National Aeronautics and
Space Administration

NASA HISTORY NEWS & NOTES

Volume 42, Number 2 Summer 2025

LEADERSHIP & DECISION-MAKING

An illustration depicts the Galileo spacecraft being deployed with Shuttle-Centaur. (Credit: NASA)

NASA HISTORY OFFICE
OFFICE OF COMMUNICATIONS

From the Chief Historian

The Apollo 8 prime crew—astronauts Frank Borman, James A. Lovell Jr., and William A. Anders—pose for a photo as their Apollo 8 space vehicle leaves the Vehicle Assembly Building on October 9, 1968, on its way to the launch pad. The Saturn V had just completed its final uncrewed test flight (Apollo 6) six months earlier. (Credit: NASA)

NASA'S IS A HISTORY MARKED by critical decisions. From George Mueller's 1963 decision for "all up" testing of the Saturn V rocket to Michael Griffin's 2006 decision to launch a final servicing mission to the Hubble Space Telescope, the agency has continually met key inflection points with bold decisions. These choices, such as the decision to send a crewed Apollo 8 mission around the Moon in December 1968, stand at the center of the agency's national legacy and promote confidence in times of crisis.

While we usually assume that those decisions were always the agency's to make, often decisions are limited by political, budgetary, cultural, and technological constraints that drive decision-makers into a narrow envelope of choices. In celebrating the historic decisions that led to monumental successes, we've often had to move on from decisions that ended years of previous intellectual and financial commitment or, worse still, resulted in unforeseen catastrophic failures.

Theorists have developed seemingly endless models for explaining decision-making. There are those that assume we reach our conclusions based on a judicious evaluation of available data with a goal of maximizing overall benefits to ourselves (rational choice

From the Chief Historian (continued)

theory), those that underscore the limitations of our reason and completeness of the information at our disposal (bounded rationality), and those that suggest we prefer smaller gains in the face of greater risk (prospect theory). Throughlines in most of these theories are the questions of how exactly decision-makers understand available information, available options, and the stakes at play in individual decisions.

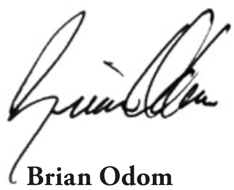
Notably, Diane Vaughan has observed that although it is not a private enterprise, NASA is not free from shared constraints. According to Vaughan, survival in an "environment populated by competitors, suppliers, customers, and controllers, all organizations must compete for scarce resources."[1] These pressures drive the processes that shape organizational culture and limit decision-making in most all instances. In this constrained environment, managers "do not weigh all possible bad outcomes" and rely instead on a smaller range of data points.[2]

Under such constraints, "the magnitude of possible bad outcomes is more salient" making cultures more risk-averse as the stakes involved increase.[3] Although there remains a cost-benefit analysis surrounding individual decisions, choices made by managers are "constrained by institutional and organizational forces."[4] In an effort to reduce uncertainty, decision-making becomes guided by "rule-following" and a narrowing of the role of rationality. The result is a culture in which "performance is described as 'satisficing' rather than optimizing" and the process for managers is more aptly described as "muddling through."[5]

Charged as it is with exploring the heavens for the benefit of humanity, decision-making at NASA takes on an elevated level of importance. From branch managers to NASA's Office of the Administrator, agency leaders are all tasked with the formidable challenge of aligning aspirational goals with available resources while solving complex technical challenges and accepting evaluated risks.

"History serves as a vital guide for decision-makers by assembling the evidentiary record, collecting institutional memory, and contextualizing and analyzing past decisions.

History serves as a vital guide for decision-makers by assembling the evidentiary record, collecting institutional memory, and contextualizing and analyzing past decisions. By assessing the decisions of previous leaders, current decision-makers can work to avoid repeating the mistakes of the past and use historical context to improve strategic thinking and recognize recurring patterns surrounding sophisticated technologies and organizational culture. As we move forward into the great unknown, Isaac Newton's adage that we "stand on the shoulders of giants" has never been more resonant or germane. ■



Brian Odom
Chief Historian

On October 31, 2006, NASA Administrator Michael Griffin announces the decision to reinstate the Hubble Space Telescope's Servicing Mission-4. (Credit: NASA)

Endnotes

1. Diane Vaughan, *The Challenger Launch Decision: Risky Technology, Culture, and Deviance at NASA* (Chicago: University of Chicago Press, 1996), p. 35.
2. Ibid., p. 37.
3. Ibid.
4. Ibid.
5. Ibid., pp. 37–38.

Shuttle-Centaur

Loss of Launch Vehicle Redundancy Leads to Discord

An early rendering of the Space Shuttle deploying a Centaur stage on orbit. (Credit: NASA)

» By **Robert Arrighi**, NASA Historian and Archivist

"ALTHOUGH THE Shuttle/Centaur decision was very difficult to make, it is the proper thing to do, and this is the time to do it."[1] With those words on June 19, 1986, NASA Administrator James Fletcher canceled the intensive effort to integrate the Centaur upper stage with the Space Shuttle to launch the Galileo and Ulysses spacecraft. The decision, which was tied to increased safety measures following the loss of Challenger several months earlier, brought to the forefront the 1970s decision to launch all U.S. payloads with the Space Shuttle.

In the 1960s, there was no shortage of proposals for future post-Apollo human space missions, but with decreasing budgets on the horizon, support grew for a reusable crewed spacecraft capable of making frequent trips into low-Earth orbit. Advocates of the Space Shuttle predicted that investment would be offset by the ability to fly multiple missions each month. That goal could only be met by assigning every satellite, telescope, and spacecraft launch to the Shuttle.

Since the early 1960s, NASA and the Air Force had purchased expendable launch vehicles to send not only their own payloads into space, but those from private industry. These single-use vehicles were expensive, but extremely reliable, and, when paired with high-energy upper stages, extremely powerful.

As development of the Shuttle neared completion in the late 1970s, the decision was made to assign all U.S. payloads to the Shuttle and eliminate the use of expendable launch vehicles. Commercial satellite groups were amenable, but there was significant pushback from the military and NASA customers who had been successfully using expendable launch vehicles for years.

Glynn Lunney, former Shuttle Program manager, stated that Air Force personnel "chafed under that arrangement quite a bit, and it never really fully resolved itself." He found even stronger opposition from the NASA centers. "It was quite a shock to us. I guess in a way we'd grown up in this manned space flight environment, and we had been successful, and we were surprised to run into this hostile reaction from a lot of other professionals at the other NASA centers."[2]

Since the Shuttle was limited to low-Earth orbit, a booster vehicle would be required to launch heavy military payloads and NASA's interplanetary spacecraft. Various studies were undertaken in the mid-1970s that confirmed the feasibility of using existing liquid-fueled stages, but NASA opted for the solid-fueled Interim Upper Stage being developed for the Air Force. This not only avoided the concerns surrounding the use of cryogenic propellants but also guaranteed military commitment to the Shuttle.

Shuttle-Centaur (continued)

Glynn Lunney autographing a Space Shuttle illustration during a visit to NASA's Lewis Research Center (now Glenn) in April 1982. (Credit: NASA)

By the late 1970s, the Jet Propulsion Laboratory (JPL) was seeking a vehicle to launch its Ulysses and Galileo missions, which would send spacecraft to the Sun and Jupiter, respectively. For the Shuttle to accomplish this, it would need upgraded main engines in conjunction with the Interim Upper Stage, which was still being developed. NASA Administrator Robert Frosch resisted congressional pressure during this period to pursue the use of Centaur with the Shuttle.

When it became apparent that the initial 1982 launch date would be missed, NASA instructed JPL to divide the Galileo spacecraft into two components, which would be launched separately. The costs associated with this process, combined with the massive budget overruns on the Interim Upper Stage, compelled Frosch to reverse his stance. In January 1981, NASA announced that the Shuttle would be paired with the Centaur stage for these missions, which now had hard launch dates just days apart in May 1986.

By that point, Centaurs, paired with either Atlas or Titan boosters, had successfully launched over three dozen payloads and had sent spacecraft to the Moon, Mars, and outer planets. Centaur was the first rocket designed to run on liquid hydrogen, a high-energy cryogenic fuel. To minimize weight, it employed a unique pressurized tankage system in which the hydrogen and oxygen tanks shared a common bulkhead. Although Centaur had experienced a handful of failures, none were related to the lightweight design or high-energy propellants.

NASA's Lewis Research Center (today, NASA Glenn) had managed the Centaur Program since 1962. Lewis engineers became experts at handling liquid hydrogen and, over time, became renowned for integrating the stages of the launch vehicle and making the detailed calculations required to launch spacecraft to distant targets. They did not, however, have any experience with human spaceflight.

> **It was clear to all, however, that Centaur was not a normal payload.**

NASA's Johnson Space Center, on the other hand, has been the nation's hub of human spaceflight since its inception in 1962. Prior to the Shuttle's coming online in 1981, Johnson had overseen over 30 successful crewed spaceflights without a single fatality. They had developed the culture and policies necessary to ensure the safety of the astronauts. As such, there was a pervasive distrust of flying the Shuttle with a cryogenic stage in the payload bay.

Lunney recalled the unspoken sentiment at Johnson regarding integrating the cryogenic stage into the Shuttle. "It wasn't a question of 'Can you do this?' It was a question of 'Can you prove that you can't?'"[3] The answer was no, Shuttle-Centaur was technically achievable, and the program proceeded.

One of the key aspects of the integration process was determining whether Centaur was a Shuttle element like the solid rocket boosters or a payload like a satellite. Its initial designation as an element severely limited Lewis's technical and fiscal input. The stage's redesignation as a payload in 1983 gave the Centaur team freedom to make the modifications necessary as long as the final configuration conformed to the Shuttle payload specifications. It was clear to all, however, that Centaur was not a normal payload.

Lewis worked with Centaur's manufacturer, General Dynamics, on the necessary modifications, including reconfiguring the stage's tank geometry to carry enough propellants for the assigned missions; developing the Centaur Integrated Support System (CISS), which would deploy the stage from the bay; and designing redundant propellant vent and dump systems. Modifications to the Shuttle primarily involved the installation of the CISS and propellant vent and dump systems in the cargo bay, but they also included the removal of a galley and minimizing the crew.

Lewis Director Andy Stofan speaks at the Shuttle-Centaur rollout ceremony in August 1985. Galileo mission crew members Dave Walker, Rick Hauck, and John Fabian were among those on stage. (Credit: NASA)

It did not take long for conflict between Johnson and Lewis to arise. As the agency's human spaceflight lead, Johnson was protective of its procedures and used to giving the orders. The center did not, however, have any experience with the complexities of launching deep space missions such as Galileo and Ulysses. A former Lewis engineer recalled, "They say, 'Look, we determine when you launch'.... We said, 'Look, you're just a truck. We're the smart upper stage. Your job is to get us to orbit and get us out, and we'll go do our thing.'"[4]

From the beginning, Johnson was wary of carrying a tank full of hydrogen on a crewed mission, despite the fact that the Shuttle's external tank carried over 384,000 gallons of hydrogen on each launch. This was less of a concern for Lewis, which had decades of experience working with cryogenic fluids. One former JPL engineer mused, "It's just a question of whether it's between their legs or behind their back is the way I view it."[5]

The more pressing concern was the ability to expel the propellants from the Shuttle bay in the case of an aborted launch. Unlike the nation's earlier crewed spacecraft, the original Shuttle design did not include a crew escape system. If an emergency occurred before reaching orbit, the Shuttle had to navigate its way back to Earth and perform a runway landing. This would be dangerous enough with an empty Centaur in tow, but nearly impossible if it still contained propellants. The Shuttle had already experienced three aborted launches, although none had required a landing.

To mitigate this issue, Lewis and Johnson developed an elaborate, redundant purge system to allow venting of gaseous cryogenics during flight and a full purge of the fluids in an emergency. It was a complex undertaking that was never fully resolved to the satisfaction of Johnson safety engineers or the crews. Late in the process, Astronaut Project Officer for Centaur Rick Hauck gave the astronauts the opportunity to excuse themselves from the mission

Shuttle-Centaur (continued)

when a valve issue was not resolved to his satisfaction.

On the other hand, the Lewis team grew increasingly frustrated with Johnson's lack of commitment to the promised launch weight. As the integration process went on, the weight limit decreased. This forced Lewis engineers to redesign the launch trajectories to reflect the reduced amounts of propellants, resulting in lower performance levels and/or shorter launch windows. Nonetheless, the issues were systematically worked out, and the program remained on schedule. In January 1986, the Shuttle-Centaur underwent a successful tanking test at Cape Canaveral and appeared to be on schedule to meet the May launch dates.

