NEWS &NOTES

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FROM THE CHIEF HISTORIAN

It's 60 years...and counting! The Space Age began 60 years ago with the launch of Sputnik on 4 October 1957. The United States took several months to respond, but by that point the world had already changed—and was about to change in ways that were unimaginable at the time. In this, our end-of-the-year issue of NASA History *News & Notes*, we are doing a thematic issue. This year, we are focusing on the 60th anniversary of the Space Age. We are especially happy to feature three articles that touch on fascinating historical aspects of the Space Age. In "The Re-Entry Test Vehicle Program and the Space Race," Jet Propulsion Laboratory historian Erik Conway gives us an inside view of the origins of the first U.S. satellite, Explorer 1. Did you ever wonder why the International Space Station is not the big wheel in the sky that we might have imagined in 1958? Our fall history intern Madison Moore discusses the interaction between science fiction and science fact in her feature article on centrifugal space stations. Finally, in "Different Worlds: The Challenges of U.S. and Soviet SETI Collaboration During the Space Age," fall history intern Rebecca Charbonneau discusses the little-known 1960s scientist-to-scientist cooperation between Carl Sagan and Soviet astronomer Iosif Shklovskii. These three fascinating articles demonstrate

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THE CENTRIFUGAL SPACE STATION COMES FULL CIRCLE

By Madison L. Moore, NASA History Division Intern

It is the age-old "chicken-and-egg" question in the history of science: which came first, science fiction or science fact? Research has been done on fanciful technologies like flying cars and wearable communication devices, which, with recent innovations in smart watches, are progressing from the realm of fantasy to reality. The centrifugal space station's development has progressed much in the manner of the chicken-and-egg question: from science fiction to science fact, with science fiction overtaking once again, bringing its history full circle.

A centrifugal space station is a wheel-shaped rotating spacecraft that uses the centrifugal force resulting from the spinning motion to create artificial gravity. The centrifugal force resulting from the spin pushes anything within the craft—an astronaut, a bed, or a table and chairs, for instance—against the outermost wall of the wheel. The spacecraft can be set to spin at a rate that produces the effects of gravity to the same degree as on Earth, allowing passengers to walk along the outer wall of the craft as if it were a floor on Earth.

The idea of a centrifugal space station was first proposed in 1881 by German inventor Hermann Ganswindt; the technology at the time did not make it possible to build it, so the idea was disregarded. The concept resurfaced nearly 50 years

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OFFICE OF COMMUNICATIONS

From the Chief Historian (continued)

the incredible range of scholarship possible in the field of space history.

As we move into the year in which we will celebrate the 60th anniversary of the creation of NASA, you can expect to see much more coverage from our History Program about the accomplishments of these first six decades of NASA. You only need to look back at everyday life in the late 1950s to realize how radically our world has changed in ways that have been driven by aerospace technology and accomplishments. Think, for example, of how you would exchange holiday greetings with family members who lived on another continent. In 1958, you probably would have done that by writing a letter and sending it weeks ahead of time by mail. If you were particularly well off, you might have splashed out on a long-distance international phone call carried by underwater cables. These days, you are more likely to send a near-instantaneous text message (complete with colorful emojis) or directly video chat on your cell phone via satellite. Many people will hop on an airplane and jet overseas in relative comfort to visit in person. This was the stuff of science fiction 60 years ago. Think also about how much our understanding of the universe has changed in these few decades. Even the newest textbooks that I used in school in the 1960s and early 1970s are completely out of date—much of our revolution in understanding coming from the space probes that we have used to reconnoiter our solar system or to stare deep into the universe, or from the humans we have sent to explore space and our Moon in person. The Big Bang was an unproven theory dating to the 1920s until we discovered the cosmic background radiation in the early 1960s and built probes to measure it in the late 1980s. Now we have the data to show that the universe began about 13 billion years ago and, surprisingly, that galaxies in our universe are not simply drifting apart but are accelerating away from one another. NASA's Dr. John Mather won NASA's first Nobel Prize in 2006 for his part in proving this using the Cosmic Background Explorer (COBE) satellite.

We have been hard at work coordinating with our colleagues across NASA to highlight how far we have come in the first 60 years of the Space Age and to see the trajectory of where the next decades will take us. The first major event in NASA's 60th year will come at the end of January, when we mark the anniversary of the launch of Explorer 1 on 31 January 1958. You will see other events as the year progresses. Keep an eye out for the tagline "60 Years and Counting." Between the anniversary of President Eisenhower signing the National Aeronautics and Space Act of 1958 (on 29 July) and the day NASA opened for business (1 October), you will see more from us about the legacy bequeathed to us by the giants of generations that have gone before at NASA. That nearly 60-day period, from the end of July to the first of October, will culminate in the celebration of NASA's "birthday" on 1 October 2018. We hope that you'll come along for the ride—and come to appreciate a bit more about our past and how it has put us on a trajectory into the future.

On the subject of leading us into the future, I am delighted to tell you that in November we won approval to hire a Chief Archivist. Hopefully, by the time you read this we will be in the process of filling that job. That position requires not only specialized expertise but also leadership and diplomacy skills to make sure that the archival collections that form the bedrock of our History Program will be effective for the next 60 years and beyond. I very much look forward to introducing you to our Chief Archivist in the new year.

In the meantime, happy holidays and Godspeed,

William P. Barry
Chief Historian

The Centrifugal Space Station Comes Full Circle (continued)

later in 1928, when Slovene rocket engineer Herman Potočnik published a book titled *The Problem of Space Travel—The Rocket Motor* (*Das Problem der Befahrung des Weltraums—der Raketen-Motor*), in which he outlined a detailed design for a space station, including one design in the shape of a wheel.

Not until 1952 did the idea of the centrifugal space station gain traction in the American imagination, largely thanks to the work of Wernher von Braun—then the Technical Director of the U.S. Army Ordnance Guided Missiles Development Group—who wrote an article for *Collier's* magazine titled "Crossing the Last Frontier." Von Braun's article features a centrifugal design for an orbital space station, which von Braun explains as "a substitution for gravity—by making the 'wheel' slowly spin…. The centrifugal force created by the slow spin of the space station forces everything out from the hub…. In other words, the inside wall of the 'wheel's' outer rim serves as the floor."[1]

Within a year following his publication in *Collier's*, von Braun published an abstract titled "The Early Steps in the Realization of the Space Station," which addressed the interests of a scientific and federal audience, saying, "The station in space…will be the most fantastic laboratory ever devised…. But it will become a reality because of its tremendous potentialities as a deterrent of war."[2]

Von Braun understood that to introduce drastically new ideas to the National Advisory Committee for Aeronautics (the NACA, predecessor to NASA)—an agency still largely focused on World War II aviation technologies—he must first inspire the general public, and second, incentivize the scientific and military communities to make the investment. He effectively inspired the general public by pointing out the wonder of space and sought to inspire the communities

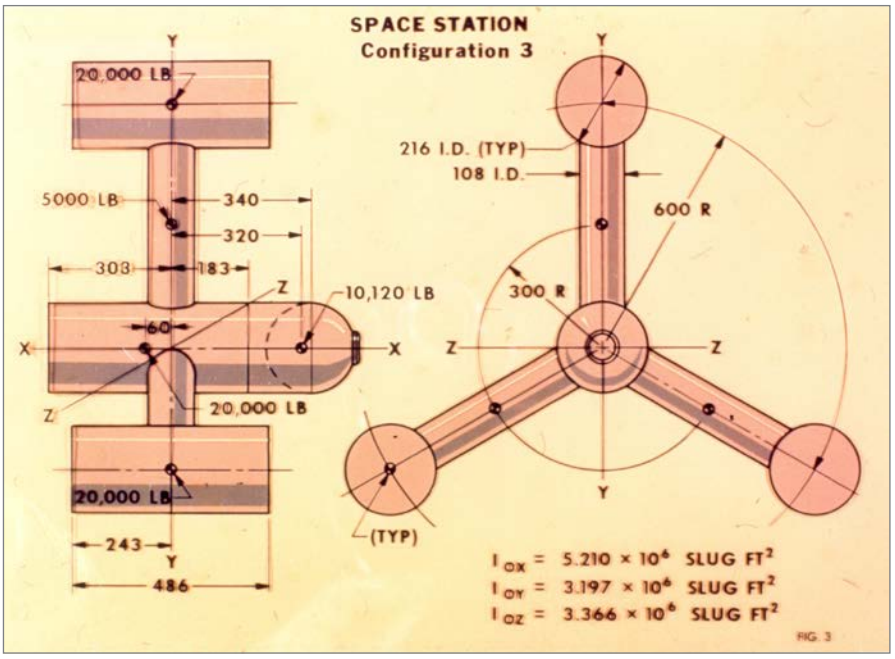
Reproduction of the Chesley Bonestell painting that accompanied Wernher von Braun's article "Crossing the Last Frontier" in *Collier's* (22 March 1952). The painting features astronauts on extravehicular activity (EVA) servicing the space station, as well as a pill-shaped "space taxi" docking at the center module.

of scientists and military officers by appealing to the potential for military gain.

