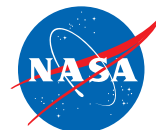


# NEWS &NOTES

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## FROM THE CHIEF HISTORIAN



We are in the middle of the 50th anniversary year of Project Gemini. From the spring of 1965 through the end of 1966, 10 crewed Gemini missions successfully propelled the United States from apparent perpetual also-ran to clear leader of the space race. But ask most people about the space program in the 1960s and you'll hear about Apollo and, sometimes, the Mercury 7 astronauts. Gemini? Hardly anybody remembers it, and fewer still appreciate how it served as the critical testing ground between our initial baby steps in Mercury to footsteps on the Moon. So we are devoting our annual theme issue this year to Gemini. This seems particularly appropriate for our December issue, since the two-person spacecraft project was announced to the public in December 1961. That's right, Gemini appeared after President John F. Kennedy committed us to landing on the Moon and long after work on Apollo had begun. While there had been discussions about developing an advanced Mercury capsule for a couple of years, the President's end-of-the-decade

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## A RECOLLECTION OF GEMINI FROM 40 FEET AND 20 KNOTS

By William R. Carpentier, M.D., with John B. Charles, Ph.D.

In January 1965, through a combination of preparation and luck, I joined NASA's Manned Spacecraft Center (now Johnson Space Center) as a flight surgeon trainee and was privileged to participate in a truly great adventure. In July, I became a staff flight surgeon in the Medical Operations Office. I was soon assigned the job of flying in the recovery helicopter for the Gemini 5, 6, 7, and 9 missions, as well as working with the Navy Underwater Demolition Team (UDT) swimmers in order to provide medical support for astronaut rescue operations. This gave me a unique perspective on this ambitious crewed program.

Project Gemini was initiated in 1961 to bridge the knowledge gap between the successful but rudimentary one-person Project Mercury flights then under way and the ambitious three-person Apollo Moon missions still a few years in the future. Gemini was intermediate in the number of astronauts it would carry, the durations of most of its flights, the

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NASA HISTORY PROGRAM OFFICE  
OFFICE OF COMMUNICATIONS



*From the Chief Historian (continued)*

deadline refocused attentions in the summer and fall of 1961. It was clear that Apollo was not going to be ready to fly for several years, and there was much to learn that could not be done with the existing Mercury design. Known as Mercury Mark II at first, the program was publicly assigned the name Project Gemini only in January 1963. The three remarkable years that followed laid the foundation for success in Apollo. Even if you are a long-standing Gemini fan, like me, I think you will find that our three feature articles in this issue will provide some perspectives that you may not have heard before. Enjoy!

One thing that we won't be enjoying in 2016 is a healthy History Program Office budget. After a 10 percent cut in the messiness of sequestration two years ago, we suffered only a 5 percent cut in fiscal year 2015. This year, though, the cut was 32 percent. I'm told that this is temporary and that things should improve next fiscal year. We will be able to sustain critical programs that need funds this year, but we won't be initiating any major new publication projects. That approach is not sustainable in the long run. However, we have enough in the publication pipeline to tide us over, and this also conveniently gives us some breathing space to implement our new publication management software system. But you can be sure that I'm very focused on the need for long-term sustainability of the history program.

Actually, while budget prospects this year seem grim, I think that the overall trend for the history program is on the upswing. Good news about the NASA history program this past year has been abundant. Our work

on the National Advisory Committee for Aeronautics (NACA) centennial in 2015 was highly successful and brought a lot of positive attention to the history program. Goddard Space Flight Center, which

had been the one Center without an archival or history program, initiated an archival program and hired a civil service archivist to run it in October. At Glenn Research Center, the upcoming 75th anniversary is driving a surge in activity and publications (both in print and online). Langley Research Center's upcoming centennial in 2017 not only has generated serious planning but appears to be leading to a rebirth of their history and archival

programs. We've seen two new Center-level Halls of Fame open this year at Langley and Glenn. In all, I think these events indicate an upward trend in the perceived value of history and archival programs across the Agency. So, as we begin the new calendar year, I see a brilliant future for our history.

Have a great holiday season and Godspeed to you in 2016,



**William P. Barry**  
Chief Historian

**“ ...WHILE BUDGET PROSPECTS THIS YEAR SEEM GRIM, I THINK THAT THE OVERALL TREND FOR THE HISTORY PROGRAM IS ON THE UPSWING. GOOD NEWS ABOUT THE NASA HISTORY PROGRAM THIS PAST YEAR HAS BEEN ABUNDANT. ”**



*A Recollection of Gemini from 40 Feet and 20 Knots (continued)*

altitudes of its orbits, and the scope of its extravehicular activities. But there was nothing intermediate about its unprecedented challenge to its pilots. Gemini was intended to define the operational limits of astronauts in upcoming lunar missions, including the most unique feature of spaceflight, weightlessness, for up to 14 days—the duration of the longest foreseen lunar mission—compounded by extended confinement in a small cockpit inside a bulky, restricting spacesuit.

The first 2-hour orbital flight of Soviet cosmonaut Yuri Gagarin in April 1961, followed by six more flights lasting up to five days each, had not revealed any unexpected life-threatening difficulties, but the Soviets did not disclose many medical details. American Mercury astronauts flew two suborbital and four orbital missions with excellent performance and no significant deleterious effects of weightlessness.

However, Gordon Cooper had a very high heart rate and was light-headed when he stood up for the first time on the deck of the recovery ship after the final Mercury flight, the 22-orbit, 34-hour mission in May 1963. This “orthostatic intolerance” was not entirely unexpected because Walter Schirra had had an increased heart rate and decreased systolic blood pressure when standing compared to lying down after his six-orbit, 9-hour flight the previous October.

Orthostatic intolerance means “intolerant of the upright posture while standing,” and its symptoms include trembling, weakness, fatigue, poor concentration, light-headedness, accelerated heart rate, and



Immediately after exiting his Mercury capsule, Cooper stands quietly on the aircraft carrier deck while his heart rate and blood pressure are measured. (Credit: NASA)

even fainting on standing because the cardiovascular system has trouble maintaining blood pressure and blood flow to the brain. These symptoms were believed to result from a decrease in blood volume during spaceflight, exacerbated by the fact that veins in the lower body may become more distensible postflight, allowing more blood to pool in the legs.

All of the Mercury astronauts had weight loss and increased heart rates, and five out of six had decreased systolic pressure after landing. No one knew how much to be concerned about these findings, but they influenced planning for the upcoming Gemini flights, which were to gradually increase the time astronauts stayed in weightlessness: from just 5 hours on Gemini 3 (as short as the Mercury flights of John Glenn and Scott Carpenter)

to 4 days on Gemini 4, 8 days (matching early Apollo missions) on Gemini 5, and finally 14 days on Gemini 7.

A defining feature of Gemini was its nearly horizontal attitude during landing, as required for its initial plan for a land landing at an air base under pilot control instead of an undignified parachute splashdown in the ocean. The paraglider, an inflatable triangular wing developed by Francis Rogallo of NASA's Langley Research Center, was to replace the parachute used by Mercury, and a successful—and safe—landing required the pilot to initiate a “flare” maneuver just before landing, bleeding off speed by slightly lifting the nose of the capsule.





If the Rogallo inflatable wing had been used for Gemini landings, it would have looked like this test except with skids instead of wheels. (Photograph credit: North American Aviation and NASA)

The Gemini capsule was to be tilted horizontally under the inflated Rogallo wing, permitting the astronauts to see the landing strip through their forward-facing windows. This meant that they were sitting upright under normal Earth gravity, as in an aircraft, only a few minutes after leaving the weightlessness of orbital flight. Orthostatic intolerance may be merely annoying on the deck of a recovery ship, but if it occurred while landing the Gemini capsule, then it could result in a crash, astronaut injury, or worse.

Engineering problems eliminated the paraglider from the Gemini program in late 1964. The Mercury-style parachute was restored, with the capsule still suspended horizontally under the parachute, but at a slight nose-up angle to permit it to splash down on the edge of its blunt heat shield instead of flat on its widest face, in order to slice into the water to minimize the shock of impact. The critical piloting task was no longer a problem, but the astronauts would still be sitting

nearly upright during parachute descent after two weeks of weightlessness, and then again while floating in the ocean for as long as it took to be rescued.

We routinely conducted pre- and postflight tests on the astronauts during the Gemini program to measure their orthostatic intolerance by putting them on a “tilt table” that tipped them from horizontal to 70 degrees upright for 15 minutes while we recorded their heart rates and blood pressures every minute. This was among the earliest provocative testing done on astronauts returning from space, but not the first. In 1963, Gordon Cooper had 11 preflight tilt tests—including 5 prior to spacecraft checkout procedures and 6 following those procedures—and 4 postflight tilt tests out to 19 hours after splashdown.

NASA had assembled a large recovery team to go out on the aircraft carrier to pick up the Gemini astronauts. The recovery team included the Navy UDT swimmers, predecessors of today’s U.S. Navy SEALs. They jumped from the recovery helicopter to assist the crew out of the capsule and into a life raft so that they could be hoisted into the helicopter using a “horse collar” rescue sling. If the astronauts were injured or required medical attention, they would instead be hoisted horizontally in a Stokes Litter Basket up into the helicopter and be attended to by a recovery physician en route back to the carrier. A group of medical specialists was stationed on board the carrier to conduct the postflight medical evaluations.

After Gemini 3 in March 1965, it was decided that, on future splashdowns, the physician in the helicopter should be able to jump with the frogmen in order to provide medical help immediately, if required. However, the physician assigned to Gemini 4 indicated that he was not a very good swimmer and did not relish the idea of jumping into the ocean. The lead NASA recovery flight surgeon had to stay on the carrier. I, on the other hand, being a new, gung-ho flight surgeon with a background in competitive swimming and scuba diving, thought jumping out of helicopters with the UDT would be a great job.



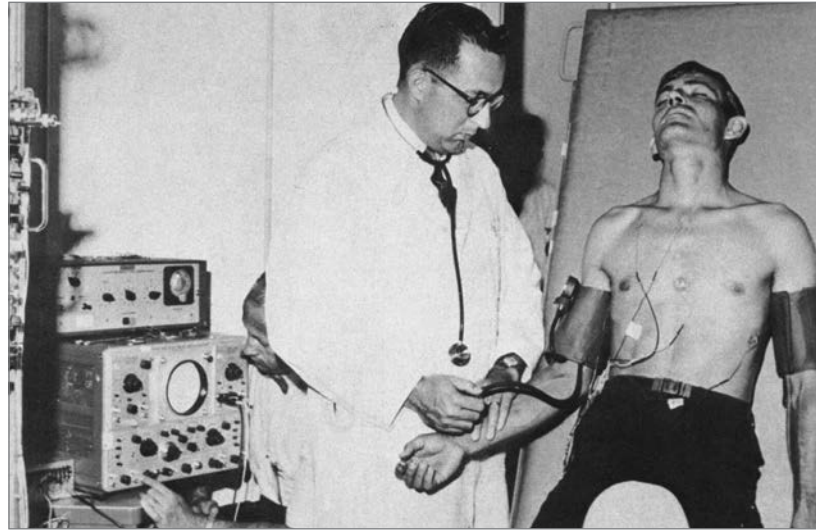


Even though it was likely I would never actually have to jump, I was required to have some practice training. A colleague in the medical office told me the frogmen went out of the helicopter 40 feet above the water at a speed of over 20 knots—something that definitely required being in good shape. I was able to do some training jumps from a U.S. Coast Guard helicopter into the Gulf of Mexico near NASA. The pilot wanted to try 20 feet and 10 knots, but I insisted on 40 feet and 20 knots (and then talked him into increasing the speed to close to 40 knots). It gave me quite a jolt, but I kept telling myself I could do whatever the UDT divers did.

When I went out to the carrier for the Gemini 5 recovery, I met the UDT team, men much larger than I and much younger than my 29 years. I was asked, “Have you ever jumped out of a helicopter?” When I responded, “Yes, I went out at 40 feet at 20 knots,” they were somewhat stunned: “You did what?” I learned that they usually went out much lower and slower.

