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From the Chief Historian

With the end of the Space Shuttle flights in 2011, we thought we'd try something new for *News and Notes* this time—a thematic approach focusing on the Shuttle Program. In addition to much of our usual content, you'll find articles inside from the Centers with perspectives on their roles in the Shuttle Program and its conclusion, information on historic preservation efforts related to the Shuttle, some great Shuttle-related pictures, and even a cartoon.

For the cartoon, we have to thank Tim Rickard, creator of "Brewster Rockit: Space Guy!," and the nice folks at Tribune Media Services for giving us permission to reprint the Sunday, 3 July 2011, edition of "Brewster Rockit." (You'll find it on page 9.) For much of America and the world, the Shuttle has become synonymous with human spaceflight. You can find depictions of the Shuttle throughout our culture—in movies, on television, on license plates, and even in comics. In many ways, the Shuttle has become a sort of visual shorthand for space exploration and the future. It is easy to see why. The Shuttle was an amazing vehicle. The people who designed, operated, and maintained it have made history that we'll be writing about for decades. So, before the remaining orbiters fly off to their new homes, take a few minutes with us and celebrate the Shuttle and, most importantly, the people behind it.

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Perspectives on the Shuttle Program

For this special issue, our contributors focused on their Centers' roles during the Space Shuttle Program. These varying articles examine the early beginnings as well as the end of this epic era and also illustrate the diversity of work at the NASA Centers.

Ames Research Center (ARC)

The NASA Ames community reflected upon its many contributions to the Space Shuttle Program at a Center-wide Shuttle Family Reunion on 9 August 2011. The highlight of the day was an award ceremony, attended by Ames staff and retirees, introduced by Jack Boyd, and with a program prepared by Sheila Johnson and Glenn Bugos. Jim Arnold spoke on his work in thermal protection systems, John Allmen on Ames's key work in the Return to Flight effort, Walt Brooks on the Columbia supercomputer to support computational fluid dynamics, Tom Alderete on pilot familiarization and cockpit simulation in the Vertical Motion Simulator, and Ken Souza on how Ames biologists used the Shuttle to advance fundamental space life science. Ten plaques were placed in hallways around the Center to recognize the people and facilities dedicated to the most important parts of the Shuttle Program, which included work with the lifting body concept and the Columbia Accident Investigation Board, as well as arc jets and reentry facilities, wind tunnel development testing, Shuttle orbiter landing site management, biomedical research and advanced life

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From the Chief Historian (continued)

Godspeed,

Bill

William P. Barry
Chief Historian

P.S.: For those of you who were wondering, we had a great Annual Program Review and Training at Glenn Research Center (GRC) in early November. My thanks to our wonderful hosts, who demonstrated Midwestern hospitality at its best. You'll find a summary of the event on page 21.

Perspectives on the Shuttle Program (continued)

Bonnie Dalton accepted a plaque on behalf of those Ames scientists and engineers who supported space life science experimentation aboard the Shuttle. Presenting the plaque were Acting Center Deputy Director Chuck Duff and Ames Center Director Pete Worden. The plaque reads: "Ames people spearheaded the use of the Shuttle for basic research in the space life sciences. In addition to their own fundamental work in gravitational and radiation biology, Ames life scientists devised and managed spaceborne laboratories for plants, animals, cells, and microbes used by scientists from around the world."

support, and education and public outreach. Following the ceremony, the Ames Exchange hosted a barbeque lunch, where Ames staff could also talk with the many student interns presenting posters of their summer research work.

As part of Ames's Shuttle retirement ceremonies, Boyd and Bugos published an article in the *Astrogram* on Ames's work in the Return to Flight.

Jim Arnold talks about Ames's legacy in thermal protection systems. Over the long life of the Shuttle, Ames researchers invented and tested tile materials to ever more effectively protect the Shuttle orbiters. Tiles of Toughened Unipiece Fibrous Insulation resolved issues of damage from ground handling and debris impact, Fibrous Refractory Composite Insulation tiles were stronger and more heat resistant, and the Ames gap filler solved a problem of heating between tiles. The hands-on experience of Ames people with Shuttle thermal protection gave the Center expertise in the future of reentry technology.

(The article is available online at *http://www.nasa.gov/centers/ames/pdf/576919main_Summer2011Astrogram.pdf*.) Arnold and Dean Kontinos prepared a history presentation on our Code TS, the old thermo- and gas-dynamics branch, which did most of the basic research that enabled the Shuttle reentry system. Dennis Gonzales prepared a Web site highlighting Ames contributions to the Shuttle Program, which included a list of all the Ames personnel honored by the Spaceflight Awareness Program. Ames led work on seven experiments carried aloft on STS-135, the final Shuttle mission. To thank Ames staff for all they had accomplished, the STS-135 crew visited with the Ames community on 22 August.

In other news, we welcome Aileen Aniciete, who is supporting Boyd. The Ames new media group published a Web site of historic sounds of NASA (*http://www.nasa.gov/connect/sounds/*) for use as ringtones. (With whom would you identify "The Eagle has landed"?)

Dryden Flight Research Center (DFRC)

The Space Shuttle Approach and Landing Tests

By Peter W. Merlin

The Space Shuttle orbiter was the first spacecraft designed with the aerodynamic characteristics and in-atmosphere handling qualities of a conventional airplane. In order to evaluate the orbiter's aerodynamic flight control systems and subsonic handling characteristics, NASA Dryden Flight Research Center undertook a series of flight tests, known as the Approach and Landing Test (ALT) program, at Edwards Air Force Base, California, in 1977.

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A full-scale orbiter prototype, named *Enterprise*, was built for the program. Because the vehicle would not be subjected to reentry heating, *Enterprise* had no need for a thermal protection system. It was not covered with the Space Shuttle's reusable surface insulation, but with substitute materials, primarily polyurethane foam and Fiberglass. The flight deck had two crew stations for the commander and pilot. Aerodynamic controls included a body flap at the aft end and elevons and a split rudder that doubled as a speed brake. Reaction control systems, unnecessary at low altitude, were not installed. For the captive flights and the first three free flights, an aerodynamic fairing covered the orbiter's aft end. Three dummy main engines were installed for the final two flights to simulate weight and aerodynamic characteristics of an operational orbiter.

The *Enterprise* was to be carried aloft by, and eventually released for flight from, a modified Boeing 747. This Shuttle Carrier Aircraft (SCA), as it came to be known, had a fuselage strengthened at key stress points, two vertical fins attached to the horizontal stabilizers, and three attach points on top of the fuselage to anchor the orbiter. All original seating except that of the first-class section of the main deck was removed.

NASA selected two two-person orbiter crews for the ALT: Fred W. Haise Jr. (commander) and C. Gordon Fullerton (pilot), and Joe H. Engle (commander) and Richard H. Truly (pilot). Crewmembers for the 747 SCA included pilots Fitzhugh L. Fulton Jr. and Thomas C. McMurtry and flight engineers Victor W. Horton, Thomas E. Guidry Jr., William R. Young, and Vincent A. Alvarez.

Wind tunnel model tests allayed concerns over the separation characteristics of the two vehicles in flight. Because of the orbiter's positive angle of attack while mated, the *Enterprise* tended to climb relative to the SCA. Meanwhile, the 747 tended to descend mildly as the crew idled the engines and deployed spoilers, allowing the orbiter to clear the SCA's tail in about 1.5 seconds.

Five captive flights with the inert, unpiloted orbiter verified the airworthiness of the 747 as an orbiter transport vehicle and established an operational flight envelope for ALT operations. These were followed by three captive-active flights, with *Enterprise* powered up and with crew in its cockpit to test controls and perform other tests.

The final phase of the ALT program comprised five free flights during which the orbiter was released from the SCA and glided to a landing at Edwards. Three of these were made with the aerodynamic tailcone on the orbiter, but the last two were made with the tailcone replaced by dummy engines in an effort to replicate actual flight conditions experienced by an orbiter returning from space. Except on the last free flight, *Enterprise* landed on Rogers Dry Lake.

The final flight ended on the 15,000-foot concrete runway at Edwards, an important demonstration of precision landing capabilities necessary for later operational missions. At touchdown, the orbiter experienced a pilot-induced oscillation, or PIO, in which the vehicle skipped and bounced down the runway several times before safely coming to a stop. Prior to the start of the Shuttle's orbital flight-test program, the PIO issue was corrected through additional research with Dryden's

F-8 Digital Fly-By-Wire test bed aircraft, which was equipped with an IBM AP-101 flight control computer identical to that used on the orbiter. Dryden engineers recreated the PIO with the F-8 and developed a software filter to correct for it.

