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Hello! I am Frank Slazer, the newly elected President of the American Astronautical Society. I am honored to have been chosen to lead a Society which, for fifty-four years, has championed the need for humanity to explore our universe as well as our world from space. In addition to advocacy, through meetings and symposia, our Journal of the Astronautical Sciences and our technical committees, AAS substantively contributes to increasing humanity's understanding of space.

I welcome the opportunity to lead the Society, but I first want to acknowledge the contributions of my predecessor, Mark Craig. Much as Newton is reported to have said that he accomplished so much because he stood on the shoulders of giants, I am certain that whatever accomplishments AAS achieves this year will benefit greatly from Mark's vision and leadership. I would also like to thank the other officers and directors who helped make Mark's tenure so productive.

On January 31st, we celebrated the 50th anniversary of the launch of the first US satellite, Explorer I. Later this year, we shall mark the 50th anniversary of the founding of NASA – the world's first civilian space agency on October 1st. This is an auspicious time. I wonder, however, how many of us truly appreciate the way space has changed our world.

While much attention is understandably drawn to the inspiring exploits of human space explorers and the stunning discoveries of robotic spacecraft, there are many other ways in which space literally has transformed our world. This transformation goes beyond better weather forecasts and entertainment options (OK, maybe just more channels). It includes profound discoveries such as those made by the Hubble Space Telescope, which have necessitated a revision of our theories of the universe. We must now accommodate the known fact that 95% of the universe is dark matter and dark energy, the existence of which was unknown only a decade ago. Global climate change research is inestimably better thanks to space monitoring of the Earth as a whole. Economic globalization is facilitated by satellite communications and navigation systems.

Beyond these leaps of scientific understanding and commerce, I would argue that space technology has changed our political world. Fifty years ago, racial discrimination and segregation were legal in much of the US. With the advent of Syncom II and other telecommunications satellites, the images of dogs being used on peaceful civil rights marchers were no longer something that could be tucked within the shadows. Televising images of the Selma police shocked the world and our national conscience. Soon, change began. The same process of public outrage and reaction have occurred during the breakup of the former Soviet Union, in Bosnia, and in many other places. When terrible actions are exposed to the view of the world, pressure for change usually follows. The omnipresence of space communications and the ease of transmitting or observing, even in the most tightly controlled societies, make reprehensible behavior much less likely to be hidden from scrutiny - and so they are less likely to occur.

I look forward to working to assure that the Society serves its members and its vital mission to advocate the benefits all can reap from space activity. I invite and encourage you, as members, to get involved. Consider participating in Society activities as we seek to grow and advance the Society in the year ahead.

AAS – Advancing All Space

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ON THE COVER

FRONT: This Chandra X-ray Observatory image shows Westerlund 2, a young star cluster with an estimated age of about one or two million years. Westerlun 2 contains some of the hottest, brightest and most massive stars known. *(Source: NASA/CXC/Univ. de Liège/Y. Naze et al)*

BACK: This visible-infrared image shows an incoming view of Mercury, about 80 minutes before MESSENGER's closest pass of the planet on January 14, 2008, from a distance of about 27,000 kilometers (17,000 miles). *(Source: NASA/Johns Hopkins University Applied Physics Laboratory/ Carnegie Institution of Washington)*

So, What is this "Not Gravity?"

by Bo Walkley

Nobel Prize winner Dr. John C. Mather recently discussed "Finding Our Origins with the James Webb Space Telescope" during a Colloquium at the NASA Langley Research Center. The first question asked from the audience at the conclusion of Dr. Mather's talk was "*What is gravity?*" Dr. Mather acknowledged the difficulty of a definitive answer to this question as mankind continues to ponder the considerable mysteries and miracles of the universe. I can add virtually nothing intellectually or philosophically to a question of this magnitude, but I did have a recent once-in-a-lifetime opportunity to experience the sensations of zero gravity. I returned to earth thrilled, yet further mystified by the realities of our lives in a 1-g environment. So what is this "not gravity" all about?

My adventure began one evening as I was working late (again). When the boss (Dr. Robert Lindberg) called this time, he posed a question I could answer easily: *"I got a call about a seat on a zero g flight and I can't go – would you like to?"* My answer was an immediate *"yes!"* I had been pondering my upcoming decadal birthday that starts with a "6," and I was looking for something to mark the event to prove I still "had it." Here it was - the opportunity to gain firsthand knowledge of something that only a small number of human beings had ever experienced – weightlessness. I'm not referring to the familiar sensation of weightlessness experienced due to buoyancy in water – we've all done that. This would be true weightlessness, just like the astronauts I've watched since the early days of the space program. I recall a black and white television with rabbit ears and a fuzzy picture, as classmates gathered around to see this new, fascinating world unfolding Items surrounding Alan Sheppard and the other Mercury and Gemini astronauts floated by. Now, it would be my turn. I smiled to myself. Then, I suddenly remembered the term "Vomit Comet."

As a member of the National Institute of Aerospace, I am associated with a number of programs undertaken to address persistent challenges in inspiring young people to pursue careers in science and engineering. NIA continues to be involved in a number of initiatives working with K-12 students, pre-service and in-service teachers, undergraduate college students, and graduate students. In addition, NIA offers opportunities for working engineers to expand their technical capabilities through short courses and workshops, and we reach out to the general public across the United States through programs such as our *Discovery Now©* radio spots. All of this activity has a single goal: to inspire and train the next generation of engineers and scientists, who will contribute to the continued advancement of mankind.

My zero g flight, I learned, would be part of a similar public outreach program sponsored by the Northrop Grumman Foundation. The *Weightless Flights of Discovery* program is offered by the Foundation to inspire the next generation of scientists, mathematicians and engineers – critical areas where the U.S. has fallen behind globally. To accomplish this goal, more than 40 middle school teachers, along with local media, were given the opportunity to experience weightless flight firsthand so they could take the experience back to their classrooms and readership. The local presence of Northrop Grumman Newport News (a major shipbuilding operation) resulted in this opportunity in our community, with the flight departing from the Newport News-Williamsburg International Airport (PHF).

All smiles and anticipation at 1 g, we anxiously await our departure to the world of weightlessness. (Source: www.gozerog.com/photos)

In the first three parabolasa, we experienced Martian and Lunar gravity. (Source: www.gozerog.com/photos)

Our weightless flight was provided by Zero Gravity Corporation (ZERO-G®, www.gozerog.com). Founded in 1993, ZERO-G is a privately held space entertainment and tourism company. Its mission is to bring the excitement and adventure of weightlessness to the public through a safe, fun and cost-effective experience. Headquartered in Las Vegas, ZERO-G is co-founded by space visionary and entrepreneur Dr. Peter H. Diamandis, veteran astronaut Dr. Byron K. Lichtenberg, and NASA engineer Ray Cronise. ZERO-G is the first and only FAA-approved provider of commercial weightless flights for the general public. The *ZERO-G Experience*™ launched in October 2004. ZERO-G has since successfully flown more than 2,500 passengers aboard 100 flights. In April 2006, ZERO-G became the first commercial company to gain permission from the Kennedy Space Center to use the shuttle runway and landing facilities to operate its weightless flights. As of April 21, 2007, ZERO-G also began offering regular flights for the general public from Signature Air Terminal at McCarran International Airport in Las Vegas.

In 2006, ZERO-G joined Northrop Grumman, sponsor of the *Weightless Flights of Discovery*, in an innovative science and engineering education program incorporating zero-gravity flight experiences for teachers. The program utilizes hands-on science workshops and ZERO-G's unique weightless flights to help educators share the fun and excitement of science, technology, engineering and math with their students. The program realizes ZERO-G's mission to utilize its capabilities for the public sector as a way to further teacher and student knowledge and understanding of science, while inspiring the next generation of space explorers. In its inaugural year, the program hosted 250 teachers representing 49 states, five U.S. territories and 24 countries. In 2007, ZERO-G and Northrop Grumman flew approximately 400 teachers and college students.

Our day began by reporting mid-morning to a local hotel. After cross checking various paperwork items submitted before the event, we were each issued a flight bag, a flight suit, and a considerable dose of enthusiasm and energy from the Northrop Grumman Foundation and ZERO-G employees awaiting us. We soon learned that we were the "second shift," as another group had already headed to the airport for their flight. We also learned that poor weather the day before had resulted in late evening arrival of the aircraft and crew, so FAA crew rest regulations would delay our flight by a couple of hours.

We suited up (including colored socks indicating which team we were assigned to) and placed personal items in our flight bags which would remain securely on the ground. The teachers began unpacking an array of experiments they planned to conduct and film during weightlessness – these had been developed in a previous workshop also sponsored by the Northrop Grumman Foundation.