Just as von Braun had hoped, the scientific community responded to his popular culture proposal by seriously approaching research for the concept of artificial gravity in an orbital space station. In 1956, a company called Lockheed (now Lockheed Martin) produced technical diagrams and concept art for the centrifugal space station. While the station strayed from the "wheel" design, as von Braun had envisioned it, it retained the "spokes." NASA even experimented with producing artificial gravity on the Gemini XI mission in 1966 by using a 30-meter cable to tether the Gemini craft to the Agena Target Vehicle and initiating spin. Though the experiment's primary goal was to

1 Wernher von Braun, "Crossing the Last Frontier," *Collier's* (22 March 1952): 30.

2 Wernher von Braun, "The Early Steps in the Realization of the Space Station," Abstract, Hayden Planetarium seminar symposium (1952).



Shown here is a Lockheed technical diagram of a centrifugal space station (1960s), including values for the craft's dimensions and mass.

"investigate modes of stabilizing a space vehicle during station keeping," the rotation did successfully—in the words of NASA's mission review video—"[create] the first small artificial gravity field."[3] The experiment was successful, and after about 3 hours of spin, the craft separated and moved apart.

A number of technical reports were filed in the late 1960s and early 1970s on the prospect of artificial gravity in response to the possibility of putting a space station with centrifugal artificial gravity into space, but these reports uncovered physiological barriers to using the craft. To quote one such report, published in 1969, contributing factors to astronaut space sickness would be "a much larger Coriolis force, relative to the nominal gravity strength, than on Earth" and "the much larger head to toe gravity gradient present in a rotating space station."[4] In other words, because of the relatively small radius of rotation in a space station, a standing person would experience a kind of constant rotational whiplash due to the Coriolis effect, which is the same force that governs the rotation of hurricanes and typhoons on Earth. Also, due to the small radius of rotation in such a craft, the astronauts would feel a drastic difference in centrifugal force applied to the head in comparison to the feet. The combined work of these two forces would disrupt the astronauts' spatial senses, which originate in the ear canal, resulting in what scientists dubbed "canal sickness."[5]

The centrifuge has largely been demoted to experimental application in the decades since Gemini XI, including centrifuges currently at NASA's Ames Research Center, which are used to study the physiological effects of high g-force situations, such as launch and reentry. Other than for these experimental applications, the centrifuge is currently too expensive and physically impractical to become NASA's next space station.

3 National Aeronautics and Space Administration, "Gemini XI" review video (1966), *https://www.youtube.com/watch?v=j6EWMjgRTdg*, 10:54–56, 15:55–16:00 (accessed 13 November 2017).

4 D. B. Hoffman and R. E. McGaughy, Bellcomm, Inc., "Centrifugally Obtained Artificial Gravity" (4 April 1969), NASA Archives.

5 Hoffman and McGaughy, "Centrifugally Obtained Artificial Gravity," p. 1.

Science gave the centrifugal space station a fair attempt. Even though the centrifugal space station is no longer in NASA's foreseeable future, von Braun's original attempts to kick-start a legitimate scientific proposal have nevertheless come full circle with the return of the centrifuge to popular culture. Centrifugal artificial gravity makes its iconic appearance in Stanley Kubrick's 1968 film, *2001: A Space Odyssey*, which itself inspired more recent films like Neill Blomkamp's *Elysium* (2013) with its orbital habitat; Christopher Nolan's *Interstellar* (2014); and Andy Weir's book and subsequent film, *The Martian* (2015).

Whether or not the concept of the centrifuge arose because of the direct influence of popular culture, perhaps even at the behest of Wernher von Braun, is yet to be determined. But the cycle of fiction inspiring science—which in turn inspires fiction—continues, leaving almost a century of individuals whose imaginations were captured by the idea. Who can say where those minds may take us next?

Still image from Stanley Kubrick's *2001: A Space Odyssey* (1968), in which a crewmember is able to jog the perimeter of the wheel-shaped station thanks to artificial gravity created by the spacecraft's spin.

Credit: Madison L. Moore and Rebecca A. Charbonneau

The Consequences of Non-Centrifugal Space Stations

The vending machine on the ISS was a novel, yet slightly impractical concept.

NEWS FROM HEADQUARTERS AND THE CENTERS

NASA HEADQUARTERS

Washington, DC

History Division

By Bill Barry

As we approach the end of the calendar year, the NASA Headquarters History Division can look back at a tumultuous and rewarding year. This fall, we earned some well-deserved recognition in the form of two Headquarters Group awards. One of them was for the President's Report Team for their dedication and Herculean efforts to get the report done by the legally mandated delivery date of May 2017. The following people were all honored for their work on the Fiscal Year 2016 President's Report: Steve Garber and former employee Andres Almeida from the History Division; Michele Ostovar, Lisa Jirousek, Maxine Aldred, Chinenye Okparanta, Chris Duncan, and Barbara Bullock from our Communications Support Services Center (we couldn't do any of this without them); Bridget Fenner of the Administrator's Office; and Maureen Muncy from the Office of Legislative Affairs. A long list of people from across Headquarters, including myself, were also honored with a Group Award for the Hidden Figures Implementation Team. The recognition is nice, but I am obliged to note that the History Division and all of the supporting staff around us do outstanding work every day.

> "THIS FALL, WE EARNED SOME WELL-DESERVED RECOGNITION IN THE FORM OF TWO HEADQUARTERS GROUP AWARDS."

I am especially thankful for the privilege of working with such capable and dedicated people when we are facing times of staffing turbulence. This winter, in addition to the usual intern turnover, we have a number of other personnel developments that are, as usual, a bittersweet mix. Will Thompson, who jumped into the proverbial deep end this fall as a replacement for Andres Almeida, was accepted at a couple of graduate schools and will begin his studies at Virginia Tech in mid-January. He had the advantage of having served as an intern in 2014, but I'm not sure he was aware of what he was getting into this fall. You would never guess that from his unfailing good humor and the phenomenal amount of work he has done for us. We knew when he joined us this fall that he was hoping to start grad school in the spring semester of 2018, but we will miss him dearly. With your drive and skill you don't need it, but good luck in school, Will!

By the time you read this, we should be hiring a new Chief Archivist. Yes, we finally got approval from our Human Relations office to advertise for that position. As you may recall, we got the go-ahead to fill the Chief Archivist position late last December, but the Trump administration's hiring freeze put an end to that effort. At last, however, in addition to the new year bringing us new interns and a replacement for Will, we also will be bringing a new Chief Archivist on staff. As if that isn't enough staffing turbulence, a new company is taking over the contract for our archival support. That transition is still ongoing as I write this, and we are hoping for a smooth transition.

On the subject of interns, Rebecca Charbonneau and Madison Moore have been an outstanding team for us this fall. Not only have they shouldered all of the usual burdens of social media, publication support, and "other duties as assigned"—such as working the sign-in desk at the International Space Station Day on Capitol Hill event—but they also have been prolific writers. You'll see an article from each of them in this issue. Oh, and did you see their team Halloween costume? Madi was the painter Bob Ross and Rebecca was the painting (wearing a painting she whipped

up herself). We wish them well and look forward to seeing them again. We are finalizing our selection of spring interns as this goes to press, so you will hear more about the next group in the spring newsletter.

AMES RESEARCH CENTER (ARC)

Moffett Field, California

By Jack Boyd and Glenn Bugos

Jack Boyd kept up his active speaking schedule. This included an interview on the NACA's research into transonic aerodynamics, conducted for a NASA video marking the 70th anniversary of Chuck Yeager's first supersonic flight on 14 October 1947. Jack also participated in a Facebook Live event tying the legacy of that early transonic work to NASA's current efforts to minimize booms, in advance of a new-generation supersonic transport aircraft.

Glenn Bugos spoke at AirVenture of the Experimental Aircraft Association, joining NASA test pilot and astronaut Joe Engle in a "Warbirds in Review" session on the history of the NACA and NASA test flights. Their panel was prompted by the Oshkosh debut of the Bell P-63 Kingcobra 42-68941. During World War II, six different P-63s were test-flown at the NACA's laboratories to advance a variety of aircraft technologies. This specific P-63 was flown at Ames in 1945 and 1946 in important tests of the laminar flow airfoil and aileron buffet. It was then surplused, and decades later the plane found its way to the Commemorative Air Force (CAF) Dixie Wing just north of Atlanta, Georgia. The museum lovingly restored it to flying condition and, after some debate, returned it to its original and operational NACA paint scheme, including the word "TEST" in bold yellow letters. The CAF Dixie Wing will fly this P-63 to air shows around the country, using it to prompt discussion on the role of the NACA and NASA in shaping American aviation and on the importance of flight testing in advancing our knowledge of aerodynamics.

Glenn also talked about the history of rotorcraft flight tests at the awards banquet of the American Helicopter Society's San Francisco Bay Area Chapter. He represented NASA Ames in accepting the induction of Smith DeFrance into the NASA Langley Hall of Honor. DeFrance was appointed as founding Director of NASA Ames, where he served for 25 years, because of his exemplary career at the NACA Langley laboratory, where he served for 18 years. At the Langley Centennial Symposium, Glenn also moderated a panel of historians talking about the storied legacy of NASA's first research installation.

In September, Glenn resigned his post as Historian at NASA Ames to pursue new projects. His contributions to both Ames history and the NASA History Program are greatly appreciated. We wish him well in his future endeavors.

Layne Karafantis will begin her tenure as Historian at NASA Ames on 4 December. Dr. Karafantis holds a Ph.D. in the history of science and technology from Johns Hopkins University. She specializes in aerospace history, the history of American military technologies, and urban and suburban history.