Shuttle-Centaur's long, arduous journey came to a premature end on January 28, 1986, when Challenger exploded shortly after launch, resulting in the loss of seven astronauts. NASA immediately paused the Shuttle Program, which grounded the Ulysses and Galileo spacecraft.

> **Shuttle-Centaur's long, arduous journey came to a premature end on January 28, 1986....**

While the agency investigated the accident, mission planners scrambled to find alternatives to alleviate the growing backlog of payloads waiting to be launched. NASA had been so confident in the Shuttle that it did not have a contingency for launching payloads.

Shuttle-Centaur (continued)

The military had already concluded that this lack of redundancy posed a national security risk and purchased 48 Titan IV rockets as backups.

In response, NASA introduced its mixed-fleet policy in which expendable launch vehicles would be used along with the Shuttle, and the Reagan administration ordered the agency to turn over responsibility for launching commercial payloads to private industry. NASA itself would no longer buy launch vehicles but instead purchase rides on commercial vehicles. These policies posed challenges for the manufacturers of expendable launch vehicles. Some had closed down production lines and reassigned personnel. Meanwhile, there was competition from European manufacturers who arose in the early 1980s to fill the void.

The Space Shuttle Program emerged from the Challenger accident with a more robust vehicle and a greater emphasis on safety and quality assurance. Although studies were undertaken regarding pairing the Centaur with the "new" Shuttles, it came as no surprise when NASA terminated the effort in June 1986. Lewis engineers felt that the updated Shuttle, with a new crew escape system, added redundancy, and reduced weight limitations, was incapable of lifting the Centaur and its payload, while Johnson's safety and reliability group argued strenuously that the Centaur's risk-mitigation efforts were not sufficient. "In the end [Johnson] decided that it was too dangerous," reflected Lewis Center Director Andy Stofan. "In retrospect, looking at it, they could have decided that when the decision was made to put it in."[6]

The Galileo and Ulysses missions were eventually launched from Shuttle orbiters using the Interim Upper Stage. Despite the years added to their respective journeys to Jupiter and the Sun, the overall missions were successes. ■

Endnotes

1. Sarah Keegan, "NASA Terminates Development of Shuttle/Centaur Upper Stage," NASA Release No. 86-80, June 19, 1986, Glenn History Collection.
2. Glynn Lunney, interview by Carol Butler, December 9, 1999, Johnson Space Center Oral History Collection.
3. Ibid.
4. Joseph Nieberding, interview by Virginia Dawson and Mark Bowles, April 15, 1999, Glenn Oral History Collection.
5. Lutha "Tom" Shaw, interview by Virginia Dawson, November 10, 1999, Glenn Oral History Collection.
6. Andrew Stofan, interview by Mark Bowles, April 13, 2000, Glenn Oral History Collection.

Left: A Centaur G-prime on a work stand at Kennedy Space Center in February 1986 being prepared for the Ulysses mission. **Right:** In 2016, a Centaur G-prime stage was put on display at Glenn Research Center. Although it was never flown on the Shuttle, the Air Force launched 16 G-primes on Titan IV rockets. (Credits: NASA)

2025 NASA HISTORY SEMINAR SERIES

Aerospace Latin America

Since February, the NASA History Office has been presenting a seminar series on the topic of Aerospace Latin America. This series explores the origins, evolution, and historical context of aerospace in the region since the dawn of the Space Age, canvasing a broad range of topics including aerospace infrastructure development, space policy and law, Earth science applications, and much more. This collaborative effort seeks to gather insight and research that will conclude in an anthology of essays to be published as a NASA History Special Publication.

Upcoming Talks

JULY 10
Pedro Alonso
Universidad Católica de Chile
"NASA in the Most Remote Area: The Laser Station and the Landing Strip on Easter Island During the 1980s"

JULY 24
Julie Klinger
University of Delaware
"China–Latin America Space Relations"

AUGUST 7
Vanessa Freije
University of Washington
"On-the-Ground Labor with Outer-Space Technologies: Workers at Mexico's Tulancingo Satellite Earth Station"

AUGUST 14
Anne W. Johnson
Universidad Iberoamericana in Mexico City
"So Far from God, So Close to NASA"

AUGUST 21
Alejandro Martin Lopez
Instituto de Ciencias Antropológicas, University of Buenos Aires
"Under an Entanglement of Skies: A Cultural Astronomy Approach to Our Relationship with the Cosmos"

SEPTEMBER 4
Brett A. Houk
Texas Tech University, Lubbock
Amy E. Thompson
The University of Texas at Austin
"Lidar and Landscape Legacies in the Maya Lowlands: Insights from Belize"

SEPTEMBER 18
Sean T. Mitchell
Rutgers University–Newark
"An Ethnographic History of Brazil's Spaceport"

Talks are held on ***Thursdays at 1 p.m. Central via Microsoft Teams.*** To receive details on how to attend, join our mailing list by sending a blank email to history-join@lists.hq.nasa.gov or request a meeting link by emailing Michele Ostovar at michele.e.ostovar@nasa.gov.

MEETING TIMES: 2 p.m. Eastern
1 p.m. Central
12 p.m. Mountain
11 a.m. Pacific

A View into NASA's Response to the Apollo 1 Tragedy

» By **Kate Mankowski**, NASA Archivist

↑ A portion of the Robert Sherrod Apollo Collection in the NASA Headquarters Archives focuses on the subject of Apollo 204, its investigation, and outcomes. (Credit: NASA/Kate Mankowski)

ON JANUARY 27, 1967, Mission AS-204 (later known as Apollo 1) was conducting a simulated countdown when a fire suddenly broke out in the spacecraft, claiming the lives of astronauts Virgil I. "Gus" Grissom, Edward H. White, and Roger B. Chaffee. The disaster highlighted the risks that come with spaceflight and the work that still needed to be accomplished to meet President Kennedy's challenge of going to the Moon before the end of the decade. With the complexity of the Apollo spacecraft, discerning the cause of the fire proved to be incredibly difficult.

An investigation launched by the Apollo 204 Review Board (including Apollo 8 astronaut Frank Borman) determined multiple contributing factors to the fire instead of a single cause. Changes needed to be made. Safety became a major focus. NASA assigned a number of its centers responsibility for specific changes ranging from the elimination of flammable materials in the Apollo Command Module (CM) and spacesuit improvements to the redesign of the CM's inward-opening hatch. The pure oxygen atmosphere inside the spacecraft was reevaluated. Communication needed to be better, not just on a technical level with corrections needed to assure reliability of the Ground Communication System, but also between different organizations working at NASA. The documentation makes it clear that it was not just one issue that led to the loss of the Apollo 1 crew, but many.

The Robert Sherrod Apollo Collection, housed in the NASA Headquarters Archive, contains a wealth of information about the Apollo missions. Robert Sherrod was a correspondent for *Time* and *Life* magazines as well as a contract historian at NASA. His extensive collection includes 91 boxes that contain NASA correspondence, reports, and memoranda, as well as oral histories and biographical files centering on the Apollo program. Two of these boxes focus on Apollo 1 and include documentation about the aftermath of the Apollo 1 fire and the investigations of the Review Board that followed. There are meeting and hearing transcripts, as well as correspondence, all of which reveal the emotions that accompanied the tragedy. Other items in the collection include flammability tests completed in 1969. There are papers regarding flammability and combustibility in various oxygen atmospheres from before 1967, as well as a literature review about fire and blast hazards that was compiled after the fire. Examining the collection, one can learn a great deal about how NASA responded to the fire and moved forward and get insight into the leadership and decision-making that followed the accident.

Archival collections such as the Robert Sherrod Collection allow us to understand how NASA has responded to crises, what was learned, and how we moved forward with those lessons. ■

Read Robert Sherrod's chapter "Men for the Moon: How They Were Chosen and Trained" in ***Apollo Expeditions to the Moon***.

The Fight to Fund AgRISTARS

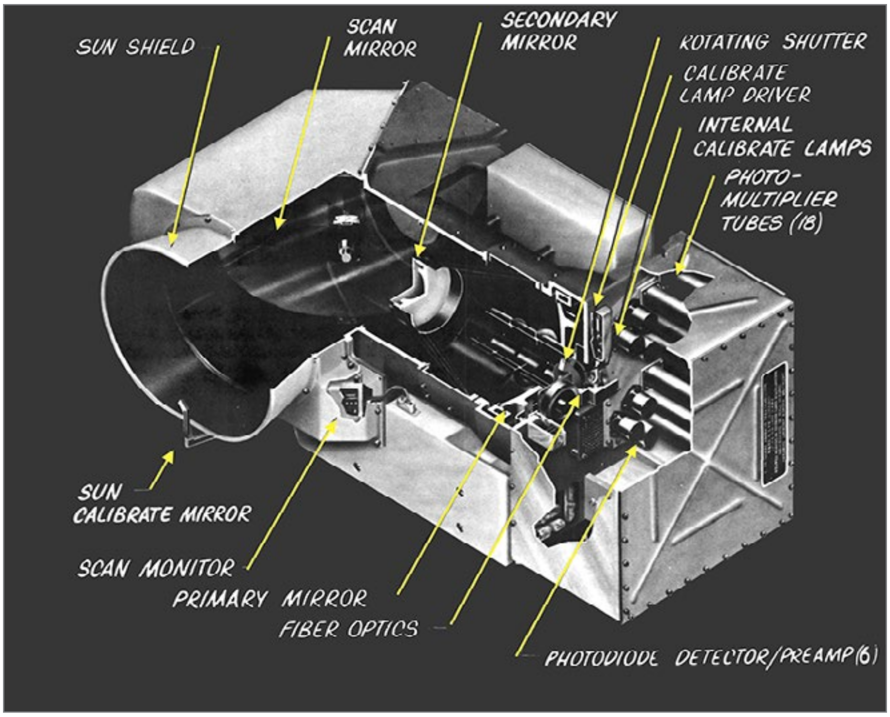
» By **Brad Massey**, NASA Historian

ROBERT MACDONALD, the manager of NASA's Large Area Crop Inventory Experiment (LACIE), was not pleased in January 1978 after he read a draft copy of the U.S. General Accounting Office's (GAO's) "Crop Forecasting by Satellite: Progress and Problems" report. The draft's authors argued that LACIE had not achieved its goals of accurately predicting harvest yields in the mid-1970s. Therefore, congressional leaders should "be aware of the disappointing performance of LACIE to date when considering the future direction of NASA's Landsat program and the plans of the Department of Agriculture."[1]

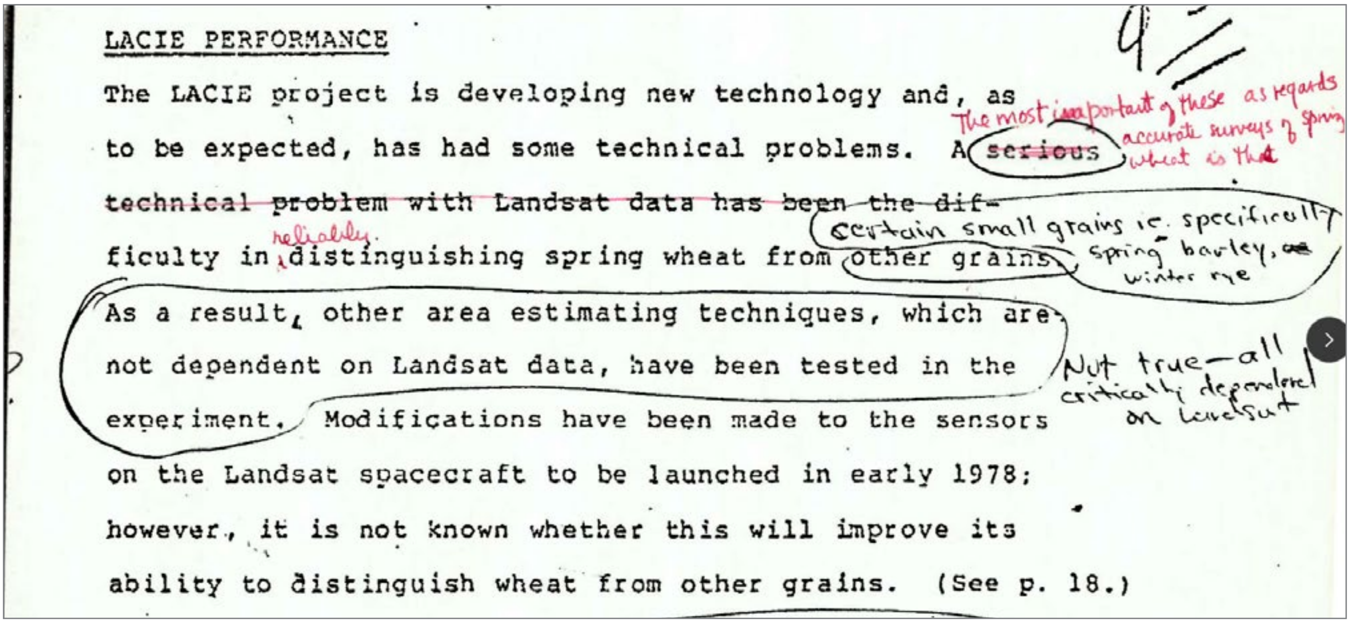
LACIE was a joint NASA, U.S. Department of Agriculture (USDA), and National Oceanic and Atmospheric Administration (NOAA) initiative born in 1974. It was created after a failed Soviet wheat harvest and a related unfavorable grain deal between Soviet trade officials and U.S. farmers led to severe food inflation in the United States, as well as a reduction in potential profits for U.S. farmers. In an effort to better predict future harvest yields, LACIE designers attempted to use Landsat, weather, and, when available, ground survey data to accurately predict harvest yields in the United States, the Soviet Union, and other grain-producing nations.[2]