My own name badge identified me as "media" – I've never served as a journalist before, so I tried to hang out with the local Daily Press newspaper writer and photographer to talk about the flight and how "we reporters" would cover it.

Rolf Bartschi, Vice President and Chief Nuclear Engineer at Northrop Grumman Newport News, spoke to the group, noting the upcoming need to hire several hundred new engineers to support the local shipbuilding industry, and the challenges being faced in recruiting qualified personnel for these well paying, technically challenging jobs. Northrop Grumman's concern about the continuing decline in the numbers of technically trained engineers and scientists was being directly addressed through programs such as the *Weightless Flights of Discovery*.

We soon moved into our pre-flight briefing. This included live discussion and a video on the do's and don'ts of weightless flight: *Do* eat the bagels and muffins provided as that's good for your stomach. *Do* lie on your back and focus on a spot on the fuselage ceiling as the parabola is entered to prepare your brain and stomach for weightlessness. *Do* listen for the "feet down" call as the aircraft exits the weightless portion of the parabola – otherwise you may return to the floor on your head (I did). *Don't* kick or swim (that won't work), and lastly, *Don't* forget to

More smiles as we enjoy the upside-down orientation while the author (second from left) attempts to simultaneously take a photo or two. (Source: www.gozerog.com/photos) have fun! Our team leaders then met with us to talk more about the experience, and to coordinate the various experiments the teachers were planning to execute. We were then issued motion sickness pills as a precaution, and headed for the bus to the airport.

As a continuing sign of our times, two representatives of the Transportation Security Administration greeted us in the hallway with their wands as we prepared to board the bus for the short ride to the airport. We soon arrived at PHF and were delivered to the aircraft, a Boeing 727-200, one of those venerable aircraft that made their mark on the world for many years as commercial carriers. These days, pilots often refer to these as "Jurassic Jets." This particular aircraft has been modified for weightless flights under the watchful eye of the FAA; we were reassured that the maneuvers to be flown were well within the aircraft's design envelope.

After a group photo, we boarded the aircraft through its rear stairs, placed our shoes in bags and put on our team socks. Though the aircraft retained several rows of seats in the back, with most of the fuselage was empty except for the padding on the interior of the fuselage, along with several camera mounts and lights. There were only a couple of windows. Excitement was building, and we were ready to go. What was this really going to be like, I wondered?

The plan for the flight was fifteen parabolas to be conducted over about thirty minutes of flight time. The first parabola was to simulate Martian gravity (1/3 g), followed by two lunar gravity events (1/6 g). Twelve zero g parabolas would then be flown. Each parabola would afford about 25-30 seconds of reduced or zero g. Parabolas would be flown in "threes", with a few minutes between each "three" as the aircraft was set up for the next series. Each maneuver began with a 45-degree climb followed by at dive at 30 degrees. As we cruised out over the Atlantic ocean to the airspace designated for our flight – a 10 mile wide by 100 miles long track up to about 30,000 feet altitude. The experiments and other items were unpacked and secured for ready access during the upcoming parabolas.

"The *Weightless Flights of Discovery* program is offered by the Foundation to inspire the next generation of scientists, mathemeticians and engineers."

And then came the call – it was time to lie down and prepare for the first parabola. There were still smiles and conversations, but this was it, no turning back now! A quiet settled over us, lying on the floor, as we stared at the ceiling of the fuselage. "Thirty seconds to Martian gravity," came the call.

And then there it began. The aircraft nosed up, taking us to 1.8g's. This was a curious sensation it itself as arms and legs grew heavy, and difficult to move. Then, smiles all around - Martian gravity…lunar gravity…twice! "Now we know what the astronauts experienced," I thought. There was much laughter. What about the experiments? Well, some are being tried. The normal sensation of 1 g returned, too soon. But we knew that more was to come.

"Thirty seconds," came the call again. This time, zero g allowed me to experience levitation. I was slowly rising, disoriented as I realized I was truly weightless. Teachers scrambled to retrieve and conduct experiments. Some were successful, but frustration showed on their faces, as it was hard to precisely control movements, or to remain still and steady for pictures. Then came the order to place "feet down." Soon, we were all on the floor, readying for the next 0 g pass. There were smiles, laughter, giggles, and chatter – this was fun!

By the next call for "Thirty seconds," we were veterans. We had been to the Moon and Mars. We had experienced 0 g. This time we were ready to truly explore this weightlessness environment. Some drink drifting globules of water, others retrieved floating M&Ms with their mouths. Superman flies! Somersaults abound. We stand on our heads. Everyone was determined to get the most from their weightless opportunity. Experiments? What experiments?

Suddenly, it was over. A dozen 0 g parabolas passed far too quickly. "Let's do it again," many shouted. The "Vomit Comet" had gotten to only two participants, but even they were still smiling. The flight back to PHF was very different than the flight out. Nervousness has been replaced with animated conversation, pure joy following this "not gravity" experience. Back at the hotel, we each proudly received our "Zeronaut" certificates and continued to relive the experience.

This truly was a once in a lifetime experience. Northrop Grumman Foundation and ZERO-G have found a way to give teachers (along with some of the rest of us) a story that will excite their students for years to come. And yes, we got to keep the flight bag and the flight suit. I wore mine to the next NIA staff meeting.

Now, if I can just find my way onto another flight … ■

Bo Walkley **is the Director for NASA Langley programs at the National Institute of Aerospace in Hampton, VA. He has worked in the aerospace industry for 35 years.**

Information in this article regarding the Zero Gravity Corporation was obtained at www.gozerog.com.

Brigadier General Bernard A. Schriever and the Foundation of our Defense of Freedom

by C.W. "Bill" Getz, Lt. Col. USAF (Retired)

The nation's ballistic missile program was born in a cradle of crisis. In early 1953, the CIA discovered that the Soviet Union was significantly ahead of the United States in the development of an intercontinental ballistic missile. It took almost a year for this nation to get a major program started and only after coalescing events which included the intelligence bombshell, the election of Dwight Eisenhower to the presidency, and a breakthrough in our own thermonuclear device tests.

After World War II, the major intercontinental ballistic missile effort in the United States was pursued in-house on a low priority by the Convair division of the General Dynamics Corporation in San Diego, using mostly their own funds. Convair gave their missile the name "Atlas."

On February 10, 1954, a group was assembled in the Pentagon to tackle the nation's missile deficiency. This group, known as the Teapot Committee, recommended that a "radical reorganization of the Atlas project and the nation's missile effort was required if a militarily useful vehicle was to be fielded within a reasonable span of time." They were talking about a six to eight year time frame.

The newly formed Ramo-Wooldridge Corporation was contracted by the Air Force to conduct an engineering evaluation of the Atlas. The report advocated the creation of a special Air Force organization to manage the entire effort on behalf of the government. By April of 1954, Air Force secretary Harold Talbot approved the committee's recommendations and Brigadier General Bernard A. Schriever was told to organize that special organization on the west coast. It was given the code name "Western Development Division, or just plain "WDD."

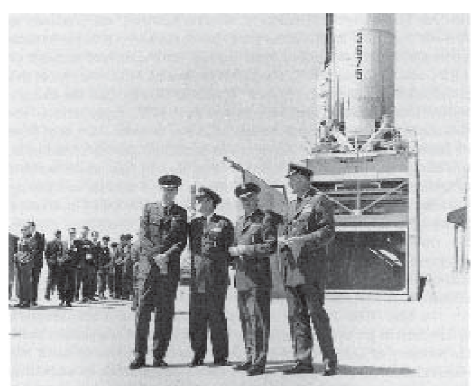
General Schriever was serving in the Pentagon at the time, and was no stranger to the politics of the military and department of defense. With the help of members of the Teapot Committee, he insisted on special organization arrangements. These were quickly approved all the way to the presidential level. Schriever's demands and results showed how a government organization can achieve extraordinary results to meet extraordinary conditions.

First, General Schriever insisted that his review and approval channels be shortened. In practice if not on paper, he reported directly to the Secretary of the Air Force, who in turn was directed to report ballistic missile program matters directly to the president. That did chafe a few egos. General Schriever's road to success was strewn with rocks and boulders of dissent.

General Schriever also requested that he have priority in the assignment of personnel no matter what their current assignment. He was given that authority. This may have been his most important authority in order to get the program started on a crash basis. It did not make him popular within the Air Force. If he had asked for Mamie Eisenhower for his Deputy, he probably would have prevailed. Washington was in panic mode.