Dr. Layne Karafantis comes to Ames from the National Air and Space Museum's Aeronautics Department, where she was most recently the Curator of Modern Military Aircraft. (Photo credit: Smithsonian National Air and Space Museum)

ARMSTRONG FLIGHT RESEARCH CENTER (AFRC)

Edwards Air Force Base, California

By Christian Gelzer

Christian Gelzer helped orchestrate a two-day CBS shoot on the Low Boom Supersonic Demonstrator work being done at the Center, focusing on the Waveform and Sonic Boom Perception and Response (WSPR) project that uses an F-18 to perform different maneuvers at Mach 1 to attenuate the shock wave. (Christian appeared briefly in the background in the final cut; one had to look quickly.) The story aired nationally on CBS on 12 October 2017.

The more important news is that the Center has agreed to fund digitizing the historical reference collection. Christian expects to start boxing and palletizing the collection in the next few weeks, and the project (not packing and shipping) is expected to take at least a year. Once this is complete and we are satisfied with the transfer of material, the collection will be sent to a National Archives and Records Administration (NARA) facility. The digital collection will remain behind a firewall at the Center because parts of it contain International Traffic in Arms Regulations (ITAR) material, but it will finally have a permanence it does not now have, and the building in which the collection currently resides can be demolished without losing anything of consequence. We plan a regular, scheduled dispatch of material to keep up with newly accessioned material.

GLENN RESEARCH CENTER (GRC)

Cleveland, Ohio

By Bob Arrighi

NACA Lewis's 1957 Transformation

"Hey, did I hear you use the word 'spaceflight'?" "Yes, sir," replied Lewis research engineer Ed Jonash. Jonash was rehearsing his talk on high-energy fuels for a small contingent of Headquarters officials days before the NACA's 7–10 October 1957 inspection. "We'd better take that out of there," warned Executive Secretary John Victory. "Suppose a Congressman heard you say 'spaceflight'?"

Lewis researchers were not focused on spaceflight at the time, but merely saw it as a logical extension of their aeronautical propulsion efforts. Victory, however, did not want to jeopardize the Agency's funding by giving the visiting officials the impression that the NACA was going beyond its aeronautical mandate. He ordered references to space to be excised from the presentations. Late in the afternoon on Friday, 4 October, the TASS news agency announced that the Soviet Union had successfully orbited the first artificial satellite. The Space Age had begun. When the inspection began on Monday morning, the statements regarding space were not only reinserted into the talks, but emphasized.

The year 1957 was one of the Lewis Flight Propulsion Laboratory's most transformative years. The laboratory took steps to accelerate the redirection of its research from aviation to missiles and to transition liquid hydrogen from an experimental fuel to a reliable, usable propellant. By the end of the year, lab leaders would urge the NACA to take the lead in the development of a new U.S. space agency. Liquid hydrogen would play a key role throughout.

In the midafternoon of 13 February 1957, NACA pilots Eb Gough and Joe Algranti took a B-57 Canberra out over Lake Erie and successfully switched the fuel supply from JP-4 to hydrogen. The aircraft performed superbly as the hydrogen-fueled engine etched a long vapor trail across the deep blue sky for the next 20 minutes before Algranti switched back to jet fuel. The mission was the first flight demonstration of liquid hydrogen. It came just two years after Lewis researchers began using small, experimental engines to study hydrogen combustion on test stands. The B-57 flight not only confirmed the performance of hydrogen, but more importantly proved that the cryogenic fluid could be safely stored and pumped in an operational system.

In early March 1957, Associate Director Abe Silverstein created the Fluid Systems Components Division to intensify the lab's efforts regarding the handling of cryogenic fluids. On 11 April, Congress approved an NACA appropriations bill that included

funds for a new cryogenic fluids research complex at Lewis. Shortly thereafter, a new Air Force–sponsored hydrogen production plant began operation nearby to supply the lab with large quantities of hydrogen to conduct its research.

On 26 April, Lewis held a conference to present the initial results of the hydrogen aircraft program to 175 guests. In addition, the lab announced that it would be hosting two larger events in the fall—an NACA inspection for industry and political leaders and a technical conference on advanced flight propulsion. The Lewis staff spent the next six months preparing for these events.

Silverstein also established a group of six senior managers in early March to guide the laboratory's research agenda and define facilities required for that research. This Research Planning Council would play a critical role in the technical and physical expansion of the laboratory in the coming months and years. The council, which disbanded the massive Compressor and Turbine Division in July, decided by the end of the summer to terminate the lab's celebrated turbojet engine program.

In August 1957, Lewis engineers started up their new Rocket Engine Test Facility (RETF) for the first time. The RETF, which could fire 20,000-pound-thrust engines, was at the time the largest U.S. facility for testing high-energy propellants. This was the first in a long succession of new or repurposed facilities dedicated to space activities. The RETF would be prominently featured at the upcoming inspection.

The NACA conducted an inspection at one if its laboratories every three years. Hundreds of public officials and industry leaders were invited to hear presentations on the laboratory's research and facilities. These elaborate events provided the NACA with a great deal of exposure, so they were subject to meticulous planning and close review by Victory and other NACA leaders. For the 1957 inspection, the Lewis staff prepared several stops highlighting some of the lab's more traditional work, such as aircraft noise reduction,

A researcher works a demonstration board in the Rocket Engine Test Facility during the 1957 inspection of the National Advisory Committee for Aeronautics (NACA) Lewis Flight Propulsion Laboratory in Cleveland, Ohio. (Photo credit: NACA)

high-temperature materials, and supersonic turbojets. In addition, there would be presentations on advanced efforts such as nuclear aircraft, hypersonic propulsion, and high-energy fuels.

The event began on Monday, 7 October, just three days after the Soviets launched Sputnik. Over the weekend, there was not only a general elevated national interest in space, but a concern by many citizens, journalists, and politicians that the Soviet Union had technologically surpassed the United States. "[Sputnik] is bad because of their progress," admitted NACA Administrator Jimmy Doolittle during one of the coffee breaks, "but good because it will shake us loose from our complacency." The Lewis staff did their best to ease these concerns for the visitors.

Lewis researchers had been studying high-energy propellants since the mid-1940s in an attempt to identify fuels that yield significantly better performance without substantial increases in risk or expense. Although the studies were geared toward aircraft and missile propulsion, by 1957 it had become apparent that these fuels could be used to launch payloads into

space. To demonstrate these capabilities, the engineers at the RETF created a display above the control panel that featured Earth with both a satellite and spacecraft orbiting above. The speakers compared the performance the solid rocket fuels then being used to propel missiles to the potential superior performance of propellants such as hydrogen, fluorine, and ammonia.

The hypersonic propulsion stop included a discussion of the nascent field of ion engines. Since these thrusters must operate in a vacuum, their only application is space propulsion. The demonstration of a rudimentary thruster within a glass jar seemed to elicit the most response from the press, who wrote articles including "Space-Ship Engine Forerunner Exhibited," "Model of Manned Space Ship Revealed by NACA," and "Ions May Hold Space Travel Key." Throughout the week, both the media and guests praised Lewis for its foresight regarding space. The *Cleveland Press* ran the headline, "Vital research in the US race to send American airmen orbiting through space ahead of the Russians is going on in NACA's Air Lab."

In this atmosphere, Silverstein requested funds to construct a million-pound-thrust rocket test stand. Headquarters, however, could not afford the expense of operating such a facility at the time. The Lewis Research Planning Council then proposed a $6 million budget request for FY 1958 to initiate a series of rocket facilities at Plum Brook Station. On 3 November 1957, the Soviets demonstrated an even higher level of technical competence by launching a dog into space aboard the significantly heavier Sputnik II. Days later, President Dwight Eisenhower gave the first indication that the United States would make space a priority by appointing a Special Assistant for Science and Technology.

Meanwhile, the Lewis staff continued to prepare for the Flight Propulsion Conference. One team of researchers wanted to include data from the firing of a small regeneratively cooled hydrogen-fluorine rocket engine in their presentation. After months of preparation, they attempted a run on 5 November. Just moments before the engine was to be activated, a fluorine leak caused the test cell to burst into flames. Over the next three weeks, the staff rushed to rebuild the cell. The team labored on the installation around the clock during the final days before the conference. At 6 a.m. on 22 November, the hydrogen-fluorine engine came to life. One of the men rushed to process the data while another went home to clean up for his talk. Hours later, he was dramatically handed the data as he spoke from the podium.

In general, Lewis used the conference to make the case that hydrogen-fueled aircraft and ramjet missiles could compete with intercontinental ballistic missiles (ICBMs). Although these vehicles did not come to fruition, the high-energy fuels and cryogenic technology discussed would soon be applied to rocket stages. Perhaps the most advanced portion of the conference was the final session on performance and missions. Here, Lewis researchers used some broad "back of the envelope" calculations to compare the performance of different types of propulsion systems for a variety of missions, including surface-to-surface missiles, Earth satellites, lunar orbits, and piloted missions to the surface of the Moon. This is likely one of the NACA's first detailed considerations of a lunar landing.

Meanwhile, both the NACA and the government deliberated on the best way to address the new space challenge. In late November, Senator Lyndon Johnson opened a series of congressional hearings to critically review the status of U.S. missile and space technology. President Eisenhower had planned to deliver a nationally broadcast speech from Cleveland on 26 November. Afterward, he was to visit the new RETF facility at Lewis. The trip was canceled at the last moment after the President suffered a mild stroke, however.

