members across the Agency.

The JSC History Office also continues its involvement with several presentations and publications. Jennifer Ross-Nazzal and Steve Garber at NASA Headquarters have continued their work on a chapter in an upcoming book entitled *Stars in Space: Makers of the United States Space Force* that aims to use the experiences of selected leaders in space to enhance the understanding of character and leadership in military space.

The JSC History Office's spring intern, Jessica Kelly, returned for the summer semester and completed her assigned work creating metadata for the existing scanned content of the JSC History Collection using a template created by Goddard Space Flight Center archivists and standards provided by the NASA acting Chief Archivist for ingesting into Archivematica and AtoM. She also wrote guidelines and procedures for future interns working on this project and was a valuable asset to the team. We were sad to see Jessica's time with us come to an end, but she is now an intern at NASA's Goddard Space Flight Center in Greenbelt, Maryland, working with the acting Chief Archivist. Our loss is Goddard's gain.

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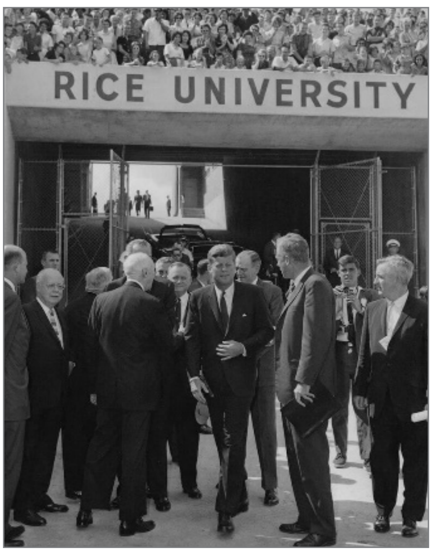
Remembering JFK's Moon Landing Speech at Rice University

» By **John Uri**, Johnson Space Center

President Kennedy addresses a crowd in Rice University's stadium, reaffirming his support for America's space program, including landing a man on the Moon. (Photo credit: NASA/JSC)

ON 12 SEPTEMBER 1962, President John F. Kennedy addressed a large crowd at Rice University in Houston during a two-day tour of space facilities across the country. During the speech, the President recommitted the nation to the Moon landing goal he had proposed to Congress in May 1961. In the intervening 16 months, NASA had made rapid and significant progress toward achieving that goal. The Agency had established new Field Centers; started new spaceflight programs; and begun designing, building, and testing some of the hardware that led to the fulfillment of President Kennedy's goal, the first human Moon landing in July 1969. Impressed by the progress he saw during his two-day tour, the President felt confident to recommit the nation to the Moon landing goal.



President John F. Kennedy arrives in Rice University's football stadium. (Photo courtesy of Woodson Research Center, Fondren Library, Rice University)

The morning of 12 September, the motorcade brought the President to Rice University. Kenneth S. Pitzer, president of Rice University, escorted President Kennedy into the football stadium and introduced him to the assembled crowd of 40,000 people. Classes at Rice had not yet resumed for the fall term, but first-year students had arrived for orientation and attended the ceremony, along with schoolchildren bused in from around Houston for the event. In the speech officially titled the "Address at Rice University on the Nation's Space Effort," President Kennedy repeated comments he had made in Huntsville and Cape Canaveral that although the Soviet Union had taken the initial lead in the space race, the United States space program had made bold strides to catch up and that he intended America to take the lead in the coming years. Linking this forward progress with where he spoke, Kennedy said, "…this city of Houston, this State of Texas, this country of the United States was not built by those who waited and rested and wished to look behind them." He continued, "We set sail on this new ocean because there is new knowledge to be gained…and used for the progress of all people." The President addressed those who doubted the Moon landing goal, saying, "But why, some say, the moon? Why choose this as our goal? And they may well ask why climb the highest mountain. Why, 35 years ago, fly the Atlantic?" In a line not in the original speech, he added his own penciled-in question, "Why does Rice

Top: A view of the crowd in Rice stadium during the President's address. (Photo credit: Robert Knudsen, White House Photographs) **Bottom:** Kennedy and his motorcade depart the Rice University stadium. (Images courtesy of the JFK Library)

play Texas?" that drew so much cheering it nearly drowned out his next point, perhaps the most often-remembered of the speech. Prepared to answer his own question, he eloquently reaffirmed the commitment he had made before Congress in May 1961:

> We choose to go to Moon in this decade and do the other things, not because they are easy but because they are hard; because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one we intend to win, and the others, too.