The way General Schriever proceeded was classic. His first priority was to get people whose competencies he knew personally. He did not select Mamie, but chose as his Deputy Commander Colonel Ozzie Ritland, then Commander of the 4925th Test Wing of the Special Weapons Command at Kirtland Air Force base, Albuquerque, New Mexico. Ozzie Ritland and Bennie Schriever had a long-time friendship dating back to the 1930s. Ritland and his Test Wing had just come off the highly successful and important thermonuclear tests at Enewetok, which made the ballistic missiles program achievable. Ritland, later promoted to Major General, in turn named a number of officers from the special weapons command including his Deputy Wing Commander in Albuquerque, Col. Charles "Terry" Terhune who in turn picked Lt. Col. Otto Glasser and others. Both Terhune and Glasser later became Lieutenant Generals. I was also in the Albuquerque contingent. All had top secret clearances, a major consideration for the initial cadre. Other initial recruits came from the Pentagon and the technical programs at Wright-Patterson Air Force Base.

From 1954 into 1955, the Ramo-Wooldridge Corporation performed a complete engineering overhaul of the Atlas.



Gen. Bernard Schriever, Maj. Gen. Thomas Gerrity, Lt. Gen. Archi Old and Lt. Gen. Howell Estes, Jr. attend ceremonies to mark operational readiness of a Titan site near Lowry Air Force Base, Colorado, in May 1962 (Source: U.S. Air Force historic photo)

It went from a six-engine, 450,000 pound behemoth to a three-engine, 240,000 pound vehicle that could deliver a thermonuclear warhead 5000 miles and impact a target with a 1500 foot circular error probability. Further, R-W estimated the program could achieve initial launch capability within three to four years, instead of six to eight years. The technical problems facing the program were formidable, involving the necessity of breakthrough technologies in nose cones, engines, and guidance systems.

The bottom line was that Bennie Schriever had unprecedented authority and resources with backing from the president himself to get the job done. These channels did not set well with all Air Force Commanders, and the inter-service political pressures were constant, and we even had the general accounting office breathing down our necks. But General Schriever handled these problems with tact in public and some times with colorful language in private.

Schriever's hand-picked blue suiters worked literally alongside the Ramo-Wooldridge staff. R-W was the technical director and system integration contractor. The Air Force was the general manager and contract administrator. It was abundantly clear the Air Force did not have the blue suit resources for the job without the help and support of the Ramo-Wooldridge staff. The Ramo-Wooldride Corporation and all of our industry partners were the unsung heroes of the program.

Operational planning for use of ICBMs started early. The boss appointed a director of operations, Colonel William "Red" Sheppard. Later, General Lemay reluctantly established a SAC liaison office with Colonel Bill Large in charge, and where panel member Dick Henry began his missile career. The Air Material Command started a small liaison office to develop logistic requirements for operational forces, and to assist General Schriever in contract administration. Headed initially by Colonel Morris, the office was soon expanded under the leadership of panel member Major General Ben Funk. On a personal note, I consider Ben Funk, who received his wings in 1936, to be one of the most gentlemanly and finest officers I have ever known.

On October 4, 1957, the Russians launched the first Sputnik orbiting vehicle. All hell broke loose again in Washington. The nation's space program was inaugurated on a crash basis with General Schriever under still more intense pressure. Two months later, on December 17, 1957, the first Atlas missile was launched, three and a half years after the start of WDD, demonstrating what one author described as "man's endless capacity to make catastrophe the catalyst of creativity."

> "Washington was in panic mode. The way General Schriever proceeded was classic."

Major credit for the technical direction rightfully belongs to the Ramo-Wooldridge technical team. The overall management of the program and unique management tools developed by General Schriever and the blue suiters became a model for future management in government and industry. At its peak, the missiles and space program under WDD, later called the Ballistic Missiles Division, or BMD (we government types love our acronyms), encompassed 2000 industrial contractors employing more than 40,000 personnel at an annual cost of more than one billion 1954-1959 dollars. General Schriever's techniques of management control over this vast operations is perhaps his most single, personal, and critical contribution to the programs, a point often overlooked in evaluating his accomplishments.

What would General Bernard Adolph Schriever say today about the Air Force's early ballistic missile programs? My own job gave me special insights into what his thoughts might be. In these closing paragraphs, permit me the audacity to suggest that if General Schriever was at this podium he might say something to you like this – particularly after attending the dedication of a statue of himself, which was unveiled yesterday at the Space and Missile Complex down the road:

"Good morning. Yesterday I stood looking at a statue of a General. He looked familiar. The first thought that came to mind was this must be one of the few statues in the world of a General who is not sitting on a horse.

My second thought was of Secretary Harold Talbott looking down from his perch above and saying, 'Bennie, that is an appropriate pose for your statue. There you are with your hand out, looking for more money for your missiles.'

Those of you who have seen the statue would understand the secretary's comment.

My third thought came as I looked at the base holding up the horseless General. I thought it was very representative of the thousands of people in blue suits, grey suits, white shirts, blue shirts and coveralls that held up that General when he was flesh and bones, and not bronze. I understand that the higher the stone in the pyramid the more stones are supporting it from below.

Like the foundation of that statue, the foundation of this nation's defense of freedom consists of the military-industrial complex. We owe the defense industry a debt of gratitude, and I wanted to take this special occasion to say to all of them, and to Si Ramo and the late Dean Wooldridge, and to all of you, a salute and a thank you."

This article is based upon a speech made on November 16, 2007. Dr. Getz was speaking on behalf of the Heritage Panel at the Air Force Association (AFA) Symposium in Los Angeles, California.

The Constellation Architecture

by Michael D. Griffin

As those who have attended any speech I've given know, I don't read well in public. Everyone seems to enjoy the interactive sessions that typically follow somewhat more. However, I wanted my thoughts on this topic to be available on the written record, so if my remarks this morning come across as an engineering lecture, then I have succeeded. I hope you all had a strong cup of coffee.

Today's topic is motivated by the inquiries I've had lately, in one forum or another, concerning various aspects of NASA's post-Shuttle spaceflight architecture. None of the questions is new, and all of them were elucidated during our Exploration Systems Architecture Study (ESAS). The architecture is essentially as it was coming out of ESAS back in September 2005, and the architectural trades we made then when considering mission requirements, operations concepts, performance, risk, reliability, and cost hold true today.

But more than two years have gone by, and the logic behind the choices we made has receded into the background. People come and go, new questioners lacking subject matter background appear, and the old questions must be answered again if there is to be general accord that NASA managers are allocating public funds in a responsible fashion. And so it seemed to me that the time was right to review, again, why we are developing the post-Shuttle space architecture in the way that we are.

As many of you know, I used to teach space system engineering at George Washington University and the University of Maryland, and am more comfortable discussing engineering design than just about any other topic. But as NASA Administrator, I must first frame the Constellation architecture and design in the context of policy and law that dictate NASA's missions. Any system architecture must be evaluated first against the tasks which it is supposed to accomplish. Only afterwards can we consider whether it accomplishes them efficiently, or presents other advantages which distinguish it from competing choices.

So to start, we need to review the requirements expressed in Presidential policy and, subsequently, Congressional direction, that were conveyed to NASA in 2004 and 2005. The principal documents pertinent to our architecture are President Bush's January 14th, 2004 speech outlining the Vision for Space Exploration, and the NASA Authorization Act of 2005. Both documents are a direct result of the policy debate that followed in the wake of the Columbia tragedy five years ago, and the observation of the Columbia Accident Investigation Board (CAIB), "The U.S. civilian space effort has moved forward for more than thirty years without a guiding vision."

Several items of specific direction are captured in the President's speech: "Our first goal is to complete the International Space Station by 2010. We will finish what we have started, we will meet our obligations to our 15 international partners on this project."

"Research on board the station and here on Earth will help us better understand and overcome the obstacles that limit exploration. Through these efforts we will develop the skills and techniques necessary to sustain further space exploration."

"Our second goal is to develop and test a new spacecraft, the Crew Exploration Vehicle, … and to conduct the first manned mission no later than 2014. The Crew Exploration Vehicle will be capable of ferrying astronauts and scientists to the Space Station after the shuttle is retired. But the main purpose of this spacecraft will be to carry astronauts beyond our orbit to other worlds."

"Our third goal is to return to the moon by 2020…" "With the experience and knowledge gained on the moon, we will then be ready to take the next steps of space exploration: human missions to Mars and to worlds beyond."