On 6 December, the first U.S. response to Sputnik ended traumatically when the Vanguard rocket toppled over on the launch pad. At Lewis, Walter Olson revisited a document he had drafted in 1955 that urged the NACA to explore spaceflight. He noted a number of space-related areas that the NACA could readily support, including a space station. His colleague Bruce Lundin, however, envisioned an even

more ambitious effort. Following the loss of Vanguard, he drafted a report that called on the NACA not only to support U.S. space efforts, but to aggressively lead the way. He and the other Research Planning Council members began developing proposal plans for a new space laboratory.

On 18 December, NACA leaders called a meeting in Washington, DC, to discuss the group's future role in space with representatives from the three laboratories. Silverstein cleaned up Lundin's proposal and presented it to the others. Lewis was the only lab that advocated for a strong role in space. When offered an opportunity to voice their opinion later that evening, younger members from the laboratories were much more universal in their desire get into the space effort. By mid-January 1958, the NACA had resolved to seek leadership of the U.S. space efforts. By March, President Eisenhower had decided to use the NACA as the basis for the new National Aeronautics and Space Administration.

JOHNSON SPACE CENTER (JSC)

Houston, Texas

By John Uri

This year's hurricane season is one for the history books. Hurricane Harvey soaked the Texas coast, and despite the Houston area receiving a year's worth of rain in four days, we survived. The Center was closed for a week, but infrastructure impacts were minimal and affected events were quickly rescheduled. History Office personnel were minimally affected, but our thoughts are with those who are still dealing with the storm's aftermath. We indirectly felt the impacts of Hurricane Irma, as Jennifer Ross-Nazzal was an invited speaker at the canceled American Institute of Aeronautics and Astronautics (AIAA) meeting in Orlando.

We continue to expand our extensive oral history collection by conducting numerous interviews for several customers: the NASA Headquarters History Office, JSC Knowledge Management Office, and NASA Headquarters Science Mission Directorate. During FY 2017, Jennifer Ross-Nazzal, Sandra Johnson, and Rebecca Wright conducted 45 interviews for the three projects. Among the many individuals interviewed were JSC Center Director Ellen Ochoa, former Flight Director Milt Heflin, Michelle Brekke, Steve Squyres, and Wendell Mendell. The transcripts of the interviews are being processed and will be uploaded to the JSC History Portal once the subjects have approved them for release.

In anticipation of upcoming major anniversaries of significant space events, the JSC History Office is embarking on several efforts. We have begun discussions with the JSC External Relations Office (ERO) regarding plans commemorating significant achievements leading up to and including the 50th anniversary of the first Moon landing in July 2019. Utilizing lessons learned from several Webinars sponsored by the American Association of State and Local History, we have begun a series of short articles in *JSC Today* that highlight the anniversaries of less-celebrated events and people that were nevertheless crucial to achieving the Moon landing within President Kennedy's timetable. Personnel in the ERO use this content to develop feature stories for JSC's home page, as well as Facebook and Twitter posts. We have reached out to other Centers for possible collaboration on future stories.

In September, Ross-Nazzal traveled to Philadelphia for the annual American Cultural Resources conference. Historians, archaeologists, and architectural historians from across the country gathered in this historic city to discuss the state of the field under the Trump administration, to learn about the vital importance of tax credits for historic properties, to explore how climate change will impact heritage sites, and to discuss how those places might be saved. A highlight of the visit was a guided walking tour of Independence National Historical Park and a private reception at the Museum of the American Revolution.

Planning for the 2018 NASA History Program Annual Review is under way. The JSC History Office will be hosting the meeting at the White Sands Test

JSC Historian Jennifer Ross-Nazzal looks over the Electrical, Environmental and COMmunication (EECOM) console as Frank Hughes, a simulator instructor, shares some of his Apollo documents with members of the historic Apollo Mission Control restoration team. (Photo credit: NASA JSC/Norah Moran)

Facility in Las Cruces, New Mexico. John Uri traveled to White Sands in August on a fact-finding mission and found the management team there eager to facilitate the conference. There will be lots of interesting facilities to tour. And based on a small sampling of local restaurants, there will be no problem choosing a suitable venue for the annual dinner.

To celebrate Docomomo Day, an annual celebration of modern architecture and design, Houston MOD, a group of architects and historians who work to preserve modern architecture in the Houston area, contacted JSC Historic Preservation Officer (HPO) Sandra Tetley to set up a visit to the Houston Center. On 6 October, Ross-Nazzal and Tetley gave a brief overview of how and why Houston became home to the Manned Spacecraft Center (now JSC), the development of the campus, its architectural style, and its master plan. Interested in seeing the Center's Brutalist architecture up close, 36 members toured the central mall where many of JSC's buildings are built out of precast exposed aggregate–faced panels in that rugged architectural style. Throughout the walk, visitors saw many of JSC's original buildings, learned more about the master plan for the Center, saw the landscape created out of prairie, and viewed other architectural features. They also visited the floor of historic Mission Control, the International Space Station (ISS) Flight Control Viewing Room, and the Space Vehicle Mockup Facility.

Restoration of the historic Mission Operations Control Room is starting. To understand how the Apollo flight controllers and instructors engaged with their consoles, the back rooms, and the front screens, a series of interviews were held on the floor of the facility in late September. Seated in front of their console, they talked with Jim Remar of the Kansas Cosmosphere about their memories of the room and its look and feel during the lunar program. The Center HPO, the Center Historian, and contractors selected to restore the room and consoles were there to learn more about the space and its layout for the restoration.

Our summer intern Carlos Amaya, a rising sophomore at the University of Houston majoring in computer science, made significant progress on upgrading the JSC History Portal. Unfortunately, the summer flew by, and due to his other commitments in the JSC Knowledge Management Office, Amaya was not able to complete all the upgrades. We are hoping to have the use of another talented intern in the near future to complete the excellent work that Amaya began.

MARSHALL SPACE FLIGHT CENTER

Huntsville, Alabama

By Brian Odom and Jordan Whetstone

The Marshall History Office has devoted much time over the past months to collecting oral histories and processing archival collections. One topic of interest has been research associated with NASA's Gravity Probe B (GP-B) Mission. Launched on 20 April 2004, GP-B utilized ultraprecise, cryogenic gyroscopes to experimentally investigate the two predicted effects of Albert Einstein's 1916 general theory of relativity, the geodetic and frame-dragging effects. Stanford University professor Dr. Leonard Schiff first proposed the experiment to NASA in January 1961. Over the 40-plus years between proposal and flight, the GP-B team at Stanford, Lockheed Martin, and Marshall Space Flight Center developed the diverse portfolio of innovative technologies that made the program a success.

A project is under way in the History Office to collect oral histories with members of the GP-B mission, including personnel from Marshall, Lockheed Martin, and Stanford University. Central to the project are interviews with Stanford University professor and GP-B Principal Investigator Dr. Francis Everitt. As a student, Professor Everitt worked under Nobel laureate P. M. S. Blackett at the University of London (Imperial College) and obtained his Ph.D. in 1959. At the invitation of William Fairbank and Leonard Schiff, Everitt came to the GP-B program in 1962 from the University of Pennsylvania, where he was working in the field of low-temperature physics. Everitt has been a major force in the development of GP-B critical technologies in the areas of magnetics, quantum devices, control systems, quartz fabrication techniques, cryogenics, and gyroscope technology as well as leading the fight to keep the mission funded over the years. NASA awarded Everitt a Distinguished Public Service Medal in 2005 in recognition of his efforts on the GP-B Mission.

Following an oral history interview with former GP-B Project Scientist Dr. Jeff Kolodziejczak, the History Office was given several boxes of materials pertaining to the development, testing, and review of the mission. These materials, along with two models, have been processed and added to the archival holdings. Included in the collection are an assortment of photographs, test data, reports, graduate student papers, publications, and presentation slides. More specifically, there are numerous papers and presentations about the University of Alabama in Huntsville's involvement in solving the problem of slosh in GP-B's 645-gallon, liquid helium–filled dewar. Baffles, or metal ridges, were added to the inside of the dewar to help suppress the sloshing motion of the superfluid helium, steadying the spacecraft when in orbit. While highly technical in nature, the contents of this collection provide an overview of the history of the program.

Shown here is the installation of the Gravity Probe B (GP-B) payload atop the Delta II launch vehicle. (Photo credit: Russ Underwood/Lockheed Martin Corporation)

For more information on the Gravity Probe B Mission, visit *https://einstein.stanford.edu/*.

STENNIS SPACE CENTER (SSC)

Stennis Space Center, Mississippi

By Jessica Herr

A Look Back at the Early Days at Stennis

In 1955, the United States announced that it would launch a satellite for the International Geophysical Year, an international scientific program that opened scientific exchanges between the East and the West that had been interrupted during the Cold War. The Soviet Union responded that they would also launch a satellite "in the near future." The space race had begun.