To close his speech, the President referred to British mountaineer George Mallory, who, when asked why he wanted to climb Mount Everest, replied, "Because it is there." President Kennedy concluded, "Well, space is there, and we're going to climb it, and the moon and the planets are there, and new hopes for knowledge and peace are there. And, therefore, as we set sail we ask God's blessing on the most hazardous and dangerous and greatest adventure on which man has ever embarked."

Over the decades, Rice University has maintained strong ties with NASA, establishing the nation's first dedicated space science department in 1963 and the Rice Space Institute (RSI) in 2000. Rice counts 15 astronauts among its alumni, as well as former NASA Administrator Jim Bridenstine, who, in April 2019, to celebrate the 50th anniversary of the first Moon landing, the fulfillment of President Kennedy's challenge to the nation, gave a speech outside Rice Stadium and unveiled a plaque commemorating the site of President Kennedy's 1962 historic speech.

On 12 September 2022, JSC and Rice University commemorated the 60th anniversary of President Kennedy's speech with a public event in the university's stadium. Reminiscent of the event in 1962, thousands of schoolchildren from around Houston attended the ceremony. The world has changed dramatically in the past 60 years, but the nation once again finds itself boldly committed to returning astronauts to the Moon. This time, the Artemis program will land the first woman and the first person of color on the Moon, leading to a permanent presence on the lunar surface as a stepping-stone to exploration missions to Mars. As a parallel to the event in 1962, Rice University President Reggie DesRoches, along with RSI Director David Alexander, introduced the event and provided their perspective on the anniversary of the speech. NASA Administrator Bill Nelson and JSC Director Vanessa E. Wyche recalled President Kennedy's words, challenging the nation to accomplish the hard things like the Moon landing, and reflected on how those words are still relevant today as the nation once again prepares to set sail on the new ocean to gain new knowledge for all humanity, this time with the participation of international partners and commercial entities, to achieve these goals. ■

Video of President John F. Kennedy's 1962 speech plays above the stage of the commemoration event. (Photo credit: NASA/JSC/James Blair)

Other Aerospace History News

American Astronautical Society (AAS) History Committee

» By **Michael Ciancone**, Chair

2021 Emme Award for Astronautical Literature

The Emme Award, named for NASA's first historian, Eugene M. Emme, recognizes outstanding books that advance public understanding of astronautics based on originality, scholarship, and readability. The Emme Award Panel, composed of Dr. Rick Sturdevant and Dr. Jennifer Levasseur and chaired by Dr. Don Elder, guided the review of submitted and solicited titles.

The recipient of the **2021 Emme Award** is *The Burning Blue* (Holt Publishing), by **Kevin Cook**.

2022 Ordway Award for Sustained Excellence in Spaceflight History

The Ordway Award is named in memory of Frederick I. Ordway III (1927–2014), human spaceflight advocate and chronicler of the history of rocketry and space travel. The award recognizes exceptional, sustained efforts to inform and educate on spaceflight and its history through one or more media, such as 1) writing, editing, or publishing; 2) preparation and/or presentation of exhibits; or 3) production for distribution through film, television, art, or other nonprint media. The award is managed by the Ordway Panel of the AAS History Committee. Members of the Panel are Michael Ciancone (chair), Robert Godwin, Dr. Valerie Neal, Ron Miller, Robert Pearlman (2021 recipient), and Dr. Asif Siddiqi (2021 recipient).

The 2022 recipients of the Ordway Award are as follows. They will be recognized for this award at the Goddard Memorial Symposium in March 2023.

Andrew Chaikin is recognized for his role in reintroducing and popularizing space exploration history through his celebrated books and articles. His work focusing on the Apollo astronauts has been credited with reigniting the public's interest in the Moon landings 25 years after the last step was taken off the lunar surface. Chaikin is perhaps best known as the author of *A Man on the Moon: The Voyages of the Apollo Astronauts*, which has been widely held as the definitive account of the first Moon missions. Published in 1994, the book served as the primary basis for Tom Hanks's 12-part HBO miniseries, *From the Earth to the Moon*.

Pamela Lee is one of the most respected artists specializing in space travel and astronomy. She was a founding member of the International Association of Astronomical Artists, an organization representing space artists from around the world, and has long been a member of the NASA Fine Art Program. She has specialized in depicting historic events and people. Her paintings have flown on the Space Shuttle and Mir, and they have been carried to Mars by the Phoenix Mars Lander and the Mars 96 Lander. Lee has been active in using art to promote international education and cooperation.