In support of the President's Vision for Space Exploration, NASA Administrator Michael Griffin is working to ultimately land humans on Mars. This region of Mars, observed by MRO, has a thin layer of bright dust that covers dark bedrock and shows evidence of Martian dust-devils. (Source: NASA/JPL/University of Arizona)

After extensive debate, the Congress offered strong bipartisan approval of these goals, while adding considerable specificity. From the 2005 Authorization Act for NASA, "The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program, to promote exploration, science, commerce, and United States preeminence in space, and as a stepping-stone to future exploration of Mars and other destinations."

"The Administrator shall manage human space flight programs to strive to achieve the following milestones.

(A) Returning Americans to the Moon no later than 2020.

(B) Launching the Crew Exploration Vehicle as close to 2010 as possible.

(C) Increasing knowledge of the impacts of long duration stays in space on the human body using the most appropriate facilities available, including the ISS.

(D) Enabling humans to land on and return from Mars and other destinations on a timetable that is technically and fiscally possible."

The bill establishes specific requirements for the International Space Station, noting that it must "have an ability to support a crew size of at least six persons," codifying a long-promised design feature in law. It also details statutory requirements for Shuttle transition, including maximizing the use of Shuttle assets and infrastructure: "The Administrator shall, to the fullest extent possible consistent with a successful development program, use the personnel, capabilities, assets, and infrastructure of the Space Shuttle program in developing the Crew Exploration Vehicle, Crew Launch Vehicle, and a heavy-lift launch vehicle."

Collectively, these requirements outline the broad policy framework for the post-Shuttle U.S. human spaceflight architecture: We will manage the U.S. space program so as to complete the International Space Station by 2010, utilizing the Space Shuttle for that purpose, after which it will be retired. After completion, the ISS will be used to "better understand and overcome the obstacles that limit exploration." The Shuttle will be replaced as soon as possible, but not later than 2014, by a Crew Exploration Vehicle designed to take humans to the Moon and beyond, but which must also be capable of servicing the ISS and its crew of six. The architecture must support human lunar return not later than 2020 and, after that, development of a sustained human lunar presence, both for its intrinsic benefits and as a "stepping stone" to Mars and beyond. Finally, the new architecture must take advantage of existing Space Shuttle program assets "to the fullest extent possible."

> "The Shuttle will be replaced as soon as possible, but not later than 2014, by a Crew Exploration Vehicle designed to take humans to the Moon and beyond, but which must also be capable of servicing the ISS and its crew of six."

Not that anyone asked, but I consider this to be the best civil space policy to be enunciated by a president, and the best Authorization Act to be approved by the Congress, since the 1960s. But no policy is perfect, and none will please everyone. In particular, many in the exploration community, as well as many of those who pursue space science, were disappointed by the reaffirmation of our nation's commitment to the ISS. But a plain reading of policy and law requires us to understand that, throughout four presidential administrations and twenty-plus Congressional votes authorizing tens of billions of dollars for its development, the ISS has remained an established feature of U.S. space policy. Its support and sustenance cannot be left to chance; the CEV must and will be capable of fulfilling this requirement, and the exploration architecture must and will take that into account. This is nothing more than common sense. The U.S. government will not abandon its commitment to the development and utilization of low Earth orbit (LEO).

There continue to be many questions about NASA's long-term commitment to ISS, so let me clarify. The Bush Administration has made no decision on the end date for ISS operations. We are, of course, concerned that Station operating costs after 2016 will detract from our next major milestone, returning to the Moon by 2020. But while the budget does not presently allocate funds for operating ISS beyond 2016, we are taking no action to preclude it. Decisions regarding U.S. participation in ISS operations after 2016 can only be made by a future Administration and a future Congress. I am sure these will be based on discussions with our international partners, progress toward our Exploration goals, utility of this national laboratory, and the affordability of projected ISS operations. Again, we plan to keep our commitments to our partners, utilizing ISS if it makes sense.

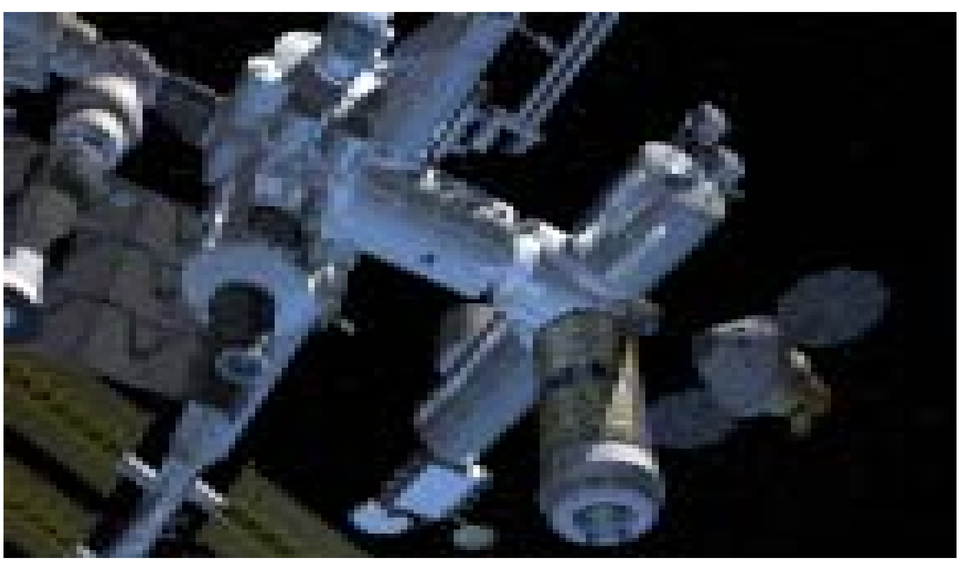
Now, returning to our space architecture, note the order of primacy in requirements. We are not primarily building a system to replace the Shuttle for access to LEO, and upgrading it later for lunar return. Instead, we are directed to build a system to "carry astronauts beyond our orbit to other worlds", but which can be put to the service of the ISS if needed.

In brief, we are designing for the Moon and beyond. That too is only common sense. Once before, an earlier generation of U.S. policymakers approved a space flight architecture intended to optimize access to LEO. It was expected – or maybe "hoped" is the better word – that, with this capability in hand, the tools to resume deep space exploration would follow. It didn't happen, and with the funding which has been allocated to the U.S. civil space program since the late 1960s, it cannot happen. Even though from an engineering perspective it would be highly desirable to have transportation systems separately optimized for LEO and deep space, NASA's budget will not support it. We get one system; it must be capable of serving in multiple roles, and it must be designed for the more difficult of those roles from the outset.

There are other common-sense requirements which have not been written down. The most obvious of these, to me, is that the new system will and should be in use for many decades. Aerospace systems are expensive and difficult to develop; when such developments are judged successful, they tend to remain in use far longer than one might at first imagine. Those who doubt this should look around. The DC-3 and the B-52, to name only two landmark aircraft, remain in service today. The Boeing 747 has been around for thirty years, and who doubts that it will be going strong for another thirty? In space, derivatives of Atlas and Delta and Soyuz are flying a half-century and more after their initial development. Ariane and its derivatives have been around for three decades, with no end in sight. Even the Space Shuttle will have been in service for thirty years by the time it retires. Apart from Saturn/Apollo, I am hard put to think of a successful aerospace system which was retired with less than several decades of use, and often more.

The implications of this are profound. We are designing today the systems that our grandchildren will use as building blocks, not just for lunar return, but for missions to Mars, to the near-Earth asteroids, to service great observatories at SunEarth L1, and for other purposes we have not yet even considered. We need a system with inherent capability for growth.

Elsewhere, I have written that a careful analysis of what we can do at NASA on constant-dollar budgets leads me to believe that we can realistically be on Mars by the mid-2030's. It is not credible to believe that we will return to the Moon and then start with a "clean sheet of paper" to design a system for Mars. That's just not fiscally, technically or politically realistic. We'll be on Mars in thirty years, and when we go, we'll be using hardware that we're building today. So we need to keep Mars in mind as we work, even now. And that means we need to look at both ends of the requirements spectrum. Our new system needs to be designed for the Moon, but allow U.S. government access to LEO. Yet, in designing for the Moon, we need also to provide the maximum possible "leave behind" for Mars. If we don't, then a generation from now there will be a group in this room, listening to the Administrator of that time ask, about those of us here today, "what were they thinking?"



NASA's Orion spacecraft will be capable of landing on the Moon, as well as supporting human and cargo delivery to the International Space Station. (Source: NASA)

Now, in mentioning "Mars" I must state for the record that I do realize that the $550 billion Consolidated Appropriations Act signed into law last month stipulated that no funds appropriated in 2008 "shall be used for any research, development, or demonstration activities related exclusively to the human exploration of Mars." While I personally consider this to be shortsighted, and while NASA was in any case spending only a few million dollars on long-term research and study efforts, we will of course follow this legislative direction. And while this provision does not affect work on Ares V, it does call into question the fundamental rationale for our use of Space Station in long-duration human spaceflight research. I hope that this funding restriction can be abandoned in/ future years.