Back on the carrier after the recovery, our testing showed that the Gemini 5 crewmembers were both significantly affected by eight days in space. During tilting, their heart rates soared and their blood pressure dropped. When we added these results to those from Gemini 3 and Gemini 4, we were concerned to see the astronauts’ orthostatic heart rates increasing and blood pressures decreasing as flights got longer. When extrapolated out to 14 days in weightlessness, a hand-drawn graph predicted tilt heart rate increases of more than 100 beats per minute above supine resting rates, which averaged over 85 beats per minute. There was no way an astronaut could maintain that kind of heart rate during a tilt test, or, by extension, any other orthostatic stress, perhaps not even sitting upright for a long period in the floating capsule.

Earth-based studies suggested that orthostatic intolerance resulted from an actual decrease in measured blood volume. This was borne out by tests on the Gemini 4 and Gemini 5 astronauts. We measured reductions in both their volume of plasma (the liquid



Dr. Charles Berry, director of space medicine, demonstrates the routine pre- and postflight tilt-test procedure for measuring heart rate and blood pressure during 70-degree tilt. (Photograph credit: NASA)



Astronaut Conrad is hoisted up into the recovery helicopter after Gemini 5 using the “horse collar” rescue sling. (Photograph credit: NASA)





Navy UDT divers with whom I helped recover the Gemini 5 astronauts. (Photograph credit: personal collection of William Carpentier)

part of blood) and their number of red blood cells. Based on our measurements of the astronauts' calf circumference, we also determined that increased pooling of blood in the legs was at least part of the reason for the Gemini 5 results.

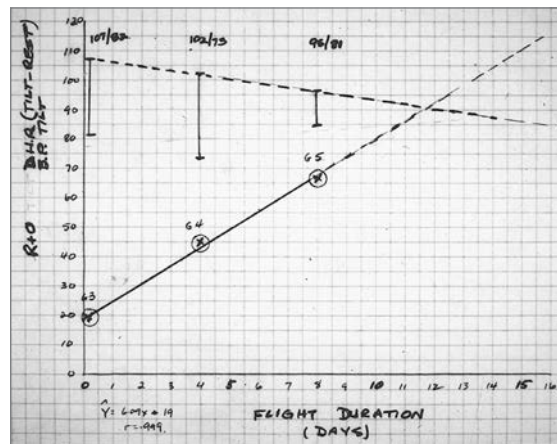
Gemini 7, which was scheduled to last 14 days in December, was my major concern. Although the Gemini 5 astronauts had returned to normal within two to three days, I was most concerned about the data from their first few minutes and hours back on Earth, especially because previous Gemini spacecraft had landed a considerable distance from the carrier; Gemini 5 had been about 90 nautical miles away—about an hour by helicopter.

As the physician member of the team that was going to have to rescue this crew if they should be incapacitated, I was incredibly concerned about how we were going to get them out of the spacecraft, into the helicopter, back to the carrier, and into the sick bay. I had a vision of me, a newly qualified flight surgeon, with three frogmen and two unconscious astronauts an hour away from the aircraft carrier and additional medical help.

So I did a lot of practicing with the UDT, trying to work out the best method of getting the crew out of the spacecraft and onto the life raft and to come up with some way to do cardiopulmonary resuscitation on a pliable raft in 6-foot seas.

I also told the Gemini 7 commander, Frank Borman, “When you land, don’t just sit there and let the blood pool in your legs. You’ve got to keep your feet moving, keep your legs moving, and keep your blood pumping upward until we can get you out of there.” In a later television interview, Borman commented, with some astonishment, that some people were afraid the crew was going to faint. I was certainly one of them.

Although neither astronaut fainted during the recovery, one did faint during a tilt table test about an hour after splashdown, but the other, tested about 2 hours after recovery, did not. In fact, his tilt test showed him to have a lower heart rate than either one of the pilots who were in space for only eight days. I was greatly relieved because this finding demonstrated that orthostatic intolerance didn’t inevitably continue to get worse over time—in fact, it appeared to level off as the missions got longer and was also very variable among individual astronauts. With this new information,



My hand-drawn graph (seen here) of the increasing trend in heart rate with increasing Gemini flight durations predicted a heart rate that was 105 beats per minute higher after a 14-day flight than during preflight—an unsustainable increase. (Photograph credit: personal collection of William Carpentier)





This photograph from a training session illustrates the challenges involved in providing medical care to incapacitated astronauts on a raft in the ocean. (Photograph credit: personal collection of William Carpenter)



we concluded 1965 with confidence that astronauts could complete the longest planned Apollo mission.

Although I did numerous jumps during training and practice exercises, medical assistance was never necessary for any crewmember during actual recovery operations. They remained conscious, not only throughout the whole parachute and floating periods, but also while being hoisted up to the recovery helicopter using the rescue sling that supported them under the arms and left their legs dangling free—an ideal way to cause fainting. (The crews of Gemini 6 and Gemini 9 elected to stay in the spacecraft and be hoisted aboard the carrier using a crane. The Gemini 8 crew climbed up a cargo net to board their recovery vessel.)

The Gemini data showed that the decreased blood volume was highly related to weight loss, as were the increased heart rate and decreased pulse pressure. There was considerable weight-loss variability among crewmembers, and factors other than duration of weightlessness must be considered. These would include caloric intake versus energy expended. They would also include fluid and electrolyte intake versus fluid and electrolytes lost in the urine plus sweating,



These photographs show me jumping from the recovery helicopter in a practice session, lower than 40 feet and slower than 20 knots. (Photograph credit: personal collection of William Carpenter)





I took this photograph of James Lovell being hoisted to the recovery helicopter after Gemini 7 using the horse-collar rescue sling, still wearing his lightweight spacesuit. (Photograph credit: NASA and personal collection of William Carpentier)

as well as insensible loss, which may vary secondarily with the dryness and warmth of the environment, especially while the astronaut is suited. The Gemini 7 astronauts were the only ones who were issued lightweight spacesuits that could be doffed in-flight, a capability that greatly enhanced their comfort and that they recommended for future missions.

I went out to the carrier for Gemini 5, Gemini 6, and Gemini 7 as an assistant recovery physician, and then as the lead for Gemini 9, before transitioning to Apollo medical operations and planning. At the end of the Gemini program, I believed that there was still much to learn and that further comprehensive, quantitative biomedical measurements should be made on Apollo to gain a better understanding of the effects of spaceflight on human physiology prior to landing on the Moon. As for the astronauts, they believed that they could take anything that was thrown at them. And, almost always, it was true.

## JAMES A. CHAMBERLIN AND THE BIRTH OF GEMINI

By Chris Gainor

At first glance, the Gemini spacecraft appears to be just a larger version of the Mercury spacecraft that carried the first American astronauts into space. Both were built by McDonnell Aircraft in St. Louis, Missouri, and both were covered with black corrugated shingles to manage the heat of launch and reentry.

But inside, the two spacecraft were very different from each other, and those differences made Gemini a much more durable and capable vehicle than Mercury. Much of the credit for those improvements goes to a lanky Canadian engineer who was responsible for the design of the two-person spacecraft and served as Gemini's first program manager.

James Arthur Chamberlin was the most prominent member of a group of 32 British and Canadian

engineers who joined the NASA Space Task Group (STG), the forerunner to Johnson Space Center, in 1959, after the Canadian government canceled a major aircraft program.<sup>1</sup>

After joining NASA in April 1959, Chamberlin soon became head of engineering for Project Mercury, the first U.S. crewed spacecraft. Unlike many of his fellow engineers at STG in those early days, Chamberlin had production experience, and as head of engineering, he saw the spacecraft through their manufacturing processes at McDonnell Aircraft in St. Louis, Missouri.

<sup>1</sup> Chamberlin's life story and the stories of the engineers who came to NASA from Avro Canada are told in Chris Gainor, *Arrows to the Moon: Avro's Engineers and the Space Race* (Burlington, Canada: Apogee Books, 2001).





He was also responsible for troubleshooting problems that cropped up during the early Mercury flights.<sup>2</sup>

Early in 1961, Chamberlin was charged with designing an advanced Mercury spacecraft that could carry an astronaut on longer missions than the three-orbit flights for which Mercury was designed. In those early days, the new spacecraft was known as Mercury Mark II.

Chamberlin disliked Mercury's internal design, where systems were "stacked like a layer cake" inside the pressurized cabin, which complicated checkout on the launch pad.<sup>3</sup>

Working with others, notably James T. Rose of NASA and William J. Blatz of McDonnell, Chamberlin placed Gemini systems outside the cabin in a modularized fashion that facilitated checkout. Many of the systems were placed inside the adapter section behind the main body of Gemini that remained attached until reentry into the atmosphere.

Gemini used ejection seats rather than an escape tower for launch aborts, and the large hatches that came with the seats facilitated extravehicular activity in orbit when that was added to the Gemini program. Based on a suggestion from Maxime A. Faget, who had designed Mercury, the new spacecraft would carry two astronauts.

During the summer of 1961, Chamberlin and his growing design team proposed six objectives for Mark II, including long-duration flights with astronauts and animals, a robotic flight through the Van Allen radiation belts, controlled landings using a

2 See Loyd S. Swenson, James M. Grimwood, and Charles C. Alexander, *This New Ocean: A History of Project Mercury* (Washington, DC: NASA SP-4201, 1966).

3 James A. Chamberlin, letter to James M. Grimwood, NASA historian, 26 March 1974. See also James A. Chamberlin, interview by James M. Grimwood, Manned Spacecraft Center, Houston, TX, 9 June 1966, transcript available in RG 255.4.7, Records of the Lyndon B. Johnson Space Center, Houston, TX, National Archives at Fort Worth, TX, National Archives and Records Administration (NARA).

paraglider on crewed flights, rendezvous and docking with an Agena rocket in Earth orbit, astronaut training, and flights around the Moon with a Mark II docked to a Centaur rocket.

A few weeks later, Chamberlin beefed up his last objective with a proposal that a Mark II vehicle launched atop a Saturn rocket head to lunar orbit, where one astronaut would descend to the surface in a small "bug" and then return to the Mark II spacecraft for the journey home to Earth.

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**ALTHOUGH CHAMBERLIN WAS ORDERED TO STOP WORK ON THE IDEA OF LUNAR FLIGHTS, HIS ADVOCACY OF LUNAR ORBIT RENDEZVOUS (LOR) HELPED CAUSE PEOPLE LIKE FAGET AND ROBERT R. GILRUTH, THE HEAD OF NASA'S HUMAN SPACE PROGRAM, TO SEE THE VIRTUE OF LOR AND CHOOSE IT AS THE METHOD BY WHICH APOLLO WOULD REACH THE MOON AND MEET THE GOAL SET BY PRESIDENT JOHN F. KENNEDY.**

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Although Chamberlin was ordered to stop work on the idea of lunar flights, his advocacy of Lunar Orbit Rendezvous (LOR) helped cause people like Faget and Robert R. Gilruth, the head of NASA's human space program, to see the virtue of LOR and choose it as the method by which Apollo would reach the Moon and meet the goal set by President John F. Kennedy. Before that time, LOR had been championed only by a Langley Research Center engineer, John C. Houbolt.<sup>4</sup>

4 James R. Hansen, *Enchanted Rendezvous: John C. Houbolt and the Genesis of the Lunar-Orbit Rendezvous Concept*, Monographs in Aerospace History, no. 4 (Washington, DC: NASA, 1995), pp. 17, 21–22.



On 7 December 1961, Gilruth announced the new program in a speech to the Houston Chamber of Commerce, and in January, the program was named Gemini and Chamberlin became program manager. The animal flights and lunar flights were gone; greater emphasis was put on rendezvous and docking; and soon, extravehicular activity would be added to the program goals.

Because of Gemini's many advances beyond Mercury, Chamberlin and his team faced many problems in the early months of the program. The environmental control system was a bigger challenge than expected, and Gemini's thrusters and heat shield experienced many development problems. Fuel cells, which were to fly on long-duration Gemini flights, proved to be troublesome. The paraglider landing system experienced many failures in tests.

The U.S. Air Force Titan II missile, which was designated to launch Gemini into orbit, suffered from pogo oscillation, the bouncing that would be highly dangerous to human passengers if not nuclear warheads. Devising a solution to this problem took longer than hoped.

As 1962 turned into 1963, Gemini's costs began to rise precipitously at the same time as Congress trimmed NASA's budget; NASA decided that Gemini would have to absorb many of the cuts. While many of Gemini's growing problems were not his fault, more fingers began to point at Chamberlin, and on 19 March 1963, Gilruth replaced Chamberlin as program manager with Charles W. Mathews.