On 4 October 1957, the Soviet Union launched Sputnik into low-Earth orbit. Then, on 12 April 1961, they launched Vostok 1, sending the first human into space, Yuri Gagarin. The United States had its eye on the big prize, though. The United States was going to the Moon. The space race morphed into the Moon race, and what was then known as the Mississippi Test Facility became a very important factor in the United States winning the race to the Moon. NASA needed a place to test the large rocket engines and stages needed to carry humans to the Moon. In August 1961, an ad hoc committee of members from NASA Headquarters and Marshall Space Flight Center began the work of finding the perfect location. There were several variables to consider, since the rockets would be assembled at the Michoud Assembly Facility outside of New Orleans, Louisiana, and launched from Cape Canaveral, Florida. NASA needed a facility that, ideally, would lie between these two places, be away from a densely populated area because of the noise associated with testing rocket engines and stages, have access to both a waterway and a highway, have a mild climate so testing could conceivably be done year-round, and have supporting communities nearby. Several already existing facilities were in the running, but the committee kept coming back to a marshy, pine tree–covered area along the Pearl River in Mississippi. The Pearl River site won out over the final six locations.

On 25 October 1961, NASA announced that a rocket engine test site would be established in Hancock County, Mississippi. The site, then known as Mississippi Test Operations, would test the Saturn rockets that would one day launch the Apollo missions to the Moon. Construction would begin as soon as possible, but first, residents living along the Pearl River would need convincing to leave their homes in preparation for the building of the test site. U.S. Senator John C. Stennis had been a proponent of the Pearl River site from the beginning and used his contacts in Washington to plant the seed of having NASA operations in Mississippi. Following NASA's announcement, Stennis himself visited residents of the Pearl River communities and appealed to their patriotism in asking them to give up their land and their homes "as a sacrifice in America's crusade against the Soviets." The Soviets had already put humans in space, and America was aiming to win the space race to get a person on the Moon. Stennis promised residents of the Pearl River communities that day that he would make sure that their sacrifice was not in vain, that they were compensated for their property, and that they would never be forgotten for "taking part in greatness."

Logtown Post Office employees lower the flag after completing their final mail delivery in May 1963. Logtown was one of several towns relocated for construction of Stennis Space Center, then known as Mississippi Test Operations. (Photo credit: Russ Underwood/Lockheed Martin Corporation)

OTHER AEROSPACE HISTORY NEWS

IAA HISTORY COMMITTEE

By Otfrid Liepack, Systems Engineer, Jet Propulsion Laboratory

The History Committee of the International Academy of Astronautics (IAA) met on 28 September 2017 in Adelaide, Australia, for its annual meeting. Two of the major topics on the agenda were to prepare for the 51st History Symposium being held at the International Astronautical Congress (IAC) and how the History Committee will continue the celebration of the Apollo 11 landing on the Moon.

"TWO OF THE MAJOR TOPICS ON THE AGENDA WERE TO PREPARE FOR THE 51ST HISTORY SYMPOSIUM BEING HELD AT THE INTERNATIONAL ASTRONAUTICAL CONGRESS (IAC) AND HOW THE HISTORY COMMITTEE WILL CONTINUE THE CELEBRATION OF THE APOLLO 11 LANDING ON THE MOON."

Theodore von Kármán championed the idea of an International Academy of Astronautics, which was created in 1960. The first History Symposium was held in Belgrade in 1967. Since then, the symposia have provided professional historians and history lovers with the chance to present unknown facts or stories of the ever-growing history of spaceflight.

Since 1967, the international history symposium has been held every year. Symposia have been attended by many prominent scholars, pioneers of modern rocketry and astronautics, and specialists in the history of science engaged in these fields. The sessions of the committee are split into Memoirs and Organizational Histories, Scientific and Technical Histories, and a special session in which the host country's contributions to spaceflight will be portrayed. During this year's conference, Australia is in the main focus of the special session. Papers were given about the Deep Space Network, the first Australian satellites, the rocketry pioneer Ken Atock, and the Parkes telescope. Next year's conference in Bremen will focus on the history of Germany's post–World War II contributions to spaceflight. Potential presenters are invited to submit an abstract to the call for papers announcement. More information can be found at *http://iac2018.org.*

Another topic of this year's committee meeting was the continuation of the celebration of the Apollo 11 lunar landing, for which a special session was created with the title "Can you believe they put a man on the Moon?" Through 2019, the History Committee of the IAA is encouraging researchers to present lesser-known stories covering this epic event. Whether these are the unknown heroes, nail-biting moments, or effects on people or societies, we would like to learn about them. Also, the U.S. aerospace industry is being asked to go through their archives to investigate and to present their Apollo 11 contributions at the conferences in Bremen and in 2019 in Washington, DC.

History can be forgotten unless it is being written down, and this is what the IAA History Committee is doing: preserving history. All presentations since 1967 are being published in the IAA History Symposia Proceedings, which are published by Univelt, Inc., at *http://www.univelt.com/History.html*.

ONLINE SOVIET SPACE DOCUMENT ARCHIVE

By Asif Siddiqi, Professor, Fordham University

The long-running Cold War International History Project run by the Woodrow Wilson Center in Washington, DC, recently unveiled a new project to commemorate the history of the space race. The multiyear initiative will involve several conferences, speakers, and events commemorating upcoming anniversaries related to the early days of the space race, including Sputnik, Explorer I, and the Apollo lunar landing. As part of the project, the Woodrow Wilson Center is hosting an archive of original primary source documents from the space race. I am curating the set of documents on the history of the Soviet space program. The first set of 19 documents, translated from the Russian into English, went live on 4 October 2017, the 60th anniversary of Sputnik, and can be found at *http://digitalarchive.wilsoncenter.org/collection/383/space-race*.

> **"THE FIRST SET OF 19 DOCUMENTS, TRANSLATED FROM THE RUSSIAN INTO ENGLISH, WENT LIVE ON 4 OCTOBER 2017…."**

In addition to selecting and editing each document to reflect accuracy in translation, I provided detailed annotations and footnotes explaining the sources. The documents describe both the development of the R-7 intercontinental ballistic missile as well as the decision to initiate the Soviet satellite project and its launch in 1957. The original Russian versions of these documents reside in Russian state archives and were officially declassified in the past decade or so. In the next few years, I hope to expand this archive to include further documents on the ICBM, Sputnik, Vostok, Voskhod, and the N-1 human lunar program.

AMERICAN ASTRONAUTICAL SOCIETY

By Michael Ciancone, Chair, History Committee

2017 Ordway Award

The American Astronautical Society (AAS) Ordway Selection Panel has considered the pool of nominees for the 2017 Ordway Award for Sustained Excellence in Spaceflight History. The Ordway Award is named in memory of Frederick I. Ordway III (1927–2014), a human spaceflight advocate and chronicler of the history of rocketry and space travel. The award recognizes exceptional, sustained efforts to inform and educate on spaceflight and its history through one or more media, such as 1) writing, editing, or publishing; 2) preparation and/or presentation of exhibits; or 3) production for distribution through film, television, art, or other non-print media. The award is managed by the History Committee of the AAS. The recipients of the 2017 Ordway Award are as follows:

- Dr. David Baker
- George S. James
- Lunar Orbiter Image Recovery Project (LOIRP)

2016 Emme Award for Astronautical Literature

The AAS Emme Selection Panel, chaired by Don Elder, has been busy this past summer reviewing titles submitted for the award. After careful consideration, the Panel has selected the following recipient of the 2016 Emme Award:

> **Julian Guthrie**, *How to Make a Spaceship: A Band of Renegades, an Epic Race, and the Birth of Private Spaceflight*, Penguin Press, 2016.

AAS History Series

Univelt has published the *Proceedings of the 49th IAA History Symposium (Jerusalem, Israel)* as volume 47 in the AAS History Series, with Tal Inbar as volume editor. Dr. Rick Sturdevant (Air Force Space Command) patiently serves as series editor.

FELLOWSHIP RECIPIENTS

By William Thompson

Alexander C. T. Geppert, an associate professor of history and European studies at New York University (NYU), is the recipient of this year's NASA Fellowship in the History of Space Technology offered by the Society for the History of Technology (SHOT). His position is divided between NYU-NY and NYU-Shanghai as a member of the university's Center for European and Mediterranean Studies. Alexander's dissertation led to the publication of the monograph *Fleeting Cities: Imperial Expositions in fin-de-siècle Europe* (2010), a historical contextualization of five European expositions. He will utilize a sabbatical from NYU to work on his upcoming book, *The Future in the Stars: Time and Transcendence in the Age of Space, 1942–1972*, a study of the cultural history of the Space Age. Alexander received master's degrees from Johns Hopkins University and Georg-August-Universität Göttingen, and his Ph.D. from the European University Institute.

Andy Bruno, assistant professor of history at Northern Illinois University, is the recipient of this year's History of Science Society (HSS) Fellowship in the History of Space Science. Andy's first book, *The Nature of Soviet Power: An Arctic Environmental History* (2016), evaluates the environmental history of economic transformation in the Russian north during the 20th century. Andy will use his HSS fellowship term to conduct research in Russia and Washington, DC, while working on his upcoming book project, *Landscape of Mystery: The Tunguska Event and the Siberian Environment*. This book will examine the natural disaster known as "the Tunguska event," which occurred in Siberia in 1908, as well as the interdisciplinary attempts to explain it. Andy received his M.A. from the European University at Saint Petersburg in 2004 and his Ph.D. from the University of Illinois at Urbana-Champaign in 2011.

