NEWS &NOTES

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FROM THE ACTING CHIEF HISTORIAN

When I was a second-grader growing up in rural south Alabama, my teacher took my 27 classmates and me to the library to view an educational program that would turn out to be one of the most tragic events in the history of human spaceflight. I seem to remember sitting at a rectangular table watching on TV when, 73 seconds into the flight, the Space Shuttle Challenger exploded. The fact that STS-51L included Christa McAuliffe and the Teacher in Space Project brought that mission squarely into classrooms across the nation and had profound consequences for my generation. Over the years, I have returned again and again to this memory, particularly when considering those moments from the history of the space program that were the most personally impactful. The passage of time has seen the attrition of other memories, but this one continues to be both resonant and clear. Or so my memory tells me.

Memory is one of the most dominant, yet untrustworthy aspects of our identity. It is vulnerable to both the passage of time and the accumulation of new information and emotional elaboration. Over the years, I've discussed the Challenger tragedy with members of the NASA workforce, past and present—those who were working at the Agency that day and those who have come on board since. These conversations have without question reshaped that memory far beyond grounded

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THE SCIENCE OF COMMEMORATING HUMAN SPACEFLIGHT

By Travis Frederick, NASA Headquarters History Spring 2021 Intern

I remember stopping and raising my fist to the Moon, and saying, "Yes, we did it!"

—David from Minnesota, recalling the night of 20 July 1969

David's reaction to the 1969 Moon landing is highly representative of the kinds of stories we heard during the Apollo 11 50th anniversary oral history project,[1] completed by NASA's Goddard Space Flight Center, which collected memories from people all over the world. Personal stories collected through oral histories such as this one inject historical research with a human touch that allows us to connect more personally and emotionally with the past. However, while typically reliable for everyday purposes, memory is notoriously fallible. Conducting analytical and fact-based history solely based on memory would be like playing trivia with the guy who

1 "Memories of Apollo from People All Over the World," *https://www.nasa.gov/feature/goddard/2019/memories-of-apollo-from-people-all-over-the-world/* (accessed 10 March 2021).

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NASA HISTORY PROGRAM OFFICE

OFFICE OF COMMUNICATIONS

From the Acting Chief Historian (continued)

reality. I'm certain I misremembered, recategorized, and added further details to my own experience of witnessing the accident.

More than we might like to think, our memories are grounded, not in some internal hard drive waiting to be recalled at a moment's notice, but in our imaginations. Philosopher Paul Ricoeur underscores this dilemma, arguing that while operating "in the wake of imagination," we have no better tool than memory to connect us to the meaningful events of our lives. The dichotomy is not between truth and fiction, but between the past as it happened and the past as we remember it. Public memory takes remembering the past a step further, creating shared identities used to foster a sense of belonging, particularly significant for creating and strengthening the imagined connections necessary for large group identities such as nationalism.

There emerges then the necessity of distinguishing between history and memory. History is the attempt to utilize available evidence in the reconstruction and analysis of the past. Memory is embodied—a living and continually evolving aspect of individual and collective identity. In this way, memory is not a preservation of the past but a *reimagining* of that past—continually under reevaluation by the one doing the remembering. In the words of Walter Benjamin, "he who seeks to approach his buried past must conduct himself like a man digging." When reflecting on events such as the Apollo 11 Moon landing (20 July 1969), the launch of STS-1 (12 April 1981), or the Space Shuttle Columbia accident (1 February 2003), we usually do so oblivious to the layers of embedded details amassed over the years.

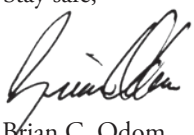
Anniversaries serve as moments of reconstituting—reimaging. When reflecting upon what we remember as the most significant, profound moments from 60 years of human spaceflight (Yuri Gagarin, April 1961) and 60 years of American spaceflight (Alan Shepard, May 1961), we are likely to select those most reflective of who we believe ourselves to be. We then begin digging through those embedded layers of memory, analyzing the significance of Alan Shepard's 5 May 1961 flight, the televised handshake during the Apollo-Soyuz mission, or that International Space Station (ISS) Expedition crew launch we witnessed at the Cape.

While it is important that we recognize its fragility, it is critical that we integrate memory fully into the work we do at the NASA History Program. The primary concern is not whether we should include memory work in the program but how to maintain an equitable balance. As Travis Frederick points out in his article below, memory work and the commemoration that comes along with it places our office at the forefront of fostering collective identity and bolstering group cohesion.

Oral histories are crucial examples of this memory work. At an individual level, our memories constitute the shape and reshaping of our identities, signaling our membership to family or communities. At NASA, these individual memories stand at the center of our organizational and institutional culture. Collecting and investigating individual memories from 60 years of human spaceflight provides a unique window into the impact our organization has on both internal and external stakeholders. The point of these memories is not to convey an undeniable truth about the past but to show *how* we think about it.

As a NASA historian, I've watched, researched, and written about numerous important milestones from the history of human spaceflight. Last year alone, America and the world watched as Bob Behnken and Doug Hurley launched on 30 May, followed by the Crew Dragon (Crew-1) on 16 November. The Artemis program promises to add many more historic missions to the long list of past achievements of human spaceflight as we journey back to the Moon and beyond. Moving forward, NASA's bold missions will continue to inspire with monumental achievements—how we choose to remember them is up to us.

Stay safe,



Brian C. Odom
Acting Chief Historian

The Science of Commemorating Human Spaceflight (continued)

Vice President Spiro Agnew and former President Lyndon B. Johnson view the liftoff of Apollo 11 from pad 39A at Kennedy Space Center. (Photo credit: NASA)

has had one too many, answering questions loudly, overconfidently—and often incorrectly.

In one illustrative study, cognitive psychologist Ulric Neisser had students in his psychology class write down memories of where they were, what they were doing, and who was with them at the moment of the Space Shuttle Challenger explosion. This was in January 1986, less than 24 hours after the disaster. Neisser waited nearly three years before returning to gather the same students' recollections of the accident, now as seniors. The questions were the same, but shockingly, the majority of what the students recalled during the second round of questions in fall 1988 failed to align with previous memories. Many students even produced entirely made-up situations.

One student, known in the study as R. T., remembered during the second session in 1988 that she and her roommate had been in their dorm room watching television when a news flash came across the TV. Shocked and upset, R. T. claimed she went upstairs to talk to a friend before calling her parents. During her original recollection, taken immediately after the Challenger disaster, R. T. described what happened this way: "I was in my religion class and some people walked in talking about it. I didn't know any of the details except that it had exploded and the schoolteacher's students had all been watching which I thought was so sad." Neisser also had students rate their confidence levels for each aspect of their memories. In 1988, R. T. maxed out the scale, saying she was "absolutely certain" of the veracity of her false Challenger memories.[2]

In the early 2000s, psychologists, building on Neisser's work, began investigating the idea that conversation and group commemoration could shape personal memories of highly emotional events, including the Space Shuttle Columbia accident. This approach involved a decade-long study of Americans' memories of the terrorist attack on 11 September 2001. Participants who had lived in New York City at the

"THE QUESTIONS WERE THE SAME, BUT SHOCKINGLY, THE MAJORITY OF WHAT THE STUDENTS RECALLED DURING THE SECOND ROUND OF QUESTIONS IN FALL 1988 FAILED TO ALIGN WITH PREVIOUS MEMORIES. MANY STUDENTS EVEN PRODUCED ENTIRELY MADE-UP SITUATIONS."

2 Ulric Neisser and Nicole Harsch, "Phantom Flashbulbs: False Recollections of Hearing the News about Challenger," in *Affect and Accuracy in Recall: Studies of "Flashbulb" Memories*, ed. E. Winograd and U. Neisser, Emory Symposia in Cognition (Cambridge, U.K.: Cambridge University Press, 1992), pp. 9–31.

time of the attack were asked to recall the details of the moment it all happened. In this study, participants were asked to repeatedly share their personal stories with one another prior to the final recall. Researchers found that for both speakers and listeners, aspects of the stories that were communicated between participants were better remembered, while related information that went unmentioned was more likely to be forgotten than unrelated, unmentioned material. Due to the respective social pressures of collaborative recall and mutual forgetting, researchers discovered that participants' deeply personal memories of this unforgettable event were actually converging![3]

What does this all mean for a history program commemorating the 60th anniversary of human spaceflight? It means that the people and events we choose to publicly commemorate, from the successes of human spaceflight and lunar landings to the tragedies recalled annually on the Day of Remembrance, are extremely consequential.

Traditionally, the purpose of the History Program Office has been publishing historical research, studying the societal impact of space exploration, and expanding the Agency's knowledge base to assist leadership in accomplishing its missions. Former NASA Chief Historian Roger Launius has described the History Program's role in commemorative events as a double-edged sword. He argued that despite offering opportunities to renew enthusiasm and resources, it is a constant balancing act to maintain focus on substantive projects in an environment that tends to rally around public commemorations—many of which are "tailor-made for hoopla, historicism, and perhaps even hysteria."[4]

It seems that the science of memory and commemoration urges us to value the History Program's role in commemoration far more highly. Commemorative events are more than opportunities to rally public support and attract resources; they are deeply important decisions that shape our shared understanding of the past. Group commemorations in the form of publishing newsletters, dedicating buildings, and establishing monuments all have the capacity to unknowingly alter even our most personal and emotional memories.

The fallibility of memory is not all bad. Shared memories foster collective identity and can bolster group cohesion. Joint commemorations offer regular opportunities to strengthen the community bonds of the extended NASA family. And, as one contributor to the Apollo 11 50th anniversary oral history project asked, "Who could forget seeing that first step?"

The Mary W. Jackson NASA Headquarters building in Washington, DC. (Photo credit: NASA)

3 Alin Coman, David Manier, and William Hirst, "Forgetting the Unforgettable Through Conversation: Socially Shared Retrieval-Induced Forgetting of September 11 Memories," *Psychological Science* 20, no. 5 (2009): 627–633.

4 Roger D. Launius, "NASA History and the Challenge of Keeping the Contemporary Past," *Public Historian* 21, no. 3 (1999): 63–81.

NASA HISTORY UPDATES

NASA HEADQUARTERS

Washington, DC

By Brian Odom

Much work has gone into finalizing the program for the "NASA and the Rise of Commercial Space" symposium, which took place 17–19 March, with an additional panel on more recent commercial space activity on 25 March. From activities in low-Earth orbit to the Artemis program, the commercial space industry is beginning to take on an increased role as innovator in space access, commerce, and exploration. This growth of commercial space over the past decades offers the potential for a new paradigm for space exploration—one in which industry transitions from supplier to partner. Still, many questions remain, spanning from the most seemingly consequential—"How will humanity explore the Moon and Mars?"—to the more basic—"What is commercial space?" This virtually hosted symposium will explore this transformation and examine the historical context for answering these questions. Our hope is that this historical analysis will inform the relationship between government and industry moving forward. The program includes keynote talks from Eric Berger (Ars Technica), Ken Davidian (Federal Aviation Administration [FAA]), Alexander MacDonald (NASA), and Steve Lee (Astrosat), in addition to four panel discussions featuring more than 20 notable speakers. I would like to extend a thank-you to planning committee members Stephen Waring, Ken Davidian, Steve Garber, and Rick Sturdevant, as well as NASA History interns Travis Frederick and Jonathan Ruff, for all the work to bring the symposium to this juncture. I would also like to thank Jason Greene (University of Alabama in Huntsville) and Christine Kretz (ISS U.S. National Laboratory) for their work pulling together the 25 March session.

Not Yet Imagined: A Study of Hubble Space Telescope Operations, by Chris Gainor, was published in January. Gainor's work documents the history of the Hubble Space Telescope from launch through the first 30 years of operations. It focuses on the interactions among the public, astronomers, engineers, government officials, and members of Congress during that time. The decision-making behind the changes in Hubble's instrument packages on servicing missions that made it a model of supranational cooperation amongst scientists is chronicled, along with Hubble's contributions to our knowledge about our solar system, our galaxy, and our universe. Visit the NASA History web page for more information on how to download the free e-book: ***https://www.nasa.gov/connect/ebooks/not-yet-imagined.html.***

Not Yet Imagined was also the subject of the NASA History monthly brown-bag lecture series on 27 January. Gainor's talk canvassed the incredible launch and operational life of Hubble to this point, including notable observations, complex design, and incredible servicing missions, which have all made the telescope a genuinely Great Observatory.