Mathews canceled the paraglider in 1964, leaving Gemini to splash down in the ocean using a parachute. Over 1963 and 1964, Mathews and his team were able to overcome Gemini's other problems. In 10 crewed flights in 1965 and 1966, Gemini met its goals, and U.S. astronauts captured the lead in the space race



Both photos feature Jim Chamberlin in his office at the Manned Spacecraft Center (later renamed Johnson Space Center) in Houston, Texas, in 1962. In one photo, Chamberlin is shown with Andre J. Meyer, Jr., and Paul M. Sturtevant. (Photo credit: NASA S62-2898 and S62-2899)

with the Soviet Union and laid down the foundation for the success of the Apollo program.<sup>5</sup>

<sup>5</sup> The most detailed account of Gemini, including Chamberlin's role in it, remains Barton C. Hacker and James M. Grimwood, *On the Shoulders of Titans: A History of Project Gemini* (Washington, DC: NASA SP-4203, 1977).



“There were a tremendous amount of development problems that had occurred, most of them not Jim’s fault,” Mathews recalled. “There were a couple of things where his futuristic look at things got things into the spacecraft that were too R&Dish that produced some of the schedule problems. But in general, you have to say that he left the program in pretty good shape.”<sup>6</sup>

Chamberlin, for his part, wrote that Gemini’s problems were smaller than the problems Mercury and Apollo faced during their development and praised Mathews’s “excellent leadership” for solving Gemini’s problems.<sup>7</sup> Others observed that Mathews made sense as manager for Gemini at that point because of his operations experience.

When Gemini concluded successfully in 1966, Chamberlin was awarded the NASA Exceptional Scientific Achievement Medal for “his outstanding scientific contributions and conceptual design of the Gemini spacecraft and program; for his leadership and technical guidance in the engineering of the basic and underlying design principles of the Gemini spacecraft and for his development of many operational concepts for the Gemini Program.”

Chamberlin was born in Kamloops, British Columbia, on 23 May 1915 and was raised by his mother in Toronto, Ontario, after his father was killed in World War I. He was educated at the University of Toronto and in London at the Imperial College of Science and Technology.

During World War II, Chamberlin worked briefly for Martin-Baker, the British ejection seat manufacturers, and a number of Canadian aircraft companies, including Noorduyn Aviation in Montreal, Quebec, builders of the Noorduyn Norseman bush plane, which was used widely in military operations during the war.

<sup>6</sup> Charles W. Mathews, telephone interview by author, 3 March 1996, transcript in author’s personal collection.

<sup>7</sup> Chamberlin letter to Grimwood.

In February 1946, Chamberlin joined the engineering staff at Avro Aircraft Ltd., of Toronto, where he rose through the ranks quickly, working as chief aerodynamicist on the Avro C-102 Jetliner and the CF-100 jet interceptor.

Chamberlin was Avro’s chief of technical design in the mid-1950s, when Avro Canada moved into design and construction of the CF-105 Avro Arrow. The twin-engine delta-winged supersonic jet interceptor was considered one of the most advanced aircraft of its time. But only five Arrows flew before the Canadian government controversially canceled it on 20 February 1959, due to its cost and the shift from defense to deterrence with intercontinental ballistic missiles.

In April 1959, NASA recruited Chamberlin and two dozen other engineers from Avro Canada. The Avro group, which eventually included 32 engineers, joined NASA’s Space Task Group at Langley Research Center in Hampton, Virginia. The group later moved to Houston, Texas, to what today is Johnson Space Center.

After he left the Gemini program in 1963, Chamberlin became one of NASA’s top troubleshooters in the Apollo program. He helped solve problems with the Apollo Command and Service Modules, the Lunar

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**AFTER HE LEFT THE GEMINI PROGRAM IN 1963, CHAMBERLIN BECAME ONE OF NASA’S TOP TROUBLESHOOTERS IN APOLLO. HE HELPED SOLVE PROBLEMS WITH THE APOLLO COMMAND AND SERVICE MODULES, THE LUNAR MODULE, THE MOBILITY UNIT USED BY ASTRONAUTS TO WALK ON THE MOON, AND THE SATURN V ROCKET.**

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Module, the mobility unit used by astronauts to walk on the Moon, and the Saturn V rocket. Jim Chamberlin became a U.S. citizen in 1964. Before he left NASA in 1970, Chamberlin was involved in drawing up early design concepts for the Space Shuttle.

In the 1970s, Chamberlin worked for McDonnell Douglas Astronautics, first participating in its unsuccessful bid for the Space Shuttle contract and later working as technical director for advanced space programs.

Chamberlin won a NASA Exceptional Service Medal for his work on Apollo and posthumously won a NASA Exceptional Engineering Achievement Medal for his work on the Space Shuttle. Chamberlin died in Houston, Texas, on 8 March 1981.

A 1996 Canadian television miniseries on the Avro Arrow featured a character based on Chamberlin, and that year Chamberlin and the Avro Arrow also appeared on a \$20 Canadian coin. In 2001, he was inducted into Canada's Aviation Hall of Fame.

Gilruth's deputy, James C. Elms, called Chamberlin Canada's biggest contribution to NASA. Rose, who helped Chamberlin design Gemini, told an interviewer, "There wouldn't have been a Gemini if it wasn't for Jim Chamberlin."<sup>8</sup>

8 James C. Elms, interview by Martin Collins, 16 September 1988, National Air and Space Museum, box 2, Glennan-Webb-Seamans Project for Research in Space History; James T. Rose, interview by James M. Grimwood, St. Louis, MO, 13 April 1966, transcript available at the National Archives at Fort Worth, NARA.

## FRANCIS ROGALLO AND THE DEVELOPMENT OF PARAWING LANDING CRAFT FOR PROJECT GEMINI

By Gail Langevin

With the goal, set by President Kennedy, of putting astronauts on the Moon and returning them safely to Earth before the end of the 1960s, NASA began researching procedures, vehicles, and propulsion systems for a lunar mission. After many discussions, analyses, and presentations, the Agency chose a modular spacecraft design and a Lunar Orbit Rendezvous (LOR) flight plan. For many in the nascent space agency, rendezvous and docking seemed difficult and dangerous. The popular press presented scenarios of a spacecraft drifting forever in space because the rendezvous maneuver had not gone as planned. Now routine, the rendezvous and docking of two spacecraft in orbit had never been tried when the Apollo mission was being planned.

The Gemini program bridged the technology gap between Mercury and Apollo. The longest Mercury mission, Gordon Cooper's, lasted 34 hours. Apollo missions would last for weeks. The goals of Project Gemini were to increase the time astronauts spent in space, develop rendezvous and docking maneuvers, and perfect reentry and landing techniques for a larger and heavier spacecraft.

To understand and perfect the delicate and precise maneuvers for successful rendezvous and docking, a team led by Arthur Vogeley and Max Kurbjun of Langley's Space Mechanics Division designed a simulator, which was suspended from the ceiling of Langley's aircraft hangar. A full-scale model of the







This time-lapse photo shows Gemini docking with the Agena docking vehicle. (Photo credit: NASA)

Gemini capsule was suspended in a circular gimbaled system that was then suspended on a 210-foot track. Astronauts “flew” the simulator from the Gemini capsule to practice docking techniques. An analog computer provided 6 degrees of motion for the cockpit in the gimbal system.

The Apollo program later adapted the Rendezvous and Docking Simulator so that astronauts could use it to practice the technique. In 1985, the Rendezvous and Docking Simulator was named a National Historic Landmark.

A flexible-wing technology under development by Langley’s Francis Rogallo since the late 1940s was

once considered for application on the Gemini spacecraft. Rogallo’s hobby of building and flying kites evolved into ideas for a flexible-winged vehicle. In 1951, he and his wife Gertrude received a U.S. patent for a V-shaped flexible wing. The couple envisioned that the flexible wing would be used by sport gliders and powered sport aircraft, but at the time no one was interested in developing the technology further. Several years later, while looking at an issue of *Collier’s* magazine that featured artist’s concepts of spaceflight, Rogallo saw a concept for a rigid wing with a shape similar to that of his flexible wing. The artist’s concept inspired him to advocate a flexible parawing concept to use in Gemini and Apollo spacecraft landings.





A Gemini model with a flexible wing attached is shown during a drop model test at Plum Tree Island, Virginia. (Photo credit: NASA)

Parawing models were tested and modified in several Langley tunnels at gradually increasing speeds until the parawing successfully operated at Mach 2. A model was launched from Wallops Flight Facility and successfully deployed at 150,000 feet at Mach 3. After Rogallo presented his findings at conferences, NASA's Marshall Space Flight Center expressed interest in developing the parawing for Saturn rocket recovery and Ryan Aircraft was interested in developing a parawing that could fly a person. Rogallo and his wife granted NASA royalty-free use of the parawing and received a one-time payment for the development of the technology.

As planning for the Gemini and Apollo programs progressed, a different method of slowing the Gemini and Apollo capsules as they returned to Earth was eventually adopted. Companies, however, did pick up the parawing technology into hang gliding and powered sport aircraft.

## NEWS FROM HEADQUARTERS AND THE CENTERS

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### NASA HEADQUARTERS

Washington, DC

#### History Program Office

By Bill Barry

As noted in my “From the Chief” article, there are a lot of positive trends for the history program. While historians and archivists across the Agency continue to face increasing budget pressures, the growing interest in leveraging the lessons of history for a wide variety of purposes provides valuable protection from the budgetary axe. Over the summer, the NASA Communications Coordinating Council (CCC), the Agency's senior decision-making body for strategic direction, planning, and implementation of Agency communications programs, events, and activities,

completed work on a set of prioritized communication events for 2016. In the past, Agency communicators (including the NASA History Program Office) tended to respond to events. The goal of the work this summer was to allow all of us to better plan, prioritize, and coordinate work across NASA. The CCC created a three-tiered system with just five items (like the end of Scott Kelly's one-year mission on the International Space Station [ISS]) getting a Priority 1 effort this fiscal year. These will be events that involve a full-scale planning effort using resources from across NASA to promote all of the major NASA communication themes. Priority 2 and 3 efforts will be significant but may be more focused on a couple of communication themes (Priority 2) or a single theme (Priority 3). The CCC was very open to historical input, and the History Program was able to inject some useful



historical consciousness into the prioritization effort. Five anniversaries were designated as Priority 3 events: the 75th anniversary of Glenn Research Center, the 40th anniversary of the Voyager 2 Uranus flyby, the 50th anniversary of Project Gemini, the 40th anniversary of the Viking probes' landing on Mars, and the 10th anniversary of the Commercial Orbital Transportation Services (COTS) program. The really great news is that there is now an agreed-upon process for strategic planning for communications—and that this process is open to History Program inputs. This is a huge step forward that will make planning for future major anniversaries (for example, the Apollo 11 50th anniversary) much more effective.

This fall, I had the pleasure of participating in the Glenn Research Center Hall of Fame inaugural inductions. My congratulations to Anne Mills and the communications team at Glenn for such a well-organized and meaningful event. With this event, we now have Halls of Fame at three Centers: Ames, Langley, and Glenn. This is a great trend. The march of time makes it all too easy for all of us to forget that our predecessors faced challenges similar to our own. A well-run hall of fame effort not only can inspire us with an appreciation for our heritage and the exploits of those who have gone before, but it can also give us insights into how problems were analyzed and solved in the past. This knowledge has real practical application to our current challenges. Frankly, I hope that the great work done so far (especially the leadership on this shown by our colleagues at Ames) encourages a spread of this great idea.

It wouldn't be a "News from Headquarters" article without saying something about interns. That is because so much of our Web and social media face relies on our interns. This fall, the usual workload we spread across two interns fell to just one: Betsy Reimer. Betsy is a senior at the Nebraska Wesleyan University, majoring in business (with a history minor). She hit the ground running right after Labor Day and found herself writing Web stories, cranking out social media posts, and assisting in our efforts relating to the release

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of the movie *The Martian*. As you read this, the semester will be wrapping up for Betsy and she'll be heading back to Nebraska for her final undergraduate semester. Her quiet focus and dedication will leave some very big shoes for our spring interns to fill.