The ALT program demonstrated the orbiter's capability for safe approach and landing after an orbital flight from space. It also validated crucial on-board control systems necessary for the Shuttle Program's next step: the launch of *Columbia*, on 12 April 1981.

Jet Propulsion Laboratory (JPL)

By Erik Conway

The Jet Propulsion Laboratory's first and last major roles in the Space Shuttle Program were flights of synthetic aperture radars aboard STS-2 and STS-99. STS-2, *Columbia*'s first engineering flight, demonstrated the usefulness of the radar and set in motion a series of four more flights of increasingly sophisticated variants. The final flight, aboard *Endeavour*, was the Shuttle Radar Topography Mission (SRTM) of February 2000. SRTM provided a very high-resolution digital elevation database for most of Earth's surface. It also put a capstone on a nearly 20-year period of Shuttle-borne JPL experiments that included four flights of its Atmospheric Trace Molecule Spectroscopy Experiment, several cryogenic technology experiments, an inflatable antenna experiment, several "KidSat" experiments, a solar irradiance monitor, and an "electronic nose," or E-nose.

JPL's relatively early exit from the Shuttle Program compared to the rest of NASA was a product of two decisions taken many years apart. After the *Challenger* accident of January 1986, the Reagan administration made a decision to restrict future Shuttle payloads to those requiring "a manned presence or the unique capabilities of the STS [Space Transportation System]."[1] Because the Laboratory's principal business was planetary exploration, its spacecraft, with three exceptions, did not meet these criteria.

Those three exceptions were the Galileo mission to Jupiter, the Magellan mission aimed for Venus, and the joint U.S.–European Space Agency solar physics mission Ulysses. Each of these spacecraft had already been designed specifically for Shuttle launch and were well along in their construction phases (Galileo was complete and in storage). Rebuilding them for launch on expendable launch vehicles would have been quite expensive. These three were, in essence, grandfathered into the post-*Challenger* Shuttle manifest. Each was launched successfully and completed its mission, with Ulysses operating for nearly 19 years. Beginning with the 1992 launch of the Mars Observer, JPL's planetary business returned to commercially procured expendable launch vehicles.

JPL-built instruments continued to fly aboard Shuttles, though, through the rest of the 1990s. Probably the most important was part of the Hubble Space Telescope (HST). Astronauts aboard STS-61 in 1993 replaced JPL's Wide-Field and Planetary Camera (WFPC) with a near-duplicate that carried optics designed to compensate for the primary mirror's spherical aberration, and they also installed a Ball

1. National Security Decision Directive 254.

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Aerospace–built unit called COSTAR that corrected HST's other instruments. The Laboratory's Wide Field and Planetary Camera 2 operated aboard HST from 1993 to 2009, when it was removed by astronauts aboard STS-125. One of the few JPL-built artifacts to return to Earth, WFPC 2 now belongs to the National Air and Space Museum.

Most of JPL's Shuttle-borne science efforts came to an end after NASA's decision to devote most of the remaining Shuttle flights after 2000 to the construction of the International Space Station. The remaining scientific missions left on the manifest were devoted to servicing the Hubble Space Telescope even after the tragic loss of *Columbia*, but these flights were canceled in February 2003. A Congressional demand ultimately led to STS-125's Hubble flight. With Shuttle flights no longer available, JPL's Shuttle instruments went into storage and to museums, with the exception of a JPL-designed electronic nose. This had flown aboard STS-95 in 1998; in 2008, STS-126 installed the E-nose on the International Space Station. It returned to Earth in 2009 with STS-128.

The end of JPL's participation in the Shuttle Program years ago has meant that the Laboratory has been largely unaffected by the Shuttle Program's closeout activities. In fact, 2011 was our busiest year, with the launches of SAC-D/Aquarius, the Gravity Recovery and Interior Laboratory (GRAIL), Juno, and the Mars Science Laboratory (MSL). Yet we face much the same uncertainty as the rest of NASA: it does not appear that Congress is willing to continue funding us at the levels of the recent past, let alone at a level that is commensurate with the ambitions of the scientific communities that we serve.

Johnson Space Center (JSC)

Houston, We Have an Orbiter!

By Sandra Jones Tetley (JSC Historic Preservation Officer)

Contributors: Don Magnusson (Manager, SAIL Test Operations and Maintenance) and Joan Deming and Trish Slovinac (Archaeological Consultants, Inc.)

When it was announced that the Johnson Space Center (JSC) was not a recipient of one of the three remaining orbiters, the disappointment was felt not only at the Center, but throughout the state of Texas. As time progressed, the reality of "Space City" being without one of its greatest achievements began to set in. However, in the end, the resiliency of JSC employees shone through and an effort was made to maintain the history of the "ghost orbiter," OV-095.

Orbiting Vehicle (OV)-095, sometimes referred to as the "ghost orbiter," is the tail number of the high-fidelity replica, minus the wings and landing gear, of an orbiter that is part of the Shuttle Avionics Integration Laboratory (SAIL). SAIL was designed and built in 1974 under contract to JSC's Avionics Systems Engineering Division (ASED) and was officially accepted on 21 February 1977 for its first assignment: providing support for the Space Shuttle Approach and Landing Test program utilizing the orbiter *Enterprise*. Later that year, SAIL was retrofitted for

The midfuselage/payload bay area of OV-095 in SAIL.

its next assignment, supporting the Orbital Flight Test (OFT) program utilizing *Columbia*. Each time the development of the Space Shuttle advanced, SAIL was updated accordingly.

As originally fabricated, the facility consisted of the full-sized orbiter framework, a Shuttle Test Station (STS), a Shuttle Dynamics Simulator (SDS), a Test Operations Center (TOC), a Computer Test Set (CTS), and a Shuttle Avionics Test Set (SATS). To support the OFT program, the Guidance, Navigation, and Control Test Station (GTS) and the Marshall Mated Elements System (MMES) lab were added. SAIL tested the integrated avionics of the Shuttle for all 135 orbital fights plus all approach and landing tests. All hardware in SAIL was exactly like the hardware flown on the orbiters down to the length of the wiring. Before any orbiter launched into space, the mission was "flown" on the ground to test the integration of computers, software, and other avionics on the orbiter.[1]

As the Space Shuttle began to fly regular missions in space following the successful completion of the OFT program, SAIL underwent additional modifications to reconfigure it to support regular flights. It was connected with the JSC Avionics Engineering Laboratory (JAEL) as the orbiters' General Purpose Computers were upgraded. The cockpit was upgraded with the new Shuttle Multifunction Electronic Display Subsystem (MEDS) glass cockpit, operations and payload recorders were added, and modifications were made to support the Orbiter Boom Sensor System and the External Tank digital camera.

Throughout its history, SAIL has served as a large, complex laboratory "where avionics and related hardware (or simulations of hardware), flight software, flight

1. *JSC Round Up*, September 2011, p. 8.

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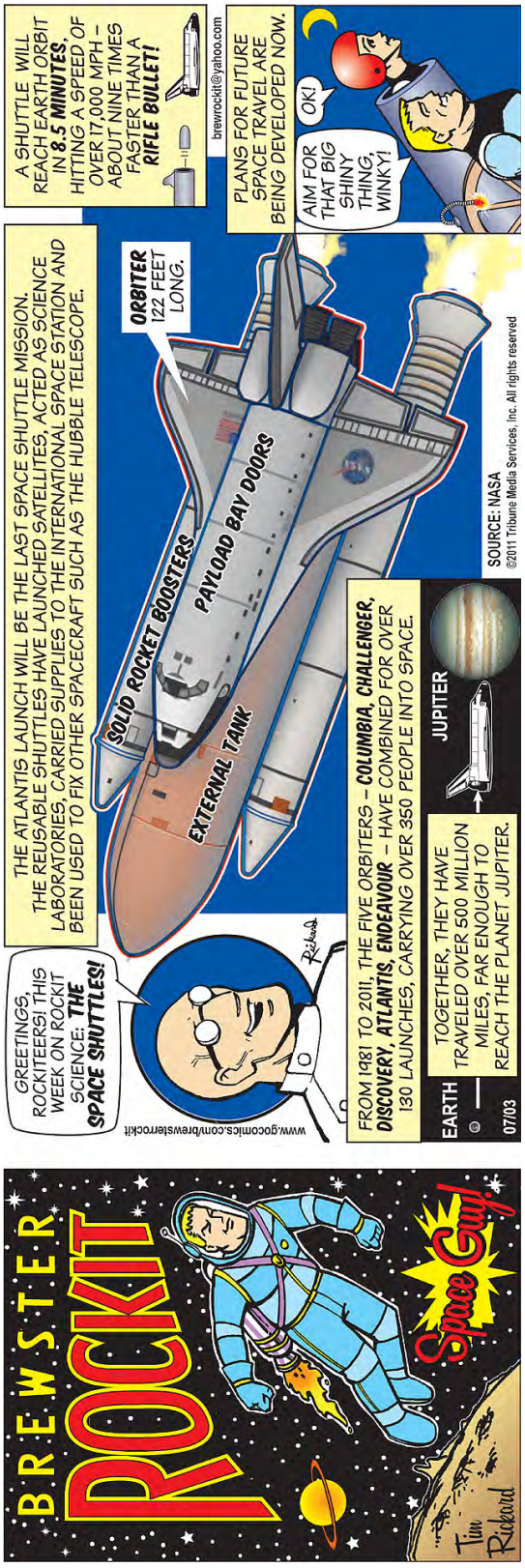
procedures, and associated ground support system equipment" have been "brought together for integration and mission verification testing" in order to certify Shuttle hardware and software for flight.[2] Additionally, SAIL performed operational support, which included real-time support of missions in progress, integration of payloads, and investigation of anomalies.