Now, after three years of operation, the program's future was under threat. The report made several arguments about why a follow-on program for LACIE might not deserve funding. First off, the report asserted that LACIE was very labor-intensive and expensive. This was true. During LACIE's first phase/year, about 400 people were needed to identify wheat fields and, in other ways, interpret and process data from Landsat's Multi-Spectral Scanner (MSS). Furthermore, LACIE cost about $60 million; and, although its creators initially committed the program to monitoring and predicting harvest yields in seven countries, the United States and Soviet Union were the primary focus of the first two phases. There were also technical challenges. For example, the coarse resolution of MSS data made it difficult to differentiate spring wheat from other grains, and cloud cover often obstructed the MSS's view of wheat fields. Finally, the study claimed that the first two phases of LACIE failed to achieve the program's goal of accurately predicting final harvest yields within a 10 percent error range.[3]

A diagram of Landsat's Multi-Spectral Scanner (MSS). The MSS detected sunlight reflected off Earth, including its vegetation, in multiple spectral bands. During LACIE and the Agriculture and Resources Inventory Surveys Through Aerospace (AgRISTARS), analysts tried to use these data to predict harvest yields in different nations, especially the USSR. (Credit: Hughes/NASA).



The Fight to Fund AgRISTARS (continued)


LACIE PERFORMANCE

The LACIE project is developing new technology and, as to be expected, has had some technical problems. A serious technical problem with Landsat data has been the difficulty in reliably distinguishing spring wheat from other grains. As a result, other area estimating techniques, which are not dependent on Landsat data, have been tested in the experiment. Modifications have been made to the sensors on the Landsat spacecraft to be launched in early 1978; however, it is not known whether this will improve its ability to distinguish wheat from other grains. (See p. 18.)

A copy of the GAO 1977 draft report from the NASA archives marked up by LACIE's defenders. (Image courtesy of the NASA Goddard Space Flight Center Archive)

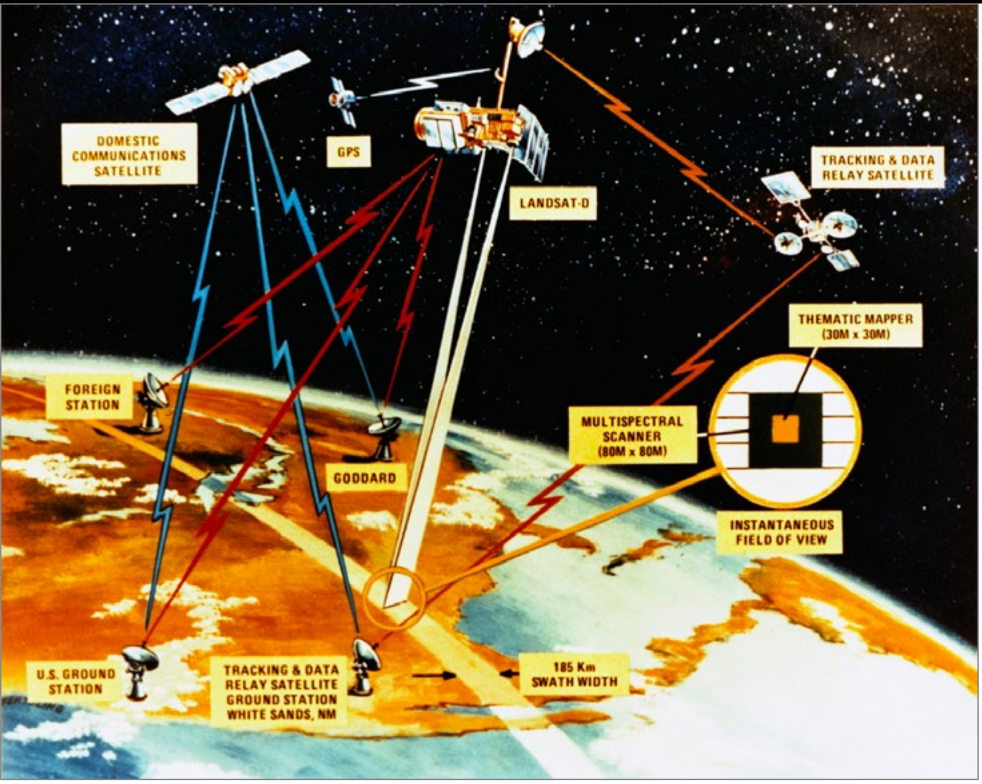
MacDonald knew LACIE was not a perfect experiment, yet he believed in the promise and value of monitoring agricultural fields from space. Therefore, after reading the draft report, MacDonald worked with NASA staff to draft a letter to NASA Headquarters highlighting the advancements LACIE had made over the course of three years. MacDonald's rebuttal noted that although the labor involved in processing LACIE data was high at first, it had decreased by nearly ⅔ during LACIE's third year and final phase. MacDonald also noted that during phase three, the results of which the authors of the GAO draft had not reviewed, LACIE captured and analyzed data for wheat fields in Canada and Australia. The third phase also predicted the USSR's final 1977 wheat harvest within the program's goal of 10 percent.

LACIE was not flawless, but MacDonald argued that the program should be "acknowledged as having achieved its initial desired accuracy even if it has not demonstrated it has reached its ultimate goal." In short, LACIE was a work in progress, needed a bit more time, and had cross-institutional support.[4]

MacDonald's desire to defend LACIE's results and support the use of Landsat data to solve an economic problem was driven by the political realities of NASA in the mid-1970s. During his first stint as NASA administrator from 1971 to 1977, James Fletcher portrayed NASA to U.S. lawmakers and the public as an agency they could count on to solve real-world problems. To make this image a reality, NASA's Applications Program needed to forge political partnerships with different government agencies and other entities. Also, as science and technology historian Pamela Mack notes, the pressure was on NASA officials to justify the cost of future Landsat satellites in the 1970s. With these political realities in mind, proving that NASA could help ensure global food, and price, stability during the inflationary 1970s was potentially a big political win for the agency's Applications Office, the Landsat program, and MacDonald.[5]

MacDonald's desire to defend LACIE's results and support the use of Landsat data to solve an economic problem was driven by the political realities of NASA in the mid-1970s.

MacDonald's campaign to challenge the report's language and his partnership with the USDA led to changes in the report. The final GAO report had more muted criticism of LACIE. It



↑ An illustration of Landsat D (also known as Landsat 4) at work. NASA's Robert MacDonald argued that Landsat D's Thematic Mapper could help improve crop forecasts. (Credit: NASA)

stated that the project "has had mixed success in achieving its performance goals," and it advised that the Secretary of Agriculture update Congress on future agricultural monitoring experiments. The report was far from an about-face, but it did give MacDonald and other LACIE defenders, like the USDA's Robert Bergland, some room to politically maneuver.

Like NASA's Robert MacDonald, U.S. Secretary of Agriculture Robert Bergland believed that LACIE could increase profits for U.S. farmers, save federal money, and stabilize global food prices. In 1978, as the debate over LACIE's results simmered, Bergland noted that the Soviet wheat shortage of 1977 was not identified until five months into U.S. farmers' sales season. He also noted that the following year, a shortfall of the Brazilian soybean harvest was not known until U.S. farmers had marketed 60 percent of their crop. The failure to accurately predict these lower harvest numbers, Bergland argued, cost the U.S. government in farm subsidies and led to a 20 percent increase in wheat prices and a 10 percent increase in soybean prices.

"We believe the department would have saved several million dollars in wheat deficiency payments and farmers would have received several million more for their 1978 soybean crop, had improved international crop production data been available," Bergland wrote. Believing in the predicting properties of Landsat data, Bergland met with NASA officials and, after follow-up internal USDA meetings, outlined a new monitoring program called Agriculture and Resources Inventory Surveys Through Aerospace (AgRISTARS). With this LACIE follow-up program outlined, Bergland

The Fight to Fund AgRISTARS (continued)

ultimately committed the USDA to funding 50 percent of the project.

The AgRISTARS proposal was ambitious. It identified seven informational needs that the USDA and NASA believed Landsat and other data sources could provide. The first two included "early warning of change affecting production and quality of commodities and renewable resources" and commodity production forecasts. Land-use classification, renewable resources inventories, land productivity, conservation assessments, and pollution detection and evaluation rounded out the remaining five informational needs. Despite the seven listed needs, crop production forecasts and predictions in the USSR and other foreign nations were the raison d'être of AgRISTARS.[6]

And therein, as far as Frederick Chasnov of the GAO was concerned, lay the problem. In 1979, Chasnov authored an investigative report on AgRISTARS upon the request of the chairman of the U.S. Senate Committee on Appropriations, Edward Kennedy. In the report, Chasnov recommended that funding be withheld for the Foreign Commodity Production Forecasting component of AgRISTARS.

Chasnov was a contributor to the earlier 1977 GAO report, and he still harbored concerns regarding LACIE's effectiveness and potential. He criticized LACIE's inability to distinguish between different types of crops and pointed out that no cost-benefit studies had been completed for LACIE. Thus, the value of LACIE and AgRISTARS, Chasnov argued, was unknown. Furthermore, Chasnov did not buy Bergland's argument that satellite remote-sensing data could have helped

The Fight to Fund AgRISTARS (continued)

↑ The AgRISTARS logo. Note the tractor and the field. (Source: NASA)

save the government money or ensured greater profits to farmers in 1977 and 1978.

These and other concerns made Chasnov an AgRISTARS skeptic. His questions were numerous, and his criticisms of agricultural monitoring via Landsat were technical and extensive, but he succinctly summed up his conclusions when he wrote, "In all of the projects, there was one significant question that could not be answered. Assuming it can be done, is it worth it?" This, he claimed, was a valid concern in light of AgRISTARS's $300-million-plus budget.