#### Historical Reference Collection (HRC)

By Jane H. Odom

In the Headquarters Archives, the staff continues to stay busy with reference requests and with the processing (arrangement and description) of collections. During the last quarter, we hosted Headquarters and Goddard Space Flight Center (GSFC) staff as well as researchers from the National Air and Space Museum, the Naval Research Laboratory, Georgetown University, Johns Hopkins University, Princeton University, Texas A&M University, Duquesne University, the Advisory Council on Historic Preservation, the Society for Aviation History, and the University of Flensburg in Germany.

A recently completed archive project that researchers will find of interest is a 4.5-cubic-foot collection on the Keck Observatory in Hawaii. The collection consists of files on the proposed addition of the



Outrigger array to the existing facility, including draft Memoranda of Understanding, draft and final Environmental Impact Statements, public comments, court testimony regarding permits, scientific instrument proposals, reports, and site surveys and proposals. The inclusive dates are 1997–2004.

A number of projects are ongoing. Liz Suckow is reviewing a 42-cubic-foot collection, dated 2001–05, of former Administrator Sean O’Keefe’s official records before its transfer to the Federal Records Center. She has completed about one-third of the collection, making appraisal decisions on what documents have historical value and therefore should be copied and added to existing subject files in the HRC. Colin Fries and Liz recently began preservation projects to re-folder and re-box deteriorating materials in the HRC. Liz is working on the files of former Administrators, and Colin is handling the Robert Sherrod Apollo History Collection.

If you are interested in visiting the Headquarters History Office to conduct research, please contact us at 202-358-0384 or at <http://history.nasa.gov/contact.html> to schedule an appointment. To search our electronic documents collection, see <https://historydms.hq.nasa.gov/>.

Jane is continuing to work closely with Goddard and Langley Research Center (LaRC) officials, with the former to establish a new archival program at the Center and with the latter in preparation for their upcoming building (and archive) renovation. At GSFC, where she is on part-time detail, she is busy examining archive policies and procedures at History Offices across the Agency to discern “best practices” that may be considered for implementation at the new GSFC archives. Jane is focusing specifically on access and collection development policies at this time. Additionally, she is meeting with officials who are supportive of NASA history to garner continuing support and to introduce the new archive program to them.

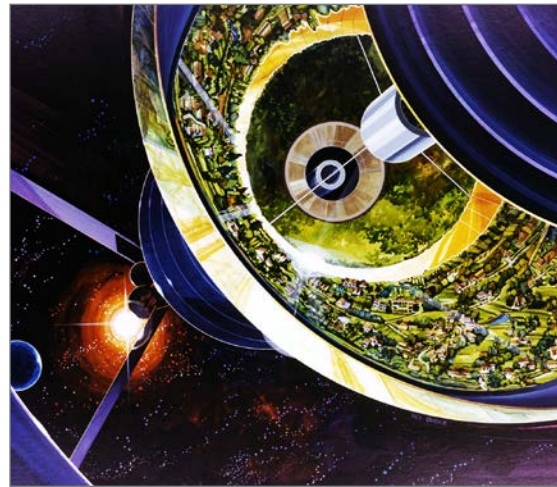
## AMES RESEARCH CENTER (ARC)

Moffett Field, California

### Reference Collection

By April Gage and Danielle Lopez

The archives team is pleased to report that after months of preparation, an exhibition featuring a selection of Rick Guidice’s space settlement paintings from the Artifacts Collection opened this September at New Museum Los Gatos (NUMU). In a stunning visual display, 11 paintings showing detailed exterior and cutaway views of the Bernal Sphere, O’Neil Cylinder, and Stanford Torus designs are suspended inside a room designed to evoke the darkness of outer space. Museumgoers entering the gallery encounter Guidice’s large, brilliantly colored depictions of orbital colonies set against black walls and hear space sounds emanating from hidden speakers. The exhibit, produced by NUMU curator Marianne McGrath and Executive Director Lisa Coscino, has attracted the attention of national media, including National Public Radio’s *Science Friday* program, which is featuring a piece about it.



*Cutaway of Bernal Sphere Habitat, by Rick Guidice, shows the inside of the sphere as viewed from the sunlight "portal." (Image credit: NASA Ames Research Center AC76-1089)*





In addition to meeting increased demand for reference services, archivists April Gage and Danielle K. Lopez have been busy with acquisitions, processing projects, and preservation management efforts. For fiscal year 2015, the archives acquired 16 lots of documents, audiovisual material, artwork, and artifacts that totaled over 65 cubic feet and 15 gigabytes. Among the material acquired this quarter is a collection of nearly 5,000 digital photographs from former biological satellite project manager Michael Skidmore, related to his work on joint U.S.-Russian Cosmos-Bion and Foton missions; a small collection from Dr. Meyya Meyyappan documenting his contributions to nanotechnology program efforts, including the formation of state and national initiatives as well as the NASA Ames Center for Nanotechnology; and a cache of *Astrogram* (the Center's newsletter) issues from a recent retiree. This last group presented an opportunity for Danielle Lopez to bring the Ames *Astrogram* Collection up to date. Danielle incorporated an accrual of eight years of issues in printed and digital form into the collection and updated the finding aid to reflect the new contents and administrative history. Conforming to the Encoded Archival Description (EAD), the updated finding aid can now be found on the Online Archive of California (<http://www.oac.cdlib.org>) and the NASA Ames History Office Web site (<http://history.arc.nasa.gov>).

Also this quarter, the archivists improved conditions in collection storage areas by having reflective, ultraviolet-light-blocking film installed on all the windows in the main storage bay and implemented preventive pest-monitoring measures.

Gage and Lopez are continuing their cross-training experiment, with Danielle working one day in the History Office archives and April working one day in the science directorate each week. April also continues to support Historic Preservation Officer Keith Venter one day a week. Recently, she updated the look and feel of the Historic Preservation Office's Web site and compiled reports for the NASA Environmental Tracking System, in conformance with Executive

Order 13287, "Preserve America." Of special note is the discovery of a Jean McComas painting commissioned by the Works Progress Administration at Moffett Field that Venter and Gage returned to the General Services Administration. The painting, which features the California Mission San Juan Bautista, will be restored, cataloged, and loaned to the Monterey Museum of Art in 2016. Their article about the painting can be found on the office's Web site (<http://historicproperties.arc.nasa.gov/announcements.html>).

Finally, April Gage met with archivists Bob Arrighi from Glenn Research Center (GRC) and Brian Odom from Marshall Space Flight Center (MSFC) during the annual meeting of the Society of American Archivists in Cleveland, Ohio, this summer. Special thanks go to Bob Arrighi, who pulled out all the stops and provided fascinating in-depth tours of GRC.

## GLENN RESEARCH CENTER (GRC)

Cleveland, Ohio

By Anne Mills

Glenn Research Center capped off its celebration of the NACA centennial with a special day to honor our NACA heritage. On 25 September, an NACA retiree reunion and the first-ever GRC Hall of Fame induction ceremony took place.

Fifty retirees who began their careers with the NACA gathered to reconnect and share memories. They heard several speakers, including NASA Chief Historian Bill Barry. Retirees and their guests learned more about our current aeronautics work and Center campus master plan. To keep with the NACA historical theme of the reunion, Bill Barry presented some lesser-known NACA history and guests enjoyed NACA exhibits displayed in the auditorium. Many stories were swapped, and we in the History Office were reminded of how grateful we are for the tremendous resource of our retirees.





This photo shows the NACA retiree reunion.

In the afternoon, current Center employees joined retirees to witness the inaugural induction ceremony of the Glenn Research Center Hall of Fame. This year's class was focused on those whose careers were rooted in the NACA. (Some of the inductions were posthumous.) Six individuals and a group of three were part of the 2015 Class of Inductees. They were as follows:

- Annie Easley, computer programmer and equal opportunity pioneer
- Bruce T. Lundin, former Center Director and advocate for the NACA's evolution as a space agency
- James J. Modarelli, designer of the NASA insignia and outreach program
- I. Irving Pinkel, leader in aerospace safety research
- Edward "Ray" Sharp, first Center Director and champion of early Center advocacy and growth
- Dr. Abraham "Abe" Silverstein, former Center Director and architect of the early space program
- Dr. Robert Deissler, Dr. Simon Ostrach, and Dr. Robert Siegel—"The Giants of Heat Transfer"—world-renowned researchers whose theories transformed the body of knowledge of heat transfer

Full profiles of each inductee can be found online at <http://www.nasa.gov/feature/nasa-glenn-inaugurates-hall-of-fame-to-honor-exemplary-employees>.

The GRC Hall of Fame was established to recognize individuals who had far-reaching influence on the direction and mission of the Center, made fundamental advancements in their field, or served as an



inspiration to employees through their character and embodiment of the NASA spirit.

Glenn will now transition from the NACA centennial observance to the celebration of our own 75th anniversary in 2016. Plenty of history-focused events and messages are planned throughout the year, including an updated Center history book, public open houses, social media content, and the induction of the second class of Hall of Fame inductees.

## LANGLEY RESEARCH CENTER (LARC)

Hampton, Virginia

### Reference Collection

By Mary Gainer Hurst

As part of NASA Langley's efforts to document the Center's history, the archives collection is being inventoried and converted to electronic format available over the Internet. Several interesting collections have recently been added to the Web site.

Langley has been awarded several Collier Trophies over the years. The Robert J. Collier Trophy is administered by the National Aeronautic Association and is awarded annually for the greatest achievement in aeronautics or astronautics in America, with respect to improving the performance, efficiency, and safety of air or space vehicles, the value of which has been thoroughly demonstrated by actual use during the preceding year. Photos of the Collier Trophies held at Langley as well as photo documentation on the associated work is now online.

The personal collection of John "Jack" Reeder (1916–99) has been scanned and is now available to the public. Mr. Reeder's extensive career with NASA and the Agency's predecessor, the NACA, began in 1938 and ended in 1980. Along the way, he captained more than 235 airplanes, 61 helicopters, and 8 vertical takeoff



Pictured is Jack Reeder's first flight, completed in 1930.

and landing aircraft. Reeder was NASA's first helicopter test pilot and was best known for his pioneering work in helicopter and vertical takeoff and landing aerodynamics and handling. He was a member of the team that drafted the original military specifications for the flying qualities of helicopters and was a founding member of the Twirly Birds, an international organization for helicopter pilots. Reeder was highly respected both by his fellow researchers and by the international aerospace community. Neil Armstrong called him "the best pilot I ever knew." Reeder was the recipient of numerous awards, including the Agency medal in 1978 for outstanding leadership, presented for demonstrating the U.S. Micro-wave Landing System (MLS) to the International Civilian Aviation Organization (ICAO). He was inducted into Langley's Hall of Honor in 2015.

Another Hall of Honor inductee, Ira H. Abbott (1906–88), came to Langley Aeronautical Laboratory in 1929 as a junior engineer in the Variable Density Tunnel. His first decade of work focused on airfoil research, and in 1945, he coauthored the NACA report titled "Summary of Airfoil Data," which is still used



by airplane designers today. He was instrumental in establishing programs in high-speed research and, with Eastman Jacobs, designed the Langley Ice Tunnel, which was quickly modified to become the Two-Dimensional Turbulence Tunnel. He also worked with John Stack in the design of the 24-Inch High-Speed Tunnel. In 1948, he transferred to Headquarters, where he served as assistant director of research (aerodynamics), director of advanced research, and finally director of advanced research and technology. Programs he supervised included the X-15, the supersonic transport, the nuclear rocket, and the advanced reentry programs. In an environment very different from today's, Abbott was given a gun at his retirement in 1962.

The collection includes a couple of interviews, photos, and numerous documents from his 32 years of service to the NACA and NASA.

NASA's Viking Project found a place in history when it became the first U.S. mission to land a spacecraft safely on the surface of Mars and return images of the surface. Two identical spacecraft, each consisting of a lander and an orbiter, were built. Each orbiter-lander pair flew together and entered Mars orbit; the landers then separated and descended to the planet's surface. The Viking collection is extensive and is composed of photographs, reports and other NASA publications, newspaper and magazine clippings, documents and photos from reunions, and videos. To date, the numerous boxes and shelved items have been inventoried and combined to form a single collection. The photos have been scanned and organized on the Web page



Ira Abbott is shown here at his 1962 retirement party.

by content. A few interesting discoveries were made when Langley personnel were unpacking boxes. Information on the prototype camera used to photograph the Mars surface was found. The camera had a movable mirror that scanned a segment of the landscape, completing a scan by rotating 360 degrees. Nearly 6,600 images were returned to Earth. The most surprising discovery, though, was finding a Lander Surface Sampler manufactured by Martin Marietta in 1974 and never used. Prior to the scoop's transfer to the exhibits office, it was measured and photographed, and 3D renderings are also now available. This large collection mainly consists of photographs issued through the Office of Public Affairs.