Further application of common sense also requires us to acknowledge that now is the time, this is the juncture, and we are the people to make provisions for the contributions of the commercial space sector to our nation's overall space enterprise. The development and exploitation of space has, so far, been accomplished in a fashion that can be described as "all government, all the time."

That's not the way the American frontier was developed, it's not the way this nation developed aviation, it's not the way the rest of our economy works, and it ought not to be good enough for space, either. So, proactively and as a matter of deliberate policy, we need to make provisions for the first step on the stairway to space to be occupied by commercial entrepreneurs – whether they reside in big companies or small ones.

The policy decision that the CEV will be designed for the Moon, while not precluding its ability to provide access to LEO, strongly reinforces this common sense objective. If designed for the Moon, the use of the CEV in LEO will inevitably be more expensive than a system designed for the much easier requirement of LEO access and no more. This lesser requirement is one that, in my judgment, can be met today by a bold commercial developer, operating without the close oversight of the U.S. government, with the goal of offering transportation for cargo and crew to LEO on a fee-for-service basis. This is a policy goal – enabling the development of commercial space transportation to LEO – that can be met if we in government are willing to create a protected niche for it. To provide that niche, we must set the requirements for the next-generation government spaceflight system at the lunar-transportation level, well above the LEO threshold.

Now again, common sense dictates that we can ISCB hostage to cfortune; we cannot gamble the fate of a multi-tens-of-billions-of-dollar facility on of a commercial operation, so the CEV must be able to operate efficiently in LEO if necessary. But we can create a clear financial incentive for commercial success, based on the financial disincentive of using government transportation to LEO at what will be an inherently higher price. To this end, as I have noted many times, we must be willing to defer the use of government systems in favor of commercial services, as and when they reach maturity. When commercial capability comes on line, we will reduce the level of our own LEO operations with Ares/Orion to that which is minimally necessary to preserve capability, and to qualify the system for lunar flight.

So how is all of this – law, policy, and common sense – realized in the architecture that came out of ESAS? As I have outlined above, policy and legislation are in some ways quite specific about the requirements for post-Shuttle U.S. spaceflight systems. They are less so where it concerns our lunar goals, beyond the clearly stated requirement to develop the capability to support a sustained human lunar presence, both for its intrinsic value and as a step toward Mars. This leaves considerably more discretion to NASA as the executive agency to set requirements, and with that considerably more responsibility to get it right. Again, I think common sense comes to our rescue.

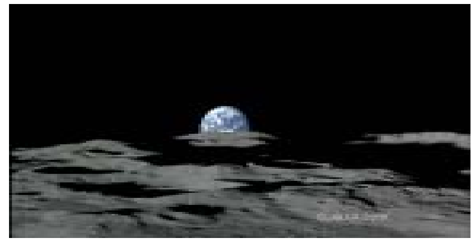
There is general agreement that our next steps to the Moon, toward a goal of sustained lunar presence, must offer something more than Apollo-class capability; e.g., sorties by two people for three days to the equatorial region. To return after fifty years with nothing more than the capability we once threw away, seems to me to fail whatever test of common sense might be applied to ourselves and our successors. Accordingly, then, in developing requirements for ESAS we specified that the lunar architecture should be capable of the following:

- Initial lunar sortie missions should be capable of sustaining a crew of four on the lunar surface for a week.

- The architecture will allow missions to any location on the Moon at any time, and will permit return to Earth at any time.

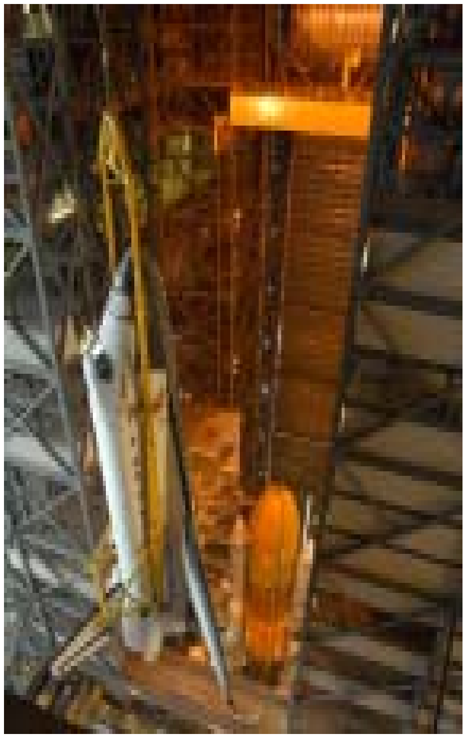
- The architecture will be designed to support the early development of an "outpost" capability at a location yet to be specified, with crew rotations planned for six-month intervals.

One could fill pages debating and justifying these requirements; mercifully, I will not do that. Perhaps another time. In any case, I think it is clear that these goals offer capability significantly beyond Apollo, yet can be achieved with the building blocks – ground facilities as well as space transportation elements – that we have or can reasonably envision, given the budgetary resources we might expect. It is worth noting that the decision to focus on early development of an outpost – while retaining the capability to conduct a dedicated point on the mission to any reasons – supports additional key goals. The most obvious of these is that it provides a more direct "stepping stone" to Mars, where even on the very first mission we will need to live for an extended period on another planetary surface. But further, even a basic human-tended outpost requires a variety of infrastructure that is neither necessary nor possible to include in a sortie mission. Such infrastructure development presents obvious possibilities for commercial international partner involvement, both of which constitute important policy objectives. But if the capability we are striving for is greater than that of Apollo, so too is the difficulty. To achieve the basic four-person lunar sortie capability anytime, anywhere, requires a trans-lunar injection (TLI) mass of 70-75 metric tons (mT), including appropriate reserve. Saturn V TLI capability on Apollo 17 was 47 mT without the launch adaptor used to protect the lunar module. Thus, more than Saturn V



Made famous during the Apollo missions, this Earth-rise photo was taken by the HDTV camera on the first Japanese Lunar explorer KAGUYA from about 100km above the surface of the Moon. (Source: JAXA/NHK) capability is required if we are to go beyond Apollo. I think we should not be surprised to find that the Apollo engineers got just about as much out of a single launch of the Saturn V as it was possible to do.

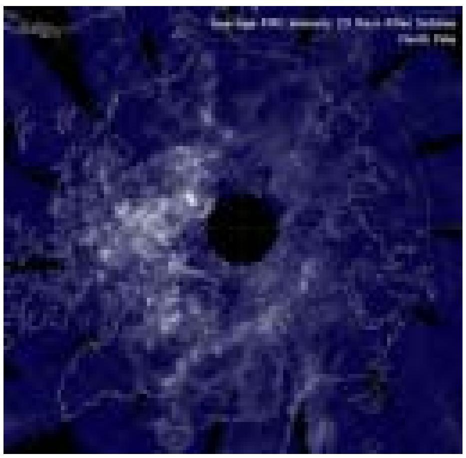
If we need more capability to TLI than can be provided by a single launch of a Saturn-class vehicle, we can reduce our objectives, build a bigger rocket, or attain the desired capability by launching more than one rocket. Setting a lesser objective seems inconsistent with our goal of developing the capability for a sustained lunar presence, and, as noted earlier, merely replicating Apollo-era capability is politically untenable. Building a larger rocket is certainly an attractive option, at least to me, but to reach the capability needed for a single launch brings with it the need for significant modifications to fabrication and launch infrastructure. The Michoud Assembly Facility and the Vertical Assembly Building were designed for the Saturn V, and have some growth margin above that. But they will not accommodate a vehicle that can support our goals for lunar return with a single launch, and the projected NASA budget does not allow the development of extensive new ground infrastructure. Further, and crucially, a single-launch architecture fails to address the requirement for ISS logistics support. Thus, after detailed consideration of the single-launch option, we settled on a dual-launch Earth-orbit rendezvous (EOR) scheme as the means by which a TLI payload of the necessary size would be assembled. However, the decision to employ EOR in the lunar transportation architecture implies nothing about how the payload should be split. Indeed, the most obvious split involves launching two identical vehicles with approximately equal payloads, mating them in orbit, and proceeding to the Moon. When EOR was considered for Apollo, it was this method that was to be employed, and it offers several advantages. Non-recurring costs are lower because only one launch vehicle development is required, recurring costs are amortized over a larger number of flights of a single vehicle, and the knowledge of system reliability is enhanced by the more rapid accumulation of flight experience. However, this architectural approach carries significant liabilities when we consider the broader requirements of the policy framework discussed earlier. As with the single-launch architecture, dual-launch EOR of identical vehicles is vastly overdesigned for ISS logistics. It is one thing to design a lunar transportation system and, if necessary, use it to service ISS while accepting some reduction in cost-effectiveness relative to a system optimized for LEO access. As noted earlier, such a plan backstops the requirement to sustain ISS without offering government competition in what we hope will prove to be a commercial market niche. But it is quite another thing to render government logistics support to ISS so expensive that the Station is immediately judged to be not worth the cost of its support. Duallaunch EOR with vehicles of similar payload class does not meet the requirement to support the ISS in any sort of cost-effective manner. On the other end of the scale, we must judge any proposed architecture against the requirements for Mars. We aren't going there now, but one day we will, and it will be within the expected operating lifetime of the system we are designing today. We know already that, when we go, we are going to need a Mars ship with a LEO mass equivalent of about a million pounds, give or take a bit. I'm trying for one-significant-digit accuracy here, but think "Space Station", in terms of mass.