After reading Chasnov's 1979 investigative report, Robert MacDonald and Secretary Bergland insisted that it *was* worth it. Once again, MacDonald and NASA defended LACIE's results and future promise, this time to the Appropriations Committee. MacDonald once again highlighted LACIE's success in predicting the 1977 Soviet Union wheat harvest yields. MacDonald and other NASA officials also noted that Landsat 4's Thematic Mapper (TM) would provide higher resolution than the MSS. The TM would therefore help improve crop identification and classification. Landsat 4 would also serve as an additional pair of eyes and increase the number of observations, which would help alleviate the cloud cover problem, when coupled with Landsat 2 and 3.[7]

The persistence of MacDonald, Bergland, and other AgRISTARS champions ultimately paid off, and the project was funded, but trying times lay ahead. The Soviet invasion of Afghanistan and U.S. President Jimmy Carter's retaliatory grain embargo brought into question the utility of using satellite data to try and predict foreign harvest yields and control food inflation. Furthermore, the move to privatize Landsat and reduce federal spending undercut AgRISTARS in the early and mid-1980s, and its budget was slashed. And Chasnov's question "Is it worth it?" still loomed. But for those, like MacDonald, who believed in continuing Landsat and attempting to use space technologies to try to solve real-world problems in the late 1970s, it was worth it. ■

Endnotes

1. "Crop Forecasting by Satellite: Progress and Problems," U.S. General Accounting Office draft report, PSAD-78-52, January 1978, Records Relating to the Large Area Crop Inventory Experiment (LACIE) GR-2022-006, Date Range: 1969–1984, NASA Goddard Archive (hereafter LACIE NASA Goddard).
2. Pamela E. Mack, *The Social Construction of the Landsat Satellite System* (Cambridge: MIT Press, 1990), p. 151. For a brief look at the relationship between food inflation and LACIE's beginnings, see Massey, "Landsat and the Green Revolution."
3. "Crop Forecasting by Satellite: Progress and Problems," final draft, PSAD 78-52, April 7, 1978, LACIE NASA Goddard; Landsat Legacy Project Team, *Landsat's Enduring Legacy: Pioneering Global Land Observations from Space* (Bethesda, MD: American Society for Photogrammetry and Remote Sensing, 2017), p. 193.
4. Robert MacDonald, LACIE Manager, to NASA Headquarters, Attn: ER/Ruth Whitman, "Review of the GAO LACIE Evaluation," October 1977; "LACIE Comments on GAO Summary Draft Code 952165," January 19, 1978; Francis Sand of Econ Incorporated to S. Ahmed Meer at NASA Goddard, "Probable Accuracy in U.S.S.R. and Argentina Wheat Field Estimates and Interpretation of LACIE Project Office Report on Forecast Errors of USDA Wheat Estimates for Six Foreign Countries 1966–1975," October 6, 1977, LACIE NASA Goddard.
5. Mack, *The Social Construction of Landsat*, p. 154; Erik M. Conway, "Bringing NASA Back to Earth: A Search for Relevance During the Cold War," *Science and Technology in the Global Cold War*, ed. Naomi Oreskes and John Krige (Cambridge: MIT Press, 2014), p. 255; Edward S. Goldstein, "NASA's Earth Science Program: The Space Agency's Mission to Our Home Planet," *NASA's First 50 Years: Historical Perspectives*, ed. Steven J. Dick (Washington, DC: NASA SP-2010-4704, 2010), p. 514.
6. "Secretary's Initiative on Aerospace Research," June 4, 1979, USDA, LACIE NASA Goddard; Comments on U.S. Senate Investigations Staff Report No. 79-5, June 1979; Proposed Joint Program for Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing (AgRISTARS), June 20, 1979, LACIE NASA Goddard.
7. Don Gray, Investigation Committee, to Dick Liberman, Subcommittee on Agriculture and Related Committees, "Response to Agency Comments on Our AgRISTARS Report," July 11, 1979, LACIE NASA Goddard. Also see Fredrick Chasnov, "Cost/Benefit Analysis—A Legislative Branch Viewpoint," U.S. General Accounting Office.

The Hubble Space Telescope

The Right Project at the Right Time

» By **Jillian Rael**, NASA Historian

For the 20th anniversary of Hubble's mission in space, this image taken by Hubble's Wide Field Camera 3 of the Carina Nebula was released. The nebula's ethereal spires made up of dust and gas led to the image being dubbed "Mystic Mountain." (Credit: NASA, European Space Agency, M. Livio, and the Hubble 20th Anniversary Team)

THIS YEAR, NASA commemorates 35 years of the Hubble Space Telescope's study of the cosmos. From observations of never-before-seen phenomena within our solar system, to the discovery of distant galaxies, the confirmation of the existence of supermassive black holes, and precision measurements of the universe's expansion, Hubble has made incredible contributions to science, technology, and even art. Yet, for all its contemporary popularity, the Hubble program initially struggled for congressional approval and consequential funding. For its part, NASA found new ways to compromise and cut costs, while Congress evaluated national priorities and NASA's other space exploration endeavors against the long-range value of Hubble.

Since the early 20th century, astronomers have advocated for space-based telescopes, free from the interference of Earth's atmosphere faced by ground-based observatories, and in the post–World War II years serious pursuit of orbital observatories was undertaken.[1] NASA's creation opened new possibilities, but its early priority was firmly set upon landing a man on the Moon. By the mid-1960s, NASA had begun to plan for its post-Apollo future, and as it did so, the astronomical community pushed it to develop a space-based telescope. The agency indeed launched orbiting observatories but did so within a frugal economic landscape. Nonetheless, NASA scientists began studies as early as 1966 that forged the way for a new "large space telescope."[2]

> NASA scientists began studies as early as 1966 that forged the way for a new "large space telescope."

Nearly a decade later, NASA sought congressional approval and funding for its new space telescope in the 1975 fiscal year. However, in a critical move in Hubble's history, Congress denied NASA's funding request, citing the telescope's $6.2 billion price tag and its lack of priority status according to the National Academy of Sciences.[3] Instead, Congress recommended that NASA consider "a less expensive and less ambitious project."[4] Yet agency leadership persisted in the quest to launch a large orbital telescope through strategic congressional advocacy and innovative cost-cutting actions.

In testimony given at fiscal year 1976 hearings before Congress, NASA Administrator Dr. James Fletcher emphasized his agency's efforts to meet Congress's prior requests to lower costs. In his remarks, Fletcher highlighted NASA's investigation of potential savings by reducing the telescope's mirror size by as much as four feet. Initial study results indicated that this measure would cut considerable costs. Moreover, NASA was "looking at increased international participation," particularly in Europe's potential contribution of solar arrays.[5] The European Space Research Organization (later the European Space Agency) accepted

This view of the Hubble Space Telescope in Earth orbit was captured by a Servicing Mission 4 crew member just after it was captured with Space Shuttle Atlantis's robotic arm on May 13, 2009. (Credit: NASA)

NASA's offer to participate in the Large Space Telescope program in 1975, thus initiating a long-term international collaboration that bolstered space diplomacy and saved federal dollars.[6] With widespread support, NASA once again requested funds for the Large Space Telescope program for fiscal year 1977, but national funding restraints ensured that the program remained halted.[7]

Change came in 1978, as Congress conceded that it was the "right project, at the right cost, at the right time," thus winning funding over "other NASA projects with potentially earlier payoffs."[8] For 1978, telescope funding came at the expense of the proposed Jupiter Orbiter Probe (later known as Galileo). In its justification, Congress stated, "[t]he telescope has been described by the scientific community as the number one astronomy project in the 1980s…[t]herefore, the Jupiter mission can be delayed…."[9] NASA's two-foot reduction in the telescope's mirror size saved some $200 million, and its European partnership brought further cost reductions. At last, NASA received its first dedicated funding of $36 million for the space telescope and planned a 1983 launch.[10]

The year 1983 passed with no telescope launch, but an important milestone was reached with the program renamed the Hubble Space Telescope. Multiple delays in optical assembly, as well as the 1986 Challenger accident, grounded Hubble until 1990.[11] Had Congress granted NASA its initial 1975 telescope funding request, Hubble history would likely look very different. The telescope might have avoided some delays, yet it could have cost many more tax dollars to complete without its mirror redesign and European involvement. That partnership enhanced American diplomacy with Europe through the shared resources of Hubble, which continue today. Thanks to its serviceable design, the telescope has been repaired, upgraded, and maintained through five Shuttle missions that have extended its 15-year anticipated lifespan by decades. In short, although critical funding decisions delayed one of NASA's most recognizable programs, solid NASA leadership landed Hubble exactly where it needed to be in NASA's history—providing not only groundbreaking astronomical data but also awe-inspiring images that captivate the world. ■

Endnotes

1. Gabriel Okolski, "A Brief History of the Hubble Space Telescope," n.d.
2. NASA, "Budget Estimates Fiscal Year 1966, Volume II," p. RD 4-5, available through the Planetary Society.
3. Although Congress provided no citation for its statement on the telescope's priority level, this information appears to be from a 1965 study of the National Academy of Sciences' Space Science Board entitled "Space Research: Directions for the Future."
4. NASA Comptroller, Office of Budget Operations, "Chronological History: Fiscal Year 1975 Budget Submission," August 13, 1975.
5. United States Congress, *Hearings Before the Committee on Aeronautical and Space Sciences United States Senate on S. 573: A Bill to Authorize Appropriations to the National Aeronautics and Space Administration for Research and Development, Construction of Facilities, and Research and Program Management, and for Other Purposes*, 94th Cong., 1st sess., February 6, 18, 19, March 3, 11, and 13, 1975.
6. Okolski, "A Brief History of the Hubble Space Telescope."
7. "National Aeronautics and Space Administration 1977 Budget: Summary Data," available through the Ford Library Museum digital files as scanned from the James M. Cannon Files at the Gerald R. Ford Presidential Library.
8. NASA Associate Administrator/Comptroller, Budget Operations Division, "Chronological History: Fiscal Year 1978 Budget Submission," October 19, 1978.
9. Ibid.
10. Okolski, "A Brief History of the Hubble Space Telescope; NASA, "Chronological History: Fiscal Year 1978 Budget Submission."
11. Okolski, "A Brief History of the Hubble Space Telescope.

Appraisal

The Science and Art of Assessing Donations to the NASA Archives

» By **Alan Arellano**, NASA Archivist

Archived files. (Credit: NASA/Christine Shaw)

THE MAJOR FUNCTIONS of an archivist center include appraising, arranging, describing, preserving, and providing access to historical records and documents. While together these are pillars of archival science, they are more of an art than a science in their application, fundamentally necessitating skilled decision making. Throughout the NASA archives, staff members make these decisions day in and day out. At the Goddard Space Flight Center archives, one of the most salient of these functions has been appraisal. The Society of American Archivists defines appraisal in an archival context as "the process of determining whether records and other materials have permanent (archival) value.… Appraisal can take place prior to donation and prior to physical transfer."[1]

> "Appraisal serves as an outreach, engagement, and collaboration opportunity.…

Appraisal serves as an outreach, engagement, and collaboration opportunity between the archival staff and the different offices at Goddard. When an office or staff member reaches out to the Goddard Archives with an interest in transferring materials after a retirement or project closeout, an opportunity arises to educate staff about what the archives does and does not accept. Resources such as the document "Identifying Materials to Transfer to the NASA Archives" are helpful tools in this regard. Permanent records—those that are intended for long-term preservation by the National Archives and Records Administration according to retention and disposition schedules—are not accepted at center archives. The Records Management Office at each NASA center can help to identify what is and is not a permanent record. The NASA archives collect only temporary and non-record material such as organizational files, major speeches, memoirs, correspondence, and other working files.

One example of a difficult appraisal decision is when smaller collections or single documents are offered to the archives office. In other words, one publication, one folder, or just a couple of documents—rather than a larger, more comprehensive collection that paints a picture of the activities of a NASA staff member or office—presents a challenging decision for the archivist. Ideally, the archives would like to have a comprehensive collection of material from an office or NASA-affiliated individual, as outlined in our collection development policy.

There are also other guiding principles to appraise records offered to NASA's archives. Can the archives properly preserve the material? For example, a recent on-site appraisal visit to a donor's home involved a collection that included viewgraphs and lantern slides. While the Goddard Archives would love to have both, it only has the infrastructure to house, preserve, digitize, and make available the viewgraph transparencies. Publications, be they books, bound volumes, newspapers, or magazines, are commonly offered by donors for archival intake. Generally, the NASA archives only accept records either created by NASA or created as part of a contract with NASA. Newspapers and broadly distributed periodicals are often preserved (continued on page 19) »

Orbit Shift

How 51 Pegasi b Helped Pull NASA Toward the Stars in the 1990s

» By **Lois Rosson**, NASA Historian

ON OCTOBER 20, 1995, the *New York Times* reported the detection of a distant planet orbiting a Sun-like star.[1] The star, catalogued as 51 Pegasi by John Flamsteed in the 18th century, was visible to the naked eye as part of the constellation Pegasus—and had wobbled on its axis just enough that two Swiss astronomers were able to deduce the presence of another object exerting its gravitational pull on the star's rotation.[2] The discovery was soon confirmed by other astronomers, and 51 Pegasi b was heralded as the first confirmed exoplanet orbiting a star similar to our own Sun.[3] This finding, the *Times* article noted, "would remove any pretension that the solar system is unique," prompting new questions about how typical Earth might be.