On 10 February, writer David Brown discussed the research behind his book *The Mission*, the story of NASA's many attempts to mount a robotic expedition to Europa, Jupiter's ocean moon. Told from multiple perspectives—through scientists, NASA Headquarters personnel, members of Congress, and White House appointees—the book offers a holistic view of how the Europa mission concept evolved and was at last realized as Europa Clipper. *The Mission* also offers a historical perspective of where outer-planet flagship missions fit in NASA's broader portfolio—particularly their relationship to Mars exploration—and examines the ways human spaceflight has hindered and ultimately helps robotic space exploration. *The Mission* is, at its heart, a story of tenacity—the tale of a few determined scientists and how they confronted and overcame years of setbacks to turn PowerPoint presentations into NASA's next flagship.

> **"ON 10 FEBRUARY, WRITER DAVID BROWN DISCUSSED THE RESEARCH BEHIND HIS BOOK *THE MISSION*, THE STORY OF NASA'S MANY ATTEMPTS TO MOUNT A ROBOTIC EXPEDITION TO EUROPA…"**

Our most recent talk took place on 24 February as Teasel Muir-Harmony discussed her recent work, *Operation Moonglow: A Political History of Project Apollo* (2020). That work considers how and why the Moon landing became one of the most decisive geopolitical events of the 20th century. Muir-Harmony points out that, in the wake of the Soviet Union's pioneering launch of cosmonaut Yuri Gagarin in 1961 and a humiliating defeat at the Bay of Pigs days later, President John F. Kennedy proposed Project Apollo as a solution to restoring America's tarnished geopolitical standing. With Cold War tensions between the Soviet Union and the United States approaching an all-time high, Kennedy argued that ramping up the space program would inspire global confidence in American excellence—and might even persuade people in developing countries to pick American "freedom" over Soviet "tyranny." Muir-Harmony is the curator of the Project Apollo collection at the Smithsonian National Air and Space Museum. Be on the lookout for many more of these brown-bag talks starting again in April! Information on these events is available via social media or by subscribing to our NASA History Office Listserv. Contact me at *brian.c.odom@nasa.gov* to be added to the listserv.

Looking ahead, the office is in the initial stages of planning our next symposium—"NASA and the Environment." The aim of this event, planned for mid- to late 2022, is to explore the role NASA programs and projects have played in the understanding of our own planet and global climate change in addition to examining the larger social, political, economic, and transnational contexts of that mission of scientific discovery. While additional information is forthcoming on the event, please do not hesitate to reach out to the NASA History Program Office with ideas or suggestions. For more information on NASA's work on climate change, visit *https://climate.nasa.gov/*.

Internship Update

As before, our NASA Headquarters History interns have different projects and responsibilities. Here is a description of each of their projects in their own words:

Travis Frederick

I am a Ph.D. candidate in security studies and a graduate researcher in a psychology of collective memory research lab. This background has allowed me to bring

a somewhat unusual perspective to the History Office. In my first article on the History Office web page, I looked back at the introduction of NASA's Day of Remembrance to reflect on why, beyond the technical lessons learned, NASA leadership decided to establish an annual commemoration marking the three most devastating catastrophes in its history. I have continued along this theme of Agency-sponsored commemoration in this newsletter, contributing a piece that explores the science behind group commemoration and its effects on individual memories. I am excited to continue exploring the boundaries between history and memory moving forward.

This internship has also given me the opportunity to learn a lot. I got to read all about NASA's regional impacts through editing the forthcoming book *NASA and the American South*. I am also helping to edit *A Wartime Necessity*, which takes a detailed look at aeronautical innovations spurred by the Second World War. In March, we will be hosting the "NASA and the Rise of Commercial Space" symposium, including a follow-on event that seeks to apply lessons learned from the history portion of the symposium to exploring the potential for a new, commercial paradigm in space exploration. It is an incredibly exciting time to be at NASA, and I'm really looking forward to soaking in as much as I can throughout the rest of the semester.

Felicia Ragucci

After first joining the History and Office of the Chief Scientist (OCS) teams in September 2020, I am excited to continue working on my project for a second semester. In the fall, I dove (no pun intended!) into the history of the 75-foot-wide, 40-foot-deep water tank that operated at Marshall Space Flight Center for nearly three decades until it closed in 1997. Known as the Neutral Buoyancy Simulator (NBS), this facility has a rich history of human factors engineering and development of tools and procedures for extravehicular activity. For example, the tank was critical in saving Skylab, the nation's first space station, and engineers used its zero-gravity environment to develop the foot restraints that astronauts use on their spacewalks. My research aims to document the NBS as a NASA facility and capture the personal narratives of those who brought the tank to life. I am helping Chief Scientist Dr. Jim Green—who was a safety diver for the tank in the 1980s—piece together this history into an e-book.

Last semester, I used archived newsletters to create a holistic timeline of NBS activities, built a visual timeline with photos and video from underwater tests, and gathered further reference materials. Since January, I have continued to update the timeline and created an abridged chronology of the tank's key missions and milestones. I have also been working through additional historical documents and photos of the NBS, thanks to the help of former facility employees and volunteer divers. Yet the highlight for me has been actually talking to those aforementioned individuals. With help from Dr. Brian Odom, I prepared to conduct my first oral history interview, and since then I have talked to several people, with more to come. It has been insightful, fun, and inspiring to hear directly from the people who made a giant pool mimic outer space.

Jonathan Ruff

I am thrilled to join the NASA History Program Office to assist in a variety of projects we are tackling this spring. I am a Ph.D. student at the School of Public Policy, Oregon State University, with a background and interest in commercial space policy. This term, I have primarily assisted in the development and organization of the recent ***"NASA and the Rise of Commercial Space" symposium*** (17–19 March). This program took watchers and participants on a journey through the history and future of civil-commercial partnerships, from the development of the space industrial base during the Apollo era to NASA's role in the future of celestial resource development. I am continuing this work with civil and commercial space leaders on a follow-up conference where our partners in the commercial sector will define opportunities for future civil-commercial partnerships in space.

In addition to these conferences, I have worked with NASA Archivist Sarah LeClaire on our newsletters'

commemoration of the 60 years of human spaceflight. Our writing describes the similarities and differences between the world in 1960 and the world today, both in space and in our daily lives. This internship has afforded me new opportunities to learn and grow in my knowledge of NASA and its past. Working with Dr. Brian Odom and Travis Frederick, I have read and edited chapters of the forthcoming books *NASA and the American South* and *A Wartime Necessity*. Using the experience gained in that process, Travis and I will be working with Jeff Pelosum to better understand the history of the NASA Explorers Program, which emphasizes rapid development and deployment of science-focused, university-developed satellites. The goal of the Explorers Program project, alongside all other projects I have the opportunity to work on this term, is to reframe NASA's history to inform our potential futures. I am excited to be working for the NASA History Program Office during this exciting time and am looking forward to growing alongside the office throughout the remainder of my time here.

Jacqueline Zito

I am currently a junior at the University of Maryland double-majoring in marketing and business administration and minoring in creative writing.

My job is to support the History Program Office's mission by creating colorful and engaging social media posts to expand NASA's public profile. I utilize humor, history, and science to capture the public's interest and support. I also track and measure public engagement using media metrics for Facebook and Twitter.

GLENN RESEARCH CENTER (GRC)

Cleveland, Ohio

By Bob Arrighi

On 23 January, we marked the 80th anniversary of the groundbreaking of the National Advisory Committee for Aeronautics (NACA) Aircraft Engine Research Laboratory—what we know today as NASA Glenn Research Center. The Center will be celebrating with a yearlong campaign of virtual activities and special communications. I have put together a resource on how Cleveland was selected as the site of the lab and the events leading up to the groundbreaking. It includes many primary source documents from our archival collection. It can be found at *https://www1.grc.nasa.gov/glenn-history/nasa-glenns-arrival-in-cleveland/*.

> **"THE CENTER WILL BE CELEBRATING WITH A YEARLONG CAMPAIGN OF VIRTUAL ACTIVITIES AND SPECIAL COMMUNICATIONS."**

The flagship event of our 80th anniversary will be the selection of the third class of inductees for the Glenn Research Center Hall of Fame. The Hall of Fame was established in 2015 as part of the NACA Centennial celebration as a means of honoring past Glenn employees who have made significant contributions to the Agency, Center, and their fields. Inductees will be selected this summer, and an induction ceremony will be planned for later. Current members of the Glenn Hall of Fame can be found here: *https://www1.grc.nasa.gov/glenn-history/hall-of-fame/*.

Glenn's historic remote testing facility, Plum Brook Station, was renamed the Neil Armstrong Test Facility in December of last year. Neil Armstrong began his NASA career at what is now Glenn in 1955. He was a research pilot for several months before moving on to the NACA High Speed Flight Station in California. Plum Brook began as the Plum Brook Ordinance Works, an Army facility, in 1941. In 1955, the NACA leased a portion of the land from the Army to build the Plum Brook Reactor Facility. Over the next 10 years, additional large, high-risk test facilities were built and planned, and in 1963, NASA took possession of the entire property. It is home to several one-of-a-kind facilities supporting Agency and commercial missions.

NASA REMEMBERS 60 YEARS OF HUMAN SPACEFLIGHT

This newsletter has already delved into the complexities of memory. However, it is important to note that memory is also a valuable tool in the study of history. The history of human spaceflight is filled with significant events that were witnessed by the entire world. The memories of the people who experienced these achievements are instrumental in shaping institutions such as NASA.

So, in honor of the 60th anniversary of human spaceflight, the NASA History Program Office has asked members of the space community to share their favorite moment in the history of human spaceflight. We received a wonderfully wide range of answers. Some individuals shared generally influential events, like the successful failure of Apollo 13; others shared significant moments in their careers, like watching NASA's first "Return to Flight" launch; and still others shared more personal memories, like looking up at the Moon in July 1969.

BILL BARRY

Former NASA Chief Historian

Choosing just one favorite moment from the first 60 years of human spaceflight strikes me as a nearly impossible task. As longtime readers of NASA History *News & Notes* may recall, the flight of John Glenn is certainly the human spaceflight event that had the most significant personal impact on me. Sitting on the cold linoleum floor in front of our tiny black-and-white television, worrying about whether Glenn would live through reentry, is both my earliest memory and the event that grabbed me by the heart and set me on the path toward (eventually) working at NASA. While the first U.S. orbital flight had a life-changing impact on my four-year-old self, I would have to say that my *favorite* moments in the history of human spaceflight have been when teams have come together to beat the odds. Apollo 13 may come to your mind here, or the rescue of the Skylab program on the first crewed flight, or even the amazing rescue of Salyut 7 in 1985. But, for me, my favorite of those beating-the-odds moments is summed up in three words: "SCE to AUX." It was 14 November 1969, and Apollo 12 was struck by lightning just after launching into a rainy overcast sky. The power surge scrambled the Command and Service Module electronics. The second lunar landing looked like it would be scrubbed within a minute of launch. But, in Mission Control, John Aaron recognized the pattern in the telemetry and recommended the change of a single switch position that would restore the instruments and telemetry. This mission save was not just a testament to "steely-eyed missile man" John Aaron, but to the incredible depth of training and devotion of the entire team that pulled off Apollo. Those thousands of hours of study and simulation not only meant that someone had the answer to an unexpected problem at their fingertips, but that Flight Director Gerry Griffin was willing to trust a critical call to a "kid" just five years out of college. That's the kind of organization NASA can be, when it is at its best.

"THOSE THOUSANDS OF HOURS OF STUDY AND SIMULATION NOT ONLY MEANT THAT SOMEONE HAD THE ANSWER TO AN UNEXPECTED PROBLEM AT THEIR FINGERTIPS, BUT THAT FLIGHT DIRECTOR GERRY GRIFFIN WAS WILLING TO TRUST A CRITICAL CALL TO A 'KID' JUST FIVE YEARS OUT OF COLLEGE. THAT'S THE KIND OF ORGANIZATION NASA CAN BE, WHEN IT IS AT ITS BEST."