Although the general public tends to associate human spaceflight

with Johnson Space Center in Houston, it actually began at Langley. The Joint Manned Satellite Panel, chaired by Robert Gilruth, was formed in September 1958. Six days after the NACA was absorbed into NASA, plans for the piloted program were approved. Within days, the Space Task Group was established with Gilruth as the director and Charles Donlan as the assistant director. Of the original 45 team members, 35 were from Langley. The 37 engineers were supported by 8 secretaries and computers (female mathematicians). The group quickly grew after President Kennedy's announcement of plans to put men on the Moon, and it eventually transferred to the new Manned Spacecraft Center (now Johnson). This collection includes photos of some of the original members and other early personnel, early documents from the Langley period, oral histories, and the buildings







Alan Shepard is shown with Boy Scouts from Franklin, Virginia, in front of the STG Offices at Langley (now building 580).

at Langley that played major roles in the program. The Lunar Orbiter Project was critical to landing on the Moon. Managed from Langley, all five of the launches were successful—an impressive record both then and now. Pictures obtained from the program assisted researchers in selecting a landing site. The photos were also used to create a 3D landscape of the landing site and were installed at the Lunar Lander Research Facility, now a National Historic Landmark, for astronaut training.

The first Earthrise photograph is recognized by all, and the photograph signed by Langley personnel involved in the project is part of the archives collection. Another piece of artwork in the collection is not widely known. Perth, Australia, became known as the “City of Light” in 1962, when residents joined the city in lighting

up the town as John Glenn passed overhead, an act repeated in 1998 when he again passed over in the Space Shuttle. Glenn’s 1962 mission report indicates, “The lights of the city of Perth, in Western Australia[,] were on and I could see them well.” Australian artist Owen Garde (1919–2008), known for his paintings of the aborigines, captured the view from the water in a painting titled *Spirit of Glenn, Light of Perth*. Although there is no documentation on how Langley obtained the painting, it also has been stored in the archives room. It was recently located, and its background came to light after some research.

The Langley Archives collection is a treasure trove, and there is much more to see. For more on the history of the Center, see <http://crgis.ndc.nasa.gov/historicllarc>.



## STENNIS SPACE CENTER (SSC)

### Stennis Space Center, Mississippi

By Daphne Alford

The year 1961 saw goals set and advancements made in NASA's programs. On 25 May 1961, President John F. Kennedy set a goal to send humans to the Moon and return them safely to Earth before the decade's end. Five months later, on 25 October 1961, NASA announced a decision to establish a national rocket engine test site in Hancock County, Mississippi. Then, about six weeks later, on 7 December 1961, NASA announced a plan to extend the existing human spaceflight program by development of a two-person spacecraft. Eleven days later, NASA's national rocket

engine test site was officially named Mississippi Test Operations (MTO—later to become Stennis Space Center) on 18 December 1961. NASA officially designated its second generation of crewed spacecraft as Gemini on 3 January 1962. Gemini would become a precursor to Apollo as Mercury was to Gemini; it would be known as the bridge between Mercury and Apollo. While the Gemini program was in progress, advances were made in the Saturn V/Apollo three-man Moon exploration program at the then-MTO and the later-renamed Mississippi Test Facility (MTF).

The mission of MTO—a division of NASA's Marshall Space Flight Center—was solely to static-test rocket engines and stages (the S-IC and S-II stages of the Saturn V space vehicle in the Apollo program) used in America's crewed space exploration program.

MTO was still under construction during Gemini's first flight on 8 April 1964. Gemini's next six missions—2, 3, 4, 5, 6, and 7—took place in 1965, the same year MTF entered into its final phase of construction and began making preparations for the arrival of the first test model of Saturn V's second stage, the "T-Bird." Dr. Wernher von Braun had appointed his technical assistant, Jackson Balch, to take over the installation as its second manager in May 1965, when construction and activation of the \$300 million test facility were at their peak.

During the last five Gemini missions in 1966, a historic test at MTF introduced southern Mississippi to the Space Age about five weeks after Gemini 8



MTF's Deputy Manager Henry Auter, right, briefs astronauts John Young (left) and Charles Duke atop the S-1C test stand on 16 September 1969.





Astronauts John Young and Charles Duke boost the morale of MTF's employees on 16 September 1969.

and about three weeks before Gemini 9. It was early morning—just after 7:30—on 23 April 1966. A heavy mist clung to the ground. A voice was heard counting down: 5, 4, 3, 2, 1...ignition! Suddenly, a loud sound—described by some as a “crack”—broke the morning silence. A bright blast of color overpowered the mist—an explosion of flame that lit up the early morning. “We have fire in the bucket!” someone shouted. It was the first test of Saturn V’s rocket booster, S-II-T.

In 1966, astronaut John W. Young made his second Gemini flight, along with crewmember Michael Collins. Young’s distinguished flight experience would

eventually span three NASA programs—two Gemini flights; two Apollo missions; and two Space Shuttle missions, including the maiden voyage of STS-1. Young made several visits to Stennis Space Center, the first in September 1969, when he and astronaut Charles Duke toured the site after Hurricane Camille ravaged the Gulf Coast area. His site visits to Stennis would take place over more than two decades, with his last official visit in July 1990. Young retired from NASA in 2004.



## OTHER AEROSPACE HISTORY NEWS

### NATIONAL AIR AND SPACE MUSEUM (NASM)

By Michael Neufeld

Preparations for the Boeing Milestones of Flight Hall, opening in July 2016, passed a major milestone when Lunar Module 2 (LM-2) was unstacked for the first time in 40 years and brought to Milestones. LM-2 was the second production Lunar Module built by Grumman. Slated for flight testing, LM-2 became a ground-testing and drop-test vehicle after the successful flight of LM-1 in January 1968. In 1970, LM-2 traveled to Japan for “Expo ’70” in Osaka before going on permanent display at the Smithsonian Institution’s Arts and Industries Building and then in the National Air and Space Museum’s new building on the Mall, which opened in July 1976. In full view of the public on the floor of the museum, conservators removed the shiny gold Kapton covering and documented all of the structures inside and out, for both the ascent

and descent stages, before replacing the Kapton with new coverings. The museum also installed in the cabin of the ascent stage a display keyboard, the input device that would have been connected to the Apollo Guidance Computer (still missing from LM-2, which as a test and display vehicle did not need one). LM-2’s Modularized Equipment Stowage Assembly (MESA) was recently opened for the first time in decades. Although the MESA was empty, save for the support structures, brackets, and labels, it offered a fascinating glimpse into what would have been the storage compartment and work space provided to the Apollo astronauts while they were on the Moon. The MESA essentially served as the “trunk” for the lunar landing vehicle: holding tools, sample return containers, and extra batteries, amongst other items. When folded down from the LM’s side, the MESA served double duty as a work surface for the astronauts, with brackets to hold sample return containers while they were being filled. In addition, the MESA carried the Apollo television camera, the lens for which poked out through a specially designed gap in the Kapton blankets. From the ascent stage’s “porch,” an Apollo astronaut could pull a cord that activated the camera, transmitting the astronaut’s descent onto the lunar surface. Once the MESA was opened by the astronauts, they could remove the television camera, unspooling the cords connecting it to the LM, and mount it on the lunar surface using a tripod carried in the MESA.

NASM undertook an experiment to crowdfund a conservation project using Kickstarter. The Kickstarter campaign, “Reboot the Suit,” concluded successfully on 19 August when 9,477 backers pledged \$719,779 to spacesuit conservation for the Neil Armstrong and Alan Shepard spacesuits. Cathy Lewis (Space History) and Lisa Young (Conservation), charged with the care of these suits, contributed considerable content and media interviews for this campaign. The entire team successfully chaperoned the first-ever Smithsonian online crowdfunding campaign and deserves credit for an outstanding entrance into this arena.



Consultants Paul Fjeld and Dave Gianakos shake hands after the successful opening and inspection of LM-2’s MESA in the Boeing Milestones of Flight Hall. (Photo credit: Vicki Portway, NASM/SI)





Carolyn Russo (Aeronautics) received the first copies of her book *Art of the Airport Tower*. The book explores the forms and functions of contemporary and historic air traffic control towers in the United States and around the world with original photography and text captions. Published by Smithsonian Books, the book features 176 pages and over 100 photographs, and it includes a foreword by the National Air Traffic Control Association and introduction by Bob van der Linden. The book will be on sale 28 October 2015, in time for a companion exhibition.

Roger Launius (NASM Associate Director for Collections and Curatorial Affairs) participated in a plenary panel, "Pioneering Space," at the American Institute of Aeronautics and Astronautics (AIAA) Space 2015 conference in Pasadena, California, on 2 September 2015. His speech covered terrestrial analogs relative to exploration and settlement and their applicability to space exploration.

David DeVorkin (Space History) and Robert Smith (University of Alberta) have published *Hubble Cosmos: 25 Years of New Vistas in Space* (National Geographic). It provides historical context for 25 of the greatest moments in the operational lifetime of the Hubble Space Telescope; these moments include discoveries, critical servicing missions, and operational milestones.

David DeVorkin participated in the International Astronomical Union (IAU) General Assembly in Honolulu, Hawaii, from 3 to 14 August 2015. He organized a session with founders of modern Western astronomy on Mauna Kea. He also conducted, in conjunction with Teasel Muir-Harmony of the American Institute of Physics (AIP), over 20 hours of oral history interviews with astronomers and observatory staff who built and have led the major Mauna Kea observatories since the late 1960s. He inspected archival holdings at the Institute for Astronomy at University of Hawaii and will make recommendations for preservation. Finally, he made many contacts regarding artifacts, publishing, and possible future research projects. More recently, he gave an invited talk for the

Virginia Association of Astronomical Societies (VAAS) statewide annual conference held at the National Radio Astronomy Observatory in Charlottesville. His speech was called "The History of Astronomy on the Nation's Mall."

Michael Neufeld (Space History) presented papers at the International Congress of the Historical Sciences in Jinan, China, in August and at the International Astronautical Congress in Jerusalem, Israel, in October. His talk at the former was titled "The Global Proliferation of German Rocket Technology after World War II"; at the latter, "The Invention and Diffusion of Neutral Buoyancy Training." The latter paper was in part based on a longer article, coauthored with John B. Charles of the NASA Human Research Program (based at Johnson Space Center), entitled "Practicing for Space Underwater: Inventing Neutral Buoyancy Training 1963–1968," published in *Endeavour Magazine* (September 2015), which significantly revises the origin story of adopting underwater training for extravehicular activities (EVAs) at NASA.

Several Aeronautics and Space History curators and fellows presented or otherwise participated in the Society for History of Technology conference in Albuquerque, New Mexico, from 7 to 11 October 2015. Among them were Martin Collins, Evelyn Crellin, Hunter Hollins, Brian Jirout, Roger Launius, Russell Lee, Jennifer Levasseur, Patrick McCray, Matthew Shindell, and Margaret Weitekamp. Many former fellows also participated.

NASM recently hired two new curators. Layne Karafantis, who is completing her dissertation at Johns Hopkins University on the history of Cold War control centers, has become the curator for modern military aviation in Aeronautics Division. Matthew Shindell, who has his doctorate in the history of science from the University of California, San Diego, and was a fellow at Harvard, is revising his dissertation on Harold Urey. He has become the curator of lunar and planetary robotic spacecraft in Space History Division.



### National Air and Space Museum Fellowship Program

The application site for the NASM Fellowships Program in aerospace history is now open. See <http://airandspace.si.edu/research/fellowships/application-instructions.cfm>. The application deadline for the Guggenheim Predoctoral and Postdoctoral Fellowships and the Verville Fellowship for midcareer academics, journalists, and professional writers is 15 January 2016 for the 2016–17 academic year. Applications for the Lindbergh Chair in Aerospace History are for the 2017–18 academic year because senior scholars usually require more time to arrange sabbatical leave. Prospective applicants are encouraged to work with curators in the Aeronautics and Space History Departments to refine their applications beforehand. See <http://airandspace.si.edu/research/staff.cfm> for staff biographies and e-mail addresses. Projects that are only partially aerospace-related will also be considered.