Poster from the Jet Propulsion Laboratory's Visions of the Future Series, 2020. (Credit: NASA/JPL-Caltech)

The discovery of 51 Pegasi b arrived at a moment when exoplanet research was still largely speculative within NASA. Although the agency had funded early-stage proposals on planet detection, the lack of confirmed planets around Sun-like stars meant much of this research remained conceptual. The sudden, unambiguous detection of 51 Pegasi b helped transform exoplanets from a theoretical pursuit into a concrete scientific subject with international momentum. NASA responded by accelerating the development of detection strategies, refining mission concepts already in progress, and initiating new ones tailored to the search for distant worlds. The confirmation of 51 Pegasi b's existence provided a new catalyst for the preexisting infrastructure of exoplanet research across the agency.[4]

> The sudden, unambiguous detection of 51 Pegasi b helped transform exoplanets from a theoretical pursuit into a concrete scientific subject with international momentum.

The search for planets beyond our solar system was proposed by a variety of NASA advisory committees in the 1990s.[5] Early in the decade, work within the agency on planetary detection was largely theoretical since no exoplanets around Sun-like stars had yet been confirmed. The coming years, however, saw a solidification of NASA's exoplanet detection strategies.[6] In 1991, the Space Interferometry Mission (SIM) was proposed as the first space-based interferometric observatory in NASA's Origins Program.[7] While ELODIE, the

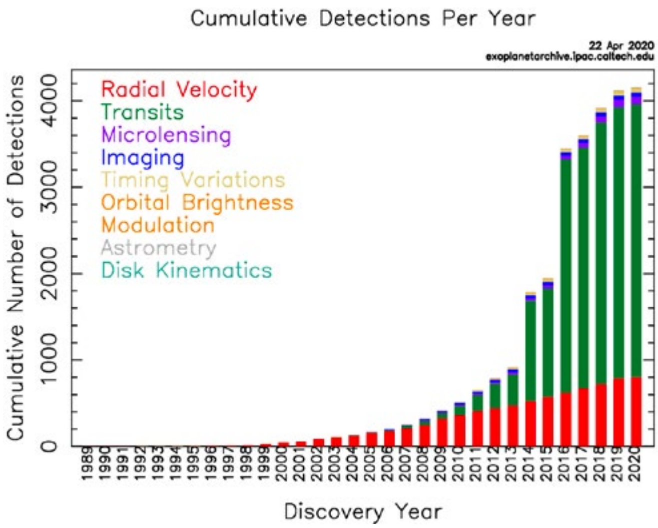
Orbit Shift (continued)

ground-based spectrograph that discovered 51 Pegasi b in 1995, used the radial velocity method to measure shifts in a star's spectra, SIM proposed using optical interferometry, a method of measuring the precise position of a star in the sky over time. Whereas ELODIE was capable of monitoring hundreds of stars, SIM would have observed individual stars in great detail, producing three-dimensional orbital information for the stars it observed.[8]

In 1994, NASA considered a mission concept called FRESIP (Frequency of Earth-Sized Inner Planets), a space-based photometer designed to continuously monitor 5,000 Sun-like stars simultaneously.[9] The scale of the project was designed to determine how common Earth-sized planets are in the habitable zones of stars similar to our own. Unlike ELODIE or SIM, FRESIP proposed to detect exoplanets using the transit method, monitoring the brightness of thousands of stars to catch the tiny, periodic dips caused by planets crossing in front of them. Though the FRESIP proposal was not selected for funding, it laid the scientific and technical groundwork for what would become the Kepler Space Telescope. Over the next decade, mission advocates—including principal investigator William Borucki—refined the concept and advanced the technology necessary for tracking Earth-sized transits. In 1996, a slightly larger version of FRESIP was proposed as Kepler, named after Johannes Kepler, who first formulated the three laws of planetary motion. By 2001, Kepler was selected for development, ultimately launching in 2009. Its design retained FRESIP's core technical strategy, but it represented a new scale of exoplanet observation: instead of monitoring 5,000 stars at once, it would be capable of looking at 80,000.[10]

“…it represented a new scale of exoplanet observation: instead of monitoring 5,000 stars at once, it would be capable of looking at 80,000.

Around the time the Kepler Space Telescope entered development, other strategies for exoplanet detection were being explored around NASA. First proposed in the mid-1990s, NASA's Terrestrial Planet Finder (TPF) began circulating



↑ This chart demonstrates the cumulative number of exoplanet detections per year by detection method. The Kepler Space Telescope began sending its first science data back to Earth in June 2009. (Source: NASA/Caltech)

technology plans for a coronagraph in 2005.[11] TPF was designed not just to find planets, but to analyze their atmospheres for signs of habitability or life, such as water vapor, oxygen, or carbon dioxide. NASA studied two complementary approaches: TPF-C (Coronagraph), a visible-light space telescope that would block starlight to directly image planets, and TPF-I (Interferometer), an infrared mission that would use nulling interferometry—a technique to combine light from multiple telescopes to cancel out starlight while preserving the signal from orbiting planets.[12] Both concepts aimed for extremely high contrast and resolution, enabling the detection of planets up to 10 billion times fainter than their host stars. Although TPF was never funded beyond preliminary design and technology development—largely due to rising costs and shifting priorities—it laid crucial groundwork for future missions like the Nancy Grace Roman Space Telescope, proposed flagship missions such as the Large Ultraviolet Optical Infrared Surveyor (LUVOIR) and the Habitable Exoplanet Observatory (HabEx), and the new Habitable Worlds Observatory.[13]

Even as NASA's exoplanet program grew more sophisticated—advancing from concepts like SIM and FRESIP to missions like Kepler and the ambitious if unrealized Terrestrial Planet Finder—51 Pegasi b has remained a touchstone in the story of planetary discovery. It demonstrated that planetary systems could look radically different from

Orbit Shift (continued)

our own, prompting NASA and the scientific community to diversify their detection strategies and commit to the long-term search for other worlds. As telescopes continue to scan the skies for signs of habitability, the significance of 51 Pegasi b endures not because it resembles Earth, but because it proved we could find what once seemed only hypothetical.

Endnotes

1 John Noble Wilford, "2 Sightings of Planet Orbiting a Sunlike Star Challenge Notions That Earth Is Unique," *New York Times* (October 20, 1995).

2 Michel Mayor and Didier Queloz, "A Jupiter-Mass Companion to a Solar-Type Star," *Nature* 378, no. 6555 (November 1995): 355–359.

3 The "b" in 51 Pegasi b signifies that it was the first exoplanet discovered orbiting around 51 Pegasi. The American astronomers who helped confirm the discovery unofficially dubbed the planet Bellerophon, after the Greek hero who rode Pegasus into battle. In December 2015, the International Astronomical Union announced that 51 Pegasi would be named Helvetios; and its exoplanet, Dimidium. International Astronomical Union Office for Astronomical Outreach, "Name ExoWorlds Approved Names," 2015 Edition.

4 The excitement was partially because 51 Pegasi b was so strange: the exoplanet was Jupiter-sized and orbiting its star very closely, completing an orbit of its star in just four days. NASA Science Editorial Team, "Nobel Winners Changed Our Understanding with Exoplanet Discovery—NASA Science," October 8, 2019.

5 In 1990, the National Research Council's (NRC's) Committee on Planetary and Lunar Exploration published *Strategy for the Detection and Study of Other Planetary Systems and Extrasolar Planetary Materials: 1990–2000* (Washington, DC: The National Academies Press, 1990). NRC also published *The Search for Life's Origins: Progress and Future Directions in Planetary Biology and Chemical Evolution* (Washington, DC: The National Academies Press, 1990).

6 In 1992, Aleksander Wolszczan and Dale Frail discovered evidence of planets orbiting the pulsar PSR B1257+12. The 1995 discovery of 51 Pegasi b was a blockbuster finding because it confirmed an exoplanet orbiting a main-sequence star. John Wenz, "How the First Exoplanets Were Discovered," *Astronomy Magazine* (October 8, 2019).

7 The mission was proposed in response to the 1991 Bahcall report, which was commissioned to recommend high-priority astronomical observation missions to be undertaken over the course of the next decade. James Marr et al., "Space Interferometry Mission: Measuring the Universe," Jet Propulsion Laboratory, January 1, 1991.

8 SIM was canceled in 2010.

9 Susan M. Niebur, *NASA's Discovery Program: The First Twenty Years of Competitive Planetary Exploration*, ed. David W. Brown (Washington, DC: NASA SP-2023-4238, 2023), p. 253.

10 Niebur, p. 255.

11 Jennifer Dooley and Peter Lawson, "Technology Plan for the Terrestrial Planet Finder Coronagraph," Jet Propulsion Laboratory, March 2005.

12 C. A. Bleichman, N. J. Woolf, and C. A. Lindensmith, "The Terrestrial Planet Finder (TPF): A NASA Origins Program to Search for Habitable Planets," Jet Propulsion Laboratory, May 1999.

13 "Habitable Worlds Observatory," NASA, December 11, 2023.

Appraisal (continued from page 16)

in other repositories like newspapers.com or the Time Magazine Archives, for example. The art of archival decision making comes into play in situations when the number of publications are substantial or in some way significant to the characteristic of the record creator or their creation activities. It is at the archivist's discretion to accept a sample that is representative of the publications' presence within the collection. Whether that be three publications or 30 depends on several factors: housing space and supplies available, preservation capabilities due to the publication's condition, or how unique the content is in relation to the rest of the repositories' holdings.

Appraisal is but one of the many aspects of an archivist's job that require decisions to be made. While very much informed by guidelines and standards, appraisal decisions also hinge on the archivist's expertise and discretion. Together, these guiding forces work to create a lasting record of the people, the projects, and the underlying culture of NASA. ■

Endnote

1 "Society of American Archivists Dictionary of Archives Terminology: Appraisal," n.d., https://dictionary.archivists.org/entry/appraisal.html.

Four, Eight, Fourteen Days

Charles A. Berry, Gemini, and the Critical Steps to Living and Working in Space

» By **Jennifer Ross-Nazzal**, NASA Historian

↑ Dr. Charles Berry, chief of the Medical Operations Office, stands by at NASA's Manned Spacecraft Center on Gemini IV's launch day. (Credit: NASA)

IN 1963, critical decisions had to be made about NASA's upcoming Gemini missions if the nation were to achieve President John F. Kennedy's lunar goals. Known as the bridge to Apollo, Project Gemini was critical to landing a man on the Moon by the end of the decade and returning him safely to Earth. The project would demonstrate that astronauts could rendezvous and dock their spacecraft to another space vehicle and give flight crews the opportunity to test the planned extravehicular capabilities in preparation for walking on the lunar surface on future Apollo flights. Perhaps most importantly, Gemini had to show that humans could live and work in space for long periods of time, a fiercely debated topic within and outside of the agency.

Despite the risks and criticism of his peers and colleagues at the Manned Spacecraft Center (MSC) in Houston, Charles A. Berry, chief of the Medical Operations Office, made a gutsy decision about how best to send astronauts into space on long-duration flights and demonstrate that humans could fly to the Moon and return home safely.[1] By the end of Project Mercury, NASA had flown only six crewed space missions for a total of 53 hours, 55 minutes, and 27 seconds, and deciding on the approach to fly astronauts on multiday spaceflights was not straightforward. Berry decided to use predictive medicine and increase the duration of the flights from 4 days to 8 and then to 14. As he later recalled, "This was a hard row to hoe."[2] Berry had to weigh the risks and make the tough call to move forward despite the pressure from others in the medical community.