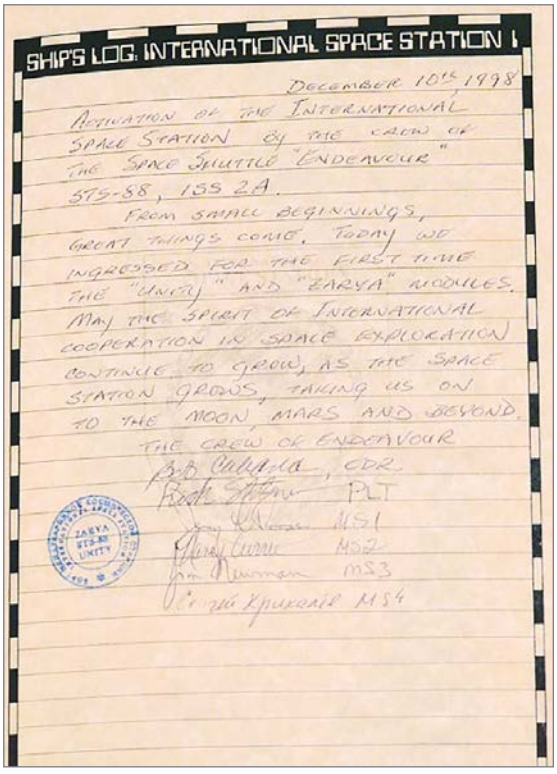
BOB CABANA

Commander, STS-88/2A
Director, John F. Kennedy Space Center

What a challenging question!

Was it as a young boy in school watching the Mercury astronauts blast off into space? Was it as a midshipman at the Naval Academy watching Neil Armstrong step down on the lunar surface, or being at Kennedy Space Center (KSC) to see Apollo 13 launch in April 1970? Was it watching that first Shuttle launch on 12 April 1981? Or maybe it was one of my own trips to space or participating in one of the many history-making moments during my tenure as KSC Director? There are so many to choose from.

When I think back, it was probably during STS-88 aboard Endeavour on the first Space Station assembly mission. There were so many memorable moments from that flight: conducting the rendezvous with, and berthing of, Zarya; activating the Space Station computers; entering the Space Station for the first time; and more. But the one that stands out to me was a quiet moment alone, tucked away in a corner of the Unity node, when I reflected on the importance of what we had accomplished and made the first entry in the ISS Log Book, 10 December1998.


SHIPS LOG: INTERNATIONAL SPACE STATION

December 10th, 1998

Activation of the International Space Station by the crew of the Space Shuttle "Endeavour" STS-88, ISS 2A.

From small beginnings, great things come. Today we ingressed for the first time the "Unity" and "Zarya" modules. May the spirit of international cooperation in space exploration continue to grow, as the Space Station grows, taking us on to the Moon, Mars and beyond.

The crew of Endeavour

Bob Cabana, CDR
Pilot
MS1
MS2
MS3
MS4

First entry in the ISS log book, 10 December 1998.

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> The crew of Endeavour

It was an outstanding mission from start to finish, but those moments lost in thought aboard this brand-new Space Station were powerful and, even 20 years later, are remembered like yesterday.

LUZ M. CALLE

Principal Investigator for Corrosion Research, NASA's Kennedy Space Center

Thinking about the past 60 years of human spaceflight takes me back to nearly 26 years ago. I had just submitted a scientific paper on corrosion for publication. I was driving into my workplace at the Materials Science Laboratory in the Operations and Checkout building at NASA's Kennedy Space Center, and as I drove along the causeway, Space Shuttle Discovery stood on the launch pad, preparing to launch on the STS-70 mission. Just to the south of it, on a different launch pad, was an Air Force Titan 4 rocket with a national security payload. This stood out to me as ironic because, only days before, the Shuttle Atlantis had docked with the Russian Mir space station. This

was the first docking with a Russian spacecraft since the Apollo-Soyuz mission in 1975.

Less than a week after Atlantis returned, Discovery would launch on the STS-70 mission, in the fastest turnaround for the Shuttle Program. While it did not feel unusual, we were making quite a bit of history that summer. Docking with Mir was just the beginning of the international cooperation on long-duration human spaceflight that would lead to the International Space Station and 20 years of people continuously living and working in space.

PETER CHITKO

Technical Integration Manager, NASA's Kennedy Space Center

In April 1981, I was a junior mechanical engineering student at Georgia Tech in Atlanta. I had grown up in Jacksonville Beach, Florida, watching all of the Apollo launches from my front yard and having become an absolute space nerd since third grade after watching the Apollo 11 mission. I had followed the challenging development and testing progress on the Space Shuttle, and, as millions of others were, I was anticipating the first flight with bated breath. I was lucky enough to have secured a car pass for viewing access to KSC, and at 7 p.m. the night before the launch, three friends and I headed south on the 8-hour drive. As we arrived at the KSC causeway in the dark early-morning hours, Columbia looked like a pristine cathedral lit up by the xenon searchlights. The mood of the thousands of us packed in the viewing site was absolutely electric. The tension was so palpable you could feel it in the air. We could not believe that this day had finally arrived—the launch of the most hazardous, daring mission that NASA had ever undertaken with a host of unknowns to be demonstrated for the first time and with a crew on board! The countdown proceeded smoothly, and at 7 a.m., Columbia came to life and literally leapt off the pad on blinding twin pillars of flame accompanied by the cheers, wishes, tears of joy, prayers, hopes, and dreams of all of us who were privileged to share that historic moment in person. I was fortunate after graduation to have been hired by NASA at KSC, where I have worked for the past 37 years, including supporting 120 Shuttle launches from the Firing Room, always carrying with me the cherished memories of witnessing that first heart-stopping launch.

SUZY CUNNINGHAM

NASA Strategy and Integration Manager

I've had a lot of exciting moments during my 34 years with NASA, but above all of the exciting, diverse work assignments I've had and the astronauts and celebrities I've encountered, my favorite moment was seeing the Shuttle Discovery STS-26 launch on 29 September 1988 and land on 3 October 1988 after working two years as the Lead Thermal Protection System Engineer helping us return to flight after the Challenger accident. If I had a second moment, it would be the STS-114 launch and landing in 2005 after working on the Columbia Reconstruction Team.

There's just nothing like seeing a launch and a landing, and returning to flight is the most special, physically and emotionally.

DAVID DEVORKIN

Senior Curator, Space History Department, Smithsonian National Air and Space Museum

Among my many favorite moments—fixing the Hubble, landing on Mars, visiting Pluto—the one that is most indelible in my mind is the first Apollo lunar landing and subsequent broadcasts from the Moon. I was a graduate student in astronomy at Yale, and about six of us, grads in astronomy and history, since the two departments were neighbors, were gathered around a small black-and-white TV to experience the moment. I blurted out something like "Wow, I'd love to be there," and historian Janice Henderson gently shot me down: "Oh, David, if you were there you'd be going crazy right now." We spent the rest of the time debating how the astronauts could keep their wits about them.

MELVIN J. FEREBEE

Director, Systems Analysis and Concepts Directorate, NASA's Langley Research Center

I've always wanted to work for NASA! I was always in front of the TV listening to Walter Cronkite and Wally Schirra on CBS providing commentary at every launch. Then, after the launch, I'd watch Jules Bergman on ABC explain what was happening during the mission. This may be funny—I wanted to become an astronaut because of astronaut Ed White. Why? Because he lost a glove during a spacewalk. I wanted to be the guy to go back and find that glove. I was an overweight kid, and my friends thought I would weigh the rocket down and it would never leave Earth. I decided I would build rockets and the spacecraft that would take humans from Earth to the Moon, Mars, and beyond. As a kid, I really wished just once that I could be one of the folks in Mission Control during a Shuttle mission. That wish came true in September 1994, when I was a member of the Lidar In-Space Technology Experiment (LiTE) team. I've been blessed to work on the Shuttle Program, the International Space Station Program, and the Constellation Program's Ares I-X rocket. These moments, indelible in my mind, contribute to living the greatest career ever!

Robert D. Cabana, mission commander (left), and Sergei Krikalev, mission specialist representing the Russian Space Agency (right), float in the pressurized mating adapter (PMA) connected to the Russian-built Zarya module in December 1998.

MARK GEYER

Director, NASA's Johnson Space Center

I have been blessed with a more-than-30-year career at NASA, and there are many moments that come to mind, including the Orion test flight (Exploration Flight Test–1) that we successfully executed after so many challenges and setbacks. However, I think my favorite moment would have been when NASA astronaut Bob Cabana and Russian cosmonaut Sergei Krikalev floated through the Node 1 hatch together, signifying the beginning of International Space Station joint operations. There were several reasons this moment was significant to me. First, it was the first program I had worked on that actually flew. Second, it was the culmination of nearly six years of hard work, including many long trips to Moscow. There were moments in these six years when the success of the program was very much in doubt because of funding issues in Russia and technical issues in the United States. I was part of the NASA team that was in Baikonur for the Functional Cargo Block (FGB) launch, and for the Node launch our team was at Johnson Space Center in Building 30, supporting operations. Even then, I doubt I could have envisioned the impact of the ISS on the U.S. exploration of space and on U.S. leadership of the international partnership. To have been a part of the beginning of this great program is a source of pride for me.

MALCOLM GLENN

Safety Engineer, Kennedy Space Center

My two favorite moments in 60 years of human spaceflight:

20 July 1969. I watched the Apollo 11 Moon landing at my grandparents' house, on a color TV my grandfather had just bought, on that Sunday night. There were a group of us watching, all amazed!

4 April 1983, the first launch of Challenger and my first launch as a T-0 console engineer, responsible for the Orbiter Access Arm (OAA) and Sound Suppression System, in KSC Launch Control Center Firing Room 1. Shortly before OAA retract at T-7 minutes 30 seconds, I looked down and my palms were sweating, not good, and the Firing Room was ice cold. The OAA and Sound Suppression System worked fine that day, and I went on to support more launches as a T-0 engineer, without my palms sweating. Live and learn!

DANA M. HUTCHERSON

Deputy Manager, NASA's Commercial Crew Program

As the former Flow Director for the Space Shuttle Endeavour, the most challenging assignment I had was to prepare my team and the orbiter for its last flight, STS-134. It was my last mission working with the Space Shuttle and my last opportunity to work with some of the most impressive and dedicated professionals with whom I had the privilege to work. Soon, we would all be working in new positions and, in some cases, changing careers—each of us bereaved of our livelihood. After this complex mission, my team accomplished precisely what we planned: preparation of Endeavour for its final resting place at the California Science Center. Once there, it genuinely broke my heart to see this extraordinary engineering marvel as a museum piece, rather than being prepared to send NASA's astronauts to space. It was at that point that I committed to helping NASA return human spaceflight to America and joined the Commercial Crew Program.

STS-134 mission specialist Greg Chamitoff greets Space Shuttle Endeavour's NASA flow manager, Dana Hutcherson, after arriving at the Shuttle Landing Facility at NASA's Kennedy Space Center in Florida.

After years of working with commercial space providers, I was absolutely delighted to be part of the team that helped return humans to space after a nine-year hiatus! My favorite moment in the history of spaceflight was during the launch of SpaceX's crewed test flight, Demonstration Mission-2 (DM-2). On 30 May 2020, SpaceX became the first private company to complete a crewed orbital spaceflight and only the fourth entity to fly humans since Yuri Gagarin's first flight in 1961. I celebrated, with tears in my eyes and pride in my soul, this amazing accomplishment with my team. But shortly after launch, what I hadn't expected was the revelation by the DM-2 crew of the name of their Crew Dragon spacecraft, Endeavour! I couldn't imagine any greater honor sharing the rich history of human spaceflight.

JIM JEFFERS

Section Supervisor, Orbital Replacement Unit (ORU) and Spacecraft Processing, NASA's Exploration Ground Systems

Liftoff of Space Shuttle Discovery at 11:37 a.m. on 29 September 1988. As a young Space Shuttle Spacecraft Technician four years into my career, I was privileged to be working in the Aft Section on the orbiter Discovery in Orbiter Processing Facility (OPF) 1 for the STS-26 Return to Flight mission. That launch was by far my most favorite moment of

human spaceflight because not only did it heal us as a team, but it brought America together again by unifying the emotional losses, strengthening our commitments, and showing the world our desires and dedication to human spaceflight. That day saw the world not only looking back at the past but looking at the present and looking toward the future. That day, in my mind, defined where we are today with human spaceflight, and so that is why it must be my favorite moment. (There have been many to choose from!)