The Vertical Assembly Building is so large that the Orbiter Atlantis is able to be laterally lifted and mounted onto the external tank, waiting with its accompanying solid rocket boosters on the mobile launcher platform below. (Source: NASA)

I hope we're smart enough that we never again try to place such a large system in orbit by doing it in twenty-ton chunks. I think we all understand that fewer launches of larger payloads requiring less on-orbit integration are to be preferred. Thus, a vehicle in the Saturn V class –some 300,000 lbs in LEO – allows us to envision a Mars mission assembly sequence requiring some four to six launches, depending on the packaging efficiency we can attain.

This is something we did once and can do again over the course of a few months, rather than many years, with the two heavy-lift pads available at KSC Complex 39. But if we split the EOR lunar architecture into two equal but smaller vehicles, we will need ten or more launches to obtain the same Mars-bound payload in LEO, and that is without assuming any loss of packaging efficiency for the launch of smaller payloads. When we consider that maybe half the Mars mission mass in LEO is liquid hydrogen, and if we understand that the hydrogen boiloff in space is one of the key limiting technologies for deep space exploration, the need to conduct fewer rather than more launches to LEO for early Mars missions becomes glaringly apparent. So if we want a lunar transportation architecture that looks back to the ISS LEO logistics requirement, and forward to the first Mars missions, it becomes apparent that the best approach is a dual-launch EOR mission, but with the total payload split unequally.



Opponents of the Vision for Space Exploration argue that a focus on human exploration will eliminate funding for smaller NASA Earth-based exploration missions like the AIM mission, which collects data on Polar Mesospheric Clouds (PMCs). (Source: CIPS Experiment data processing team at LASP)

The smaller launch vehicle puts a crew in LEO every time it flies, whether they are going to the ISS or to the Moon. The larger launch vehicle puts the lunar (or, later, Mars) cargo in orbit. After rendezvous and docking, they are off to their final destination. Once the rationale for this particular dual-launch EOR scenario is understood, the next question is, logically, "why don't we use the existing EELV fleet for the smaller launch?" I'm sure you will understand when I tell you that I get this question all the time. And frankly, it's a logical question. I started with that premise myself, some years back. To cut to the chase, it will work – as long as you are willing to define "Orion" as that vehicle which can fit on top of an EELV. Unfortunately, we can't do that.

The adoption of the shuttle-derived approach of Ares I, with a new lox/hydrogen upper stage on a reusable solid rocket booster (RSRB) first stage, has been one of our more controversial decisions. The Ares V heavy-lift design, with its external-tank-derived core stage augmented by two RSRBs and a new Earth departure stage (EDS), has been less controversial, but still not without its vre the desired lift capacity, the comparative reliability, and the development and life-cycle costs of competing approaches. Performance, risk, and cost – I'm sure you are shocked.

The Ares I lift requirement is 20.3 mT for the ISS mission and 23.3 mT for the lunar mission. EELV lift capacity for both the Delta IV and Atlas V are insufficient, so a new RL-10 powered upper stage would be required, similar to the J-2X based upper stage for Ares I. We considered using additional strap-on solid rocket boosters to increase EELV performance, but such clustering lowers overall reliability. It is also important to consider the growth path to heavy lift capability which results from the choice of a particular launch vehicle family. Again, we are designing an architecture, not a point solution for access to LEO. To grow significantly beyond today's EELV family for lunar missions requires essentially a "clean sheet of paper" design, whereas the Ares V design makes extensive use of existing elements, or straightforward modifications of existing elements, which are also common to Ares I.

Next up for consideration are mission reliability and crew risk. EELVs were not originally designed to carry astronauts, and various human-rating improvements are required to do so. Significant upgrades to the Atlas V core stage are necessary, and abort from the Delta IV exceeds allowable g-loads. In the end, the probabilistic risk assessment (PRA) derived during ESAS indicated that the Shuttle-derived Ares I was almost twice as safe as that of a human-rated EELV.

Finally, we considered both development and full life cycle costs. I cannot go into the details of this analysis in a speech, and in any case much of it involves proprietary data. We have shared the complete analysis with the DoD, various White House staff offices, CBO, GAO, and our Congressional oversight committees. Our analysis showed that for the combined crew and heavy-lift launch vehicles, the development cost of an EELV-derived architecture is almost 25% higher than that of the Shuttle-derived approach. The recurring cost of the heavy-lift Ares V is substantially less than competing approaches, and the recurring cost of an EELV upgraded to meet CEV requirements is, at best, comparable to that for Ares I. All independent cost analyses have been in agreement with these conclusions.

So, while we might wish that "off the shelf" EELVs could be easily and cheaply modified to meet NASA's human spaceflight requirements, the data say otherwise. Careful analysis showed EELV-derived solutions meeting our performance requirements to be less safe, less reliable, and more costly than the Shuttle-derived Ares I and Ares V.

Now is a good time to recall that all of the trades discussed above assumed the use of a production version of the Space Shuttle Main Engine (SSME). But, returning to a point I made earlier, we continued our system analysis following the architecture definition of ESAS, looking for refinements to enhance performance and reduce risk and cost. We decided for Ares I to make an early transition to the 5-segment RSRB, and to eliminate the SSME in favor of the J-2X on the upper stage. Similarly, elimination of the SSME in favor of an upgraded version of the USAF-developed RS-68 engine for the Ares V core stage, with the EDS powered by the J-2X, offered numerous benefits. These changes yielded several billion dollars in life-cycle cost savings over our earlier estimates, and foster the use of a common RS-68 core engine line for DoD, civil, and commercial users.

Praise is tough to come by in Washington, so I was particularly pleased with the comment about our decision on the 5-segment RSRB and J-2X engine in the recent GAO review: "NASA has taken steps toward making sound investment decisions for Ares I." Just for balance, of course, the GAO also provided some other comments. So, for the record, let me acknowledge on behalf of the entire Constellation team that, yes, we do realize that there remain "challenging knowledge gaps", as the GAO so quaintly phrased it, between system concepts today and hardware on the pad tomorrow. Really. We do.

It's time now for a little perspective. We are developing a new system to bring new capabilities to the U.S. space program, capabilities lost to us since the early 1970s. It isn't going to be easy. Let me pause for a moment and repeat that. It isn't going to be easy. Did any of you here today think it was going to be easy?

May I see a show of hands? How many of you thought we were going to re-create a capability for the United States to go to the Moon, a capability well beyond Apollo, and do it without any development problems? Anyone?

So, no, we don't yet have all the answers to the engineering questions we will face, and in some cases we don't even know what those questions will be. That is the nature of engineering development. But we are going to continue to follow the data in our decision-making, continue to test our theories, and continue to make changes if necessary. We have been, I think, extraordinarily open about all of this. Following the practice I enunciated in my first all-hands on my first day as Administrator, in connection with the then-pressing concerns about Shuttle return-to-flight, we are resolved to listen carefully and respectfully to any technical concern or suggestion which is respectfully expressed, and to evaluate on their merits any new ideas brought to us. We are doing that, every day. We will continue to do it.

> "My considered assessment of the Constellation Architecture is that while we will encounter a number of engineering design problems as we move forward, we are not facing any showstoppers."