NASA began winding down Project Mercury in 1963 as plans for Gemini were underway. Astronaut L. Gordon Cooper flew the last, and only, Mercury mission that year and spent a record 34 hours in space, NASA's longest human spaceflight mission to date. After landing, Cooper felt faint while on the USS Kearsarge flight deck—his heart rate rose and his blood pressure fell. Cooper continued to experience lightheadedness and dizziness for several hours after landing.[3] This issue and the Soviet cosmonauts' experiences with disorientation in flight led many life scientists to question if there might be a limit to man's ability to function in weightlessness.[4]

Berry wanted another Mercury flight, one that could fly at least three days, and explained his idea of an extended Mercury mission to NASA Administrator James E. Webb and others at NASA Headquarters as well as to Kenneth S. Kleinknecht, manager of Mercury, but the proposal

Four, Eight, Fourteen Days (continued)

Mercury astronaut L. Gordon Cooper walks away from his Faith 7 spacecraft on the deck of the USS Kearsarge after his 1.5-day spaceflight in May 1963. (Credit: NASA)

was denied because, as Berry recalled, Gemini was the priority.[5]

At the start of Gemini, NASA had found "no serious gross effects" on the astronauts in space but planned to monitor for and document "more subtle changes" during the Gemini flights. The project's first crewed mission, Gemini III, flew in March 1965 for nearly 5 hours. Mission planners wanted the next flight to be seven days, but the aerospace medicine community—including Berry—disagreed. Jumping from one day in orbit to seven days seemed too risky. There were so many unknowns about how the human body might respond to extended time in space. Seven days in orbit might place the crew in jeopardy and therefore threaten the future Moon landings. There had to be a compromise, so Berry came up with a gradual process to mitigate the risks and allow his team to measure the less obvious impacts of prolonged weightlessness on the human body. He decided to start with a 4-day mission, later doubling that number to an 8-day flight, and finally "going to the maximum time we expected to see in Apollo," a 14-day mission. This, in his mind, "was biologically sound and safe" and would demonstrate that crews could safely fly to the Moon and back without any serious risks to their health.[6]

Berry, like all physicians, had taken the Hippocratic Oath; and, like his colleagues at Houston's MSC, he believed that his role in the mission was to assure that nothing endangered the crew during flight. Some in the medical field, however, questioned Berry's logic behind the length of the Gemini missions—even some of his own employees at MSC believed that four days in space was too dangerous. Outside researchers demanded further reviews before the flight. Physiologists called Berry to tell him that NASA did not have the scientific data to demonstrate that it was safe to fly two men for four days. He remembered prestigious medical and scientific groups questioning his plans and telling him repeatedly, "You really don't have any data" to prove that NASA could protect the flight crews. He recalled, "They were always predicting these dire things." The potential list of effects included—among other things—nausea, disorientation, sleeplessness, fatigue, and hallucinations. Some even thought that the two-man Gemini crew might drown if they tried to get out of the spacecraft without assistance because they might exhibit similar symptoms Cooper faced after his flight and fall into the ocean.[7]

> **Physiologists flooded the MSC with calls the night before the Gemini IV launch, hoping to talk some sense into Berry.**

Physiologists flooded the MSC with calls the night before the Gemini IV launch, hoping to talk some sense into Berry. The doctor remembered the stack of messages he received the next morning. Some told him he "didn't know what [he] was doing" while others said Berry was sending James A. McDivitt and Edward H. White II "to their death." He, however, was comfortable with his decision, so he did not bend to their pressure campaign. Berry, an optimist, "felt man was capable of" flying in space for four days "if we supported him properly."[8]

Neither McDivitt nor White experienced the postflight hypotension symptoms experienced by Cooper. Furthermore, neither astronaut experienced any disorientation or "other untoward effects" in flight. MSC Center Director Robert R. Gilruth recalled with pride that Berry "was right.... There are a lot of doctors you could have found in this country who would have said something else," he

Left: Dr. Charles Berry prepares to check the blood pressure of James A. McDivitt, Command Pilot for the Gemini IV mission. McDivitt is on the tilt table at the Aero Medical Area, Merritt Island, FL, where he and Gemini IV pilot Edward H. White II underwent preflight physicals in preparation for their four-day spaceflight. **Right:** Prior to the Gemini VII mission, Berry checks astronaut James A. Lovell Jr. following a workout on an exercise machine. (Credits: NASA)

said.[9] Instead, the crew dedicated their time in space to everyday activities humans do on Earth, such as eating and sleeping.[10] These medical findings, Berry noted, "made things easier later."[11] Some continued to believe that the data gathered thus far remained insufficient. There still was not enough scientific information to prove spaceflight was safe.

Gemini V doubled the number of days the crew spent in space, from four to eight, and once again demonstrated the ability of a flight crew to operate in space for a longer duration and to successfully readapt to gravity. Upon their return, the astronauts, Cooper and Charles "Pete" Conrad, visited Washington, DC, where they spoke in the halls of Congress and to the National Academy of Sciences. The response of some of Berry's colleagues to this flight surprised him. They still believed NASA was not being scientific in their approach.[12]

Berry did have some concerns flying men in space for 14 days, not because of any medical concerns, but because of the size of the spacecraft. The Gemini capsule was cramped—about the size of the front of a Volkswagen Beetle. Astronaut Conrad jokingly referred to his flight as "eight days in a garbage can." Berry was pleased that the Gemini VII crew persevered. He credited their success to being able to take off their spacesuits in flight. Throughout their mission, the two-man crew remained healthy and successfully completed their flight with no adverse effects on their mental health. It was a "miraculous thing," he said, to see the crew walk on the carrier deck after their recovery.[13]

About 10 days later, Berry, along with astronaut Ed White, gave an address at the American Association for the Advancement of Science on the long-duration missions of Gemini IV, V, and VII and what NASA had learned thus far. Berry presented the data and emphasized that his team had very few spaceflyers to establish baseline data about humans and spaceflight. He admitted that NASA might not be able to prove that the physiological changes experienced by the crew were the result of being exposed to microgravity. Aerospace physicians would not be able to look at an astronaut's physiological change and say with certainty that the cause was weightlessness. "We're not going to be able to pull out weightlessness as one single variable…and I would like to make that very clear," he said. He was also quite clear on another

Gemini VII astronauts James A. Lovell Jr. (left) and Frank Borman arrive aboard the aircraft carrier USS Wasp following their record-breaking 14-day mission in space. (Credit: NASA)

thing: he did not anticipate any physiological issues popping up on a lunar mission.[14]

Looking back, Berry's incremental approach to long-duration missions helped to lay the foundation for the Apollo Moon landings, Skylab, Space Shuttle missions, and today's much longer expeditions on the International Space Station. Gilruth believed Berry's decision to incrementally increase the length of the missions from 4, to 8, and then 14 days was one of the reasons Gemini succeeded.[15] His stepwise approach stands out as one of the key decisions in the program and as a significant milestone on the way to the Moon. Berry's judgment on this critical issue demonstrates the importance of competence, conviction, and courage in solving particularly challenging spaceflight problems. Thanks to these missions, flight surgeons were confident that the Apollo crews could complete a lunar mission.[16] ■

Endnotes

1. When asked about the incremental approach, A. Duane Catterson, who worked at the MSC Medical Operations Office, could only recall Berry being the person to come up with the idea. A. Duane Catterson, interview by Carol Butler, February 17, 2000, transcript, Johnson Space Center (JSC) Oral History Project.
2. Charles A. Berry, interview by James M. Grimwood and Ivan D. Ertel, March 18, 1968, transcript, NASA Headquarters Archives, Washington, DC.
3. "Postlaunch Memorandum Report for Mercury-Atlas No. 9 (MA-9)," Part I Mission Analysis (Cape Canaveral: NASA, 1963), pp. 7-15, 7-21, 7-23.
4. Charles A. Berry, D. O. Coons, A. D. Catterson, and G. Fred Kelly, "Man's Response to Long-Duration Flight in the Gemini Spacecraft," in *Gemini Midprogram Conference Including Experiment Results* (Washington, DC: NASA, 1966), p. 235.
5. Berry interview, March 18, 1968; Charles A. Berry, interview by unidentified interviewer, December 2, 1985, transcript, Great Moments in Space Medicine Oral History Project, JSC Archives, Houston, TX.
6. Berry interview, March 18, 1968; Berry, Coons, Catterson, and Kelly, "Man's Response to Long-Duration Flight in the Gemini Spacecraft," p. 235.
7. Berry interview, December 2, 1985; Berry, Coons, Catterson, and Kelly, "Man's Response to Long-Duration Flight in the Gemini Spacecraft," p. 235.
8. Berry interview, December 2, 1985.
9. Robert R. Gilruth, interview by James M. Grimwood and Ivan D. Ertel, March 21, 1968, transcript, NASA Headquarters Archives, Washington, DC.
10. *Gemini Program Mission Report: Gemini IV* (Houston: NASA, 1965), pp. 7-47, 7-49.
11. Berry interview, March 18, 1968.
12. Berry interview, December 2, 1985.
13. Berry interview, March 18, 1968.
14. "Berry's Speech AAS," General Reference, General History I, Box 47, Speeches and Articles, JSC Archives, Houston, TX.
15. Gilruth interview.
16. Berry, Coons, Catterson, and Kelly, "Man's Response to Long-Duration Flight in the Gemini Spacecraft," p. 261.

NASA ORAL HISTORY

Imagining Space

The Life and Art of Robert McCall

» By **Sandra Johnson**, Oral History Lead

↑ Artist Bob McCall in his studio in Paradise Valley, Arizona surrounded by his artwork. (Credit: NASA)

AS WE WALKED into Bob McCall's Arizona home, it quickly became obvious that two talented and creative people lived there. Tasked with interviewing one of the first artists to be invited to join the NASA Art Program, our oral history team quickly realized the session with McCall would include a unique perspective on NASA's history. We traveled to Arizona in the spring of 2000 to capture interviews with some of the pioneers of spaceflight and had already talked to an eclectic group of subjects in their homes, including a flight controller for both Gemini and Apollo, an astronaut who had flown on both Skylab and Space Shuttle missions, a former NASA center director, and two former Women's Airforce Service Pilots (WASPs) who ferried airplanes during WWII. However, unlike most interviews, the setting itself provided a rare glimpse into the man and his inspiration.

Sitting in the light-filled studio surrounded by his art—both finished and in progress—McCall shared the story of those first steps into his future with NASA. The journey began when, as a child, he gazed into the heavens through an inexpensive telescope, a present from his parents.

> I was able to look at the Moon and I saw the craters on the Moon for the first time. Now, we're talking about a 10-year-old boy that was made aware of the incredible universe that surrounded us, and I understood...that those points of light in the night sky were enormous worlds much larger than our own world, bigger than our own Sun... and that the Moon was an enormous sphere orbiting planet Earth. The universe, to me, is the incredible and great inspiration.[1]

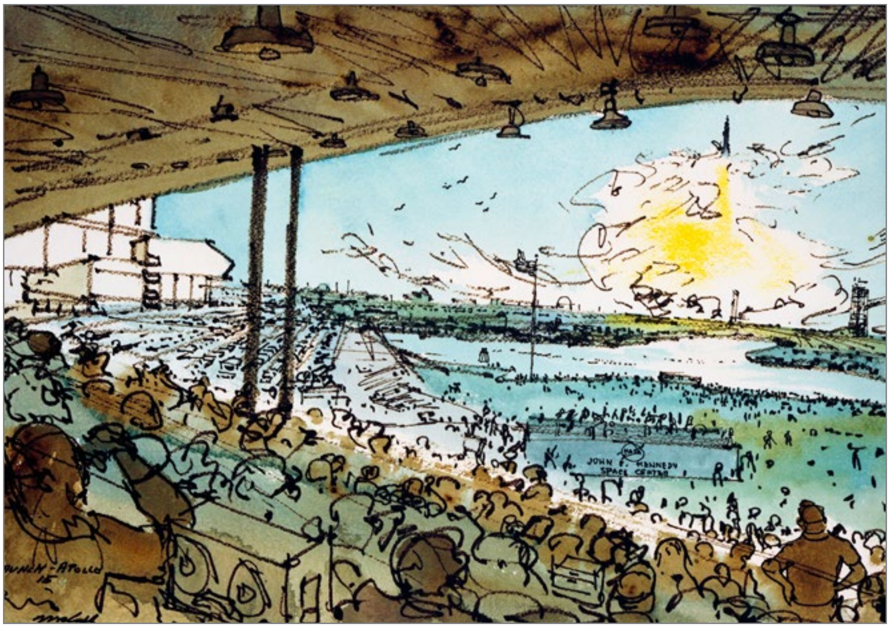
As a youth, McCall discovered he also had a talent and ambition to make art and began his career at 17 at a sign shop in Columbus, Ohio. After two years at art school, he moved to Chicago to work for *Popular Aviation* magazine. The opportunity led to working for various magazines and science fiction publications, and he honed his skills as he developed an even deeper interest in aviation and spaceflight. Like most young men at the time, he enlisted in 1941 to serve the country at wartime.

> I loved aviation and I wanted to be involved. I went through flight training, did some flying, specifically as a bombardier navigator in big bombers...and still an artist, made lots of drawings and sketches.

While stationed at Kirtland Field (now Air Force Base) in New Mexico, Bob met his wife, Louise, who studied art at the University of New Mexico, and the couple soon married and began planning their life together. After first returning to Chicago at the end of the war, McCall soon realized he needed to be in New York, the location of the major magazine publishers, so he could work with some of the most prestigious publications at that time. He shared during the interview that his talent and persistence opened doors at *Life Magazine*, the *Saturday Evening Post*, *Collier's*, and *Popular Science*, and he "was established rather quickly as one of their artists." Most of his work involved the military and aviation, and, as the decade unfolded, more and more often, space. NASA, the new federal agency, and its first seven astronauts were beginning to attract the world's imagination.