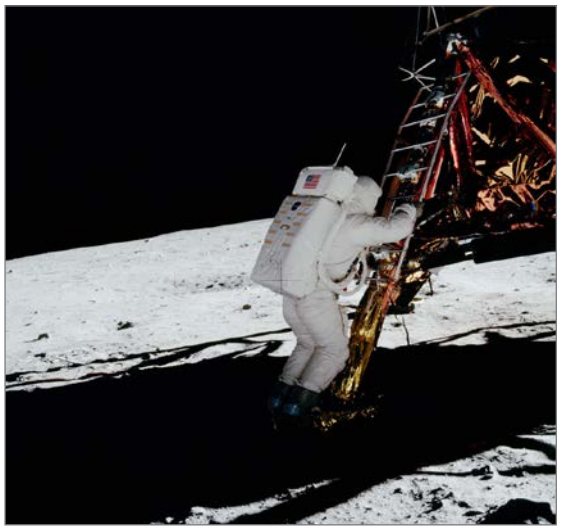
BHAVYA LAL

NASA's Acting Chief of Staff

In 1969, when we landed on the Moon, I was not quite two years old. My father was still in his 20s, a newly trained electrical engineer sent to a rural and remote part of northern India to manage a factory that manufactured heavy equipment for power generation. The factory was part of a grand plan by the Indian government to electrify India and create jobs in the countryside. We lived in a small and modest apartment at the outskirts of a small town called Hardwar. We didn't have a TV or any modern appliances. My mom was a homemaker barely twenty years old, and my parents lived a quiet, happy, and contented life. I am told I was a precocious toddler always trying to find danger! I have few memories of the time, but one stands out.

On the evening of July 20 1969, my father put me on his shoulders (as he often did, I must have liked sitting and observing the world from high above) and took me to a forest that abutted the apartment building where they lived. This wasn't a fake planted forest, it was a right proper tropical one, with pythons, cobras, scorpions and mountain lions. We went to a clearing and sat down, and looked up at the Moon, a thin but bright crescent. And then he started something that I don't remember the details of, but the memory is indelible. He started narrating the Moon landing.

He of course didn't know what was actually going on—we had no TV or real avenues for news beyond the occasional big-city newspaper. He worked long hours in the factory and didn't have time to find specialized



Astronaut Edwin "Buzz" Aldrin takes his first step onto the surface of the Moon in July 1969.

avenues of information about the Apollo program. But growing up on Flash Gordon comic books, he was imaginative, and made up an elaborate story—how Armstrong and Aldrin were landing, bouncing around the craters, and collecting Moon dust. I listened in rapt attention hanging on to every word even when I didn't understand what he was saying. We pointed to the Moon, imagined all the excitement, and looked up for a long time until I probably fell asleep.

Over the years, my dad and I watched Star Trek together and talked about how humans would one day travel to the stars. Thanks to my parents getting me interested in science and engineering, I grew up loving math and science, attended a STEM magnet high school in Delhi, and eventually came to MIT to study engineering. I now focus on space technology, policy and strategy, working as hard as I can not only to ensure a bright future in the stars for humanity, but also to thank my parents for raising me with a love for science and engineering.

I have many fond memories of growing up, mostly in Delhi, where I spent most of my childhood, but of all the memories, my favorite is the day my father took me into the forest to "watch" the Moon landing. What started that day has continued on to make me the person I am today.

Oh and one last story—When I first met my husband, he asked me what my favorite place on *all of Earth* was. He was expecting perhaps I would say Italy or Hawaii or something like that; someplace where we'd go on a romantic vacation. I told him (of course) that my favorite place on *all of Earth* was where the Lunar Lander at the Smithsonian National Air and Space Museum in Washington DC stood. He must have remembered, because a year later he proposed to me in front of the lunar module. The ring was inside the blueprint of the first print of the lander.

MARK LARSON

Engineer, NASA's Exploration Ground Systems

For myself, my favorite moment would have been watching Neil Armstrong take that first step onto the Moon in July of 1969. I was 13 years old at the time and watched it live on TV with my family as it happened. I was aware, of course, of the previous flights of Gemini (Mercury being a little before my time of understanding), but Apollo brought everything into the living room for us to see for ourselves as NASA brought us video from space for the evening news.

Being a teenager and watching *Star Trek* as it came on our TV each week, I was caught up in "What if that were us exploring" moments, hoping someday that humans would be going out there to explore new worlds. When Neil stepped on the Moon, it became real, and I knew I was seeing the start of where it was all beginning for mankind, just as Neil proclaimed as he stepped onto the lunar surface. We had just taken our first step on another world, a starting point that has no finish line, only more destinations!

ROGER D. LAUNIUS

Former NASA Chief Historian

There are so many moments in the history of Space Age. An easy answer would be the landing of Apollo 11 on the Moon in July 1969, but let me emphasize a different Apollo mission, the landing of Apollo 12 on 19 November 1969. Apollo 12 entered the public's perception in a way different from the first Moon landing. It represented exciting and significant advances in capability over Apollo 11, but it did not have a broadcast component since the camera failed on the lunar surface. Instead, Apollo 12 really broke open the space race with the Soviet Union. Apollo 11 might have been a fluke, but this mission required a precision landing close to a robotic Surveyor III spacecraft that had touched down on the lunar surface in 1967. Soviet space exploration officials knew that if the Americans pulled that off, that meant that the Soviets could not compete in the Moon race. The descent was automatic, with only a few manual corrections required by Charles "Pete" Conrad and Alan L. Bean to bring the Lunar Module Intrepid within walking distance—600 feet (182.88 meters)—of Surveyor III.

In contrast to Neil Armstrong's memorable first words as he stepped onto the Moon, "one giant leap for mankind," Conrad's statement was more human, if less memorable. Conrad was always something of a jokester and definitely more flamboyant that many of the other astronauts. He demonstrated that when arriving on the lunar surface. He said, "Whoopee! Man, that may have been a small one for Neil, but that's a long one for me." Conrad and Bean took two Moonwalks lasting just under 4 hours each and collected pieces of Surveyor III to take back to Earth for analysis.

They collected rocks and set up experiments that measured the Moon's seismic activity, solar wind flux, and magnetic field. Meanwhile, Richard Gordon, on board the Yankee Clipper in lunar orbit, took multispectral photographs of the surface. The crew stayed an extra day in lunar orbit taking photographs. When the Lunar Module ascent stage was dropped onto the Moon after Conrad and Bean rejoined Gordon in orbit, the seismometers the astronauts had left on the lunar surface registered the vibrations, demonstrating their functionality.

That mission really sealed the reality that the United States had won the space race, and I believe it deserves more attention.

AMANDA MITSKEVICH

Program Manager, NASA's Launch Services Program

I started at NASA in the Shuttle Program at KSC, right from Georgia Tech. I remember coming back from class for lunch one cold January day and being stunned seeing the Challenger disaster unfold on TV. That fall, NASA came to campus to interview for all kinds of engineering disciplines. I distinctly remember my interviewer wearing suspenders with pictures of palm trees and beaches…. My first day was 20 July 1987, the anniversary of the Apollo Moon landing. Just over a year later, on 29 September 1988, a beautiful perfect day, my new teammates and I walked from our building to the parking lot of the Vehicle Assembly Building to watch the return of humans to space with the spectacular launch of Discovery. For most of us, it was our very first in-person launch, as we had gotten hired in the last year and a half, when NASA went on a massive hiring spree after the Challenger disaster. Witnessing our first launch was an amazing experience. I can still see it and feel it, but I can't really describe it in words. It brought tears to our eyes, as did every launch and landing I saw after. I met the most dedicated people who put their hearts and talents into preparing the Shuttles for flight, no matter the job—and I learned that everyone at NASA is like that. I eventually left human spaceflight to be on a team that places NASA's amazing science missions into space, and I have loved every minute of it. But I still care deeply about human spaceflight, and my next vivid memory was watching Bob and Doug enter the International Space Station. The long journey to once again launch American astronauts from American soil on an American rocket was an incredible feat. Another tear-making moment.

MARLA E. PEREZ-DAVIS

Director, NASA's Glenn Research Center

I vividly remember sitting in front of our black-and-white TV at my childhood home watching Neil Armstrong and Buzz Aldrin bouncing around on the Moon. I was a young girl, and I could never have dreamt I would end up working at NASA, but I could sense it was a moment I would never forget. It's one of the greatest memories of my life.

Another fond memory is STS-95, the first launch I was able to watch in person. There are many things I remember about that launch—the sound, the vibration, the entire physical experience. But the thing that has stuck with me from that launch is the complexity of making something like that happen. The number of people and organizations that have to come together to make a launch successful, it's astounding, and it's done for something bigger than any one entity. It's even more meaningful to me now because I lead the Center named after a very special astronaut on that flight, the late John Glenn.

Finally, being a woman of color, I loved watching Sally Ride, Mae Jemison, and Ellen Ochoa break the highest of ceilings. I remember when each of them launched and the pride I felt knowing women were now represented in the astronaut core. It's been great to see our astronaut classes continue to diversify.

DENISE PHAM

Chief, Fleets and Systems Management Division, NASA's Launch Services Program

Where do I begin? I can vividly remember the first day I reported to work for NASA at Kennedy Space Center. That beautiful and hot August day began a series of amazing chapters of my career, as well as my life. Having the opportunity to be part of the U.S. space program, not from a distance, but up close and personal, shaped me into who I am today. Every time I walk into Kennedy Space Center's Visitor Complex and see the Space Shuttle Atlantis proudly displayed, I can't help but feel overwhelming pride. In fact, I am quite overcome with powerful, inspiring emotions, not unlike those that I felt the first few days on the job! You see, my first assignment was as an engineer working on the Atlantis orbiter! Fast forward to today, and once again I am fortunate enough to be part of the team that launches astronauts into space

using U.S. commercial launch vehicles. How lucky I am! NASA opened doors to my American dream; it humanized and personalized the once seemingly faraway space exploration vision. It is still surreal! My greatest moments of personal satisfaction come when I am able to pave the way for the next generation, just as those who came before me did. As for my favorite memories, I would say sitting on console for launch days and saying "Go" for launch as a member of the best team ever! The adrenaline….

RALPH ROE

NASA's Chief Engineer

My favorite moment in human spaceflight in the last 60 years is not one specific moment or event, but rather our team's response to some of our darkest moments. Everyone knows the scene in the movie *Apollo 13* where, after the explosion on board the spacecraft and the loss of their oxygen supply, the ground team dumps out all the equipment the astronauts have in space on a table and begins to figure out how to solve the problem of keeping the astronauts alive. While that moment has been made famous by the movie, I have seen that same can-do attitude from our team many, many times at NASA. While no one wants any mission to go wrong, when it does, it's usually that can-do attitude that moves to the forefront and helps us solve some very challenging problems. It doesn't matter what the issue is—hydrogen leaks, wire damage, software defects—when everything looks bleak, our team responds, pulls together as one, and develops innovative solutions to continue our mission of human exploration of space.

"IT DOESN'T MATTER WHAT THE ISSUE IS—HYDROGEN LEAKS, WIRE DAMAGE, SOFTWARE DEFECTS—WHEN EVERYTHING LOOKS BLEAK, OUR TEAM RESPONDS, PULLS TOGETHER AS ONE, AND DEVELOPS INNOVATIVE SOLUTIONS TO CONTINUE OUR MISSION OF HUMAN EXPLORATION OF SPACE."

The passion and dedication of our team, both NASA and contractor, is what has made human spaceflight in the last 60 years such a resounding success.

STEVE SHIH

Associate Administrator, Diversity and Equal Opportunity, NASA

As we celebrate NASA's 60th anniversary of human spaceflight, it's the moments from NASA's human spaceflight history with the greatest impacts on human existence that are my favorite. These moments exemplify the wonderful ways that NASA's leadership and accomplishments, along with the inclusiveness and teamwork with which we perform our missions, have inspired human beings, elevated their focus to a common higher purpose, and reinforced to all people a sense of connection and unity.