> **"ANDY BRUNO, ASSISTANT PROFESSOR OF HISTORY AT NORTHERN ILLINOIS UNIVERSITY, IS THE RECIPIENT OF THIS YEAR'S HISTORY OF SCIENCE SOCIETY (HSS) FELLOWSHIP IN THE HISTORY OF SPACE SCIENCE."**

Emily Margolis, a doctoral candidate at Johns Hopkins University, is the recipient of this year's NASA-supported Fellowship in Aerospace History offered by the American Historical Association. Her dissertation, "Space Travel at 1G: Space Tourism in Cold War America," focuses on the phenomena of space exploration sites becoming tourist attractions in 20th-century America. Emily focuses on public engagement during the Space Age, as well as the economic benefits in the hospitality sector. Emily hopes to use her fellowship term to conduct research at NASA Centers and archival collections in support of her dissertation. She received her B.A. in physics from Princeton University in 2010 and her M.A. in the history of science and technology from the University of Oklahoma in 2013.

CALL FOR PAPERS

2018 Forum on Philosophy, Engineering and Technology

The mission of the Forum on Philosophy, Engineering and Technology (fPET) is to encourage reflection on engineering, engineers, and technology and to build bridges between existing organizations of philosophers, engineers, and scholars in related fields. The 2018 Forum will be held **30 May–1 June 2018** in College Park, Maryland.

Deadline: 500-word-maximum abstracts must be submitted by **14 January 2018** to *https://easychair.org/conferences/?conf=fpet2018*.

For additional information, visit *https://philosophyengineering.com/*.

DIFFERENT WORLDS: THE CHALLENGES OF U.S. AND SOVIET SETI COLLABORATION DURING THE SPACE AGE[1]

By Rebecca A. Charbonneau, NASA History Division Intern

In 1964, Carl Sagan co-published a now little-known book on the search for extraterrestrial intelligence (SETI) with Iosif Samuilovich Shklovskii, a Soviet radio astronomer. Their book, titled *Intelligent Life in the Universe* (1966), is a fascinating example of scientific collaboration during the Cold War and of how such collaborations were rife with challenges. Shklovskii's relationship with Sagan illuminates these challenges and serves as an example of the ingenuity of Soviet scientists in their struggle to collaborate with their international peers within a contentious system fraught with restrictions and danger.

Carl Sagan (left) and Iosif S. Shklovskii from *Communication with Extraterrestrial Intelligence*, ed. Carl Sagan (Cambridge, 1973). In his compilation of the conference proceedings, Carl Sagan labeled this picture "I. S. Shklovsky, right, unimpressed by an argument."

While Sagan is a household name in the United States, Shklovskii has received little attention from historians, despite being one of the most widely admired astrophysicists and radio astronomers in the USSR.[2] His expertise in radio astronomy prompted a curiosity about the potential of radio waves in interstellar communication, which led to a lifelong obsession with the search for and communication with extraterrestrial intelligence, a subject on which he published extensively. For example, in 1958, in a popular scientific magazine called *Technology for Youths*, Shklovskii speculated on whether or not Mars's moon Phobos might be a hollow artificial satellite created by extraterrestrial beings (a theory he repeated in multiple publications).[3] These eccentric ideas sometimes confused colleagues who could not tell whether or not he was being tongue-in-cheek; a colleague of his once remarked that "50 percent of Shklovskii's ideas are brilliant, but no one can tell which 50 percent they are."[4]

The collaboration between Sagan and Shklovskii first began when Sagan wrote a letter to Shklovskii in 1962.[5] Sagan, who had heard that Shklovskii was the primary Soviet scientist pushing SETI development in the USSR, sent Shklovskii an article he had written, titled "Direct Contact Among Galactic Civilizations by Relativistic Interstellar Spaceflight."[6] Shklovskii told Sagan he wanted to incorporate the paper into the upcoming edition of his popular astronomy book,

1 This essay is adapted from Rebecca A. Charbonneau, "Examining Intelligent Life in the Universe: How SETI Internationalism Facilitated Scientific Collaboration During the Cold War" (master's thesis, University of Oxford, 2017).

2 I. S. Shklovskii, *Five Billion Vodka Bottles to the Moon: Tales of a Soviet Scientist* (New York: W.W. Norton & Co., 1991), p. 35.

3 Carl Sagan and I. S. Shklovskii, *Intelligent Life in the Universe* (San Francisco: Holden-Day, Inc., 1966), p. 362.

4 Herbert Friedman, Introduction to *Five Billion Vodka Bottles to the Moon*, p. 29.

5 Sagan and Shklovskii, *Intelligent Life in the Universe*, p. vii.

6 Carl Sagan, "Direct Contact Among Galactic Civilizations by Relativistic Interstellar Spaceflight," *Planetary and Space Science* 11 (December 1963): 485–498; Sagan and Shklovskii, *Intelligent Life in the Universe*, p. vii.

Universe, Life, Mind.[7] Shklovskii had recently become excited by the prospect of communication with extraterrestrial intelligence and had set out to write a book that addressed the prospect of finding life in space, as well as the significance of the field of radio astronomy in this search.[8] Pleased to share his work with a fellow SETI enthusiast, Shklovskii sent Sagan a copy of the manuscript of his book.[9] Sagan loved the book and wanted to have an English translation made. Shklovskii, enthusiastic about the prospect of sharing his newfound passion for SETI with the rest of the world, agreed.

During the translation process, Sagan contributed to the original text, annotating and adding bits of relevant information for an American audience, until the book had about doubled in size.[10] Sagan marked his contributions to the text by enclosing them within small symbols ("△"and "▽") to delineate his words from Shklovskii's original writing. In his autobiography, Shklovskii recounted his surprise at receiving the English manuscript in the mail, with Sagan's name squished next to his own on the title page, and remarked on how Sagan had "interpreted [his permission for translation] broadly."[11] Despite the danger of miscommunication and hard feelings, however, Sagan and Shklovskii maintained an amiable relationship.

The English manuscript, which was titled *Intelligent Life in the Universe,* was one of the earliest SETI texts published for a general audience, and possibly the first of its kind. In addition to shedding light on the ideas of early SETI and planetary science, *Intelligent Life in the Universe* also illuminates the extent to which Soviet and American scientific writing differed. The differences in language used by Shklovskii and Sagan make it easy to determine who wrote any given paragraph, even if Sagan had not provided the helpful symbols. As a result, the book reads (a little sloppily, in some places) as a dialogue between an American and a Soviet, in which the participants sometimes eagerly supplement each other's thoughts and at other times dispute the roles of dialectic materialism and Marxism in the future of human space travel. For example, "at this point in the Russian edition," Sagan writes in one chapter, "Shklovskii…expresses his belief that as long as capitalism exists on Earth, a violent end to intelligent life on the planet is probable…. I am able to imagine alternative scenarios for the future."[12]

The discordant nature of the book's dialogue did have some advantages, however. In an interview with Bernard Oliver (another SETI pioneer) at a SETI conference in Estonia in 1981, Shklovskii revealed his private thoughts regarding the strong differences of opinion within *Intelligent Life in the Universe*. As a Soviet scientist, he explained,

> I must show respect to Marxism and work "according to Marx," but after preamble Sagan can write "according to Kant…." This is fine because I can show Soviet officials, who say this book has a mistake, that it is not *my* mistake, it's Carl's.[13]

The Soviet officials, whom Shklovskii once, in irritation, dubbed "our vigilant readers," certainly made the publishing of the English translation a challenge.[14]

7 Sagan and Shklovskii, *Intelligent Life in the Universe*, p. vii.

8 Frank Drake and Dava Sobel, *Is Anyone Out There?: The Scientific Search for Artificial Intelligence* (New York: Delacorte Press, 1992), p. 99.

9 Sagan and Shklovskii, *Intelligent Life in the Universe*, p. vii.

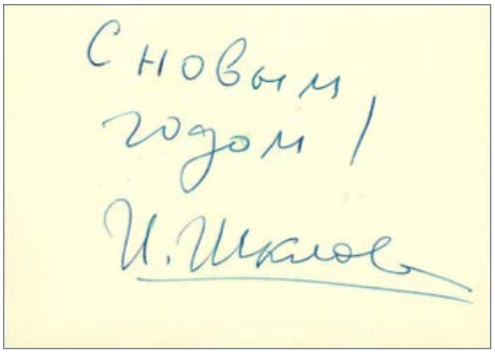
10 Ibid.

11 Shklovskii, *Five Billion Vodka Bottles to the Moon*, p. 251.

12 Sagan and Shklovskii, *Intelligent Life in the Universe*, p. 37.

13 David W. Swift, *SETI Pioneers: Scientists Talk about Their Search for Extraterrestrial Intelligence* (Tucson: University of Arizona Press, 1993), p. 173.

14 Shklovskii, *Five Billion Vodka Bottles to the Moon*, p. 252.



A slightly passive-aggressive note and cartoon, attached with a letter asking why Sagan has taken so long publishing their book. (Image credit: Letter from Shklovskii to Sagan in 1964, located in the Library of Congress, "Correspondence between Iosif S. Shklovskii and Carl Sagan," in The Seth MacFarlane Collection of the Carl Sagan and Ann Druyan Archive, Box 1244, Shklovskii I.S. [Translation: "I hope in this new year my book will be translated in your country! Happy New Year."])