By 1963, McCall's work and reputation had garnered an invitation to join the initial group of artists in the new NASA Art Program, established the

Imagining Space (continued)



A loose sketch of the Apollo 15 launch and its spectators that McCall prepared in 1972 as part of his activities with the NASA Art Program. (Credit: Robert McCall)

previous year by NASA Administrator James Webb. The program invited well-known artists and illustrators to create their visual interpretations of the agency's plans and accomplishments and, according to Webb, would "give a unique insight into significant aspects of our history-making advance into space."[2] McCall embraced that challenge, and it changed his life. The opportunity ushered him into a world of creativity and opened doors to his lifelong focus.

> There were other artists, a whole list of them, and some very, very talented and very famous, who were engaged too, but not to the extent that I was. [M]y commitment was not just for a few months, it was a lifetime. It was a commitment that was so intense that I was content to make this my work for the rest of my career.… I wanted to be part of this history-making story.

McCall enjoyed unfettered access to NASA sites in pursuit of recording the agency's history. He sketched the daily activities of the workforce preparing for and during missions at Kennedy Space Center in Florida and the Manned Spacecraft Center (later Johnson Space Center [JSC]) in Houston, including astronauts going about their training, mission launch events, and flight controllers manning the consoles in Mission Control.

"There were other artists, a whole list of them, and some very, very talented and very famous, who were engaged too, but not to the extent that I was.

— Bob McCall

His finished works of art on canvas were large because the scale of the subject matter was immense, but McCall wanted to tackle a much bigger project. He contacted the assistant director of the Smithsonian National Air and Space Museum, Fred Durant, and explained his plan. Durant talked to Mike Collins, the museum's director and former Command Module pilot on Apollo 11. After Collins agreed to support the project, McCall returned home and began making sketches of his ideas. But first he had to learn how to deliver what he proposed.

> I had done some big paintings, but I had never done a mural on a wall. So I did research on that, a lot of research. I visited [muralist] Thomas Hart Benton…. This was a man that I admired enormously, loved what he did, and he was a great American artist. So I visited him, talked to him, showed him what I had in mind, and he gave me some counsel and advice, which was very valuable.

Taking eight months to complete and spanning 46 by 146 feet, *The Space Mural, A Cosmic View* greets guests as they walk through the museum's Independence Avenue entrance. McCall called this work "My great pride, because it's effective, it's a good work of art, and a lot of people see it. And I like the fact that it's likely to be there for a very long time."

NASA's Johnson Space Center became the site of his next mural in 1979. At the time, the lobby of Teague Auditorium in Building 2 served as the only visitor center at the site and included spacecraft mockups, displays, and interactive exhibits for the public. In a 2002 oral history interview, Chuck Biggs, chief

Imagining Space (continued)

of the Public Services Branch, shared how the mural project had begun.

> There are a few people that I hold in great esteem, and Bob's one of them. [He] was always one of my idols. I thought it would be great if he could do a mural talking about the space program in the auditorium.... So I talked to Chris Kraft, who was the director at the time, and he said, "Okay, get him to put together a proposal."[3]

McCall submitted his ideas for the design, which would be painted on the top portion of the curved wall over the auditorium's entrance and cover a 16- by 72-foot area. Scaffolding was built, and work began on the mural; however, the area had to remain open to the public throughout the creation. Center visitors could watch as he created the artwork, entitled *Opening the Space Frontier—The Next Giant Step,* and occasionally the artist himself became an interactive exhibit.

According to Biggs,

> The public would come through and look at the exhibit, and here's Bob McCall up there painting away.... I remember one day I was over there, and this little girl was saying, "Mr. McCall." He's up on the scaffolding. "Mr. McCall." Finally he recognized she was calling him. He said, "Yes, dear?" She says, "How does this exhibit work?" He said [to Biggs], "I should get a training course on your exhibits."

↑ **Top left:** Chuck Biggs (left) and Bob McCall in front of a portion of the mural, *Opening the Space Frontier—The Next Giant Step* at NASA's Johnson Space Center. **Top right:** Bob McCall stands on scaffolding while painting a portion of the mural depicting the launch of an Apollo mission. **Bottom:** McCall works on his mural at JSC while visitors tour the exhibit area. (Credits: NASA)

As McCall filled in the details of the mural, he rendered his vision to "tell the story of our manned space program from the beginning...then looking into the future with some fantastic space stations orbiting that are really just dreams of a future that might be." The artist also wanted to include NASA personnel as models for portions of the scene. One afternoon, he asked Biggs to come over to the auditorium and pose leaning against the scaffolding. The artist told him, "You're the guy that made this happen, so I want to make sure that you're in the mural." His likeness appears leaning on a console in Mission Control. Also depicted are Bob Gilruth, Chris Kraft, George Abbey,

Imagining Space (continued)

Top: McCall and Apollo astronaut Alan Bean on scaffolding in front of Bean's rendition of an astronaut pin at the top portion of the mural. Silver pins are awarded to candidates who have successfully completed astronaut training; gold pins are reserved for astronauts who have flown in space. **Bottom:** Bob McCall and astronaut candidate Judy Resnik in front of the 16- by 72-foot mural in the Building 2 Visitor Center at JSC. McCall painted Resnik's likeness to represent the new astronaut class, which included the first six female candidates. (Credits: NASA)

Gene Kranz, Glynn Lunney, Ed Fendell, astronauts Judy Resnik and John Young, and many others.

McCall continued to create works of art and murals for NASA locations, visitor centers, and museums across the country as well as mission patches and books. Outside of NASA, he produced space-themed movie posters, postage stamps, and illustrated books, and his work reflected that creative vision of space for the rest of his life. When asked about inspiration, his answer called to mind that 10-year-old boy viewing the universe through a small telescope so many years ago.

> When I make a painting of a space scene, I visualize myself in that environment and in that picture. So as an artist, I am in that enviable position of being able to fly over the rings of Saturn and view that incredible sight. I can travel over the canyons of Mars that are so spectacular.... I am trying to make people aware of the absolute glory and magic...to give them a sense of the marvel of the universe that we know so little about it, but the little that we know is inspirational and marvelous.... The possibilities to be aware, to communicate a sense of the wonderful possibilities, and the glory, the sublime nature of it all is what thrills me basically and fundamentally and in a wonderful way. ■

- Read Bob McCall's Oral History Transcript
- Read Chuck Biggs's Oral History Transcript
- Learn About the History of NASA's Art Program

Endnotes

1 Quotations from Bob McCall for this article are taken from Robert T. McCall, interview by Rebecca Wright, March 28, 2000, edited transcript, JSC Oral History Project.

2 "Artist's Program Yields Sketches of MA-9 Launch," Manned Spacecraft Center's *Space News Roundup* (July 10, 1963).

3 Charles A. Biggs, interview by Rebecca Wright, August 1, 2002, edited transcript, JSC Oral History Project.

COLLECTION HIGHLIGHT

Inside the Archives

Biomedical Branch Files

» By **Alejandra Lopez**, NASA History Office Spring 2025 Intern

THE BIOMEDICAL BRANCH FILES (1966–2008) in the Johnson Space Center archives showcase the inner workings of a NASA office established to perform testing to provide a better understanding of the impacts of spaceflight on the human body. Ranging from memos and notes to documents and reports, this collection is an invaluable resource on the biomedical research done with NASA's Apollo, Skylab, Space Shuttle, and Space Station projects. Files in the collection cover work done by groups within the branch such as the Toxicology, Microbiology, Clinical, and Biochemistry Laboratories. It also reveals the branch's evolution and changes in its decision-making process over the years.

The collection includes almost the entire life of the branch, distinguished by its almost continuous female leadership throughout its existence. As part of the Space and Life Sciences Directorate, the branch fell under the Medical Sciences Division. After its establishment in 1974, the branch was temporarily led by the division chief in an acting capacity. In 1977, Dr. Carolyn S. Huntoon became the branch's first chief, and the collection includes records she brought from her previous position as head of the Endocrine and Biochemistry Laboratories. Succeeding Huntoon was Dr. Nitza M. Cintrón, who served as chief from 1986 to 1992 after Huntoon's departure in 1984. Cintrón was followed by Dr. Helen W. Lane, who served as the branch chief from 1992 until its closure in 1998. Collection records cover Huntoon's and Cintrón's time as chief, as well as the beginning of Lane's tenure.

Transitions in leadership and differences in decision-making styles between these three women are reflected in the collection materials as the branch's biomedical research projects and experiments changed and shifted. The differences in leadership are seen not only through their respective communication styles, but also through the organizational structure of the collection. The first series of the collection consists of what would have been one of the branch's filing cabinets. A distinctive feature is that files contributed during Cintrón's leadership almost all had notes about where they should be filed, a practice not normally utilized by her predecessor or successor. The information from the notes is reflected in the current arrangement and were a useful tool to better contextualize the collection. This collection is an excellent resource for those wanting to know more about the research and projects done to understand and prepare for human spaceflight. ■

↑ **Top:** Dr. Carolyn S. Huntoon, shown here in 1972, became the Biomedical Branch's first chief in 1977. **Bottom:** Dr. Nitza M. Cintrón works in the lab in 1980. In 1986, she became the chief of the Biomedical Branch at Johnson Space Center. (Credits: NASA)

News from Around NASA

Summer Interns Provide Invaluable Assistance for NASA's History Office

This summer, the NASA History Office is pleased to be joined by four interns working with NASA's archival collections at Glenn Research Center (GRC), Goddard Space Flight Center (GSFC), and Langley Research Center (LaRC).

Marley Crusch. (Photo courtesy of Marley Crusch)

Marley Crusch is pursuing her MLIS with an archival concentration at Emporia State University in Kansas with hopes to graduate in 2027. She's excited to explore Cleveland and the historical materials housed at Glenn Research Center this summer. In addition to building her metadata skills at an iconic institution, she has enjoyed diving into the more human side of the archives while reviewing pictures from agency social events, such as musical performances.

April Graham. (Photo courtesy of April Graham)

April Graham joins us this summer as a recent graduate of Kent State University. She graduated with an MLIS with an archival concentration in the spring of 2025 and is interested in working with federal archives institutions with an emphasis on the future of archival accessibility and usability. She was born and raised in Cleveland, Ohio, and obtained her undergraduate degree in English from Case Western Reserve University in 2022. As someone who is passionate about Cleveland history as well as having a personal interest in aviation and aeronautics, she is thrilled to be working at GRC. Over the summer, she will be working to migrate metadata from Glenn's Archival Collection to the agency's new archival database.

Emily Goss. (Photo courtesy of Emily Goss)

Emily Goss worked as an archives intern at Langley Research Center in the spring and fall of 2024 and is returning for the summer 2025 session. During her past internships at NASA, she assisted the NASA History Office by processing, arranging, and describing the unprocessed analog collections in the Langley Research Center archives. This summer, she continues this important work as she creates an inventory of the backlog analog collections in the archives and begins processing and arranging these collections. Emily recently graduated from the University of Oklahoma in May 2025 with an MLIS and a graduate certificate in archival studies. She looks forward to working more with the materials in the LaRC archives and gaining additional experience with archival description and arrangement.

Becca Massey. (Photo courtesy of Becca Massey)

Rebecca Massey joins the Goddard Space Flight Center Archives as an intern for her third semester this summer. She is a graduate student at the University of Maryland studying library and information science, with a focus on archives and digital curation. She is passionate about preserving both cultural memory and scientific data for future generations. Originally from Pennsylvania, Rebecca moved to Maryland to attend Towson University, where she earned her bachelor's degree in English with a focus on writing. Her work at Goddard consists of processing archival collections relating to the culture and history of the center, as well as digitizing textual records. This summer, she will be processing a collection of material from the Cosmic Background Explorer (COBE) satellite in support of the Observational Cosmology Laboratory. ■

Former JPL Space Historian Dies at 88

Portrait of Robert Cargill Hall Sr. (Credit: National Reconnaissance Office)

ROBERT CARGILL HALL SR., esteemed aerospace historian, died on April 10, 2025, in Arlington, Texas, at the age of 88.

Hall was born in Rochester, Minnesota, on January 17, 1937, and moved with his family to San Francisco in 1952. Beginning in 1955, he attended Whitman College in Walla Walla, Washington. It was there that he married Beverley Anne Chichester, completing his Bachelor of Arts degree in 1959. Upon graduation, he and Beverley returned to the Bay Area, where Hall accepted a position with Lockheed Missile and Space Division in Sunnyvale. Between 1959 and 1961, the couple became the proud parents of three children: Robert Cargill Hall Jr., Melanie Anne Hall, and Bradshaw Chichester Hall. While working at Lockheed, Hall also attended San Jose State College (now known as San Jose State University), receiving a Master of Arts degree in 1966.