My single favorite moment is the STS-88 Space Shuttle mission, especially the 5 December 1998 connection of the first American module of the International Space Station (ISS), aptly named Unity, with the Russian module Zarya. This physical connection served as a transcendental symbol and roadmap of international and human connection and collaboration on a higher common purpose during a time of extreme conflict and division between people on the Earth below. This symbolism was further reinforced on 10 December 1998, when U.S. astronaut Bob Cabana made a decision to jointly enter the ISS with Russian cosmonaut Sergei Krikalev as the first humans to board the ISS.

STS-88 provides a perfect example of the history and impact of NASA's human spaceflight. These accomplishments have provided clarity and inspiration to human beings across our planet on the importance of a transcendental focus on a common and higher purpose, as well as the importance of connection and collaboration to accomplish the most impactful achievements for the benefit of all humankind. These milestones reflect the important leadership and model that NASA has continually provided to all humans on the need for us to work jointly and collaboratively because—as our astronauts have seen from the overview effect in space—our planet is very small, fragile, and unique; and our health, sustainability, and fates as human beings are interconnected and interdependent.

DIANE STEES

Cryogenic Operations and Cryogenic Propulsion Ground and Flight Application Software Team (GFAST) Lead

My 25 years on the Space Shuttle launch team as a liquid hydrogen engineer at Kennedy Space Center provided many treasured memories of human spaceflight. How does one pick a favorite moment after supporting more than 100 launches and witnessing many KSC landings, with all the thrills and challenges encountered during launch vehicle flow processing? After some thought, I decided that my favorite moment in human spaceflight was an unplanned encounter with the STS-132 flight crew shortly after Space Shuttle Atlantis arrived at Launch Pad 39A after rollout from the Vehicle Assembly Building on 22 April 2010.

I went to the pad with my 30th high school reunion banner that morning to get a picture with Atlantis in the background. The picture would be included in a slide show during my reunion that June. A pad security guard could hold one side of the banner and I would hold the other. When I arrived, the guard informed me that the flight crew was inside for a press conference and that I should ask them to hold the banner. My heart skipped a beat as I was directed to someone who had me wait until the press conference

was over. I was then permitted to walk up to the flight crew and ask them to help me hold the banner for a picture. They enthusiastically obliged, and there I was, flanked by three blue-suited Shuttle astronauts on each side on a beautiful, sunny day with Atlantis in all her glory behind us. I was proud to be a part of the Shuttle family committed to flying humans safely to space and returning them home. And my former high school classmates loved the photo!

ELLEN STOFAN

Under Secretary for Science and Research, Smithsonian Institution

It's incredible how far we've gone in space in the last 60 years. From launching the first American astronauts into orbit to sending robotic explorers out into the solar system to see what they could find—our success in space exploration is truly an idea that would have defied imagination a few hundred years ago. One moment from our history as a spacefaring nation that really stands out to me is 18 June 1983, when Sally K. Ride became the first American woman in space on board Space Shuttle Challenger. I had just graduated from college and was getting ready to start my Ph.D. studies in geological sciences at Brown University. Despite having found incredible mentors in aerospace and planetary science—including my father, who worked for NASA when I was a kid—I couldn't help but worry about how being a woman would impact my opportunities in grad school, internships, and

ultimately the workforce. Even though I was confident in my abilities, I didn't know if my classmates and colleagues would afford me the same respect I afforded them, just because I was a woman.

And here was a woman, serving as an astronaut—arguably the most visible job at NASA and one of the most visible in the United States—and flying through glass ceilings all the way into space. It really had a huge impact on me as I prepared to start my graduate studies. And it was a moment that felt long overdue: The first woman in space, cosmonaut Valentina Tereshkova, had achieved that milestone 20 years before, so the fact that America had not yet afforded a woman that opportunity was discouraging. But that all changed with NASA's 1978 class of astronauts, the first to include women, and then Sally's first spaceflight in 1983. Marian Wright Edelman once said, "You can't be what you can't see"; that day, girls and women around the country saw Sally Ride launch into space, and a whole new frontier was opened to them.

MARGARET A. WEITEKAMP

Curator and Department Chair, Space History Department, National Air and Space Museum

Witnessing the launch of STS-7 with Dr. Sally K. Ride aboard as the first American woman in space was my favorite moment. In June 1983, my family was on vacation in Florida, visiting my aunt and uncle near Daytona Beach, so we took a trip down the coast to visit Kennedy Space Center. Our tour was the day before the launch, and the place was abuzz. The signs outside nearby hotels and restaurants read, "Ride, Sally Ride!" My mother kept asking various staff members how our family could get back onto the KSC grounds the next day to see the launch. Finally, someone explained to her that, unlike our home in the mountains in Pennsylvania, Florida was flat. Even people miles away would be able to see the launch easily. So that is how we came to be among the thousands of onlookers listening to the preparations on the radio as we drove along the highway as the countdown neared. When the launch was imminent, it was an amazing moment. All of the cars pulled off the highway onto the shoulder and all heads turned toward KSC. We sat on the hood of the rental car and cheered as Sally Ride made history.

I never got to meet Dr. Ride in person, but I was a part of the team from the Smithsonian's National Air and Space Museum that helped to bring her archives and artifacts to the museum after her untimely death in 2012.

VANESSA WYCHE

Deputy Director, NASA's Johnson Space Center

My favorite moment from the past 60 years of human spaceflight occurred during my eighth year with NASA, as the payload manager for STS-95, a Spacehab research mission in which John Glenn returned to space after his first flight on Mercury 7. The mission was historic because of the research conducted on, and by, John Glenn, the first American to orbit Earth and the oldest person to fly in space at the age of 77 years. While John Glenn was a national hero and a U.S. Senator, he insisted that he be referred to as John. He was extremely focused on his training, and his stamina was amazing. His humility and dedication to the successful outcome of the mission and NASA left a lasting impression on me. One particular example did not happen during the extremely successful flight or the many months of intense training. It was at a restaurant one night after a full day of training, when a waitress asked to take a photo with him. He said sure. She then informed us that her son needed to bring the camera from her house—this was before smartphones. He said no problem, and we waited 20 minutes for her son to arrive with the camera. John Glenn not only took the photo with the waitress, but he also took photos with all of the employees at the restaurant, and because of timing, it was now well after the restaurant had closed for the night. Witnessing this selfless act, as well as his consistent demonstration of humility and dedication to being the best at his assignment, had a profound impact on me. I patterned my conduct as a public servant after the example of John Glenn.

FOREWORD TO SPACEFLIGHT

By Michael L. Ciancone

Michael Ciancone is an engineer at NASA's Johnson Space Center (JSC) in Houston, Texas. He currently serves as the NASA Lead for Safety and Reliability on the Orion Program. Ciancone also chairs the History Committee of the American Astronautical Society (AAS) and is a member of the History Committee of the International Academy of Astronautics (IAA).

This article is adapted from a presentation the author gave at IAC 2019 (Washington DC), which was based on his book, Foreword to Spaceflight: An Illustrated Bibliography of pre-1958 Books on Rocketry & Space Travel *(Apogee, 2018)*

This article provides a visual and literary "photo album" to satisfy readers interested in the literary foundations of human spaceflight.

Three men are widely recognized as the fathers of rocketry for spaceflight—Konstantin Tsiolkovskii, Hermann Oberth, and Robert Goddard. Tsiolkovskii published numerous books on space travel and cosmology (the expansion of humans into the cosmos). The "holy grail" of this genre is an article he wrote in the May 1903 issue of *Nauchnoe Obozrenie* [Scientific Review] on "Exploration of Space by Means of Reactive Devices" (Figure 1) in which he applied the "rocket equation" to spaceflight and addressed various aspects of future spaceflight. Oberth was also an early theoretician. Oberth privately published one of the most influential books on spaceflight—*Die Rakete zu den Planetenräumen* [The Rocket into Planetary Space] (1923) (Figure 2). Goddard was an experimenter who spent his life building and testing rockets. He published his seminal monograph, *A Method of Reaching Extreme Altitudes* (Figure 3), in 1919 and launched the first liquid-fuel rocket on 16 March 1926.

What began as a solitary endeavor grew, as people with similar interests formed small groups to share news and plan for the future. Writers, particularly during the 1920s and 1930s, used their medium to spread the "gospel" of spaceflight. The first book of nonfiction in English on the use of rockets for human spaceflight, *The Conquest of Space* (1931) (Figure 4), was written by David Lasser, a founder and the first president of the American Interplanetary Society (later renamed the American Rocket Society, which exists today as the American Institute of Aeronautics and Astronautics). The first British books appeared shortly thereafter—*Stratosphere and Rocket Flight (Astronautics)* (1935) (Figure 5) by C. G. Philp and *Rockets Through Space:*

Figure 1. Tsiolkovskii, "Exploration of Space by Means of Reactive Devices"

Figure 2. Oberth, *Die Rakete zu den Planetenräumen*

Figure 3. Goddard, *A Method of Reaching Extreme Altitudes*

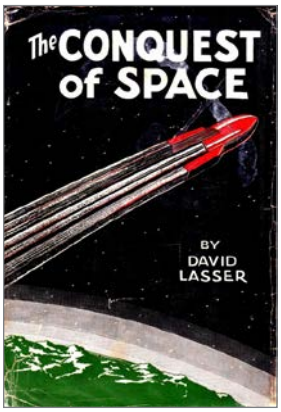


Figure 4. Lasser, *The Conquest of Space*

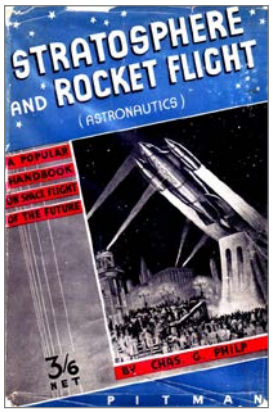


Figure 5. Philp, *Stratosphere and Rocket Flight (Astronautics)*

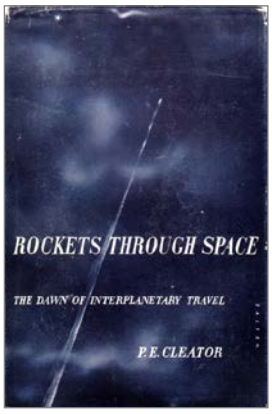


Figure 6. Cleator, *Rocket Through Space: The Dawn of Interplanetary Travel*

Figure 7. Perel'man, *Mezhplanetnye puteschesviia*

Figure 8. Rynin, *Mezhplanetnye soobshscheniia*

The Dawn of Interplanetary Travel (1936) (Figure 6) by P. E. Cleator. Although many of these early rocketeers were writers, they were soon joined by technical members, such as engineers, who were interested in the practical application of rocketry to human spaceflight. Together, these groups of dreamers and doers provided a fertile breeding ground that merely awaited a catalyst to reach fruition.

Russian writers also harbored dreams of travel to other worlds. Yakov Perel'man published a series of popular books on spaceflight from the 1910s into the 1930s, including *Mezhplanetnye puteschesviia* [Interplanetary Travels] (1919 edition depicted in Figure 7). Nikolai Rynin also published a compendium of knowledge on spaceflight in a series of books from 1928 to 1932 under the title *Mezhplanetnye soobshscheniia* [Interplanetary Communications] (Volume 2 depicted in Figure 8).

Early experimenters were pleased to see their rockets launch without exploding. Then, they were eager to send them higher and further. The German Army soon took notice. The V-2 rocket program of World War II offered the first industrial-level development and production of rockets (albeit using slave labor). One of the most interesting contemporary books on the V-2, *Ballistics of the Future* by Kooy and Uytenbogaart (1946) (Figure 9), provides detailed schematics of the V-2 rocket and the location of launch sites in The Netherlands. One of the first popular accounts of the V-2 program was offered by Walter Dornberger in *V2: Der Schuss ins Weltall* [The Shot into Space] (1952) (Figure 10).