International Academy of Astronautics History Series

Univelt has published the last two volumes in the International Academy of Astronautics (IAA) History Series that fall under their publishing arrangement with AAS: *Proceedings of the 52nd History Symposium of the International Academy of Astronautics (IAA)*, edited by Hannes Mayer, and *Proceedings of the 53rd History Symposium of the International Academy of Astronautics (IAA)*, edited by Otfrid G. Liepack. The AAS would like to recognize Dr. Rick Sturdevant for his service as Series Editor since 2009, during which time we have published 22 volumes in the series. The AAS would also like to acknowledge the decades-long Univelt publishing effort under the stewardship of Horace and Robert Jacobs.

Other Aerospace History News (continued)

Call for Proposals for Policy History Conference in June 2023

» By **Donald Critchlow**, Arizona State University Katzin Family Professor of History

The Institute for Political History, the *Journal of Policy History*, and the newly established Arizona State University Center for American Institutions are hosting the Policy History Conference in Columbus, Ohio, on 7–9 June 2023.

Panel and paper proposals on all topics regarding American political and policy history, political development, and comparative historical analysis are currently being accepted. Complete sessions, including two or three presenters with chair/commentator(s), and individual paper proposals are welcome. Participants may appear only once as a presenter in the program. The deadline for submission is 31 December 2022.

Proposals for papers must be submitted using the web form.

Pwyll Crater on Europa as imaged by the Galileo spacecraft in March 1998.

Application Deadline Approaching for the Blumberg Chair

Applications are currently being accepted from distinguished scholars for the Baruch S. Blumberg NASA/Library of Congress Chair in Astrobiology, Exploration, and Scientific Innovation. As a partnership between NASA's Astrobiology Program and the Library of Congress, the Blumberg Chair, an annually selected position, supports a scholar in the sciences, humanities, or social sciences to take up residence in the Library's John W. Kluge Center.

The Blumberg Chair creates an opportunity to research the range and complexity of societal issues related to how life begins and evolves and to examine philosophical, religious, literary, ethical, legal, cultural, and other concerns arising from scientific research on the origin, evolution, and nature of life.

Within the parameters of NASA's mission, a Chair might also seek to investigate how innovative quests for fundamental understanding may lead to major developments for the betterment of society. Barry Blumberg, for whom the Chair is named, conducted groundbreaking research addressing a simple but fundamental question: Why do some people get sick while others, exposed to the same environment, remain healthy? That this work unexpectedly led to the discovery of the hepatitis B virus, the development of a vaccine, and the awarding of the Nobel Prize in Physiology or Medicine illustrates the potential for unconventional thinking about fundamental questions to yield great rewards. Using methodologies from the history and sociology of science; the philosophy of science; legal, political, and cultural history; and other disciplines, a Chair might study and tell the story of how a basic research initiative led to completely unexpected discoveries and applications.

Completed applications are due by 15 October 2022. For further information, please consult the Kluge Center's Web page: https://www.loc.gov/programs/john-w-kluge-center/chairs-fellowships/chairs/blumberg-nasa-chair-in-astrobiology/.

Submissions Sought for Spaceflight History Journal *Quest*

» By **Christopher Gainor**, *Quest* editor

The academic peer-reviewed journal dedicated to the history of spaceflight, *Quest: The History of Spaceflight Quarterly*, is about to begin its 30th year of publication. Featuring historical articles, oral history interviews, and book reviews about the history of space exploration relating to space programs from around the world, *Quest* is seeking articles about spaceflight history for its upcoming issues. Articles can be submitted to *Quest* editor Christopher Gainor. Additionally, *Quest* is looking for reviews of books on spaceflight history. If you are interested in reviewing books for *Quest* or know someone who is, please contact the editor. Those who contribute an article receive four free issues of *Quest*, and each published book review gets the reviewer one free issue of *Quest*.