With the end of the Shuttle Program, SAIL was scheduled for demolition, and the dismantling had actually begun when a group of JSC employees, including SAIL operators along with the JSC Historic Preservation Officer, encouraged JSC Center Director Michael Coats to step in and save this engineering phenomenon. On the last day of operation of SAIL, Coats, along with the original SAIL Test Operations and Maintenance Manager, Don Magnusson, flew the final flight of OV-095. Upon its final landing, OV-095 was saved, and it will soon become a comprehensive exhibit and tour in conjunction with Space Center Houston.

Magnusson, now leading the project to create the exhibit, explained, "When I heard the disappointing news that JSC would not be receiving one of the flight orbiters, I sent the Center Director an e-mail and began discussions with other SAIL astronauts, the Public Affairs Office, the Historic Preservation Officer, and anyone else who would listen, that we now must turn our efforts towards preserving the orbiter that's already located at JSC, the SAIL OV-095. Everyone I talked with was completely in favor of this idea, and I was extremely pleased when NASA finally made the decision. In fact, a fallout of these discussions was that our 'nameless' orbiter should have a unique name as do the other flight vehicles. That idea is still evolving and I have already received several suggestions from SAILors and astronauts who worked in the lab. Before we complete the task of preservation, we must come up with a name for this historic 'ghost orbiter,' and only then will the task be complete."

The two-story exhibit will contain the actual "skinless" orbiter, detailing the miles of wires and cables that made the orbiter fly. It will also have components of the Shuttle Test Station, the Test Operations Center, the Launch Processing System, and the Marshall Mated Elements System, as well as the forward and aft cockpit Shuttle Engineering System Simulators. The SAIL exhibit will tell the story of how the orbiters, the launch and ground operations, communications, navigation, and all associated software and hardware were developed and tested simultaneously. The exhibit will give visitors insight into the engineering feats that it took to develop, test, and eventually fly the Space Shuttles. Whereas visitors viewing the actual orbiters will look upon history, visitors to SAIL will see where that history began.

2. NASA JSC, "Shuttle Avionics Integration Laboratory," JSC-13037, Rev. B, July 1990.



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Artist's rendition of the floor-level viewing of the orbiter as it will appear in the KSC Visitor's Center.

Kennedy Space Center (KSC)

The Kennedy Space Center Visitor Complex (KSC VC) is embarking on a 10-year master plan that will include creating a permanent home for the orbiter *Atlantis.* Groundbreaking for the facility took place in January 2012, with a grand opening in the summer of 2013. The orbiter home is a brand-new facility that will include not only *Atlantis*, but also exhibits on the ISS and Hubble and a memorial to *Columbia* and *Challenger*. The facility will be linked to the existing Shuttle Launch Experience, which provides an immersive experience into the Space Shuttle Program and its major accomplishments as part of the Nation's space program. Exhibits will also highlight Space Shuttle Program workers from throughout the Agency and the teamwork necessary to make the program a success. There will be a collection of simulators and interactive exhibits for hands-on learning and for exploring science, technology, engineering, and mathematics (STEM) concepts.

In addition to the home for *Atlantis*, other major developments are planned for the KSC VC. The Launch Complex-39 Tour Stop, which overlooks Pads A and B, is being completely updated to replace the predominantly Shuttle processing story with exhibits that reflect on past, present, and future exploration programs from the perspective of Kennedy Space Center. Content included in the new story zone will focus on unpiloted launch vehicles and missions, commercial launch capabilities (including resupply missions to the International Space Station and the emerging commercial crew program), and missions beyond low-Earth orbit that will use NASA's new Space Launch System. Significant STEM learning opportunities will also be integrated into this location.

Other near-term projects to improve the guest experience include reorienting the entrance through the iconic Rocket Garden, renovating food and retail venues, and revamping the tour embarkation experience. A more long-term project planned during the 10-year phasing includes the construction of a new Legacy Museum that will feature the Astronaut Hall of Fame collection. Throughout the 10-year master plan, a commitment to emphasize STEM learning opportunities throughout the KSC VC is a primary objective within each project.

Langley Research Center (LaRC)

From Preflight to Final Mission, Langley Contributed to the Space Shuttle's Success

Langley's contributions to the Space Shuttle reflect the Center's areas of expertise in aeronautics, space exploration, structures, materials, and science. Research experience with hypersonic gliders, the X-15 program, and the HL-10 heavy lifting body paved the way for contributions to the design of the Shuttle. Over 60,000 hours of research in several Langley wind tunnels helped to refine the final design and provided over half of the information in the Shuttle's Aerodynamic Design Data Book. Many of the models for these studies were built in Langley's Fabrication Shop. Langley researchers made the recommendation for the modified delta wing for the spacecraft. Langley's Engineering Directorate made major contributions to the flight dynamics and flight control systems.

Langley investigated and certified the thermal protection system for the launch environment prior to the Shuttle's first flight. Langley's Aircraft Landing Dynamics Facility conducted landing tests on the main and nose-gear tires and braking systems. The facility was also used to conduct runway surface texture tests that resulted in modifications to the Shuttle landing runway at Kennedy Space Center.

Langley's pioneering work with pilots and improving cockpit instrumentation led to the development of the flat-panel multifunction electronic display subsystem that was first installed in the cockpit of Space Shuttle *Atlantis.* More commonly called a "glass cockpit," the technology was initially developed in ground simulators and the NASA 737 flying laboratory, which was based at Langley. The system improved crew and orbiter interaction with easy-to-read graphics of flight parameters and was used to help land the Shuttle.

Langley helped the Space Shuttle fleet return to flight after the *Challenger* and *Columbia* tragedies. Langley researchers supported the redesign of the solid rocket motor case field joints and sealing system after the *Challenger* was lost. Following the *Columbia* accident, Langley performed reinforced carbon-carbon foam impact analysis, external tank foam protuberance aerodynamic load and ice frost assessment, and an external tank stringer crack investigation, among other research activities. Researchers at Langley conducted extensive wind tunnel tests and analysis to

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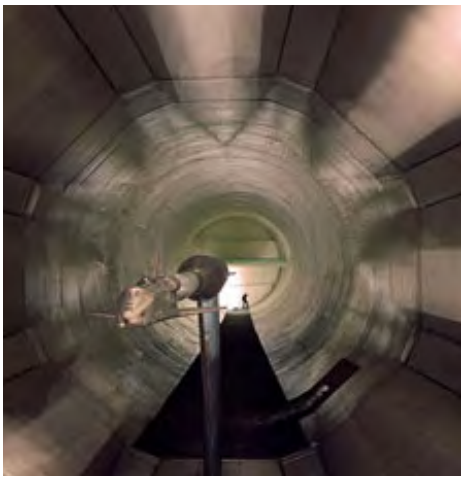
Perspectives on the Shuttle Program (continued)

Space Shuttle deploying LDEF.

Astronaut Pat Forrester working with MISSE.



Model of the Space Shuttle in Langley's 16-Foot Transonic Tunnel.

The "glass cockpit" on Space Shuttle *Atlantis*.

better understand the Shuttle orbiter aerothermodynamic phenomena, which was critical to the accident investigation and safe return to flight. Langley's Nondestructive Evaluation Sciences Branch developed extensive technology for Shuttle tile and leading edge inspection and repair.

Langley researchers needed to improve computer modeling of the hypersonic thermodynamics of Shuttle and future spacecraft reentry. To do this, actual thermodynamic reentry data needed to be collected. The Hypersonic Thermodynamic Infrared Measurements (HYTHIRM) team decided to use a strategically placed Navy NP-3D Orion aircraft to chase the Shuttle as it landed. Researchers on the aircraft used a special long-range infrared camera to remotely monitor heating of the Shuttle orbiter as it reentered the atmosphere. Thermal observations were successfully collected during the last seven Shuttle missions, and the data were used to improve the computer modeling of spacecraft reentry.