To advocates of human spaceflight, the goal was to place a spacecraft into orbit around the Earth or to send it to the Moon or Mars. Perhaps the most influential book on this theme was *Das Marsprojekt* [The Mars Project] (1952) (Figure 11) by Wernher von Braun, who was an early member of the German

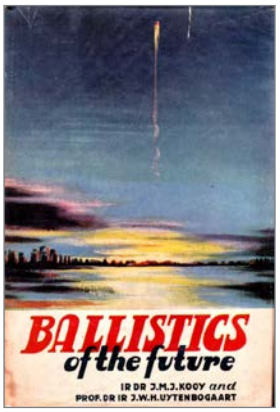


Figure 9. Kooy and Uytenbogaart, *Ballistics of the Future*

Figure 10. Dornberger, *V2: Der Schuss ins Weltall*

Figure 11. Von Braun, *Das Marsprojekt*

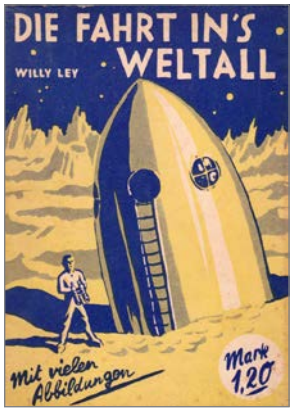


Figure 12. Ley, *Die Fahrt ins Weltall*

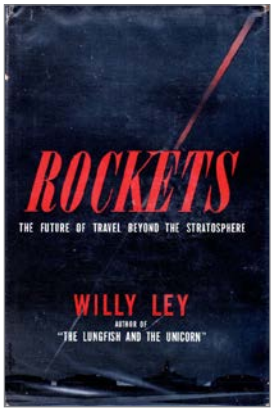


Figure 13. Ley, *Rockets: The Future of Flight Beyond the Stratosphere*

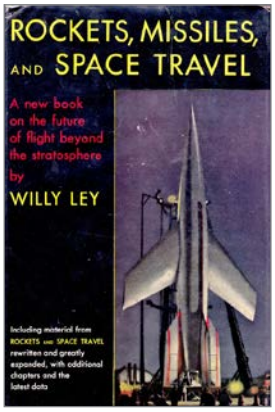


Figure 14. Ley, *Rockets, Missiles, and Space Travel*

Figure 15. Ryan (ed.), *Across the Space Frontier*

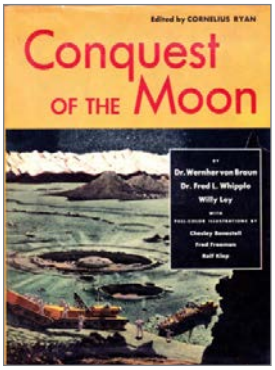


Figure 16. Ryan (ed.), *Conquest of the Moon*

Figure 17. Bendick, *The First Book of Space Travel*

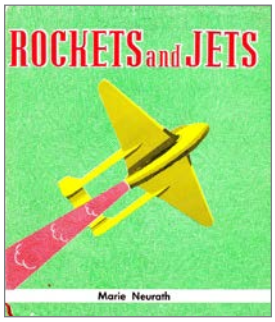


Figure 18. Neurath, *Rockets and Jets*

Society for Space Travel and architect of the V-2 program, as well as a prominent figure in the U.S. space program.

Willy Ley was an early chronicler of the history, current status, and future of human spaceflight, who escaped Nazi Germany in 1935. His first book on the prospects of spaceflight appeared in 1926 under the title *Die Fahrt ins Weltall* [The Journey into Space] (Figure 12). He continued writing about spaceflight following World War II and is perhaps best known for *Rockets, Missiles and Space Travel* (Figure 14), which first appeared as *Rockets: The Future of Flight Beyond the Stratosphere* (1944) (Figure 13), and which went through many editions and printings through the 1960s.

As the 1950s ushered in an era of prosperity and plans for the future, a group of spaceflight professionals, including Ley and von Braun, and under the editorial guidance of Cornelius Ryan, published a series of articles in *Collier's* magazine in 1952–54 that envisioned the coming space age. These articles were later published in book form, including *Across the Space Frontier* (1952) (Figure 15) and *Conquest of the Moon* (1953) (Figure 16).

In addition to the staples of the Wild West, children were also captivated by this "next frontier." Books began appearing that specifically targeted younger readers, such as *The First Book of Space Travel* (1953) (Figure 17) by Jeanne Bendick and *Rockets and Jets* (1952) (Figure 18) by Marie Neurath.

The history of spaceflight is still being written as mankind continues its journey, back to the Moon and on to Mars.

SPACE EXPLORATION LAUNCHED FROM KENNEDY SPACE CENTER

By Linda Herridge

NASA's Kennedy Space Center in Florida has played a significant role in the Agency's space exploration programs for the past 60 years. Since the early 1960s, when many of the Center's facilities were constructed, to the present day, a workforce of NASA civil servants, contractors, and international partners has prepared payloads and spacecraft bound for the Moon, the International Space Station, and destinations beyond. They gained valuable processing and launch expertise along the way while reaching for the stars.

1960S

After the Mercury and Gemini missions, larger and more complex facilities were needed for the Apollo program. The iconic Vehicle Assembly Building, Launch Control Center, and Launch Complexes 39A and 39B were constructed to support the processing and launch of Saturn V rockets and the Apollo missions to the Moon. In the Industrial Area, the Operations and Checkout (O&C) Building (renamed for astronaut Neil Armstrong in July 2014) was constructed for the processing of Apollo Command and Service Modules and Lunar Modules. The astronaut crew quarters and some training facilities are located in the O&C. In total, 11 crewed Apollo missions were processed and launched from Kennedy.

1970S

Skylab, America's first space station, launched atop a two-stage Saturn V rocket from Launch Complex 39A at Kennedy on 14 May 1973 and was placed into Earth orbit. The Skylab 1 mission launched on 25 May 1973, sending the first three-man crew to live and work on the orbiting lab. Skylab 2 launched on 28 July 1973, with the second three-man crew to live and work on the lab. Skylab 3 launched on 16 November 1973, carrying the final three to the lab. The crew of Skylab 3 achieved the longest permanent occupation of space with 84 days, 1 hour, 15 minutes, and 31 seconds—a record not exceeded until long-duration stays on the International Space Station.

> "THE CREW OF SKYLAB 3 ACHIEVED THE LONGEST PERMANENT OCCUPATION OF SPACE WITH 84 DAYS, 1 HOUR, 15 MINUTES, AND 31 SECONDS—A RECORD NOT EXCEEDED UNTIL LONG-DURATION STAYS ON THE INTERNATIONAL SPACE STATION."

The Apollo-Soyuz Test Project (ASTP) was the first international crewed spaceflight. The purpose of the nine-day joint mission was to flight-test a mechanism for joining two orbiting spacecraft and demonstrate that international space rescue missions would be feasible in the future. During ASTP planning, Kennedy hosted the cosmonauts for a tour of the Center and meetings with the Apollo astronauts. Workers stacked the Saturn 1B rocket on the mobile launcher in the Vehicle Assembly Building (VAB). Apollo underwent testing in the O&C, and extra propellant tanks were added for the reaction control system, as well as equipment to operate the docking module and system. Apollo/Saturn 1B launched on 15 July 1975 from Launch Complex 39B. Workers at Kennedy helped design the mechanism that allowed Apollo to dock with Soyuz on 17 July.

More than 40 years ago, Voyagers 1 and 2 were prepared for launch inside the Center's Spacecraft Assembly and Encapsulation Facility. Voyager 2 launched on

20 August 1977 on a Titan IIIE/Centaur from Launch Complex 41. Voyager 1 launched on a Titan IIIE/Centaur from the same launch pad 16 days later. These satellites embarked on an ambitious mission to explore the giant outer planets—Jupiter, Saturn, Uranus, and Neptune. Since completing their flybys in 1989, they have continued to journey to the outer reaches of our solar system—where no spacecraft has been before. NASA continues to receive data from these two spacecraft, offering a window into the mysterious outer realms of our solar system and beyond.

As the Apollo program ended, efforts began to ***upgrade and modernize several facilities*** to process and launch the Space Shuttle. Vehicle Assembly Building high and low bays were converted to handle Shuttle stacking operations. The consoles and computers in the Launch Control Center firing rooms were upgraded. Launch Complexes 39A and 39B were outfitted with fixed and rotating service structures that provided access to and protected the Space Shuttle. The Orbiter Processing Facilities (OPFs) and engine shop were constructed to process the orbiters and main engines before and after a launch. Other facilities were converted, including Hangar AF to handle solid rocket booster (SRB) disassembly, the Vertical Processing Facility for Shuttle payloads, and the Parachute Refurbishment Facility to handle SRB parachutes.

1980S

Beginning with the first Space Shuttle launch, ***STS-1, on 12 April 1981***, and continuing through 1989, workers processed 32 Shuttle missions. Orbiter vehicles were processed in OPFs and then were joined with the external tank and twin solid rocket boosters on top of mobile launcher platforms in the VAB for the slow trek on a crawler-transporter to Launch Complex 39A or B. Among the payloads prepared at Kennedy for release on a Space Shuttle were Magellan, on STS-30 (Atlantis), to map the surface of Venus; Galileo orbiter and probe on STS-34 (Atlantis), launched to Jupiter; and five missions dedicated to Department of Defense payloads. Mission specialist astronauts launched for the first time aboard STS-5 (Columbia) on 11 November 1982.

Launch of Challenger on mission STS-51F in July 1985.

Spacelab, developed by the European Space Agency, was a reusable laboratory that flew on several Space Shuttle missions. The first, called Spacelab-1, flew on STS-9 in August 1983. The laboratory included a pressurized module, an unpressurized carrier, and other related hardware housed in the Shuttle's cargo bay. Subsequent missions were Spacelab-3 on STS-51B in April 1985, Spacelab-2 on STS-51F in July 1985, and Spacelab-D-1 on STS-61A in October 1985.

1990S

Between 1990 and 1999, the Kennedy workforce processed and launched 64 Space Shuttle missions. Major payloads launched from the Shuttle included Ulysses, the Chandra X-ray Observatory, and the Hubble Space Telescope.

The Hubble Space Telescope arrived at Kennedy on 6 October 1989 and was moved to the Vertical Processing Facility. During processing, technicians powered up the telescope for the first time on 28 October. On 25 March 1990, Hubble was delivered to Launch Complex 39B in a payload canister. The telescope launched aboard Space Shuttle Discovery on STS-31 on 24 April 1990.

The Space Station Processing Facility (SSPF) was built for preflight checkout and processing of hardware and components for the International Space Station. Groundbreaking occurred in March 1991, and the facility opened in June 1994. At the time, it was the biggest facility built at Kennedy since the Apollo days. The first U.S.-built component for the Space Station, Node 1 Unity, arrived for processing in June 1997. The node launched on *STS-88* on 4 December 1998. During the 1990s, workers processed, tested, and prepared Station components, including all of the truss support structures and solar arrays, *the U.S. Lab/Destiny Module*, three multipurpose logistics modules, *the Joint Airlock*, *the Central Truss Assembly S0 truss*, *the Mobile Base System*, *the S1 (Starboard Side Thermal Radiator) truss*, and *the P1 (Port Side Thermal Radiator) truss.*

In 1998, the launch vehicle programs at several NASA Centers were consolidated and established as the *Launch Services Program* (LSP) at Kennedy. The program brings together technology, business, procurement, engineering best practices, strategic planning, studies, and cutting-edge techniques—all instrumental components for the United States to have a dependable and secure Earth-to-space bridge that is dedicated to launching all types of spacecraft.

2000S

Between 2000 and 2009, Kennedy processed and launched 33 Space Shuttle missions. Components, supplies, and equipment for the Space Station were processed in the SSPF high bay. These included the Cupola, the European Science Module Columbus, the ISS Quest Joint Airlock, the Harmony Node 2, the Japanese Experiment Module (JEM), the Japanese JEM Exposed Facility, the Express Logistics Carrier with 30,000 pounds of parts, the Russian Mini-Research module Rassvet, and the Alpha Magnetic Spectrometer.

MISSIONS TO MARS

Several probes and landers were processed at Kennedy before launching to Mars. These included *Mars Odyssey*, atop a Delta II rocket on 7 April 2001; Mars Express, a European Space Agency (ESA) mission with NASA participation, on 2 June 2003; the *Mars Reconnaissance Orbiter*, atop an Atlas V rocket on 12 August 2005; the Mars Science Laboratory (*Curiosity*), atop an Atlas V on 26 November 2011; the Mars Atmosphere and Volatile Evolution (*MAVEN*), also on an Atlas V, on 18 November 2013, and *InSight*, on an Atlas V on 5 May 2018. *Mars Exploration Rovers* Spirit and Opportunity were processed at Kennedy and launched on Delta II rockets from Launch Complex 17; Spirit on 10 June 2003 from LC-17A, and Opportunity on 7 July 2003 from LC-17B. The *Phoenix Mars Mission* launched on a Delta II on 4 August 2007, from LC-17.