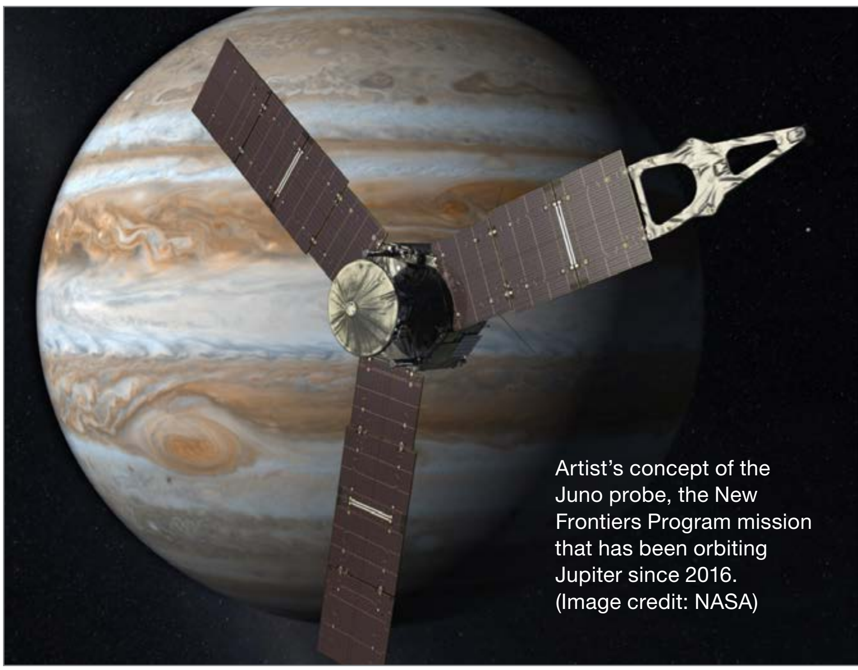
Quest is also seeking entries for the 2022 Sacknoff Prize for original research in spaceflight history by undergraduate or graduate students. The deadline for submitting articles for this prize for 2022 is 30 November. Submission instructions are available at https://spacehistory101.com/space-history-resources/sacknoff-prize/.

Comments or suggestions about future directions for *Quest* are always welcome. To subscribe or find more information, visit https://spacehistory101.com/about-quest/.

Call for Papers for Discovery@30, New Frontiers@20: A Symposium on the History of NASA's Discovery and New Frontiers Programs

» By **Brian Odom**, Marshall Space Flight Center

Date: 12–13 October 2023
Location: Washington, DC (Location TBD)



Artist's concept of the Juno probe, the New Frontiers Program mission that has been orbiting Jupiter since 2016. (Image credit: NASA)

Congress approved NASA's Discovery Program in 1993, initiating a new era of lower-cost, competed missions to explore the solar system. Like NASA's older Explorer program of astronomy and astrophysics missions, these missions were to be developed and led by principal investigators. In 2002, based on the model of Discovery but recognizing a need for medium-class science missions to tackle questions identified in the Decadal Survey, NASA initiated the New Frontiers Program. Over the past 30 years, missions from these two programs have transformed our understanding of our solar system and have accomplished historic firsts. They have also redefined the role of science and scientists in the development of planetary science missions, even as this willingness to experiment with innovative management approaches created a tension with an often risk-averse NASA.

The NASA History Office and the Smithsonian's National Air and Space Museum invite proposals for papers to be presented at a two-day symposium to be held 12–13 October 2023 in Washington, DC. We welcome diverse voices and perspectives to examine the history of the Discovery and New Frontiers Programs, their successes and failures, and their impact on knowledge and the practice of planetary science.

The symposium will be a combination of panel discussions, keynote talks, and group discussion. The intention is to publish an anthology of selected papers.

Potential topics for papers include, but are not limited to the following themes:

- **Why We Explore.** What do Discovery and New Frontiers missions tell us about our motivations for exploration?
- **Societal Impact.** What have the results of Discovery and New Frontiers missions meant for science and society?
- **Origin and Impact.** What are the benefits and challengers of the Discovery and New Frontiers models of exploration?
- **Indigenous Perspectives.** What has the indigenous experience in the field been and how might further participation inspire new understandings of and approaches to solar system exploration?
- **Firsts and Milestones.** What contributions have Discovery and New Frontiers missions played in defining the timeline of exploration?
- **Risk and Reward.** What is the role of the principal investigator and what challenges do they face?
- **Major Discoveries.** How have Discovery and New Frontiers missions surprised us?
- **Technological Evolution.** How have the fields of robotics and systems engineering changed in the last 30 years? How have these changes made new missions/capabilities possible?
- **Commercial and International Perspectives.** What impact have commercial and international participation had on the programs?
- **The Missions of Tomorrow.** What's next for the Discovery and New Frontiers Programs?

Submission Procedure

If you wish to present a paper, please send the title, an abstract of no more than 400 words, and a short biography or curriculum vitae, including affiliation, by 1 May 2023 to Dr. Brian C. Odom, NASA's Acting Chief Historian. Questions about the symposium are also welcome.