Two Langley-researchers-turned-astronauts were on the return-to-flight mission. Stephen Robinson and Charlie Camarda were crewmembers of *Discovery*'s flight STS-114. Steve was head of the Experimental Flow Physics Branch and Charlie was head of the Thermal Structures Branch when they were selected to be astronauts. Steve also flew on STS-85, STS-95, and STS-130. Langley researcher Roger Crouch flew on STS-83 and STS-94. At the time of his astronaut selection, he was the lead scientist for the Microgravity Space and Application Division at Langley. Current Associate Administrator for Education Leland Melvin was a researcher in the Fiber Optics Group of the Nondestructive Evaluation Sciences Branch when he was chosen for the astronaut corps. He went on to fly missions STS-122 and STS-129. Former NASA Deputy Administrator Fred Gregory was on detail from the Air Force to NASA Langley as a research pilot when he was selected as an astronaut in 1978. He was a pilot on STS-51B and commanded STS-33 and STS-44. Roy Bridges was a pilot on STS-51F prior to serving as Langley's Center Director from 2003 to 2005.

Langley also contributed to scientific payloads for the Space Shuttle Program. Beginning on STS-2 and ending with STS-134, Langley researchers designed the following systems:

- Measurements of Air Pollution from Satellites (MAPS) on STS-2
- Shuttle Entry Air Data System (SEADS) on STS-28, -32, -35, -40, and -61C
- Assembly Concept for Construction of Erectable Space Structures (ACCESS) on STS-61B
- Shuttle Infrared Leeside Temperature Sensing (SILTS) on STS-61C
- Mir Environmental Effects Payload (MEEP) deployed/retrieved on STS-76/-86
- Gas Permeable Polymer Materials (GPPM) on STS-77
- Materials in Devices as Superconductors (MIDAS) on STS-79
- Fiber Optic Sensor System (FOSS) on STS-96
- Crew Equipment Translation Aid (CETA) on STS-118

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- EVA Infrared Camera on STS-121
- Materials International Space Station Experiment (MISSE) installed/retrieved on STS-105/-114, STS-121/-118, STS-114/-115, STS-123/-128, STS-129/-134

Langley's Engineering Directorate led the development of two primary Shuttle payloads: the Long Duration Exposure Facility (LDEF) and the Lidar in-Space Technology Experiment (LITE). LDEF was a 12-sided, cylindrical, school-bus-sized structure that carried 57 experiments in 86 trays mounted on the outside. Deployed in 1984 from the cargo bay of *Challenger*, the experiments were exposed to the space environment to provide long-term data on the effects of space on various materials. LDEF orbited Earth until it was retrieved by *Columbia* in 1990. LITE was a LIght Detection and Ranging (lidar) that was developed by Langley and flew in the cargo bay of STS-64 to explore and validate lidar technology for spaceborne applications. LITE provided the first highly detailed global view of the vertical structure of clouds and aerosols and was a precursor to the currently orbiting Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO).

Langley Research Center honored Shuttle Program contributors with an evening reception at the Virginia Air and Space Center and is proud to have contributed to the success of the program.

Marshall Space Flight Center (MSFC)

By Tracy McMahan

In 2011, the Marshall History Office focused on the Space Shuttle's final mission and the program's legacy. For more than 30 years, the Space Shuttle, or Space Transportation System, as it is officially known, has touched the lives of most Center employees. People in the Shuttle Propulsion Office were responsible for the manufacture, assembly, and operation of the primary propulsion elements—the main engines, the external tank, and the solid rocket boosters—that launched the Shuttle, its payloads, and its crews into orbit. Engineers at Marshall tested Space Shuttle engines, oversaw external tank manufacturing, and participated in static firings of the solid rocket motors. But the Shuttle's reach extended much further than that at Marshall. Hundreds of people designed and operated the Shuttle's precious cargo: payloads that made the Shuttle so valuable. Shuttle payloads developed at Marshall included 21 Spacelab missions, the Hubble Space Telescope, the Chandra X-ray Telescope, and International Space Station components and facilities. Marshall's engineering directorate also played a key role in the design of both the Shuttle and its payloads and in providing sustained engineering support to ensure safe and reliable performance of Shuttle and payload systems.

The Shuttle and payload hardware was a significant American achievement, but when it came down to the end, it was more about the shared experience. For the last few missions, people gathered at Marshall to watch the launches and landings at Shuttle Pride Socials. Through a Web site, people shared their Shuttle memories. Thousands of people from the Huntsville, Alabama, community joined Marshall employees at a Shuttle celebration at the U.S. Space and Rocket Center. The Marshall History Office staffed an exhibit filled with Shuttle photos,

In 1978, *Enterprise* arrived at Marshall for vertical ground-vibration testing.

On the 25th anniversary of the Apollo 11 (the first Moon landing mission) launch, Marshall celebrated with a test firing of the Space Shuttle main engine (SSME) at the Technology Test Bed (TTB). This drew a large crowd who stood in the fields around the test site and watched as plumes of white smoke verified ignition.

Several thousand people attended the “Salute to the Space Shuttle Program” at the U.S. Space and Rocket Center (USSRC) in August 2011.

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video, and memorabilia. Marshall Director Robert Lightfoot—who held numerous positions supporting the Shuttle, from his first job to executive positions at NASA Headquarters—said, "At the end of the program, what we find ourselves talking about is the people and the team, not the vehicle."

The Marshall History Office created products to help people remember both the vehicle and the people. Marshall Historian Mike Wright researched and wrote a long article describing the many changes to the Shuttle propulsion systems made over the years to improve performance, reliability, and safety. Two astronauts who served at the Marshall Center shared memories of their flights. Johnson Space Center oral historians came to Marshall and recorded interviews with current and former Marshall employees. More interviews are planned.

The History Office is continuing efforts to ensure that Space Shuttle history is captured and stored in the historical reference collection. In October, a new office—the Shuttle-Ares Transition Office—became part of the Marshall organization. One of the office's duties is to ensure that knowledge, records, and other important information are properly archived and maintained. To date, the office has identified three terabytes of digital information and hard copies of documents as well. The History Office is working with the transition office to access the information and determine its historical significance. In the transition from Shuttle-related jobs to new positions, many employees are sorting through their own files. To help employees understand what the History Office does and what items might be of historical importance, the History Office produced a presentation to explain our functions, items of interest for the collection, and how the office interacts with other groups, such as historic preservation and records management.

As NASA looks to the future, the History Office has also experienced an increased interest from internal and external researchers who want to know more about the early research and thought put into the Space Shuttle design. Work on the vehicle started at Marshall in 1969 with the Space Shuttle Task team. The first Marshall Director, Dr. Wernher von Braun, included Shuttle vehicles in the plan he presented to President Richard Nixon's Space Task Group. Besides all the fire-and-smoke testing and fuel tank manufacturing that highlighted Space Shuttle development by Marshall, another proud moment was orbiter vibration testing at Marshall in 1978. Employees gathered to see the *Enterprise* test vehicle as it was transported to the dynamic test stand. The Marshall History Office has many items that document important moments in the Shuttle's historic development and operations.

Stennis Space Center (SSC)

With 520 seconds of shake, rattle, and roar on 29 July 2009, NASA's John C. Stennis Space Center marked the end of an era for testing the Space Shuttle main engines that powered the nation's Space Shuttle Program for nearly three decades.

Steam billows from the A-2 Test Stand at NASA's John C. Stennis Space Center during a 29 July 2009 Space Shuttle main engine test. The test was the last planned test for the Space Shuttle Program. Stennis engineers conducted their first test of a Space Shuttle main engine in 1975 and tested every engine used in the program since that time. During those 34 years, no mission has failed due to engine malfunction.

This was the final planned test of a main engine for the Space Shuttle. More than 34 years earlier, on 27 June 1975, Stennis engineers conducted the first test on one of the world's most sophisticated rocket engines.

NASA assigned Stennis to test Space Shuttle main engines in 1971. Prior to the first Shuttle flight, Stennis engineers conducted some 500 tests on the engine and its components. They also test-fired the three-engine cluster arrangement—the main propulsion test article—that was used to power the Shuttle, an accomplishment some called the facility's "finest hour."

In single-engine and cluster testing alike, the goal was the same: 8½ minutes of successful firing, duplicating the amount of time it took the engines to power the Shuttle from launch to orbit.