In addition to the challenges of Soviet bureaucracy, as a Jewish scientist, Shklovskii faced difficulties with the anti-Semitism prevalent in the USSR Academy of Sciences.[15] In spite of his many accomplishments, including a Lenin Prize for his work on satellites during the space race, Shklovskii was never elected as a full member of the Soviet Academy of Sciences, which he resentfully concluded was due to his Jewish heritage and his commitment to promoting human rights.[16] Even as his fellow physicists occasionally disappeared or died in mysterious circumstances, Shklovskii would stand up for mistreated colleagues and denounce what he viewed as ethical transgressions committed by the Academy.[17] His penchant for criticism often worked against him, however, as he was frequently barred from traveling abroad. Frustration with the travel restrictions that plagued Shklovskii's life arose time and time again in his correspondence with his international peers. In one letter to Sagan, he wryly wrote: "The probability of us meeting is unlikely to be smaller than the probability of a visit to the Earth by an extraterrestrial cosmonaut."[18]

Unfortunately, travel restrictions were not the only impediments to communication between Soviets and Americans. In another letter from Shklovskii to Sagan in 1963, Shklovskii expressed frustration with the amount of time it had taken to publish *Intelligent Life in the Universe,* and it became clear that the letters Shklovskii sent to Sagan did not always reach him. In one case, it was not until the third attempt at sending one of his letters that Sagan received the information he needed for the publication.[19] It is unclear whether these difficulties were the result of deliberate interference or postal incompetence, but there is a history of evidence of the Soviet government tampering with mail.[20]

In addition to the difficulty surrounding travel and communication, there were also issues regarding finances in Soviet and American collaboration. As noted earlier, despite the success of Sagan and Shklovskii's book, Shklovskii did not receive the proper royalties. In one letter, Sagan noted that the reason for the difficulty in Shklovskii receiving his honorarium was because the "Soviet Union [did] not adhere to the international copyright convention."[21] Sagan was distressed by this inequity and gave Shklovskii a check from his own royalties when they were finally able to meet, at an International Astronomical Union meeting

15 Ibid., p. 16.

16 Friedman, Introduction to *Five Billion Vodka Bottles to the Moon*, p. 17.

17 Ibid., p. 25.

18 Sagan and Shklovskii, *Intelligent Life in the Universe*, p. vii.

19 Library of Congress, "Correspondence between Iosif S. Shklovskii and Carl Sagan," in The Seth MacFarlane Collection of the Carl Sagan and Ann Druyan Archive, Box 1244, Shklovskii I.S.

20 Naomi Godfrey, "U.S. Questions Soviet Interception of Overseas Mail," *The New York Jewish Week* 197 (July 1984): 8.

21 Library of Congress, "Correspondence between Iosif S. Shklovskii and Carl Sagan."

in Prague in 1967. Shklovskii received the check but never cashed it out of fear he would face trouble with the KGB for receiving unauthorized payment from the United States.[22] Given the travel restrictions, KGB, and other potential barriers to communication, it is surprising that there was interaction between Soviet and American scientists at all.

In a 1981 interview given just four years before his death, Shklovskii was asked: "Have you suffered any real sorrow or disappointment or plain real tragedy in your life?" Shklovskii, a man who had labored on rail tracks as a teenager, narrowly survived the Great Terror of the 1930s, experienced both World War II and Stalin's reign, faced anti-Semitism from his Soviet colleagues, and lived all of his life in near-poverty despite his great achievements, replied: "Tragedy? No, absolute [*sic*] 100 percent satisfied. Life is a blue dream."[23] Such a statement elegantly sums up the spirit of the man, who somehow managed to find humor in even the bleakest of moments. He was not completely satisfied with his life, however. When asked what he would like "people in the future to know about [his] feelings," Shklovskii expressed his long-held desire for "a little more degree of freedom."[24] Such a perspective is emblematic of SETI in the mid-20th century—optimistic despite challenges, yet dissatisfied with institutional and national interference. Shklovskii's collaboration with Sagan on *Intelligent Life in the Universe* demonstrates that SETI pioneers operated within the tension between institutional and ideological restraints and were able to connect and form international relationships within a system that often centered on the restriction of free information and international collaboration.

22 Drake and Sobel, *Is Anyone Out There?*, p. 100.

23 Swift, *SETI Pioneers*, p. 174.

24 Ibid., p. 177.

UPCOMING MEETINGS

The 2018 AIAA SciTech Forum will be held **8–12 January 2018** in Orlando, Florida. Visit ***https://scitech.aiaa.org*** for details.

"To Boldly Preserve: Archiving for the Next Half-Century of Space Flight" will be held **1–2 March 2018** at the Center for the History of Physics at the American Institute of Physics in College Park, Maryland. Contact Jonathan Coopersmith at ***j-coopersmith@tamu.edu***, Angelina Callahan at ***angelina.callahan@nrl.navy.mil***, or Greg Good at ***ggood@aip.org*** for details. You may also visit ***https://go.nasa.gov/2v3DUF8***.

The annual meeting for the Society for History in the Federal Government (SHFG) will be held **23–24 March 2018** at the Robert C. Byrd Center for Legislative Studies in Shepherdstown, West Virginia. The theme for the conference is "Federal History in Times of Transition." Visit ***http://shfg.org/shfg/events/annual-meeting/*** for details.

The annual meeting for the Organization of American Historians (OAH) will be held **12–14 April 2018** at the Sacramento Convention Center in Sacramento, California. Visit ***http://www.oah.org/meetings-events/2018/*** for details.

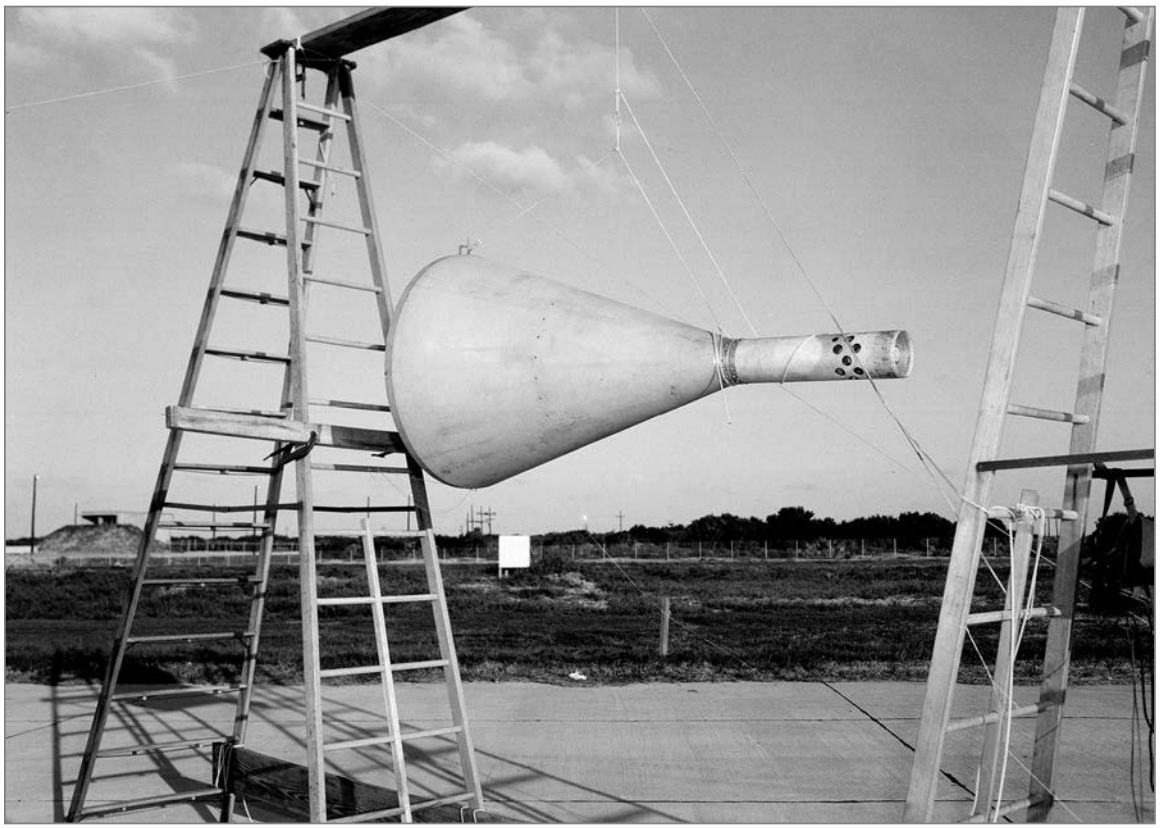
The annual meeting for the National Council on Public History (NCPH) will be held **18–21 April 2018** in Las Vegas, Nevada. Visit ***http://ncph.org/conference/2018-annual-meeting-2/*** for details.

THE RE-ENTRY TEST VEHICLE PROGRAM AND THE SPACE RACE[1]

By Erik M Conway

As NASA is preparing to celebrate its 60th anniversary, I thought it appropriate to dredge up out of JPL's photo archives some rare images of its mid-1950s collaboration with the then–Army Ballistic Missile Agency's (ABMA) Redstone Arsenal. In what was known as the Re-Entry Test Vehicle (RTV) program, the two organizations developed the ability to test the idea of ablative reentry, using a modified Redstone booster, known as a Juno, and subscale Sergeant solid rocket motors. Leftover hardware from that effort was repurposed into the much more famous Explorer 1.