Applicants are encouraged to file a parallel application with the Smithsonian Institution Fellowships Program. See <http://www.smithsonianofi.com/fellowship-opportunities/smithsonian-institution-fellowship-program/> and <http://www.smithsonianofi.com/fellowship-opportunities/> for other opportunities. Note that their deadline is 15 December.

## AMERICAN ASTRONAUTICAL SOCIETY (AAS) HISTORY COMMITTEE

Michael Ciancone, Chair

### Ordway Award

The AAS announced the following recipients of the inaugural Ordway Award for Sustained Excellence in Spaceflight History on 29 October 2015 during the von Braun Memorial Symposium in Huntsville, Alabama: Leonard David won for journalism; David Hardy won for art; Mark Wade won the Web site category; and *Quest: The History of Spaceflight* won the publications category.

The Ordway Award is named in memory of Frederick I. Ordway III (1927–2014), human spaceflight advocate and chronicler of the history of rocketry and space travel. The award recognizes exceptional, sustained efforts to inform and educate on spaceflight and its history through one or more media, such as writing, editing, or publishing; preparation and/or presentation of exhibits; or production for distribution through film, television, art, or other nonprint media. The award is managed by the History Committee of the AAS.

### Emme Award

Marc Kaufman is the recipient of the 2014 Emme Award for *Mars Up Close: Inside the Curiosity Mission* (National Geographic). The AAS would also like to recognize the other finalists, listed alphabetically as follows:

- Michael Neufeld, *Milestones of Space: Eleven Iconic Objects from the Smithsonian National Air and Space Museum* (Zenith Press)
- Lynn Sherr, *Sally Ride: America's First Woman in Space* (Simon & Schuster)
- Michael Smith, *Rockets and Revolution: A Cultural History of Early Spaceflight* (University of Nebraska Press)

This award will be presented in March 2016 during the Goddard Memorial Symposium. Additional information on the Emme award and a list of past recipients is located on the AAS Web site at <http://www.astronautical.org/awardslemme>.

### History Series Publications

Univelt has announced the publication of volume 44 in the AAS History Series, *Pioneering American Rocketry: The Reaction Motors, Inc. (RMI) Story, 1941–1972*, by Frank H. Winter and Frederick I. Ordway III.



## RECENT PUBLICATIONS AND ONLINE RESOURCES

### COMMERCIALY PUBLISHED WORKS

By Chris Gamble

*German Rocketeers in the Heart of Dixie: Making Sense of the Nazi Past During the Civil Rights Era*, by Monique Laney (Yale University Press, June 2015). This thought-provoking study by historian Monique Laney focuses on the government-assisted integration of German rocket specialists and their families into a small southern community soon after World War II. Based on oral histories provided by members of the African American and Jewish communities, as well as by the rocketeers' families, coworkers, friends, and neighbors, Laney's book demonstrates how the histories of German Nazism and Jim Crow in the American South intertwine in narratives about the past. This is a critical reassessment of a singular time that links the Cold War, the space race, and the Civil Rights era while addressing important issues of transnational science and technology and asking Americans to consider their country's own history of racism when reflecting on the Nazi past.

*The Hubble Space Telescope: A Universe of New Discovery*, by the Associated Press (AP Editions, February 2015). On 24 April 1990, after years of planning and delays, the Space Shuttle Discovery lifted the Hubble Space Telescope into an orbit 350 miles above Earth. Over the last 25 years, Hubble has opened a new and unimaginably beautiful universe for humankind.

*Seeing Like a Rover: How Robots, Teams, and Images Craft Knowledge of Mars*, by Janet Vertesi (University of Chicago Press, April 2015). In this book, the author takes us behind the scenes to reveal the work that goes into building our knowledge of Mars. Janet Vertesi's account of the inspiringly successful Rover project reveals science in action in a world where digital processing uncovers scientific truths, where images are used to craft consensus, and where team

members develop an uncanny intimacy with the sensory apparatus of a robot that is millions of miles away. Ultimately, Vertesi shows that every image taken by the Mars Rovers is not merely a picture of Mars—it's a portrait of the whole Rover team as well.

*The Drake Equation: Estimating the Prevalence of Extraterrestrial Life Through the Ages*, edited by Douglas A. Vakoch and Matthew F. Dowd (Cambridge University Press, July 2015). In this book, leading scientists and historians explore the Drake Equation, which guides modern astrobiology's search for life beyond Earth. First used in 1961 as the organizing framework for a conference in Green Bank, West Virginia, it uses seven factors to estimate the number of extraterrestrial civilizations in our galaxy. Using the equation primarily as a heuristic device, this engaging text examines the astronomical, biological, and cultural factors that determine the abundance or rarity of life beyond Earth and provides a thematic history of the search for extraterrestrial life. Each factor is explored over two chapters, discussing the preconference thinking and a modern analysis.

*Asteroids: Relics of Ancient Time*, by Michael K. Shepard (Cambridge University Press, April 2015). Where do asteroids come from, and what are they made of? What clues do they hold about the evolution of the solar system? Scientists have cataloged hundreds of thousands of asteroids, and many are thought to contain water and amino acids, the building blocks of life. Michael Shepard tells the fascinating story of their discovery and what they can tell us about the history of our own planet.

*Expanding Universe: Photographs from the Hubble Space Telescope*, with contributions from Owen Edwards, Zoltan Levay, Charles F. Bolden, Jr., and John Mace Grunsfeld (Taschen, May 2015). With investigations into everything from black holes to exoplanets, the



Hubble Telescope has changed not only the face of astronomy, but also our very sense of being in the universe. On the 25th anniversary of the telescope's launch into low-Earth orbit, Taschen celebrates Hubble's most breathtaking deep space images both as scientific feats and as photographic masterpieces. Ultra-high-resolution and taken with almost no background light, these pictures have answered some of the most compelling questions of time and space while also revealing new mysteries, like the strange "dark energy" that permeates the expanding universe.

*New Solutions for the Space Debris Problem*, by Joseph N. Pelton (Springer, May 2015). Addressing a pressing issue in space policy, Pelton explores the new forms of technology that are being developed to actively remove defunct space objects from orbit and analyzes their implications in the existing regime of international space law and public international law.

*Global Navigation Satellite Systems and Their Applications*, by Scott Madry (Springer, May 2015). This book concisely addresses the latest technology, the applications, the regulatory issues, and the strategic implications of satellite navigation systems. Scott Madry assesses the strengths and weaknesses of satellite navigation networks and reviews all the various national systems now being deployed and the motivation behind the proliferation of these systems.

*Moonwatch Only: The Ultimate Omega Speedmaster Guide*, by Grégoire Rossier and Anthony Marquié (Watchprint.com SARL, May 2015). Initially designed for automobile racing teams and engineers, the Omega Speedmaster embarked on a very different trajectory when NASA chose it in 1965 to accompany astronauts heading for the Moon. Its involvement in the space adventure has propelled the Moonwatch to the top of the list of celebrated timepieces.

*Tupolev Tu-144: The Soviet Supersonic Airliner*, by Yefim Gordon, Dmitriy Komissarov, and Vladimir Rigmant (Schiffer Publishing, Ltd., May 2015).

Developed in the 1960s and '70s, the Tu-144 was the Soviet Union's only practical venture into supersonic commercial aviation. Though its career was brief, it was a major technological achievement for the Soviet aircraft industry. The book provides in-depth coverage of the "Concordski," including projected versions, the Tu-144's production and service history, and a comparison with the Concorde. The book describes the Tu-144's versions (including the Tu-144LL research aircraft developed under a Russian-U.S. program) and touches on the projected military derivatives.

*The Wright Brothers*, by David McCullough (Simon & Schuster, May 2015). Two-time Pulitzer Prize winner David McCullough tells the dramatic story-behind-the-story of Wilbur and Orville Wright. In this book, the author draws on the immense riches of the Wright Papers, including private diaries, notebooks, scrapbooks, and more than one thousand letters, to tell the human side of the Wright brothers' story, including the little-known contributions of their sister, Katharine, without whom things might well have gone differently for them.

*We Could Not Fail: The First African Americans in the Space Program*, by Richard Paul and Steven Moss (University of Texas Press, May 2015). Profiling 10 pioneer African American space workers, including technicians, mathematicians, engineers, and an astronaut candidate, this book tells an inspiring, largely unknown story of how the space program served as a launching pad for a more integrated America.

*The Ordinary Spaceman: From Boyhood Dreams to Astronaut*, by Clayton C. Anderson (University of Nebraska Press, June 2015). This book puts you in the flight suit of astronaut Clayton Anderson and takes you on the journey of this small-town boy from Nebraska who spent 167 days living and working on the International Space Station, including more than 40 hours of spacewalks. Having applied to NASA 15 times over 15 years to become an astronaut before his ultimate selection, Anderson offers a unique





perspective on his life as a veteran space flier, one characterized by humility and perseverance.

*Space Safety Is No Accident—The 7th IAASS Conference*, edited by Tommaso Sgobba and Isabelle Rongier (Springer, June 2015). The 7th International Association for the Advancement of Space Safety (IAASS) conference was an invitation to reflect and exchange information on a number of topics in space safety and sustainability of national and international interest. The once exclusive “club” of nations with autonomous suborbital and orbital space access capabilities is becoming crowded with fresh and ambitious new entrants. New commercial spaceports are starting operations, and others are being built.

*Sacramento’s Moon Rocket*, by Alan Lawrie (Arcadia Publishing, August 2015). On 16 July 1969, a Saturn V rocket launched American astronauts aboard Apollo 11 toward the surface of the Moon, where Neil Armstrong would take his famous first steps and fulfill President John F. Kennedy’s goal of a successful lunar landing by the end of the decade. This event marks one of the greatest achievements in human history and is in large part due to the years of rocket testing that took place at the Douglas Aircraft Company’s Sacramento testing facility (SACTO). The SACTO facility played one of the most important roles in the success of the Apollo 11 lunar mission and is where the Saturn rocket’s S-IVB stage was developed and tested—making this historic accomplishment possible.

*Spaceshots and Snapshots of Projects Mercury and Gemini: A Rare Photographic History*, by John Bisney and J. L. Pickering (University of New Mexico Press, June 2015). This book tells the story of the people and events of Projects Mercury and Gemini with hundreds of unpublished and rare photographs—both color and black-and-white. Unlike other publications, which illustrate the space race with well-known and easily accessible images, this history draws from the authors’ private library of over 100,000 (and growing) high-quality photos of the early space program.

Collected over a lifetime from public and private sources—including NASA archives, fellow collectors, retired NASA and news photographers, and auction houses—the images document American space missions of the Cold War era. Devoting a chapter to each flight, the authors also include detailed descriptions.

*Moonshots and Snapshots of Project Apollo: A Rare Photographic History*, by John Bisney and J. L. Pickering (University of New Mexico Press, September 2015). In this companion volume to John Bisney and J. L. Pickering’s extraordinary book of rare photographs from the Mercury and Gemini missions, the authors now present the rest of the golden age of U.S. piloted spaceflight with a photographic history of Project Apollo. Beginning in 1967, *Moonshots and Snapshots of Project Apollo* chronicles the program’s 12 missions and its 2 follow-ons, Skylab and the Apollo-Soyuz Test Project. The authors draw from rarely seen NASA, industry, and news media images, taking readers to the Moon, on months-long odysseys above Earth, and finally on the first international crewed spaceflight in 1975.

*Soviet Space Mythologies: Public Images, Private Memories, and the Making of a Cultural Identity*, by Slava Gerovitch (University of Pittsburgh Press, May 2015). The book explores the history of the Soviet human space program within a political and cultural context, giving particular attention to the two professional groups—space engineers and cosmonauts—who secretly built and publicly represented the program. Drawing on recent scholarship on memory and identity formation, this book shows how both the myths of Soviet official history and privately circulating countermyths have served as instruments of collective memory and professional identity. These practices shaped the evolving cultural image of the Space Age in the popular Soviet imagination.

*Celebrating Half a Century in Space—Recollections of the 2014 Anniversary Events*, by Mélanie Legru, Piero Messina, Kai-Uwe Schrogl, and Nathalie Tinjod



(Beauchesne Editeur, June 2015). The European Space Agency (ESA) convened a series of events whose purpose was to celebrate, with the whole European space sector, 50 years of successful cooperation. Industrial success and scientific achievements are two key indicators of the benefits of European space cooperation and of the ESA model that embodies it. Specific international, high-level events were organized to focus on each of these two domains. Events at ESA sites, with high-level national political representatives and local partners, national space days, and exhibitions were also planned.