Overall, in more than three decades of testing, about 50 main engines were certified for 135 Shuttle missions. These engines were used to power more than a dozen flights before being retested.

At one point, all three of the large test stands at Stennis were involved in Shuttle engine testing.

"The excellent flight record of the Space Shuttle main engine can be largely attributed to the test team at Stennis Space Center," said Ronnie Rigney, who was the acting Space Shuttle Main Engine Test Project Manager at Stennis. "We performed over 2,000 tests, totaling more than 1 million seconds of accumulated hot-fire time in support of the development, certification, acceptance, and anomaly resolution for the Space Shuttle main engine."

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Stennis history dates back to testing the engines that carried Americans to space during the Apollo era.

"Stennis Space Center is truly unique in that propulsion test operations expertise has been passed from generation to generation through the Apollo and Shuttle programs since the mid-1960s, making this workforce one of the most knowledgeable in its field," Rigney explained. "This last test of the Space Shuttle main engine represents great accomplishments for this team, as well as new opportunities and challenges to transition to a new era in the nation's space program."

On 9 November 2011, NASA conducted a successful 500-second test firing of the J-2X rocket engine, marking an important step in the development of an upper stage for the heavy-lift Space Launch System (SLS).

The SLS will carry the Orion spacecraft, its crew, cargo, equipment, and science experiments to destinations in deep space. The SLS will be safe, affordable, and sustainable in its efforts to continue America's journey of discovery from the unique vantage point of space.

"The J-2X engine is critical to the development of the Space Launch System," Dan Dumbacher, NASA's Deputy Associate Administrator for Exploration Systems Development, said after the test at NASA's Stennis Space Center in Mississippi. "Today's test means NASA is moving closer to developing the rocket it needs if humans are to explore beyond low-Earth orbit."

The J-2X engine and the RS-25D/E (Space Shuttle main engine), which will power the SLS core stage, will be tested for flight certification at Stennis. Both engines use liquid-hydrogen and liquid-oxygen propellants. The J-2X engine is being developed for Marshall Space Flight Center by Pratt & Whitney Rocketdyne of Canoga Park, California.

"We look forward to adding to the legacy [of Stennis] as we fulfill our responsibility to test engines that will power America's next launch vehicle," said Stennis Director Patrick Scheuermann.

Historic Preservation News

Before the announcement of orbiter placements to museums across the country, NASA staff worked closely with state and federal regulators to ensure a seamless process for the transfer of the orbiters to their new homes. In 2007, NASA identified each of the orbiters, *Discovery*, *Atlantis*, and *Endeavour*, as being eligible for the National Register of Historic Places, which is America's official list of historic property worthy of preservation. Consequently, in accordance with the National Historic Preservation Act, NASA was obliged to assess what effect the transfer from federal protection would have on the orbiters. NASA developed a Memorandum of Agreement in accordance with Section 106 of the Act with the State Historic Preservation Officers of Alabama, California, Florida, and Texas as well as the Advisory Council on Historic Preservation.

The Memorandum acknowledges that in order to mitigate the potential adverse effect of the transfer out of NASA ownership, NASA would develop significant records and documents that would be available to the public as physical reminders and evidence of the national significance of these spaceflight vehicles. In accordance with the agreement, NASA will host a Web site dedicated to all the documents produced under this process. NASA will develop products that include oral histories with personnel who were involved with the design and processing of the orbiters for flight, a large narrative history of the development of the Space Shuttle Program, and specifically the history of *Discovery* as the orbiter of record for the project. Additionally, NASA engaged the National Park Service to produce measured, detailed drawings of *Discovery* that will be submitted to the Library of Congress's Historic American Engineering Records collection. A product of this effort will also be a 3D digital model of *Discovery* that will be available on the Web. Each of these products will be available through NASA's public Web site at *http://www.nasa.gov/agency/crm/shuttle/index.html.*

National Air and Space Museum (NASM)

By Valerie Neal

The National Air and Space Museum is gearing up for the arrival of *Discovery* and the departure of *Enterprise* in spring 2012. Two planning teams are hard at work, one focused on the logistics of the orbiter exchange and another focused on ceremonial/celebratory public events. Both NASM teams are working in close coordination with NASA counterparts at Headquarters, KSC, and JSC.

An artifact acquisition of this magnitude affects almost every department in the museum, especially the space history curators and collections management staff. Already, artifacts displayed behind *Enterprise* at the Udvar-Hazy Center have been temporarily removed to make room for cranes and other equipment needed to install the ferry Orbital Maneuvering System (OMS) pods and tail cone early in the new year. The public events and display plans for the orbiter exchange are rapidly evolving. Even the museum shop is stocking up on merchandise in anticipation of heightened interest in all things Shuttle. More details will be reported in the next edition of this newsletter.

Have a Piece of the Space Program for Your School

Shuttle Artifacts for Schools: Tiles for Teachers and Space Food for Schools

NASA is offering unflown Space Shuttle thermal protection system tiles developed to protect the Space Shuttle from the temperatures of reentry into Earth's atmosphere and space food intended to have been used on the Space Shuttle and International Space Station. These items are available on a first-come, first-served basis to eligible schools, limit one per school, free of charge except for the cost of shipping and handling. Online resources including educational lessons are available in support of these offers. Please go to *http://artifacts.nasa.gov* for more information.

News from Headquarters and the Centers

Headquarters

Headquarters Historical Reference Collection

In the Headquarters archives, the staff continued to stay busy with reference services and processing and preservation projects. During the last quarter, we hosted an average of 20 people per month who came in person to the History Program Office to conduct research. We had research visits by NASA staff as well as visitors from the National Air and Space Museum, George Washington University, the Naval Research Laboratory, Virginia Commonwealth University, the University of Cincinnati, and the University of Kansas.

A number of archive projects are either under way or have been completed recently that researchers will find of interest. A set of Office of Manned Spaceflight chronological correspondence files, 1984–90, has been processed and made available for research use. While not complete, it represents a seven-year look at human spaceflight operations, including the Shuttle Program, and will be valuable to historians and other researchers who wish to search by date. It supplements over 90 cubic feet of existing Shuttle files in the Historical Reference Collection (HRC), one set organized by subject and the other arranged chronologically by mission number.

A review of boxes on loan from the Federal Records Center continues with material currently being added to the HRC on the Television Infrared Observation Satellite (TIROS) and International Telecommunications Satellite Organization (INTELSAT) weather satellites. Recently, a small collection of scientific ballooning material was processed and made available to researchers. Under way are two additional projects: the processing of a large audiovisual collection, 1960–2011, with plans being made to digitize a portion of the audio reels; and the digitization of a hard-copy collection of NASA Program Reviews and General Management Reviews, 1961–92, and a set of Administrators' calendars, 1961–93.

Jane Odom represented the office at the nearly weeklong Society of American Archivists Annual Meeting held in Chicago in August. Between sessions she visited with April Gage, the Ames Research Center Archivist, and other colleagues from around the country. Colin Fries attended a one-day Library of Congress symposium in the fall titled "Transitioning to a Digital Future." It brought together senior managers from the National Archives, the Library of Congress, the Smithsonian Institution, and others who discussed the growing need to provide electronic access to converted and born-digital material using limited resources and collaboration.

Glenn Research Center (GRC)

The Glenn History program is pleased to announce the latest Web site in our growing historic facility documentation series. The High Energy Rocket Engine

Research Facility and Nuclear Rocket Dynamics and Control Facility (more commonly known as B-1 and B-3) test stands were constructed at Glenn Research Center's Plum Brook Station in the early 1960s to test full-scale liquid-hydrogen fuel systems in simulated altitude conditions. B-1 and B-3 were mothballed and put into a standby mode in the early 1970s after the cancellation of the Nuclear Engine for Rocket Vehicle Application (NERVA) program. In the late 1970s, components of the facilities were cannibalized and repurposed at other NASA facilities. These two facilities were demolished late last year. This Web site is part of the documentation requirements of the National Historic Preservation Act. On the Web site, viewers will find a full history of the facility and the role it played in the programs it was built to support, many photos, and historic documents. The Web site is available online at *http://pbhistoryb1b3.grc.nasa.gov/.*

NASA History Program Review

By Anna Stolitzka

The Glenn Research Center (GRC) in Cleveland, Ohio, hosted the 2011 NASA History Program Review from 1 to 3 November. Historians, archivists, researchers, and program support staff from the NASA Centers and Headquarters, as well as a number of interested guests, gathered to discuss the shared achievements and challenges of the history program across the Centers. For the first time, this program review included a WebEx live-stream of the conference that allowed those unable to attend to tune in. Bill Barry, NASA Chief Historian, and Bill Wessel, Associate Director of GRC, welcomed the group, highlighting the importance of the annual program review as a place to share experience and ideas.