So, in conclusion, this is the architecture which I think best meets all of the requirements of law, policy, budget, and common sense that constrain us in the post-Shuttle era. It certainly does not satisfy everyone, not that I believe that goal to be achievable. To that point, one of the more common criticisms I receive is that it "looks too much like Apollo". I'm still struggling to figure out why, if indeed that is so, it is bad. My considered assessment of the Constellation Architecture is that while we will encounter a number of engineering design problems as we move forward, we are not facing any showstoppers. Constellation is primarily a systems engineering and integration effort, based on the use of as many flight-proven concepts and hardware as possible, including the capsule design of Orion, the Shuttle RSRBs and External Tank, the Apollo-era J-2X upper stage engine, and the RS-68 core engine. We're capitalizing on the nation's prior investments in space technology wherever possible. I am really quite proud of the progress this multi-disciplinary, geographically dispersed, NASA/industry engineering team has made thus far. But even so, the development of new systems remains hard work. It is not for the faint of heart, or those who are easily distracted. We can do it if, but only if, we retain our sense of purpose. In this regard, I'm reminded of two sobering quotes from the CAIB report. First, "the previous attempts to develop a replacement vehicle for the aging Shuttle represent a failure of national leadership." Also, the Board noted that such leadership can only be successful "if it is sustained over the decade; if by the time a decision to develop a new vehicle is made there is a clearer idea of how the new transportation system fits into the nation's overall plans for space; and if the U.S. government is willing at the time a development decision is made to commit the substantial resources required to implement it."

That sort of commitment is what the mantle of leadership in space exploration means, and the engineers working to build Constellation know it every day. Thus, I can only hope to inspire them, and you, with the immortal words of that great engineer, Montgomery Scott, of the USS Enterprise: "I'm givin' 'er all she's got, Captain." Thank you. ■

Michael D. Griffin **is the Administrator of the National Aeronautics and Space Administration (NASA). Mr. Griffin gave this speech before the Space Transportation Association on January 22, 2008.**

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FINAL MANUSCRIPT DEADLINE: August 11, 2008

AIAA/AAS Astrodynamics Specialist Conference

Hilton Hawaiian Village
Honolulu, Hawaii
August 18-21, 2008

The 2008 Astrodynamics Specialist Conference, hosted by the American Institute of Aeronautics and Astronautics (AIAA) and cosponsored by the American Astronautical Society (AAS), will be held August 18-21, 2008 in Honolulu, Hawaii. The conference is organized by the AIAA Astrodynamics and AAS Space Flight Mechanics Technical Committees. Papers are solicited on topics related to space flight mechanics and astrodynamics, including, but not limited to:

- Artificial and natural space debris
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Papers will be accepted based on the quality of the extended abstract, originality of work and/or ideas, and anticipated interest in the proposed subject. Papers that contain experimental results or current data, or report on ongoing missions, are especially encouraged.

Final manuscripts are required before the conference. The working language for the conference is English.

SPECIAL SESSIONS

Proposals are being considered for appropriate special sessions, such as topical panel discussions, invited sessions, workshops, mini-symposia, and technology demonstrations. Prospective special-session organizers should submit their proposals to the Technical Chairs. A proposal for panel discussion should include a session title, a brief description of the discussion topic(s), and a list of the speakers and their qualifications. For an invited session, workshop, mini-symposium, or demonstration, a proposal should include the session title, a brief description, and a list of proposed activities and/or invited speakers and paper titles.

INFORMATION FOR AUTHORS

Authors shall submit their abstracts and papers through the AIAA website at http://www.aiaa.org.

Submitting authors are expected to provide:

1. A paper title, as well as the name, affiliation, postal address, telephone number, and email address of the corresponding author.
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3. A condensed abstract (100 words maximum, strictly enforced) to be included in the printed conference program. The condensed abstract shall be directly typed into the text box provided on the web page, and must avoid the use of special symbols or characters, such as Greek letters.

Technology Transfer Warning. Technology transfer guidelines substantially extend the time required to review abstracts and papers by private enterprises and government agencies. These reviews can require four (4) months or more. To preclude late submissions and paper withdrawals, it is the responsibility of the author(s) to determine the extent of necessary approvals prior to submitting an abstract.

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Abstract Deadline:	February 4, 2008
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Questions concerning the submission of papers should be addressed to the technical chairs or AIAA technical support at paper_tech_support@aiaa.org.

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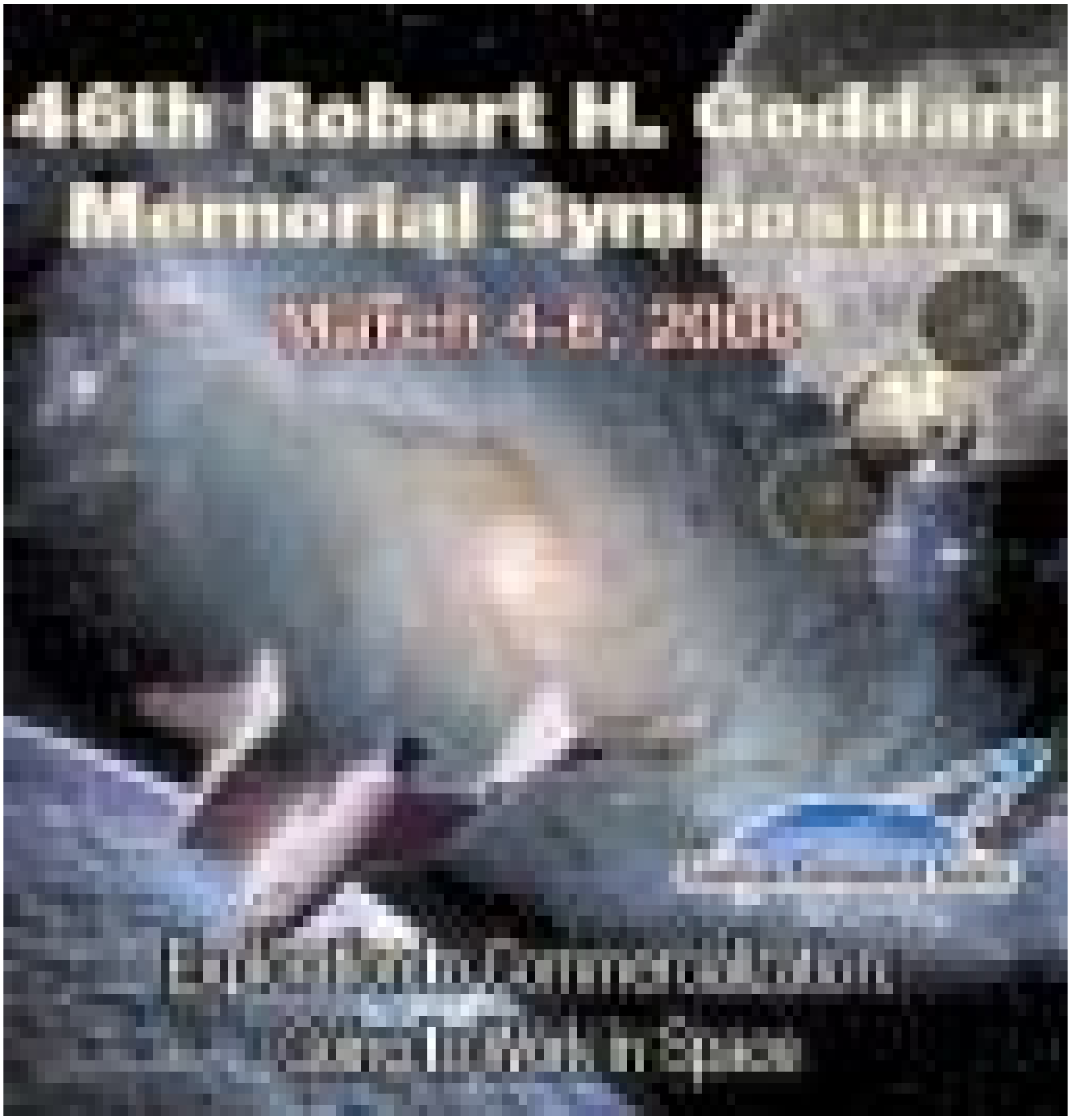

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46th Robert H. Goddard Memorial Symposium