In 1954, the United States proposed putting a scientific satellite into space as an experiment for the International Geophysical Year, which spanned from 1 July 1957 to 31 December 1958. President Dwight Eisenhower had arranged for this satellite to be financed by the National Science Foundation, with the Ad-Hoc Advisory Group on Special Capabilities committee, chaired by Homer Stewart of the Jet Propulsion Laboratory (JPL), who was given the responsibility of choosing the winning proposal. JPL Director William Pickering and Wernher von Braun of the Redstone Arsenal proposed a joint ABMA-JPL project to launch



Shown here is part of the Project Orbiter–configured payload shroud, 14 September 1956. (Copyright California Institute of Technology)

1 This essay is adapted from Erik M. Conway, "From Rockets to Spacecraft: Making JPL a Place for Planetary Science," *Engineering and Science* 4 (2007): 2–10.

a satellite, called Project Orbiter. The other substantial proposal came from the Naval Research Laboratory (NRL) in Maryland, which teamed up with Glenn L. Martin Corporation to use NRL's sounding rocket, the Viking, to launch a 25-pound satellite carrying small instruments and a transmitter. This was called Project Vanguard. In August 1955, the Ad-Hoc Advisory Group on Special Capabilities made its recommendation: Project Vanguard should be approved. The Vanguard proposal had offered a greater scientific return than Orbiter, making it more appealing to a majority of the committee.

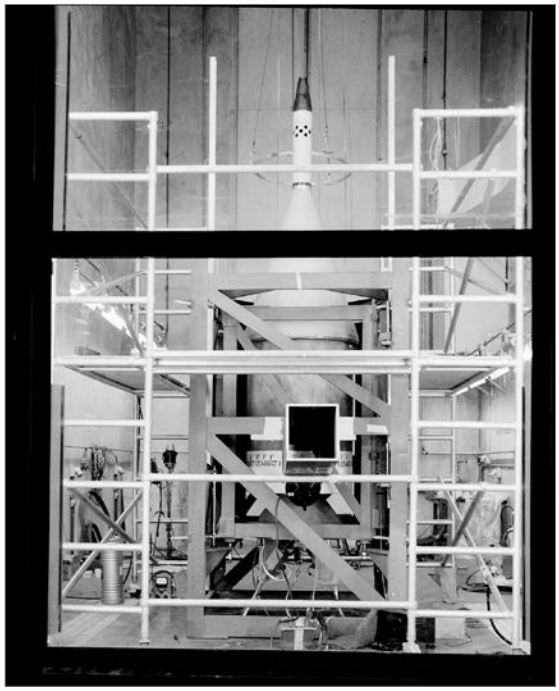
Stewart and one other committee member disagreed vehemently enough to write their own minority report. "I remember staying up 'til three o'clock in the morning at home writing the most purple prose that I have probably ever written, trying to write the minority report as to why I thought that was the wrong way to go," Stewart remembered much later. He thought the Vanguard proposal, which required a substantial scaling-up of its Viking first stage and newly developed second and third stages, would need more developmental work than there was time for, while the ABMA Juno launcher powering the Orbiter program was much further along.

Having lost out on the satellite program, JPL and ABMA instead teamed up on the Re-Entry Test Vehicle Program. The two organizations were involved in the design of an intermediate range ballistic missile named Jupiter, with JPL providing the guidance and control system and ABMA the rocket hardware. The full-scale Jupiter warhead would reach space and have to reenter Earth's atmosphere, which meant it would experience enormous temperatures. Von Braun's V-2 rocket had experienced problems with this heating during World War II—the V-2s had literally disappeared. JPL's Pickering explained later that von Braun's team fired literally hundreds of V-2s in an effort to find out what was happening: the answer was they were exploding from reentry heat. So ABMA needed to prove that it could prevent the Jupiter from experiencing this little problem. The RTV program was designed to prove that an ablative material would provide sufficient protection by simply burning away, carrying much of the heat with it.

Here is another view of the Project Orbiter–configured upper stages, 29 August 1956. (Copyright California Institute of Technology)

Pickering explained it this way: "The idea was to take a Redstone rocket, stick some of these Sergeants on top of it, and throw a reentry test nose cone about two or three thousand miles out into the Atlantic and instrument it to see how it worked. The arrangement of Sergeant rockets was a group of eleven rockets in a ring and inside that was a group of three rockets. What happened was this whole thing was in a circle tub sitting on top of the Redstone rocket, spinning around to give it directional stability. You fired the eleven, then you fired the three, and by then you were going fast enough to go three thousand miles." And, he could have added, fast enough to reach the proper temperature.

JPL also developed the tracking system used for RTV. This was called Microlock. It enabled reception



Missile 27 is shown on the launcher, 17 September 1956. (Copyright California Institute of Technology)

Shown here is the Missile 34 high-speed stages and experimental reentry vehicle, 24 May 1957. (Copyright California Institute of Technology)

of signals as small as a milliwatt in strength from thousands of miles away. ABMA had decided to use transistors—brand new technology—for the RTV's transmitter, but at the time these could operate only at extremely low power levels. The Microlock tracking system could maintain a lock even at those low levels, allowing the missile to be tracked through its entire flight. This was important because the team intended to retrieve the experimental warhead from the ocean so that they could inspect the heat shield. Not getting the warhead back amounted to a failed test.

The RTV program carried out three flights of the ABMA-JPL "stack" in 1956 and 1957, using two different configurations. The first configuration was the "Project Orbiter" configuration, complete with cylindrical spacecraft. General John Medaris had the fourth stage section filled with sand on orders from his superiors, to ensure it did not "accidentally" go into orbit. Known as "Missile 27" and flown on 20 September 1956, this shot was completely successful, proving the functionality of the launch vehicle, tracking, and communications systems. It did not demonstrate the ablative reentry technology, however, as the final stage was not the proper warhead shape. This configuration flew first because the design was done first; surviving correspondence suggests, but does not prove, that JPL and ABMA leaders also hoped its success would overturn the decision to let Vanguard be the first public launch. If that was their intent, it did not work. Medaris ordered Missile 27's backup, Missile 29, put into storage and Missile 34, which had been built with the warhead shape intended for the Jupiter Intermediate Range Ballistic Missile, moved to the front of the queue.

Missile 34's flight in May 1957 was a partial failure. The guidance system failed, but it happened far enough into the flight that the launch vehicle survived it, and it was tracked successfully to its impact in the Atlantic Ocean. The recovery team heard the explosion of a "sonar bomb" they had built into the test vehicle, in approximately the expected location. But the device

This is the Missile 40 reentry vehicle, 6 August 1957. (Copyright California Institute of Technology)

intended to separate the experimental reentry vehicle from the final rocket stage had also failed, and it did not separate. The team assumed it had sunk from the extra weight.

The third flight, Missile 40, was a complete success, and the USS Escape retrieved the floating experimental warhead. This showed little damage from its hypersonic flight—although one of its float bags had shark bites in it, leading to a joke that the previous attempt had been eaten. The ablative heat shield had worked well, although it had not been subjected to as rigorous a test as intended, again due to guidance system troubles. Medaris ended the program after only 3 of the intended 12 flights, and the remaining sets of RTV hardware joined Missile 29 in storage.

At the end of October, President Eisenhower approved Medaris's recommendation to pull Missile 29, the backup to the Project Orbiter–configured RTV flight #1, out of storage. On 7 November, four days after the launch of Sputnik II, Eisenhower made a televised address to the nation on science and technology in national security, using Missile 40's recovered payload as a prop. He explained:

> One difficult obstacle on the way to producing a useful long-range weapon is that of bringing a missile back from outer space without its burning up like a meteor, because of friction with the earth's atmosphere.
>
> Our scientists and engineers have solved that problem. This object here in my office is an experimental missile—a nose cone. It has been hundreds of miles to outer space and back. Here it is, completely intact.

Eisenhower also authorized a payload for Missile 29 after the Sputnik II launch.

Missile 29 became the basis of "Project Deal," the code name for Explorer 1, launched 31 January 1958. The first American artificial satellite, Explorer 1 carried instrumentation for cosmic-ray science and meteoroid detection. Explorer 1 operated for nearly four months and reentered Earth's atmosphere 31 March 1970. The Army's space program ended during 1958, as the U.S. Air Force gained responsibility for intercontinental ballistic missiles (ICBMs), and the National Advisory Committee for Aeronautics (NACA) was transformed into NASA. JPL joined NASA in December 1958, followed in 1960 by the former Army Ballistic Missile Agency's Redstone Arsenal Facility, renamed Marshall Space Flight Center.

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IMAGES IN NASA HISTORY

The NACA shield-and-wings logo was replaced on 1 October 1958, the day NASA officially began operations. With the NASA insignia still in the making, the Centers had to make do by painting over or replacing the "C" in "NACA" with the "S" in "NASA." Today, this door at Armstrong Flight Research Center (then titled the "High-Speed Flight Center") boasts the NASA "meatball" insignia, but the NASA seal, as seen in the bottom photo from 1962, was the immediate successor to the NACA logo.

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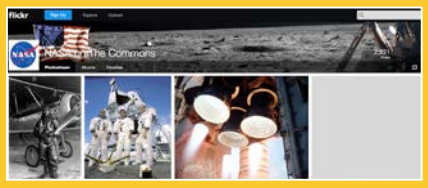

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