Barry commenced the presentations by walking through an overview of the last year at the History Program Office and gave his perspectives on the mission of the history program at NASA. He summarized the mission in three verbs: preserve, stimulate, and communicate. He explained that without quality archives and diligent archivists, historians won't have the materials needed to write quality history in the future. Therefore, preservation is the foundation of our history program. Barry also emphasized the importance of stimulating the study and understanding of aerospace history in a variety of ways. He particularly mentioned the need to leverage resources in order to encourage new scholars and volunteers to expand and improve the field. Finally, Barry stated that the history program has a mandate to communicate NASA history, both internally and externally, using tried-and-true tools such as symposia, books, and newsletters, and also new media like iTunes U and Twitter. He concluded that through these actions we can continue to forge a robust and effective history program across the Agency.

The opening remarks and discussion were followed by a set of presentations on different aspects of broader aerospace history. Chief Archivist Jane Odom delivered an overview of the archival activities at NASA Headquarters and developments in the NASA Historical Reference Collection. Bringing a local perspective to the day,

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NASA History Program Review (continued)

a number of guest speakers joined the program review to discuss their areas of expertise. This began with Bill Meixner, an air race historian, who discussed the legacy of the Cleveland Air Races. The group also enjoyed presentations from the International Women's Air and Space Museum (located at Lakefront Airport in Cleveland); Case Western Reserve University Archivists Eleanor Blackman and Helen Conger, who spoke about their collection of NASA Administrator (and former Case President) T. Keith Glennan's papers; and Jeff Thomas, from Ohio State University, on the John Glenn Archives. The first day concluded with an interesting and informative tour of NASA GRC, highlighting the Zero G Facility, Exercise Countermeasures Facility, 8' x 6' Supersonic Wind Tunnel, and GRC Archives.

Wednesday morning was devoted to Center updates, which illustrated the unique circumstances but similar challenges that each Center faces in carrying out a history program in a tight budget environment. Historian Steve Garber followed with an update on Headquarters publication plans, including the status of the various manuscripts in the publication queue. After lunch, our longstanding friend Dr. Jim Hansen entertained the audience with his presentation entitled "Astronaut Tales: A Personal Account of the Neil Armstrong Biography and John Young Autobiography." The group then discussed future plans for upcoming events and anniversaries as well as new developments, including e-books. Archivist Liz Suckow ended the afternoon with an informative demonstration of the Headquarters Reference Database—a tool designed to capture the answers to the many "space trivia" questions that land on the history program's doorstep.

The attendees of the 2011 NASA History Program Review Meeting at Glenn Research Center: (front row, from left to right) Jane Odom, Mike Wright, Rebecca Wright, Suzanne Dills, April Gage, Gail Langevin, Daphne Alford, and Tessa Keating; (middle row) Kevin Coleman, Bob Arrighi, Jennifer Ross-Nazzal, James Hansen, Nadine Andreassen, Marcy Frumker, Casper Uhl, Liz Suckow, Jeff Thomas, and Bill Barry; and (back row) Steve Garber, Gregg Buckingham, Erik Conway, Sunny Tsiao, Michael Meltzer, Glenn Bugos, and Anne Mills.

The attendees explore the Zero G Facility, the world's largest facility that provides ground-based microgravity research.

The Exercise Countermeasures Facility researches exercise protocols to prevent or minimize the health detriments for astronauts in reduced gravity as well as to optimize equipment designs for mass, volume, and spacecraft.

Chief Historian Bill Barry presents the 2011 NASA Headquarters History Program Award to Jennifer Ross-Nazzal for her work at Johnson Space Center.

The 8' x 6' Supersonic Wind Tunnel serves as NASA's only transonic-propulsion wind tunnel, which has been in operation for over 60 years.

The attendees tour the GRC archive, which includes over 600 cubic feet of records.

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NASA History Program Review (continued)

Although formal sessions ended on 2 November, many participants spent Thursday morning on an optional tour of the Plum Brook Station, an active testing and research installation housing some of the world's most advanced space environment simulation facilities.

Thanks to our wonderful hosts at GRC, the program review was both successful and enjoyable. Stennis Space Center has agreed to host the next Annual Program Review and Training. The dates for this are still under discussion.

Other Aerospace History News

NASA Aeronautics

By Tony Springer

Forthcoming Title from NASA Aeronautics Research

Dressing for Altitude: U.S. Aviation Pressure Suits—Wiley Post to Space Shuttle by Dennis R. Jenkins

A number of books have been written about spacesuits but none on the development of the full pressure suits for aviation. NASA Aeronautics has commissioned the development of this volume. The volume will cover the technical development and use of aviation pressure suits from their earliest days to their use today in high-altitude aircraft and on the Space Shuttle. This highly illustrated volume will be released in early 2012 by NASA in both hard-copy and e-book formats at *http://www.aeronautics.nasa.gov/ebooks/index.htm.*

"Solar System Exploration @ 50"

Second Announcement—Note Change of Date

Call for Papers

To commemorate the 50th anniversary of the first successful planetary mission, Mariner 2 to Venus, the NASA History Program Office, the Division of Space History at the National Air and Space Museum, the NASA Science Mission Directorate, and the Jet Propulsion Laboratory invite papers for a conference relating to the history of planetary exploration. This historical symposium will be held in Washington, DC, from 25 to 26 October 2012.

Entitled "Solar System Exploration @ 50," the purpose of this symposium is to consider, over the more-than-50-year history of the Space Age, what we have learned about the other bodies of the solar system and the process whereby we have learned it. This symposium seeks to pursue broader questions relating to the history of planetary exploration, such as the following:

- The various flight projects and their broader implications for the exploration of other solar system bodies.
- The development of space science disciplines and institution building.
- The big questions of planetary science and what has been learned in the 50 years of planetary exploration.
- The relationships of organizations: international, civil, military, etc., one to another.
- The uneasy alliance between robotic exploration and human spaceflight.
- The management of the space science community and the setting of priorities for missions, instruments, and knowledge generation.
- The manner in which scientific knowledge has been acquired, refined, analyzed, and disseminated over time.
- The development of theories about planetary science.
- The development of instruments and methodologies for scientific exploration.
- The analysis of the science of solar system origins and evolution.

Possible topics are not restricted to these major themes. All papers are envisioned as scholarly contributions exploring broad thematic issues and questions.

Contributions from international scholars and graduate students with an interest in history are welcome.

Some travel support scholarships may be available for international scholars and graduate students. Please indicate your interest in a need statement included with your paper proposal.

We intend that a subset of the papers will merit publication.

Proposals for papers should include a title and abstract, the author's curriculum vitae, and a travel support need statement (as appropriate). Please send all proposals, in the form of a 300-word abstract and a brief vitae, electronically to Dr. William P. Barry, NASA Chief Historian, at *bill.barry@nasa.gov*, and Dr. Roger D. Launius, Senior Curator in Space History at the National Air and Space Museum, *launiusr@si.edu*. **The deadline for abstract submissions is 21 February 2012.**

Recent Publications and Online Resources

NASA Publications Reprinted by Dover Publications

Living and Working in Space: A NASA History of Skylab, by William David Compton and Charles D. Benson (Dover Publications, August 2011). The official record of

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Recent Publications and Online Resources (continued)

America's first space station, this book from the NASA History Series chronicles the Skylab program from its planning during the 1960s through its 1973 launch and its conclusion in 1979. A reprint of the 1983 NASA SP-4208 edition.

NASA Multimedia

Space Shuttle Missions Summary, by Robert D. Legler and Floyd V. Bennett (NASA/TM-2011-216142, NASA Johnson Space Center, September 2011). This document was originally produced as an informal mission operations book and has been updated since Space Shuttle flight STS-1 and throughout the program. It is a handy reference guide for flight data for all Space Shuttle missions. "As-flown" data are provided as compiled from many flight support sources for ascent, on-orbit events, and descent mission phases. In addition, the specific Shuttle vehicle configuration, payload, flight crew, and flight directors are identified for each flight.