Exploration to Commercialization: Going to Work in Space

Greenbelt Marriott Hotel, Greenbelt, Maryland
March 4-6, 2008

AGENDA

Tuesday, March 4

6:00 pm Future Leaders Networking Reception

Wednesday, March 5

7:15 am Corporate Members Breakfast
7:30 Registration Opens / Continental Breakfast
8:30 Welcome
Frank Slazer, AAS President
8:40 Introduction of Keynote Speaker
Edward Weiler, Director, NASA GSFC
8:45 Keynote
Michael Griffin, NASA Administrator
9:30 BREAK
9:45 Perspectives on the 50th Anniversary of NASA's Founding
Roger G. Launius, Chair, Division of Space History, NASM, Smithsonian Institution
10:15 Reflections on Humans Working in Space
William H. Gerstenmaier, Associate Administrator for Space Operations, NASA HQ
10:45 Sustaining a Human Presence in Space
Richard J. Gilbrech, Associate Administrator for Exploration Systems, NASA HQ
11:15 The International Role in Expanding Human Presence in Space
Lon Rains, Editor, *Space News*
11:45 LUNCHEON
Rep. Steny Hoyer, House Majority Leader, D-MD (invited)
1:15 pm The Unknown History of the Vision for Space Exploration (VSE)
Stephen J. Garber, History Division, NASA HQ
1:45 Prizes and Emerging Markets: Encouraging Commercial Space Capabilities
Ken Davidian, Commercial Development Policy Lead, NASA HQ
2:15 BREAK
2:30 A Ticket to Ride: An Emerging Space Adventure Industry
Moderator: *Clayton Mowry*, President, Arianespace, Inc.
Panelists:
- *Bretton Alexander*, Executive Director, X PRIZE Foundation
- *George Whitesides*, Executive Director, National Space Society
- *George Nield*, Deputy Associate Administrator for Commercial Space Transportation, FAA
- *Franceska Schroeder*, Principal, Fish & Richardson, P.C.

3:30 Spaceports and Commercial Space Launches
Moderator: *John Campbell*, Director, Wallops Flight Facility and Suborbital and Special Orbital Projects Directorate, NASA GSFC
Panelists:
- *Billie Reed*, Executive Director, Virginia Commercial Space Flight Authority
- *Stuart Witt*, General Manager, Mojave Air and Space Port (invited)
- *Patricia W. McCarthy*, Director of Spaceport Operations, Space Florida
- *Neil Milburn*, Vice President, Federal Liaison and Program Manager, Armadillo Aerospace

5:00 RECEPTION

Thursday, March 6

7:30 am Registration Opens / Continental Breakfast
8:30 Keynote
Alan Stern, Associate Administrator for Science, NASA HQ
9:15 Earth Science from Space
Conrad C. Lautenbacher, Undersecretary of Commerce for Oceans and Atmosphere (NOAA Administrator) (invited)
Mary E. Kicza, NOAA Assistant Administrator, National Environmental Satellite, Data & Information Services
9:45 Investing in Technology to Enable Future Science Missions in Space
Laurie A. Leshin, Deputy Director for Science and Technology, NASA GSFC
10:15 BREAK
10:30 Faces of the Future
Alexis Livanos, Corporate Vice President and President, Northrop Grumman Space Technology
11:15 Moon Science
David E. Smith, Deputy Director for Planetary Science, Solar System Exploration Division, NASA GSFC
11:45 LUNCHEON
Senator Barbara Mikulski, D-MD (invited)
1:15 pm Summer Jobs: Hubble Servicing Mission
Frank Cepollina, Manager, Hubble Space Telescope Development Project, NASA GSFC
1:45 Space Weather: Survival of People and Robots
Louis Lanzerotti, Distinguished Research Professor, Center for Solar-Terrestrial, New Jersey Institute of Technology
2:15 BREAK
2:30 Mars on the Horizon
James B. Garvin, Chief Scientist, NASA GSFC
3:00 Before Earth and Beyond Mars: Planetary Science
Jonathan Lunine, Professor, Lunar and Planetary Laboratory, The University of Arizona
3:30 Astrophysics Beyond 2020: The Big Questions
Mario Livio, Head, Office of Public Outreach, Space Telescope Science Institute
4:00 NASA at 50: Oh, Say Can You See?
Wesley T. Huntress, Director, Geophysical Laboratory, Carnegie Institution of Washington
4:30 Closing Remarks
Frank Slazer, AAS President
5:00 Reception - Celebrating NASA's 50th
Special Guest: *Alan Stern*, Associate Administrator for Science, NASA HQ

In the Shadow of the Moon: A Challenging Journey to Tranquility, 1965-1969

Reviewed by James M. Busby

In the Shadow of the Moon: A Challenging Journey to Tranquility, 1965-1969, Francis French and Colin Burgess, University of Nebraska Press, 2007, 448 pages, ISBN 0803211287 [hardcover]. *Outward Odyssey Series: A People's History of Spaceflight Volume 2.*

In the fifty years since the space age began, many writers have tackled the stories of early space explorers. Most of these books concocted histories larger than real life. By the mid-1970s, writer Tom Wolfe's *The Right Stuff* finally blew some of the stardust off these lives, letting us meet the people beneath the spacesuits.

In the late 1990's, two respected space enthusiasts and educators from opposite sides of the world decided to follow that course with a more comprehensive overview. Francis French (now of the San Diego Aerospace Museum) and Colin Burgess (an accomplished writer who formerly worked for Qantas Airlines) began pulling together friends and resources to tell the personal histories of the men and women who first stepped off our planet. They felt that the end of the Cold War marked the time for a proper accounting of the lives of early space explorers, before they were gone.

In The Shadow of the Moon begins in 1965 with the first mission of Project Gemini, the start of the busiest period of manned Space travel to date. The writers describe the lives of astronauts who faced deadly challenges every time Gemini, Soyuz or Apollo flew. Many of us who grew up in those days wondered how we would have handled emergencies in space. What would we have done if we were on the malfunctioning Titan II like Schirra and Stafford? Would we have stayed or ejected? Could we have maintained cool heads like Neil Armstrong and Dave Scott if we were spinning out of control aboard Gemini 8? Could we have cut Gene Cernan adrift if he had died during the Gemini 9 space walk?

The book also goes into the lives of those who *almost* made it, like the original crew of Gemini 9 and the astronauts who perished in the tragic Apollo 1 fire. It also covers the loss of Soyuz 1 with Cosmonaut Vladimir Komarov. The authors reveal many failures that occurred on Soyuz before Komarov's flight, and how close other Russian cosmonauts came to death. The writers have gone beyond old soviet propaganda to tell the untold stories of heroic cosmonauts through new and recent interviews.

This volume captures the anxiety and haste shown by both nations at the height of the space race, illuminating the United States' risky decision to launch the first lunar mission after only one manned test flight. Apollo 8's crew was launched because of fears that a Soviet manned lunar flight was preparing for take off. On Apollo's return from the Moon, the astronauts were almost lost in space as they suffered a major navigational failure. The Soyuz 4 and 5 docking mission was launched only weeks later in the middle of a snow storm. Soyuz 5 was almost destroyed on its return as its service module re-entered backwards. It nearly burned up before crashing to Earth. Cosmonaut Volynov survived with a smashed jaw and broken teeth, but he would fly again.

The book concludes with a very different look at the crew of Apollo 11, the first men to land on the Moon. Most readers know that this was a more divergent crew than any other Apollo lunar team. The authors instead focus on how they bonded to complete their complex task. It is told not only in their words, but in the words of the other close members of the Mission control team who trained beside them.

In The Shadow of the Moon finds these brave people near the end of their lives. That is what makes these books so important. Most books or autobiographies have arrived during or soon after astronauts' space careers. Here, these explorers' lives are examined from the beginning and conclude with descriptions of how they fared once back on Earth. This series will be read by future generations when they want the complete perspectives of the original generation of space explorers. ■

***James M. Busby* is Director of the Aerospace Legacy Foundation in Downey, California.**

AAS EVENTS SCHEDULE

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46th Robert H. Goddard Memorial Symposium
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March 27, 2008
International Polar Year: Understanding the Poles of the Earth, Moon and Mars
Marie Curie Auditorium
Paris, France
For information:
www7.nationalacademies.org/ssb

April 7-11, 2008
Short Course: Humans in Space – Challenges for Exploration
University of Tennessee Space Institute
Tullahoma, Tennessee
For information:
www.utsi.edu/ContEd/courses.htm

June 13-15, 2008
***Student CanSat Competition**
Amarillo, Texas
For information: www.cansatcompetition.com

June 29-July 1, 2008
***F. Landis Markley Astronautics Symposium**
The Hyatt Regency Chesapeake Bay
Cambridge, Maryland
For information: johnc@eng.buffalo.edu

August 18-21, 2008
***AIAA/AAS Astrodynamics Specialist Conference**
Hilton Hawaiian Village
Honolulu, Hawaii
For information: www.aiaa.org

November 17-19.2008
AAS National Conference and 55th Annual Meeting
Pasadena Hilton
Pasadena, California
For information: www.astronautical.org

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