*U.S. Weather Satellites: Background, Program Challenges and Potential Data Gaps*, edited by Louise O. Berkan (Nova Science Publishers, June 2015). The National Oceanic and Atmospheric Administration (NOAA), with the aid of NASA, is procuring the next generation of geostationary weather satellites. This book assesses progress on program schedule, cost, and functionality; assesses efforts to identify and address issues discovered during integration and testing; and evaluates the likelihood of a gap in satellite coverage and actions to prevent or mitigate such a gap. This book also evaluates NOAA's progress on the Joint Polar Satellite System (JPSS) satellite program with respect to cost, schedule, and mitigation of key risks; identifies the benefits and challenges of alternatives for polar satellite gap mitigation; and assesses NOAA's efforts to establish and implement a comprehensive contingency plan for potential gaps in polar satellite data.

*Go for Orbit: One of America's First Female Astronauts Finds Her Space*, by Rhea Seddon (Your Space Press, June 2015). This book is the autobiography of a NASA astronaut who flew aboard three Space Shuttle missions (STS-51D, STS-40, and STS-58).

*Humans in Space: The Psychological Hurdles*, by Nick Kanas (Springer-Praxis, June 2015). Using anecdotal reports from astronauts and cosmonauts, as well as the results from studies conducted in space analog environments on Earth and in the actual space

environment, this book broadly reviews the various psychosocial issues that affect space travelers. Unlike other books that are more technical in format, this text is targeted for the general public. With the advent of space tourism and the increasing involvement of private enterprise in space, there is now a need to explore the impact of space missions on the human psyche and on the interpersonal relationships of the crewmembers.

*Pioneering American Rocketry: The Reaction Motors, Inc. (RMI) Story, 1941–1972*, by Frank H. Winter and Frederick I. Ordway III (Univelt, September 2015). This book is volume 44 of the AAS History Series.

*Skylab 1 & 2: The NASA Mission Reports*, edited by Dwight Steven Boniecki (Collector's Guide Publishing, Inc., September 2015). Taking full advantage of the massive lifting power of the Saturn V launch vehicle, the engineers in Huntsville and Houston turned the shell of a Saturn IVB into the largest pressurized and habitable vehicle ever to fly into space. The first crew to board Skylab, veteran Moonwalker Pete Conrad and his companions Joe Kerwin and Paul Weitz, suddenly found themselves having to unlearn their mission plans and hastily put together an audacious rescue to save the multimillion-dollar project. The mission of Skylab 2 was the forerunner of all of NASA's subsequent orbital repair missions. Conrad, Kerwin, and Weitz proved to the world that astronauts could conduct long and ambitious repairs in space and go on to fulfill many of their original scientific objectives. They also established a new record for the longest time in space for a U.S. space mission, remaining in orbit for almost a month. This is the story of the beginning of the colonization of space.

*Nutrition Physiology and Metabolism in Spaceflight and Analog Studies*, by Martina Heer, Jens Titze, Scott M. Smith, and Natalie Bäcker, Springer Briefs in Space Life Sciences (Springer, July 2015). This book provides an overview of microgravity-induced changes in human metabolism, muscle, and bone, as well



as the cardiovascular system, and discusses in detail the nutrient uptake required during spaceflight to counteract these adaptive mechanisms and ensure an improved physical constitution upon returning to Earth.

*Harnessing the Sky: Frederick “Trap” Trapnell, the U.S. Navy’s Aviation Pioneer, 1923–1952*, by Frederick M. Trapnell, Jr., and Dana Trapnell Tibbits (Naval Institute Press, July 2015). This biography fills an important void in the history of flight testing and explores the legacy of the man who has been called the godfather of current naval aviation. Over the course of two decades (1930–50), Frederick Trapnell tested virtually every naval aircraft prototype and became the first U.S. Navy pilot to fly a jet. He pioneered the philosophy and perfected many of the methods of the engineering test pilot, demanding aircraft that pushed the performance envelope up to the limits of safety in all flight regimes. He insisted on comprehensive testing of each airplane with all of its equipment in all missions, conditions, and maneuvers it would face in wartime fleet operations. These innovations advanced the tactical capability of naval air power, have kept it at the forefront of modern aviation, and stand as an enduring legacy to the man who is regarded as the foremost test pilot in a century of naval aviation.

*The Lunar Atmosphere and Dust Environment Explorer Mission (LADEE)*, edited by Richard C. Elphic and Christopher Russell (Springer, August 2015). This book presents a comprehensive overview of the Lunar Atmosphere and Dust Environment Explorer Mission (LADEE), the first mission devoted to the study of the lunar exosphere and its dust phenomena. This volume contains five articles describing the mission and its instruments that were originally published in *Space Science Reviews*, volume 185, nos. 1–4, 2014.

*NASA Voyager 1 & 2 Owners’ Workshop Manual: 1977 Onwards*, by Christopher Riley (Haynes Publishing, August 2015). In 1977, NASA sent two probes—Voyager 1 and Voyager 2—to study the planets in the

outer solar system, including Jupiter, Saturn, Uranus, and Neptune, and dwarf planet Pluto. This manual provides a fascinating insight into the Voyager program—illustrated with a wealth of photographs and technical illustrations—and presents a guide to the golden discs attached to each probe, explaining how these time capsules of human culture were created and how an alien race might one day decode them to read these messages from Earth.

*Planetary Vistas—The Landscapes of Other Worlds*, by Paul Murdin (Springer, June 2015). *Planetary Vistas* is part science text and part travel book; it takes armchair explorers across the planets and moons of the solar system. Recent advances in space exploration imaging have allowed us to view landscapes that we could never see before, and this book collects some of the greatest vistas of Mars, Titan, Io, and more in their full glory, with background information to put into context the foreign landforms of our solar system.

*Defining the Limits of Outer Space for Regulatory Purposes*, by Olavo de Oliveira Bittencourt Neto (Springer, May 2015). With different countries ascribing to different theories of airspace and outer space law, Dr. Olavo de Oliveira Bittencourt Neto proposes in this reassessment of the international law related to the extension of state territories vertically. Taking into consideration the vast number of proposals offered by scholars and diplomatic delegations on this subject matter, as well as the principles of comparative law, the author proposes a compromise to allow for peaceful development as the only way forward.

*China’s Space Programs: Progress and Military Implications*, edited by Larry Rogers (Nova Science Publishers, Inc., August 2015). As China evolves, its rise as a world power is echoed in its rise as a space power. This book examines China’s space programs and how they advance China’s national security, economic, and diplomatic interests. The book also discusses China’s progress in space technologies and examines the implications it has for the United States.



Included is a review of the evolution of China's military thinking and the changed role of space within that context. The book examines China's space capabilities and development before discussing its concepts for military space operations and concludes with future Chinese space operations.

*Space-Based Solar Power: Feasible Idea or Folly?*, edited by Carl P. Thompson (Nova Science Publishers, Inc., August 2015). Space-based solar power (SBSP) is a concept for a revolutionary energy system. It involves placing into orbit stupendously large orbital power plants—kilometers across—that collect the Sun's raw energy. In theory, SBSP could scale to meet all of humanity's energy needs, providing virtually unlimited green, renewable power to an energy-hungry world. With growing international awareness of energy security challenges, the promise of space-based solar power for clean and unlimited energy for all humankind is certainly appealing. While significant progress continues in the enabling technologies of such systems, is there compelling evidence that space-based solar power systems will provide the best energy solution? The practical application of this method of power generation requires economical and operational considerations. This book examines the current progress of space-based power in the areas of technology, economics, and operations.

*Galina Balashova: Architect of the Soviet Space Programme*, by Philipp Meuser (DOM Publishers, September 2015). This monograph on the work of the Russian architect Galina Balashova presents a unique collection of designs for Soviet cosmonautics. These include plans and engineering drawings for Soyuz capsules and the space stations Salyut and Mir. Balashova acted as a consultant to the Buran program, the Soviet counterpart to the American Space Shuttle. Striving for harmony and beauty, the architect strikes an emotional chord in the high-tech world of carrier rockets, laboratories, and survival equipment. It is therefore due to Balashova's talent that a unique chapter has been added to Soviet architectural history: Architecture for

Cosmonautics. Her exceptional achievements, including designs for medals and emblems, are still scarcely known today—even in Russia.

*Rocket Ranch: The Nuts and Bolts of the Apollo Moon Program at Kennedy Space Center*, by Jonathan H. Ward (Springer-Praxis, June 2015). The author takes the reader deep into the facilities at Kennedy Space Center to describe NASA's first computer systems used for spacecraft and rocket checkout and explain how tests and launches proceeded. Descriptions of early operations include a harrowing account of the heroic efforts of pad workers during the Apollo 1 fire. A companion to the author's book *Countdown to a Moon Launch: Preparing Apollo for Its Historic Journey*, *Rocket Ranch* explores every facet of the facilities that served as the base for the Apollo/Saturn missions. Hundreds of illustrations complement the firsthand accounts of more than 70 Apollo program managers and engineers.

*Countdown to a Moon Launch: Preparing Apollo for Its Historic Journey*, by Jonathan H. Ward (Springer-Praxis, July 2015). This book provides an in-depth look at the carefully choreographed workflow for an Apollo mission at Kennedy Space Center. Using the Apollo 11 mission as an example, readers will learn what went on day by day to transform partially completed stages and crates of parts into a ready-to-fly Saturn V. Firsthand accounts of launch pad accidents, near misses, suspected sabotage, and last-minute changes to hardware are told by more than 70 NASA employees and contractors. A companion to *Rocket Ranch*, this book includes many diagrams and photographs, some never before published, to illustrate all aspects of the process. NASA's groundbreaking use of computers for testing and advanced management techniques are also covered in detail.

*The Making of Stanley Kubrick's "2001: A Space Odyssey"*, by Piers Bizony (Taschen, September 2015). Get closer than ever to the movie that changed the movies. This behind-the-scenes spectacular of *2001:*





*A Space Odyssey* sheds light on the lead actors, senior production designers, and special-effects experts, who, together with Kubrick himself, revolutionized science fiction and the art of cinema. This exhaustive visual record includes on- and off-set photographs, preproduction paintings, conceptual designs, and publicity materials from the Kubrick archives. With numerous foldouts, these dazzling images offer insight both into Kubrick's meticulous directorial methods and into the mysteries and magnetism of a film at once vast in scope and intricate in its human interest.

*Friendship 7: The Epic Orbital Flight of John H. Glenn, Jr.*, by Colin Burgess (Springer-Praxis, April 2015). In this spellbinding account of a historic but troubled orbital mission, noted space historian Colin Burgess takes us back to an electrifying time in American history, when intrepid pioneers were launched atop notoriously unreliable rockets at the very dawn of human space exploration. The book's tension-filled narrative faithfully unfolds through contemporary reports and the personal recollections of astronaut John Glenn, along with those closest to the Friendship 7 story. This book reveals previously unknown facts behind one of America's most ambitious and memorable pioneering space missions.

*When China Goes to the Moon*, by Marco Aliberti (Springer, July 2015). This book is about China's ambitions in its most complex and internationally visible space endeavor and provides a comprehensive reflection on China's strategic direction and objectives in space, particularly including those set forth in its human spaceflight program. Marco Aliberti analyzes the key domestic and external factors affecting the country's presumed crewed lunar ambitions.

*Human Space Exploration: Early Assessments of NASA's Next Steps*, edited by Darrel Gibbs (Nova Science Publishers, Inc., April 2015). NASA is undertaking a trio of closely related programs to continue human space exploration beyond low-Earth orbit: the Space Launch System (SLS) vehicle; the Orion

capsule, which will launch atop the SLS and carry astronauts; and the supporting ground systems. As a whole, the efforts represent NASA's largest exploration investment over the next decade to demonstrate initial capabilities. This book examines the scope of NASA's preliminary cost estimates for the three programs. It also examines the SLS program's progress toward and risks for its first test flight in 2017.