Ascent: Commemorating Shuttle (iPad app, NASA Glenn Research Center, November 2011). *Ascent* is a compilation of film and video representing the best-of-the-best ground-based Shuttle motion imagery from the STS-114, STS-117, and STS-124 missions. This app includes the entire *Ascent* production with commentary, numerous additional scenes, selected images, production notes, and an unreleased trailer. More information about the iPad app is available online at *http://www.nasa.gov/centers/glenn/multimedia/ascent.html*. Additional information about making this photographic story is available online in an article in *ASK the Academy*, the monthly newsletter from the Academy of Program/Project and Engineering Leadership: *http://www.nasa.gov/offices/oce/appel/ask-academy/issues/volume4/ata_4-7_shuttle_tracker.html.*

Wings in Orbit: Scientific and Engineering Legacies of the Space Shuttle, edited by Wayne Hale, Helen Lane, Gail Chapline, and Kamlesh Lulla (NASA JSC, February 2011). The book describes the scientific, engineering, and cultural contributions of the Space Shuttle through text, photographs, and graphics that were written or selected by those who worked in the Shuttle Program. This book is available online at *http://www.nasa.gov/centers/johnson/wingsinorbit/index.html.*

The NASA History Program Office is also updating its Shuttle bibliography. Meanwhile, the older version is available online from *http://www.hq.nasa.gov/office/pao/History/Shuttlebib/cover.html*.

Commercially Published Works

Compiled by Chris Gamble

Multimedia

Space Shuttle Almanac, by Joe W. Powell and Lee Robert Brandon-Cremer (Microgravity Productions, Calgary, Canada, and Launch Pad Publishing, Sydney, Australia, October 2011). A comprehensive overview of 40 years of Space Shuttle development and operations, 1972–2012. Containing 1,400 pages of facts, color photos, diagrams, and lists, the e-book covers all aspects of the Space Shuttle Program.

The Race for Space—Race to the Moon: Volume 1, Dawn of the Space Age (MP3 Editorial Ltd., October 2011). Subtitled "From the Wright Brothers to Sputnik 1, 1903–1930," the e-book starts with rocket pioneers and visionaries and continues with Wernher von Braun and the V-2, the race to acquire German rocket know-how, and the first satellite in space (Sputnik); it concludes with preparations for human flight. Note to readers: the document is now part of a planned six-volume set. It was originally listed in the first quarter 2011, vol. 28-1, edition of this newsletter under "The Race for Space—A Human Odyssey, Volume 1." This e-book is also available as a print-on-demand book.

Books

Gemini 4: America's First Space Walk: The NASA Mission Reports, edited by Steve Whitfield (Collector's Guide Publishing, Inc., October 2011). This book, filled with information on the mission's crew, engineers, and equipment, gives the complete account of the first American spacewalk, which took place on 3 June 1965. A companion DVD is included that features spectacular photographs and documents from the NASA archives.

The Space Shuttle: Celebrating Thirty Years of NASA's First Space Plane, by Piers Bizony (Zenith Press, October 2011). The author has put together a retrospective that covers the entire Space Shuttle Program, from the development and design to the last mission.

Smoke Jumper, Moon Pilot—The Remarkable Life of Apollo 14 Astronaut Stuart Roosa, by Willie G. Moseley (Acclaim Press, October 2011). This is the family-authorized biography of Apollo 14 Command Module Pilot Stuart A. Roosa (1933–94).

The Space Economy at a Glance 2010, revised edition, by Organization for Economic Cooperation and Development (OECD, August 2011). The book paints a detailed picture of the international space industry, its downstream services activities, and its wider economic and social impacts. The book answers key questions such as: Who are the main spacefaring nations? How large are revenues, and how much employment is there in the sector? How much research and development goes on, and where? What is the value of spinoffs from space spending?

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Recent Publications and Online Resources (continued)

Icarus' Second Chance—The Basis and Perspectives of Space Ethics (Studies in Space Policy, vol. 6) by Jacques Arnould (Springer, September 2011). This book focuses on the period from 1961 to 2011: 50 years during which space largely contributed to the scientific and technical, political and economic, and cultural and social transformation of humanity. This book is a critical analysis of the decisions and the actions that constitute the field of astronautic activities and their consequences on the natural environment and on humans. This work is the fruit of research carried out by the French Centre National d'Études Spatiales (CNES) over the past 10 years, in collaboration with many organizations such as ESA, NASA, and especially the European Space Policy Institute (ESPI).

Gaia, by Guy Laliberté (Assouline Publishing, May 2011). A collection of Earth photographs taken by Cirque du Soleil founder Guy Laliberté during his weeklong stay aboard the International Space Station from September to October 2009.

Grappling with Gravity: How Will Life Adapt to Living in Space? by Robert W. Phillips (Springer, October 2011). This book explores the physiological changes that will occur in humans and in the plants and animals that travel to new worlds, whether it be as a colony in the emptiness of space or in settlements on the Moon, Mars, or other planetary bodies.

Fundamentals of Space Medicine, 2nd edition, by Gilles Clément (Springer, June 2011). This book, written for a general audience, presents findings from life science experiments conducted during and after space missions. The book also looks at the future of human spaceflight and the showstoppers that are foreseen for all these space missions, as well as what we need to learn to understand the implications and risks for space explorers and space tourists.

At Home in Space: The Eighties, by Ben Evans (Springer-Praxis, September 2011). *At Home in Space*, the third book in the series, continues the story of human spaceflight throughout the later 1970s and into the '80s. It was a period of time characterized by great promise with both regular Soviet missions and the arrival of the Space Shuttle. Living in space became truly international as astronauts from many nations lived and worked together on Soviet space stations and aboard the Shuttle. This third volume charts the progress made in space during this pivotal phase of humanity's quest to explore the final frontier.

Falling to Earth: An Apollo 15 Astronaut's Journey to the Moon, by Al Worden and French Francis (Smithsonian Books, July 2011). As Command Module pilot for the Apollo 15 mission to the Moon in 1971, Al Worden flew on what is widely regarded as the greatest exploration mission that humans have ever attempted. Nine months after his return from the Moon, Worden received a phone call telling him he was fired. What happened in those nine months, from being honored with parades and meeting with world leaders to being unceremoniously fired, has been a source of much speculation for four decades. Worden has never before told the full story around the dramatic events. Readers will learn them here for the first time, along with the exhilarating account of what it is like to journey to the Moon and back. It is an unprecedentedly candid account of what it was like to be an Apollo astronaut, with all its glory but also its pitfalls.

Outer Space in Society, Politics and Law, edited by Christian Brünner and Alexander Soucek (Springer, November 2011). This book is an interdisciplinary approach to the understanding of modern space law. Technical, cultural, and historical aspects lay the foundation for a sound comprehension.

High Above—The Untold Story of Astra, Europe's Leading Satellite Company, edited by Chris Forrester (Springer, July 2011). Luxembourg-based SES Astra appeared on the TV scene in the mid-1980s. Astra was instrumental in the dramatic developments in television that have since taken place. This is the company's story.

Lunar Module Orientation and Compartment Familiarization Guide, by Robert Godwin (Apogee Prime, July 2011). The Lunar Module Familiarization Guide is a combination of several documents that include detailed diagrams of the interior of the final flight model of the Lunar Module. Also included in the guide are an overview of the Lunar Module's instrumentation, a fold-out of the instrument panels, maps, plan views of the vehicle, diagrams of the main on-board systems, and more. It also comes with a DVD.

Soviet Space Culture: Cosmic Enthusiasm in Socialist Societies, edited by Eva Maurer, Julia Richers, Monica Ruthers, and Carmen Scheide (Palgrave Macmillan, September 2011). Starting with the first artificial satellite, Sputnik, in 1957 and culminating four years later with the first human in space, Yuri Gagarin, space became a new utopian horizon. This book explores the profound repercussions of the Soviet space exploration program on culture and everyday life in Eastern Europe, especially in the Soviet Union itself.

The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests, 2nd edition, by James Moltz (Stanford Security Studies, August 2011). The past five decades have witnessed often fierce international rivalry in space, but also surprising military restraint. Now, with an increasing number of countries capable of harming U.S. space assets, experts and officials have renewed a longstanding debate over the best route to space security: Will space defenses be needed, or should space be free of deployed weapons? The author puts this debate into historical context by explaining the main trends in military space developments since Sputnik, their underlying causes, and the factors that are likely to influence their future course.

Selecting the Mercury Seven: The Search for America's First Astronauts, by Colin Burgess (Springer-Praxis, August 2011). To become part of NASA's human-in-space program, known as Project Mercury, NASA performed an exhaustive search through military service records. Following in-depth medical and psychological screening, 32 finalists were chosen. NASA wanted the best of the best in its quest for the nation's first astronauts, and this is the story of that search for a group of near-supermen who were destined to become trailblazing pioneers of American spaceflight.

Direction—Space! by Maria Gruzdeva (Dewi Lewis Publishing, August 2011). Half a century after the legendary flight of Yuri Gagarin, *Direction—Space!* looks at two

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sites that were key to the Soviet space program: Star City and Baikonur. The book is a fascinating study of those two sites that incorporates unique archive materials. The book explores the reality of the space community firsthand, investigating the physical and psychological space as well as the routine and lives of its residents. It offers a new insight into a subject central to the Cold War history of the Soviet Union, and it raises questions over attitudes and perceptions that have been formed over past decades.