After completing his masters degree, R. Cargill Hall was hired in 1967 as a public historian, for the California Institute of Technology's Jet Propulsion Laboratory (JPL). There, he researched and wrote a history of Ranger, NASA's first successful lunar probe. His book *Lunar Impact: A History of Project Ranger* was published by NASA in 1976. Upon completing the Ranger history, Hall joined the Air Force History and Museums Program as a historian at Headquarters Strategic Air Command (SAC) in Nebraska (1977–80). He subsequently served as deputy command historian at Headquarters Military Airlift Command (MAC) in Illinois (1980–81), and then as chief of the Research Division and (concurrently) deputy director of the Air Force Historical Research Agency at Air University in Montgomery, Alabama (1981–89).

In addition to his book on Project Ranger, Hall edited *Case Studies in Strategic Bombardment*; *The U.S. Air Force in Space*; *Early Cold War Overflights, 1950–1956*; and *Lightning over Bougainville: The Yamamoto Mission Reconsidered*. He also wrote "Clandestine Victory: Eisenhower and Overhead Reconnaissance in the Cold War," which appears in Dennis E. Showalter, ed., *Forging the Shield: Eisenhower and National Security for the 21st Century*. Hall contributed numerous articles and chapters on the history of aeronautics, astronautics, space law, and U.S. space policy to various journals, anthologies, and encyclopedias.

Selected in 1998 as chief historian of the National Reconnaissance Office (NRO), Hall researched and wrote classified histories of the nation's reconnaissance programs until his retirement in 2003. He subsequently worked for a contractor at the NRO, declassifying 25-year-old reconnaissance records until his final retirement in 2008.

Hall was a corresponding member of the International Academy of Astronautics (IAA) and the International Institute of Space Law (IISL). Among his awards and honors were the Robert H. Goddard Historical Essay Award, National Space Club, in 1962 and 1963; *Outstanding Young Men of America* 1968, U.S. Junior Chamber of Commerce; and more recently, the NRO Director's Circle Award; the NRO Distinguished Service Gold Medallion; the American Institute of Aeronautics and Astronautics History Manuscript Award for 2012 for *Ace of Chaos: Frank G. Tinker and the Air War in Spain* (published as *Five Down, No Glory*); and the Air Force Historical Foundation Major General I.B. Holley History Award for 2019. ■

This remembrance of R. Cargill Hall is adapted from an obituary he thoughtfully composed himself prior to his passing.

Other Aerospace History News

Call for Papers on Commercial Space History

Quest: The History of Spaceflight Quarterly invites historians and those who have worked in the commercial space industry to help document commercial space. Authors are invited to write about the contractors, entrepreneurial firms, executives, innovators, ventures, policies, economics, or other areas of interest. Articles need not be limited to human space exploration and can target markets such as satellite communications; remote sensing; positioning, navigation, and mapping; satellite services such as radio, television, or broadband; tourism; launch services; or commercial activities such as finance, insurance, policy, etc.

This upcoming special issue of *Quest* challenges authors and those who may have worked in the space industry to examine and profile an area that has not been well explored and stimulate discussion and analysis of "commercial space." Contributors to this special issue will be asked to submit pieces of roughly 3,000 to 5,000 words in length on their chosen topic. Those who have questions or wish to contribute to this special issue should contact *Quest* by June 30, 2025. The Commercial Space issue is being planned for publication in the fourth quarter of 2025, volume 32, number 4. The tentative deadline for submissions is September 1, 2025.

Get more information on how to submit a proposal.

Call for Nominations for the Ordway Award for Sustained Excellence in Spaceflight History

The American Astronautical Society (AAS) is accepting nominations for the Ordway Award for Sustained Excellence in Spaceflight History for 2025. 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, including 1) writing, editing, or publishing; 2) preparation and/or presentation of exhibits; or 3) production for distribution through film, television, art, or other non-print media. **The deadline for nominations is July 1.**

For information about past recipients or to make a nomination, visit https://astronautical.org/awards/ordway/.

In this July 1965 photo, astronaut Neil A. Armstrong, command pilot for the Gemini V backup crew, participates in water egress training, working inside the Gemini Static Article 5 spacecraft. (Credit: NASA)

NASA HISTORY OFFICE SPEAKERS SERIES

The NASA History Office invites you to attend upcoming presentations on Microsoft Teams.

July 22, 2025, noon ET

Life Lessons from the Space Shuttle Columbia Tragedy for Engineers, Managers, and Leaders

Steven R. Hirshorn
NASA Chief Engineer for Aeronautics

August 13, 2025, noon ET

Machinist on the Moon: The Dreams of Space Age Labor Relations and How They Failed

Renny Hahamovitch
PhD candidate in History and Science and Technology Studies
University of Michigan

Upcoming Meetings

JULY 7–11, 2025
International Conference on Transdisciplinary Engineering 2025
Monterrey, Mexico
https://intsoctransde.org/current-conference/

JULY 15–18, 2025
2025 National Association of Government Archives and Records Administrators (NAGARA) Annual Conference
Oklahoma City, Oklahoma
https://nagara.org/annualconference

JULY 21–25, 2025
2025 American Institute of Aeronautics and Astronautics (AIAA) Aviation and Aeronautics Forum and Exposition
Las Vegas, Nevada
https://www.aiaa.org/aviation

JULY 21–27, 2025
Experimental Aircraft Association (EAA) AirVenture
Oshkosh, Wisconsin
https://www.eaa.org/airventure/

AUGUST 24–27, 2025
ARCHIVES * RECORDS 2025 (89th Annual Meeting of the Society of American Archivists)
Anaheim, California
https://www2.archivists.org/conference

SEPTEMBER 3–6, 2025
Society for Social Studies of Science (4S) Conference 2025
Seattle, Washington
https://www.4sonline.org/meeting.php

SEPTEMBER 8–10, 2025
American Astronautical Society's John Glenn Memorial Symposium
Cleveland, Ohio
https://astronautical.org/events/john-glenn-memorial-symposium/

SEPTEMBER 29–OCTOBER 3, 2025
International Astronautical Congress (IAC) 2025
Sydney, Australia
https://www.iac2025.org/

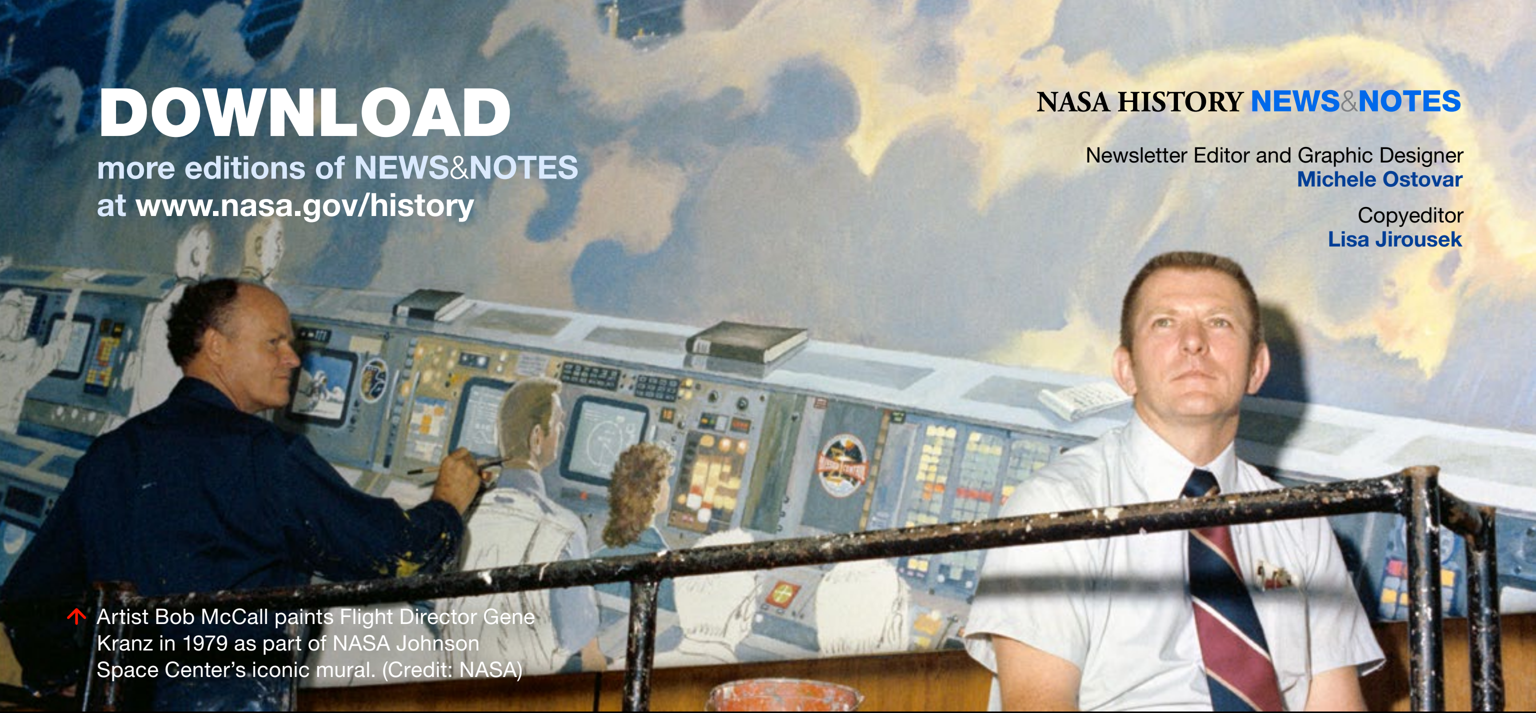
OCTOBER 9–11, 2025
Society for the History of Technology (SHOT) 2025 Annual Meeting
Esch-sur-Alzette, Luxembourg
https://www.historyoftechnology.org/annual-meeting/2025-shot-annual-meeting/

OCTOBER 15–18, 2025
Oral History Association (OHA) Annual Meeting
Atlanta, Georgia
https://oralhistory.org/annual-meeting/

OCTOBER 27–29, 2025
2025 von Braun Space Exploration Symposium
Huntsville, Alabama
https://astronautical.org/events/vbs/

NOVEMBER 13–16, 2025
History of Science Society (HSS) Annual Meeting
New Orleans, Louisiana
https://hssonline.org/page/HSS25

DECEMBER 15–19, 2025
AGU25 (American Geophysical Union) Annual Meeting
New Orleans, Louisiana
https://www.agu.org/annual-meeting



DOWNLOAD

more editions of NEWS&NOTES at www.nasa.gov/history

NASA HISTORY NEWS&NOTES

Newsletter Editor and Graphic Designer
Michele Ostovar

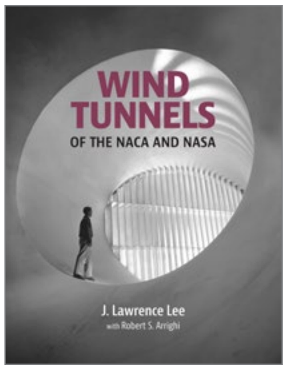
Copyeditor
Lisa Jirousek

↑ Artist Bob McCall paints Flight Director Gene Kranz in 1979 as part of NASA Johnson Space Center's iconic mural. (Credit: NASA)

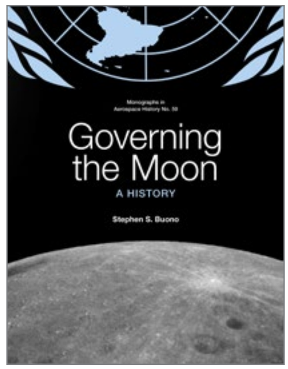
EXPLORE →

New Titles in the NASA History Series

COMING SOON
Ascension: Life Lessons from the Space Shuttle Columbia Tragedy...
By Stephen R. Hirshorn



COMING SOON
Wind Tunnels of the NACA and NASA
By J. Lawrence Lee with Robert S. Arrighi



Governing the Moon: A History
By Stephen S. Buono

FOLLOW →

NASA History on Social Media

X
@NASAhistory

Facebook
@NASAHistoryOffice

Flickr
nasacommons

National Aeronautics and Space Administration

Mary W. Jackson NASA Headquarters
300 E Street SW
Washington, DC 20546

www.nasa.gov