2010S

During 2010 and 2011, the final six Space Shuttle missions (STS-130 through STS-135) were launched from Launch Complex 39A. As the Space Shuttle completed its mission in July 2011, work had begun to prepare the Center for NASA's Space Launch System rocket and Orion spacecraft. In 2012, the Center rolled out its 20-year vision for the evolution of a post–Space Shuttle age, in which NASA would continue reaching for the stars while nurturing commercial spacefaring ventures. A master plan outlined the roadmap for becoming a multi-user spaceport, where both government and commercial partners use the launch facilities.

The *Commercial Crew Program* was formed in 2014 to facilitate the development of a U.S. commercial crew space transportation capability with the goal of

achieving safe, reliable, and cost-effective access to and from the International Space Station and low-Earth orbit. The program is primarily based at Kennedy.

PREPARING FOR ARTEMIS

The *Exploration Ground Systems (EGS) Program*, based at Kennedy, was established to develop and operate the systems and facilities necessary to process and launch rockets and spacecraft during assembly, transport, and launch. EGS led the efforts to transform the Center from a government-only launch complex to a multi-user spaceport.

NASA's first spacebound Orion spacecraft, Exploration Flight Test–1, launched atop a Delta IV rocket on 5 December 2014 from Space Launch Complex 37 for its flight test as NASA's newest human-rated spacecraft. Kennedy led the recovery efforts as splashdown occurred in the Pacific Ocean, concluding the 4.5-hour flight.

Inside the Vehicle Assembly Building, EGS workers removed hundreds of miles of cables and replaced them with state-of-the art command, control, and communications systems. Workers also removed Space Shuttle–era work platforms from High Bay 3 to make room for 10 levels of new platforms that can accommodate a variety of vehicles, including NASA's heavy-lift rocket, the Space Launch System, and the Orion spacecraft. The O&C high bay was remodeled, and new test equipment and test cells were installed to handle Orion buildup, processing, and checkout for Artemis missions. Launch Control Center Firing Room 1 received a total makeover. The rotating and fixed service structures at Launch Complex 39B were removed to create a clean pad, and three 600-foot-tall lighting protection towers were installed around the pad. Construction workers upgraded the pad's flame trench and installed a new flame deflector. The Multi-Payload Processing Facility was remodeled to handle Orion fueling.

2020S

More progress with the Artemis program continued with the creation of Gateway—NASA's permanent lunar outpost that will be positioned in orbit around the Moon. While the Gateway Program is led out of the Agency's Johnson Space Center in Houston, Deep Space Logistics (DSL) is the Gateway Project office established in 2019 at Kennedy—leading the commercial supply chain in deep space by procuring services for transporting cargo, equipment, and consumables to enable exploration of the Moon and Mars.

LSP also is supporting NASA's return to the Moon, with sights on Mars—serving in a major consulting role for components of the Gateway. They also are leveraging their expertise in *Venture Class Launch Services* (VCLS) for precursor lunar CubeSat missions to reduce technical risk in advance of crewed Artemis campaigns. The LSP processing team prepared the Mars Perseverance rover for launch atop an Atlas V rocket from Space Launch Complex 41 on 30 July 2020.

On 30 May 2020, the United States returned humans to space from American soil on American rockets when SpaceX launched its crewed Demo-2 mission from Kennedy Space Center to dock with the international Space Station as part of NASA's Commercial Crew Program. SpaceX launched its second crewed mission, Crew-1, on 15 November 2020 to the Space Station. Boeing launched its first uncrewed orbital flight test last year and is preparing to launch its second uncrewed orbital flight test to dock with the Space Station later this year.

The spaceport also increased commercial opportunities with its newly completed *Launch Complex 48*, a dedicated site for small-class launch vehicles. The complex offers a "clean pad" concept, allowing companies to bring in their own resources and commodities for launch, thus reducing their investment in launch pad infrastructure.

Kennedy Space Center is now firmly established as a multi-user spaceport for government and commercial customers. Many types of partnering opportunities, including launch systems, spacecraft and payloads, capabilities and testing, and emerging markets, are now part of Kennedy's space exploration landscape.

A SPRING OF ACHIEVEMENT AND GROWTH: LOOKING BACK ON 1961

By Sarah LeClaire, Archivist, and Jonathon Ruff, Marshall Space Flight Center Intern

In the spring of 1961, humanity reached for the stars, and we found ourselves at the precipice of technological achievement and social change. Twenty-seven-year old Soviet pilot Yuri Gagarin became a household name after his historic flight as the first human to reach orbital space on 12 April 1961. After he launched from Baikonur Cosmodrome in the Soviet Union, Gagarin's journey aboard Vostok 1 lasted 108 minutes. Less than a month later, on board the Freedom 7 Mercury capsule, Alan Shepard, Jr., became the first American to fly to space on 5 May 1961. Gagarin and Shepard's journeys captured the world's attention just as the Wright brothers' first aircraft flights had approximately 60 years prior. Almost exactly equidistant in time from the Wright brothers' flight and the present day, Gagarin's and Shepard's achievements in spaceflight occurred at a time when the United States was in the midst of great social change.

Astronaut Alan B. Shepard, Jr., preparing for his Mercury Redstone 3 launch on 5 May 1961. (Image credit: NASA, *https://www.nasa.gov/image-feature/may-5-1961-alan-shepard-in-spacesuit-before-mercury-launch*)

Between Gagarin's and Shepard's spaceflights in April and May 1961, the United States became embroiled in conflicts at home and abroad. Less than a week after the first Soviet human spaceflight, the U.S. Central Intelligence Agency (CIA) sponsored a failed invasion operation on the Southwestern coast of Cuba, an event later known as the Bay of Pigs. This resonated with an American public wary of communism. A Gallup survey[1] conducted in April 1961 revealed that the public largely agreed with a trade embargo against Cuba but disagreed with the use of U.S. troops to help overthrow Cuban leader Fidel Castro.

Domestically, the U.S. public was in the midst of a civil rights evolution. In April 1961, the *Washington Post* reported on a meeting between Rev. Franklin Jackson and District of Columbia Police officials to discuss the rise of police brutality against Black people in the city. Later that month, the *Jackson Advocate* reported that the National Association for the Advancement of Colored People (NAACP) had been urged by the Kennedy administration to limit protest activities in their fight for civil rights as four students were arrested after a sit-in on a Jackson, Mississippi, city bus. By 4 May 1961, the U.S. Supreme Court had found segregation practices in interstate transportation unconstitutional. That same day, a group of civil rights activists known as the Freedom Riders boarded a bus in Washington, DC, bound for the Louisiana (and stopping in several southern states), to protest the continued use of illegal segregation practices in the South.

Americans seeking a respite from the news had plenty of options for art and entertainment. The year 1961 saw the debut of a number of influential television shows: *Mister Ed*, *ABC's Wide World of Sports*, *Hazel*, *The Dick Van Dyke Show*, and *Ben Casey*. The same week of Gagarin's flight, we were celebrating achievements in the arts. At the 33rd Academy Awards, *The Apartment* won Best Motion Picture; Billy Wilder

1 See *https://news.gallup.com/vault/190772/gallup-vault-cuba-embargo-popular-bay-pigs-fiasco.aspx* (accessed 15 March 2021).

won Best Director; and Burt Lancaster and Elizabeth Taylor won Best Actor and Actress, respectively. The still-young Grammy Awards had appeared for the third year just days prior. Percy Faith's "Theme from *A Summer Place*" took Record of the Year and "Let the Good Times Roll" by Ray Charles won Best R&B Performance. (Charles proved to be a big influence on a then-unknown British band who were playing a 92-night engagement at The Top Ten Club in Hamburg, Germany, at the time of the awards. As the Beatles, they later ushered in a revolution of their own.) On 23 April, Judy Garland's concert at Carnegie Hall attracted thousands of attendees and Del Shannon's "Runaway" topped the charts as the #1 hit single on the radio.

The awe-inspiring achievement of the first human spaceflight came at a time of difficult social realities and new sights and sounds in the arts. Yet, on 12 April 1961, we put aside our differences for a moment to celebrate the achievement of our political adversaries as an achievement of humanity. In a NASA news release later that day, newly appointed NASA Administrator James Webb commented on the success of Gagarin's mission: "I would like to state for myself that I regard this as a splendid accomplishment. It is certainly an indication of a high state of advanced technology, and is a significant event in terms of the program of space exploration, both with respect to the USSR and with respect to ourselves and other nations interested in it." After that moment passed, however, Administrator Webb, NASA personnel, and countless others across the country worked tirelessly throughout the remainder of April 1961 to send the first American to space within one month of Gagarin's historic flight.

As we continue our journey in human spaceflight with new programs such as Artemis,[2] we must remember that our achievements in space may also come during times of national growth and social exploration. Just as 1961 America was marred by diplomatic failures and matured in the civil rights movement, 2021 America finds itself in a time of global diplomatic uncertainties and opportunities for domestic growth in civil protection. Just as 1961 America occasionally tuned out the news to enjoy entertainers and artists, 2021 America tunes into podcasts, streaming services, and sea shanties to soothe our anxious captivity in a time of quarantine. As much as the advancements of the past 60 years have propelled us to new heights of technological and social achievement, we reflect some of the political, social, and artistic realities of 1961. As we were then, we remain a people focused on a future in the stars while battling for growth at home.

2 See *https://www.nasa.gov/specials/artemis/* (accessed 15 March 2021).

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SPACE BIOLOGY AT AMES RESEARCH CENTER

By James Anderson

Harold Klein turns over the ceremonial first spade of dirt at the groundbreaking for the life sciences research laboratory at Ames on 13 April 1964. (Photo credit: NASA)

For 60 years now, human spaceflight has drawn upon insights from more than 70 years of sending nonhuman life into space. Before astronauts were ever sent on suborbital and orbital flights, fruit flies, fungal spores, and seeds were among some of the first organisms to be sent into space in the years preceding the formation of NASA.

Almost as soon as NASA was founded, the Agency began developing plans for the life sciences. Those early years were programmatically tumultuous, and the changes that Ames made to its organizational structure to support the Agency back then both shaped the character of Ames today and have had a lasting impact on the study of Earthly life in space.

What we today would call space biology—a field of research that focuses on the fundamental mechanisms of life to understand how spaceflight and space itself affect processes such as metabolism, growth, and stress responses—developed as part of a broader program within NASA when the Agency founded the Office of Life Sciences Programs at Headquarters in 1960. Although the Life Sciences Office was given equal footing with NASA's other program offices at the time, it existed for less than two years. The reason for the dissolution was a lack of commitment to funding and a failure to provide enough personnel to support the venture, plus the impression from the Office of Space Flight Programs, which managed Project Mercury, that the new Life Sciences Office was impinging on its

territory. That territory covered human factors and the testing of life-support systems that the Air Force conducted for NASA during the early stages of the program. NASA's Administrator, T. Keith Glennan, had nevertheless wanted the Agency to develop a more expansive vision for the life sciences. While establishing the Office of Life Sciences Programs had been one of the recommendations of the Bioscience Advisory Committee (also known as the Kety Committee), so too was establishing a central research facility to conduct the investigations into fundamental questions about life in space, in addition to studying more immediate applications emerging out of medical and behavioral studies related to human spaceflight.

The life sciences research laboratory at Ames as it appeared shortly after construction; it was completed in 1965. (Photo credit: NASA)

In his final years as the Ames Director, Smith DeFrance vigorously lobbied for Ames to be the Center where the facility would be located. Newly formed Goddard Space Flight Center and the National Institutes of Health were early favorites, but DeFrance ultimately prevailed. Concurrently, the life sciences were divided among the offices at NASA Headquarters as the programmatic tumult continued. At Ames, by the time the first Director of Life Sciences had arrived, the dissolution of the Office of Life Sciences Programs had already occurred. The Director, Webb Haymaker, also found that his research interests—combined with a desire for an almost completely academic atmosphere—would not align well with NASA's goals.