*The History Program Office wishes to thank volunteer Chris Gamble, who compiles this section for us every quarter. Please note that the descriptions have been derived by Chris from promotional material and do not represent an endorsement by NASA.*



## UPCOMING MEETINGS

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The American Institute of Aeronautics and Astronautics will hold SciTech 2016 **4–8 January 2016** in San Diego, California. Visit <https://www.aiaa-scitech.org/> for details.

The American Astronautical Society will hold its 54th Robert H. Goddard Memorial Symposium **8–10 March 2016** in Greenbelt, Maryland. Visit <http://www.astronautical.org/goddard> for details.

The National Council on Public History and the Society for History in the Federal Government will host a joint conference **16–19 March 2016** in Baltimore, Maryland. Visit <http://ncph.org/cms/conferences/2016-annual-meeting/> for details.

The International Astronautical Federation will hold its annual Spring Meetings **22–24 March 2016** in Paris. Visit <http://www.iafastro.org/events/iaf-spring-meetings/spring-meetings-2016/> for details.

The Organization of American Historians will host its annual meeting **7–10 April 2016** in Providence, Rhode Island. Visit <http://www.oah.org/meetings-events/2016/> for details.

The American Institute of Aeronautics and Astronautics will host the 2016 Aviation and Aeronautics Forum and Exposition **13–17 June 2016** in Washington, DC. Visit <http://www.aiaa-aviation.org/FutureEvents/> for details.

The Society for the History of Technology will host its annual meeting in Singapore **22–26 June 2016**. Visit [http://www.historyoftechnology.org/call\\_for\\_papers/index.html](http://www.historyoftechnology.org/call_for_papers/index.html) for more information on the call for papers and details on the conference.

The Society for Historians of American Foreign Relations will hold its 2016 annual meeting **23–25 June 2016**. Visit <https://shafr.org/conferences/annual/2016-annual-meeting> for more information on the call for papers and the conference.

## OBITUARIES

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### GEORGE MUELLER, LEADER OF EARLY HUMAN SPACEFLIGHT

**D**r. George E. Mueller, the leader of NASA's human spaceflight programs in the tumultuous 1960s, died on Monday, 12 October 2015, after a short illness. Mueller effectively created the Office of Manned Space Flight at NASA Headquarters (now the Human Operations and Exploration Mission Directorate) and headed it from 1963 to 1969. He was responsible for overseeing the completion of Project Apollo and beginning the development of the Skylab and Space Shuttle projects. Mueller introduced a remarkable series of management changes within the

Agency during his six years of service at NASA, a time when strong leadership and direction were critical to achieving success on a set of extraordinary goals.

Originally sworn in as the Deputy Associate Administrator for Manned Space Flight on 1 September 1963, he quickly pushed through a reorganization that changed his title to Associate Administrator for Manned Space Flight, a position he held until leaving the Agency in 1969. In this new management structure, Mueller was not only in charge of the Gemini, Apollo, and future human spaceflight programs, but he directly supervised the three NASA Centers devoted to human spaceflight: Marshall Space





George E. Mueller is sworn in as Associate Administrator for the Office of Manned Space Flight for NASA by Hugh Dryden, NASA's Deputy Administrator. The ceremony took place at NASA Headquarters in Washington, DC. Mueller served as Associate Administrator from 1963 to 1969; he was responsible for overseeing the completion of Project Apollo and for beginning the development of the Space Shuttle. (Photo credit: NASA)

Flight Center, the Manned Spacecraft Center (now Johnson Space Center), and Kennedy Space Center. At the time, all three of these Centers were undergoing a massive growth in facilities and staff. Mueller, a no-nonsense, forward-thinking leader, introduced management concepts and practices that not only ensured the achievement of landing on the Moon by the end of the decade but also had a long-lasting impact on NASA.

In his six years at NASA, Mueller's impacts were far-reaching, from accelerating Project Gemini to pushing forward initial designs for Skylab and laying the groundwork for the Space Shuttle. However, he is probably best known for his daring solutions to the

schedule problems in the Apollo program. Knowing that the plans he had inherited in 1963 would never succeed in achieving the presidential goal of a Moon mission by the end of the decade, Mueller overhauled the management system to facilitate concurrent development of the many needed systems. Most importantly, and most controversially, Mueller instituted the "all-up" testing approach. This approach was a radical change to the building-block approach then in use, which was vigorously defended by Wernher von Braun and his team developing the Saturn V rocket. But Mueller insisted that testing each stage of the Saturn rocket before adding the next was not necessary and would be impossible to complete by the end of the decade. Mueller's logic carried the day, and his calculated risk proved critical in achieving President Kennedy's goal of landing on the Moon before the end of the decade.

Mueller was born in St. Louis, Missouri, on 16 July 1918. Trained as an electrical engineer, with a B.S. from the Missouri School of Mines (1939) and an M.S. from Purdue (1940), Mueller served as a researcher at Bell Telephone Laboratories during World War II. After the war, he taught at Ohio State University while completing his Ph.D. in physics (1951). By the mid-1950s, he was consulting with major aerospace companies and quickly rose to management positions of space programs at the Space Technology Laboratories (STL), a division of TRW, Inc. He was serving as vice president of research and development for STL when NASA hired him in 1963. In 1969, after the success of Apollo 11, Mueller returned to industry, where he had a long and distinguished career. He was also active in, and served as a leader in, a number of professional societies. His many awards and honors include three NASA Distinguished Service Medals and the National Medal of Science.

Mueller is survived by his wife, Darla; his son, Bill Schwartzman; and his three daughters, Karen Hyvonen, Jean Porter, and Wendy Schwartzman, and also by his 13 grandchildren and 13 great-grandchildren.



## ROBERT FARQUHAR, PLANETARY SCIENCE PIONEER

Robert Farquhar, a visionary and expert in planetary exploration, spacecraft design, and celestial navigation at NASA; the Johns Hopkins Applied Physics Laboratory (APL) in Laurel, Maryland; and KinetX, Inc., in Tempe, Arizona, died from complications following a respiratory illness at his home in Burke, Virginia, on Sunday, 18 October. He was 83.

A 50-year veteran of deep space missions and often referred to as a genius in his field, Farquhar made pivotal contributions to deep space missions to asteroids and comets.

In 1960, he joined NASA's Marshall Space Flight Center in Huntsville, Alabama, where he participated

in the design of the Saturn V launch vehicle. From 1961 to 1964, he worked at the Lockheed Missiles and Space Company in California, perfecting orbital dynamics and control of satellites while also assisting in the preparation of an interplanetary flight handbook for NASA.

From 1969 to 1990, he was employed at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and NASA Headquarters in Washington, DC. He held a number of positions that involved studying post-Apollo lunar exploration concepts and the lunar shuttle transportation system; he also held key management positions for numerous satellite projects.

At APL from 1990 to 2007, he conceived and was the flight director for the Near Earth Asteroid Rendezvous (NEAR) mission to the asteroid named Eros. Launched in 1996, NEAR (later called NEAR-Shoemaker) was the first spacecraft to orbit and perform an in-depth investigation of an asteroid and then safely land on it, which it did in February 2001. Thanks to Farquhar's efforts, the mission answered many fundamental questions about the nature and origin of asteroids.

Also while at APL, he helped lead the Comet Nucleus Tour (CONTOUR) mission; the MErcury Surface, Space ENvironment, GEOchemistry, and Ranging (MESSENGER) mission to the planet Mercury; and the New Horizons mission to the dwarf planet Pluto and its moon, Charon.

Also among Farquhar's career highlights was the International Sun-Earth Explorer-3/International Cometary Explorer (ISEE-3/ICE) mission. As the mission's flight director, Farquhar led the crew that placed ISEE-3 in a "halo orbit" (a term that he had coined in his 1969 dissertation at Stanford University) around the gravitational balancing or libration point between the Sun and Earth. He designed the quintuple lunar flyby trajectory that sent the spacecraft through the tail of 21P/Giacobini-Zinner in September 1985. Farquhar invented this trajectory, which allowed the United States to become the first nation to encounter



Dr. James L. Green, Director of Planetary Science at NASA, right, speaks with Dr. Robert Farquhar, an executive for space exploration at KinetX, Inc., during a symposium commemorating a quarter century of comet discoveries on Friday, 10 September 2010, in the Knight Studio at the Newseum in Washington, DC. The International Sun-Earth Explorer-3 (ISEE-3) spacecraft flew past the comet 21P/Giacobini-Zinner on 11 September 1985, an accomplishment that established a foundation of discoveries that continue today. (Photo credit: NASA/Paul E. Alers)





a comet. Farquhar's knowledge of halo orbits was critical in calculating the trajectory for the successful mission.

Born in September 1932, Farquhar attended elementary and high school in Chicago. As a child, he became interested in aviation, often reading about it and building model airplanes of his own design.

Farquhar attended college briefly before joining the Army in April 1951. He completed basic training at Fort Knox and jump training at Fort Benning before being deployed to Fort Bragg as part of the 82nd Airborne Division.

In late 1952, Farquhar requested to be transferred to a division that was taking part in the Korean War. He was deployed to the 187th Infantry Regiment stationed in Japan. After some training in Japan, Farquhar was invited to attend clerk typist school and for some time served as the company clerk, writing reports. One day, after some North Korean prisoners were released, Farquhar's division was moved to Kimpo Airfield for one month. There, he was on the front lines until the ceasefire.

Returning to the United States, Farquhar attended the University of Illinois Navy Pier campus before moving to the main campus at Champaign in 1957. There, he decided on a career in spaceflight, finishing his bachelor's degree in aeronautical engineering in 1959. He stayed at the University of Illinois for graduate school before applying and being accepted for a position at the University of California, Los Angeles.

During the summer after he graduated, Farquhar worked at the RAND Corporation in California. He completed his engineering master's degree at the University of California and attended Stanford



**A 50-YEAR VETERAN OF DEEP SPACE MISSIONS AND OFTEN REFERRED TO AS A GENIUS IN HIS FIELD, FARQUHAR MADE PIVOTAL CONTRIBUTIONS TO DEEP SPACE MISSIONS TO ASTEROIDS AND COMETS.**



University for his doctorate in astronautics, which he obtained in 1968. He worked with John Breakwell to develop halo orbit and other libration point trajectory concepts and applications.

Farquhar received numerous honors and awards from the military, NASA, and a variety of space organizations and associations. Farquhar wrote the book *Fifty Years on the Space Frontier: Halo Orbits, Comets, Asteroids, and More*,

voted the best book of the year by the International Academy of Astronautics. He also wrote, cowrote, or contributed to over 200 other publications.

He is survived by his wife, Irina; his stepdaughter, Anya; and a host of other relatives.

## FREDERICK C. DURANT III, SPACEFLIGHT PIONEER

*"I consider myself lucky to have lived during the countdown to space flight, to have seen the realization of the dreams of industry pioneers."<sup>1</sup>*

Aviation pioneer Fred Durant passed away on 21 October, two months shy of his 99th birthday. Durant had a long and industrious career serving the country in the fields of aeronautics and astronautics. Durant was part of the group that put the first American satellite into orbit. Led by Wernher von Braun, the team developed a concept called Project Orbiter, which later served as the foundation of the

<sup>1</sup> Frederick C. Durant III, quoted on the Haverford School's Web site, [http://www.haverford.org/alumni/spotlights/Fred\\_Durant/index.aspx](http://www.haverford.org/alumni/spotlights/Fred_Durant/index.aspx) (accessed 6 November 2015).



successful Explorer 1 mission that launched on 31 January 1958. A 1939 engineering graduate of Lehigh University, Durant served as a naval aviator during World War II and emerged as one of the nation's leading postwar authorities on rocketry and spaceflight. He was a fellow of the AIAA and served as president of both the American Rocket Society (1953) and the International Astronautical Federation (1953–56). Durant began his tenure at the Smithsonian Institution's National Air Museum (now the Air and Space Museum) in 1964 and was charged with bringing the museum into the Space Age, a task that he undertook with great delight. He was named assistant to the Director for Astronautics the next year and remained with the museum until his retirement in 1980. While at the Smithsonian, he also served as the aerospace historian for the *Encyclopaedia Britannica*.



This still photograph was taken during a 1958 television broadcast lecture on rockets by Frederick C. Durant III (right). (Photo credit: NASM)

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## IMAGE IN NASA HISTORY

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This time-exposure photograph shows the Gemini 10 spacecraft, which launched from Complex 19 on 18 July 1966 with astronauts John Young and Michael Collins on board. (Photo credit: NASA)



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