Upcoming Meetings

19–22 OCTOBER 2022

2022 Oral History Association Annual Meeting
Los Angeles, California
https://www.oralhistory.org/annual-meeting/

10–13 NOVEMBER 2002

Society for the History of Technology Annual Meeting
New Orleans, Louisiana
https://www.historyoftechnology.org/

17–20 NOVEMBER 2022

2022 History of Science Society (HSS) Annual Meeting
Chicago, Illinois
https://hssonline.org/page/hss22

7–10 DECEMBER 2022

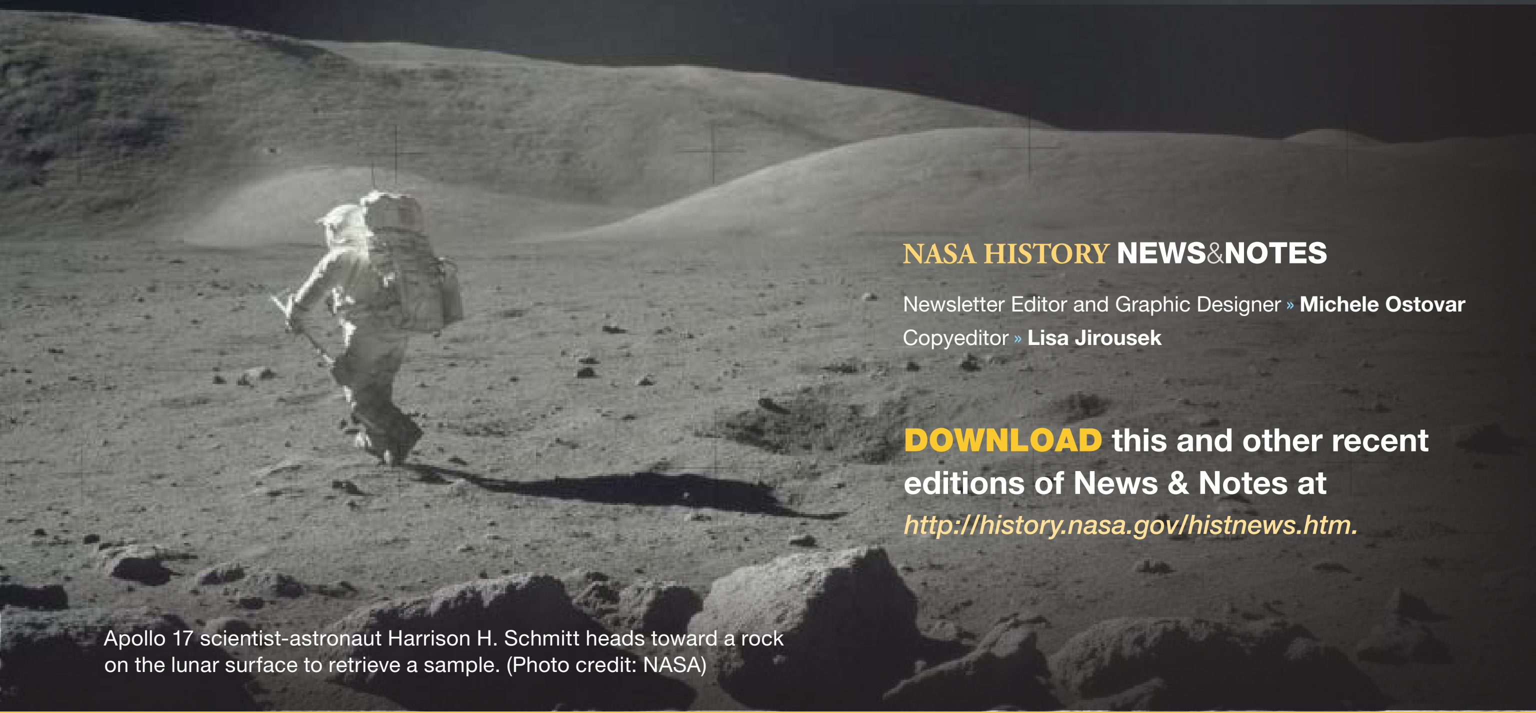
Joint meeting of the Society for Social Studies of Science (4S) and ESOCITE (Asociación Latinoamericana de Estudios Sociales de la Ciencia y la Tecnología)
Cholula, Mexico
https://www.4sonline.org/meeting/

5–8 JANUARY 2023

American Historical Association 137th Annual Meeting
Philadelphia, Pennsylvania
https://www.historians.org/annual-meeting

23–27 JANUARY 2023

2023 American Institute of Aeronautics and Astronautics (AIAA) SciTech Forum
National Harbor, Maryland, and online
https://www.aiaa.org/scitech



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Apollo 17 scientist-astronaut Harrison H. Schmitt heads toward a rock on the lunar surface to retrieve a sample. (Photo credit: NASA)

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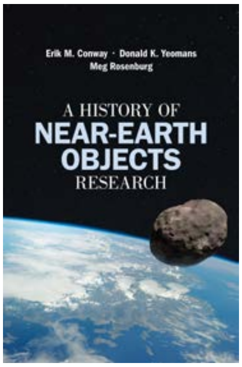

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