In 2017, acting NASA Administrator Robert Lightfoot, acting Deputy NASA Administrator Lesa Roe, Ames Center Director Eugene Tu, Ames Director of Science Michael Bicay, and Amoroso Construction Northern California Operations Manager Michael Chambers donned hard hats and used golden shovels to ceremonially begin construction of the new Biosciences Collaborative Laboratory, which held its ribbon-cutting ceremony in February 2020. The new facility houses laboratories designed with the latest technology to serve NASA's programs in fundamental space biology, astrobiology, and bioengineering. (Photo credit: NASA)

Haymaker was succeeded in January 1964 by the head of the Exobiology Division, Harold Klein, who became the new Director of Life Sciences at Ames. Klein had first come to Ames on a sabbatical from Brandeis University in Massachusetts, where he had helped create the biology department. Like the National Advisory Committee for Aeronautics (NACA) researchers before them, the life scientists arriving at Ames prized basic research, which Klein proved much more capable of organizing within the context of the new agency. What set the life scientists apart from the aerodynamicists was indeed a more academic culture that they both prized and fought for, with Klein working to ensure that the organization was simultaneously academic and mission-driven. In his recollections years later, Klein recalled threatening to quit if a library was not included in the new life sciences building at Ames.

The differences between the life scientists and the aerodynamicists proved beneficial, reinforcing the Ames culture of inquisitiveness and an openness to new ideas. Existing Ames expertise in simulation would make use of centrifuges, and the centrifuge facilities were expanded to support the life sciences. Those ground facilities and numerous other labs complemented the many biological payloads that Ames has managed since Project Gemini in the 1960s, when the first life sciences payload managed at Ames carried sea urchin cells in an experiment to investigate the effects

of microgravity on fertilization, cell division, differentiation, and growth in a biological system.

Since then, hundreds of space biology experiments managed by Ames as well as Kennedy Space Center have continued to carry a variety of model organisms into space. And when BioSentinel launches under the Artemis program, it will mark the first study of the biological response to space radiation outside low-Earth orbit (LEO) in almost 50 years. This research in space biology continues to expand our understanding of fundamental biological mechanisms, adding to our knowledge and preparing us for extended human spaceflight beyond Earth orbit.

STENNIS SPACE CENTER AND HUMAN SPACEFLIGHT

By Jessica Herr

In 1915, the National Advisory Committee for Aeronautics (NACA) was created to promote aeronautical research. It existed until 1 October 1958, when it was converted to a new agency, the National Aeronautics and Space Administration (NASA). The primary reason for the conversion was the Soviet Union launch of the first humanmade satellite, Sputnik, into low-Earth orbit on 4 October 1957. There was a congressional review of the American space program under way at the time of the Sputnik launch, and using the bones of the NACA, a bill was presented to President Dwight Eisenhower in July 1958 to create NASA.

In May 1961, President John F. Kennedy delivered a speech before a special joint session of Congress, proclaiming that the United States should put a person on the Moon before the decade was out, giving NASA less than nine years to achieve this lofty goal. In order to do so, the Agency needed to test rockets, and in August 1961, an ad hoc committee of members from NASA Headquarters and Marshall Space Flight Center began the work of finding the perfect location to do so.

There were several variables to consider since the rockets would be assembled at the Michoud Assembly Facility outside of New Orleans and launched from Cape Canaveral, Florida. NASA needed a facility that, ideally, would lie between these two places, be situated away from a densely populated area because of the noise associated with testing rocket engines, have both waterway and highway access, have a mild climate so testing could conceivably be conducted year-round, and have supportive communities nearby.

The beginning of the construction of Mississippi Test Operations. (Photo credit: NASA)

On 25 October 1961, NASA announced that a rocket test site would be established in Hancock County, Mississippi. The site, then known as Mississippi Test Operations, now known as Stennis Space Center, would be the facility to test every single rocket engine that has put astronauts into space from American soil.

GLENN RESEARCH CENTER AND THE ISS

By Bob Arrighi, ATS

As NASA celebrates the 60th anniversary of human spaceflight and the recently passed 20 years of continuous human presence on the International Space Station (ISS), Glenn Research Center reflects on some of our many contributions to the success of this global achievement in human spaceflight.

On 3 and 4 November 2000, the crew of STS-97 unfurled the first permanent solar arrays on the International Space Station. The football-field-sized collection of 32,800 reflective solar cells instantly became one of the brightest objects in the night sky and the largest electrical power system (EPS) ever in space. Glenn (previously named Lewis Research Center) has played a significant role in the Station from its inception in 1982 to today, most notably the development of the EPS.

From 1982 to 1984, Lewis personnel on NASA's Space Station Task Force analyzed options for power and propulsion systems. During this period, the Center crusaded for the station's power system assignment. After President Reagan formally initiated the Space Station Freedom (SSF) program in January 1984, two dozen Lewis engineers relocated to Houston to participate in the grueling yearlong Agency effort to define the station's requirements.

In the summer of 1984, NASA divided the SSF project into four work packages and assigned the critical electric power package to Lewis. The power system is essential for maintaining the station position, operating electronics, and conducting experiments. Lewis created the Space Station Freedom Directorate to devise a startup system for the station, develop the permanent system using either solar arrays or a solar mirror, and integrate it into various space station designs.

For the next few years, Lewis strove to develop a system to meet the station's ever-changing power requirements and configurations. This work included the design, construction, and testing of the power generation, storage, and distribution systems.

In 1992, Lewis launch vehicle experts made several trips to Moscow to evaluate the Russian Soyuz spacecraft as a rescue vehicle for SSF. Their analysis demonstrated that the Soyuz could be paired with U.S. launch vehicles to reach the SSF.

In early 1993, President Clinton ordered an overhaul of the station design. Lewis personnel served on the team that reconfigured the design of what would become the ISS. During this period, Russia became a participant in the station's activities. Lewis personnel led the Agency's interactions with the Russians and determined that the station's orbital inclination would have to be altered to accommodate Russian launch vehicles. In December 1993, Russia became a full partner in the station, now named the ISS. Lewis led the Agency's cooperative efforts with the Russians for several years.

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The management structure for the ISS was consolidated in 1994, leading to the disbanding of Lewis's space station directorate. Nonetheless, 100 Lewis employees continued to support the development of

the ISS power system, which was a larger version of the photovoltaic power system that Lewis developed for SSF.

The Center developed cathodes for the plasma contactor that prevented electrical charge buildups and nickel-hydrogen batteries that stored electrical energy for use during the eclipse period of orbit. The operation and deployment of the ISS's radiator panels were verified at the Space Power Facility, and the Station's electronics were tested at the Power Systems Facility.

Construction of the ISS began in 1999, and the first occupants arrived in October 2000. The expansion of the electric power system in the late 2000s made it the brightest object in the sky. The Center remains active in ISS operations by continually monitoring the power system, utilizing a computer code to predict the power level for each orbit and configuration, and analyzing the Station's environment for astronaut health.

The Center has also actively utilized the ISS for research. The Fluids and Combustion Facility is a permanent ISS experiment that allows Glenn researchers to remotely conduct microgravity experiments in space. The Space Communications and Navigation testbed tested a communications system that employs computer codes to transmit signals. Glenn also introduced a new treadmill harness design for crewmembers for comfort during treadmill exercise in space.

UPCOMING MEETINGS

The annual meeting of the Organization of American Historians will be held virtually **15–18 April 2021**. Visit *https://www.oah.org* for more details.

The American Astronautical Society's annual Goddard Memorial Symposium will be held virtually **4–6 May 2021**. Visit *https://astronautical.org/events/goddard* for more details.

The Annual Meeting of the Society of American Archivists will be held virtually **2–6 August 2021**. Visit *https://www2.archivists.org/conference* for more details.

The annual meeting of the Oral History Association will be held virtually in **October 2021**. Visit *https://www.oralhistory.org/annual-meeting/* for more details.

The annual meeting of the Society for the History of Technology will be held **18–21 November 2021** in New Orleans, Louisiana. Visit *https://www.historyoftechnology.org/annual-meeting* for more details.

THE OVERVIEW EFFECT: PERSPECTIVE GAINED FROM LOOKING BACK AT EARTH

By: Jacqueline Zito, NASA Headquarters History Spring 2021 Intern

The photo called *Earthrise* was taken by the Apollo 8 crew on 24 December 1968. (Photo credit: NASA)

After his historic orbit around Earth in 1962, people wanted to know if John Glenn had seen God.

"No," the Mercury astronaut recalled in his memoir. "I didn't expect to. The God I believe in isn't so small that I would run into him just a little bit above the atmosphere."[1] However, Glenn did have an experience many would consider spiritual and recalled the indescribable sensation of watching four sunsets in one day. The first American to orbit Earth, he returned home with a newfound sense of humanity's place in the universe.

Glenn didn't know it at the time, but he was one of the first to experience what would become known as the "overview effect." Officially coined in 1987 by space philosopher Frank White, the overview effect occurs when astronauts observe Earth from space for

1 John Glenn and Nick Taylor, *John Glenn: A Memoir* (New York: Bantam Books, 1999), p. 382.

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the first time.[2] Studies published by the American Psychological Association have defined the overview effect as an astronaut's "overwhelming emotion and feelings of identification with humankind and the planet as a whole."[3] From hundreds of miles above the planet, nearly all astronauts undergo a cognitive shift and are flooded with intense feelings of "universal brotherhood."[4] There is a realization—almost an enlightenment—that every single being that has ever lived or died shares an existence on a single blue dot in an endless black void. Unity. Ecstasy. Reverence. Ultimately, it reinforces the notion that one of the most significant consequences of spaceflight occurs when an astronaut simply looks back at Earth.

America was wonder-struck by the early space programs and fixated by nonstop coverage of the astronauts, frequent breakthroughs in aerospace technology, and the race to beat the Soviet Union to the Moon. It was not until the Apollo 8 mission photographed *Earthrise* that all people began to appreciate the larger humanistic perspective. Taken only seven years after the first American traveled to space in 1961, *Earthrise* is now one of the most famous pictures in photographic history. In colorized film, Earth rises out of the Moon's horizon, a blue-white planet growing out of a barren moon in the otherwise black void of space. Nothing like the photo had ever been taken before, and the world was enthralled. The magazine *The Last Whole Earth Catalogue* described the picture as one that "began to bend the human consciousness,"[5] and for one powerful moment, the overview effect seemed transferable.

As the Apollo program chugged forward, however, NASA did not focus on the philosophical aspects of space exploration. When Neil Armstrong first stepped from the Lunar Module onto the surface of the Moon, his exclamation of "one small step for man, one giant leap for mankind" rang through the American psyche, fueling the public appetite for missions that delved ever further into space for inspiration, and not glancing back at Earth. This attitude was further reflected in NASA's next achievements: the 1970s were a flurry of Moon landings and satellite deployments driven by a political and scientific agenda, and the '80s were distinguished by Space Shuttles and the initiation of the International Space Station. Nevertheless, astronauts like Sally Ride were "usually at a window looking down at Earth."[6] While NASA focused on exploring deep space, astronauts continued to experience the psychological impact of the overview effect.

For this reason alone, spaceflight is important. If astronauts return from space having gained only their new perspectives and nothing else, then humankind has gained something invaluable. As we celebrate the 60th anniversary of spaceflight, and in a world marked by increasing conflict, the overview effect is a reminder that, ultimately, the planet Earth binds us together.

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2 Frank White, *The Overview Effect: Space Exploration and Human Evolution* (Reston, VA: American Institute of Aeronautics and Astronautics, Inc., 2014).

3 D. B. Yaden, J. Iwry, K. J. Slack, J. C. Eichstaedt, Y. Zhao, G. E. Vaillant, and A. B. Newberg, "The Overview Effect: Awe and Self-Transcendent Experience in Space Flight," *Psychology of Consciousness: Theory, Research, and Practice* 3, no. 1 (2016): 1–11.

4 White, *The Overview Effect*.

5 Steward Brand, *The Last Whole Earth Catalogue* (New York: Random House, 1971).

6 "Sally Ride Interview," Scholastic.com, 20 November 1998, *http://teacher.scholastic.com/space/sts7/interview.htm* (accessed 15 March 2021).

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