Contracting for Space, by Lesley Jane Smith and Ingo Baumann (Ashgate Publishing Limited, September 2011). Recent significant developments in the European space sector have had an impact on business and the growth of national and European commercial space law. This book analyzes and assesses the legal issues and key factors influencing the space sector in Europe. It is an up-to-date guide to the regulatory background of space projects and examines the typical legal problems that need to be solved by practitioners in the field. Taking into account public and commercial international law and practice, this book examines substantive issues of law specific to launchers, satellite manufacturers, and space service providers with contributions from leading experts and practitioners in the field of European space law and policy.

The Cosmic Tour: 1001 Must-See Images from Across the Universe, by Piers Bizony (Quercus Publishing Plc., September 2011). The magnificent vault of stars emblazoning Earth's night skies are but an infinitesimal fraction of the hundreds of billions of stars that inhabit our galaxy—and there are at least as many galaxies in the universe as there are stars in the Milky Way. *The Cosmic Tour* makes sense of this dizzying celestial panorama by exploring it one step at a time, illustrating the planets, moons, stars, nebulae, white dwarfs, black holes, and other exotica that populate the heavens with an astounding 1,001 of science's most spectacular photographs.

Into the Cosmos: Space Exploration and Soviet Culture, edited by James T. Andrews and Asif A. Siddiqi (University of Pittsburgh Press, September 2011). The launch of the Sputnik satellite in October 1957 changed the course of human history. In the span of a few years, Soviets sent the first animal into space, the first man, and the first woman. These events were a direct challenge to the United States and the capitalist model that claimed ownership of scientific aspiration and achievement. *Into the Cosmos* shows us the fascinating interplay of Soviet politics, science, and culture during the Khrushchev era and how the space program became a binding force between these elements.

Space Probes: 50 Years of Exploration from Luna 1 to New Horizons, by Philippe Séguéla (Firefly Books, October 2011). This book is the first complete and fully illustrated history of the international space exploration program. Thoroughly up to date, it is organized by destination and includes every space probe launched. The book also catalogs each probe's objective, technologies, hurdles, and successes and failures, as well as the information gained and the lessons learned from each mission.

The Need for an Integrated Regulatory Regime for Aviation and Space: ICAO for Space? (Studies in Space Policy, vol. 7), edited by Ram S. Jakhu, Tommaso Sgobba, and Paul Stephen Dempsey (Springer, October 2011). In the new Space Age after the end of the Cold War, orbit and frequency allocations, traffic control, safety, and a number of support services (such as space weather forecast and orbital debris monitoring) need to be coordinated transparently and effectively by clear rules at an international level. The establishment of an international civil space regulatory framework is the central theme of this book, particularly the possible extension to space of the international regulatory framework model adopted for aviation more than 60 years ago, the International Civil Aviation Organization (ICAO).

Integrating Women into the Astronaut Corps: Politics and Logistics at NASA, 1972–2004, by Amy E. Foster (The Johns Hopkins University Press, November 2011). Why was the United States two decades behind the Soviet Union in sending its first female astronaut into space? In answering this question, Foster recounts the complicated history of integrating women into NASA's astronaut corps. She details how NASA had long developed progressive hiring policies but was limited in executing them by a national agenda to beat the Soviets to the Moon, budget constraints, and cultural ideas about women's roles in America.

U.S. Spacesuits, 2nd edition, by Kenneth S. Thomas and Harold J. McMann (Springer-Praxis, November 2011). In this new edition, the authors update the story of U.S. spacesuit development and efforts, from the design challenges modern engineers face to the latest roles of spacesuits in space exploration. The book also provides a close-up look at NASA's new Constellation Space Suit System as well as Apollo prototype configurations that have been discovered since 2005.

Into the Blue: American Writing on Aviation and Spaceflight, edited by Joseph J. Corn (Library of America, October 2011). This book revisits the remarkable trajectory of Americans in the air, gathering 60 of the most vivid and compelling pieces on aviation and spaceflight, from Benjamin Franklin's letters on the first balloons to Chris Jones's account of astronauts stranded on the International Space Station.

Sovereignty and Jurisdiction in Airspace and Outer Space: Legal Criteria for Spatial Delimitation, by Gbenga Oduntan (Routledge, November 2011). This book's focus is primarily on the issues of sovereignty, jurisdiction, and control in airspace and outer space and their effects on public and private activities. The book also looks at related issues that pertain to the oceans and Antarctica. Older problems of international law such as crimes in the air and airspace trespassing are examined along with newer developments such as space tourism and the growing demand for private ownership and involvement in outer space development. The book goes on to consider the distinction between airspace and outer space and puts forward legal criteria that would allow for the resolution of the spatial delimitation dispute.

Civilizations Beyond Earth: Extraterrestrial Life and Society, edited by Douglas A. Vakoch and Albert A. Harrison (Berghahn Books, September 2011). In thinking about first contact, the contributors to this volume present new empirical and

continued on next page

Recent Publications and Online Resources (continued)

theoretical research on the societal dimensions of the Search for Extraterrestrial Intelligence (SETI). Archaeologists and astronomers explore the likelihood that extraterrestrial intelligence exists; sociologists present the latest findings of novel surveys, tapping into the public's attitudes about life beyond Earth to show how religion and education influence beliefs about extraterrestrials; scholars from such diverse disciplines as mathematics, chemistry, journalism, and religious studies offer innovative solutions for bridging the cultural gap between human and extraterrestrial civilizations while recognizing the tremendous challenges of communicating at interstellar distances.

Manned Space Flight—Personal Reflections on the Space Program, by LeRoy "Roy" Day. *Manned Space Flight* relates the remembrances of the author who spent 19 years with NASA in three major piloted space programs: the two-person Gemini, the Apollo Moon landing, and the Space Shuttle. His management involvement in these programs allowed him to witness a number of significant space milestones: the first rendezvous of two piloted spacecraft, the first time an astronaut moved from a spacecraft into free space, the first flight of Apollo around the Moon, the landing of astronauts Neil Armstrong and Buzz Aldrin on the Moon, and the development and successful flights of the Space Shuttle. Many of the early pioneers who were associates of the author are identified.

The History Program Office gives sincere thanks to 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

The 16th Annual International Space University (ISU) Symposium will be held **21–23 February 2012** in Strasbourg, France. Please see *http://www.isunet.edu/annualsymposium* for more details.

The 43rd Lunar and Planetary Science Conference (LPSC 2011) will be held in conjunction with the Nuclear and Emerging Technologies for Space meeting on **19–23 March 2012** at The Woodlands, Texas. Please see *http://anstd.ans.org/NETS2012/NETS2012Home.html* for more details.

The Society for History in the Federal Government (SHFG) annual meeting will be held **21 March 2012** in College Park, Maryland. Please see *http://www.shfg.org* for more details.

The 28th National Space Symposium will be held **16–19 April 2012** in Colorado Springs, Colorado. Please see *http://www.nationalspacesymposium.org/* for more details.

The annual meeting for the Organization of American Historians will be held **19–22 April 2012** in Milwaukee, Wisconsin. Please see *http://annualmeeting.oah.org/* for more details.

The Global Space Exploration Conference will be held **22–24 May 2012** in Washington, DC. Please see *http://www.glex2012.org/* for more details.

Images in Aerospace History

On 12 April 1981, *Columbia* officially launched the world's first reusable Space Transportation System into orbit, with John Young and Bob Crippen on board. The STS-1 crew tested the new spacecraft during 36 orbits around Earth and landed at Edwards Air Force Base in California nearly 55 hours later.

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Images in Aerospace History News (continued)

On 21 July 2011, *Atlantis* made the final flight of the Space Shuttle. The STS-135 mission to the International Space Station delivered the Raffaello Multi-Purpose Logistics Module (MPLM), installed the Robotic Refueling Mission experiment and Optical Reflector Materials experiment, and retrieved a broken cooling system pump module. *Atlantis* also deployed PicoSat, a small technology demonstration satellite, which became the 180th and last payload from a Space Shuttle. After 13 days, Doug Hurley, Chris Ferguson, Rex Walheim, and Sandy Magnus returned home for a predawn landing at Kennedy Space Center in Florida.

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Do you have more questions about NASA history in general? Please check out our NASA History Program Office Home Page at *http://history.nasa.gov* on the Web. For information about doing research in the NASA History Program Office, please e-mail us at *histinfo@hq.nasa.gov* or call 202-358-0384.

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