

Space Exploration: A Frontier for American Collaboration

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Good morning, and thank you for inviting me to deliver this Loewy Lecture. I would like to thank the Walsh School of Foreign Service, and the Loewy Family, for sponsoring this lecture series in honor of Ludwig and Erwin Loewy, two brothers who were born in Czechoslovakia and escaped Nazi Germany to settle in America. They were great engineers who in the course of their careers built things from ships and airplanes to the Polaris missile and Vanguard rocket. This lecture honors the Loewy brothers' memory by discussing the intersecting relationships between technological innovation and international affairs.

A few weeks ago, I was asked to speak in Chicago about the role of space exploration in spurring innovation and American competitiveness in the world. Today, I would like to address the

opposite question: how can space exploration spur greater collaboration between our nation and others?

I will observe that it is necessary to be successful both in competition and in collaboration if we are to survive and prosper, whether as individuals or as a society. We cannot thrive if our presence offers nothing to others that they cannot do more easily themselves. And we cannot thrive if every other hand is turned against us. So, I believe that it is important to strike a thoughtful balance between competition and collaboration. In the most fundamental sense of the words, it is crucial to our national security to do so.

“National security” is an elusive concept, and its fulfillment imposes different requirements upon a great nation than upon a small one. Most obviously, it consists of having the wherewithal to act, militarily, in support of our nation’s perceived interests. At a higher level, it consists in part of a measure of deterrence against potential adversaries; in George Washington’s famous words, “if you would have peace, prepare for war.” But I would submit to you that the highest possible form of national security, well above having better guns and

bombs, is that which comes from being a nation which seeks to carry out the great deeds that cause other countries want to join with us in pursuing those objectives. In this sense, it is of enormous value to our nation to collaborate with others in the most technically challenging endeavor of our time – space exploration.

As the present Administrator of NASA, I am fortunate to bear witness to an enormous effort carried out daily on the frontiers of both technology and international cooperation. With sixteen participating nations, the International Space Station under construction today is a testament to the perseverance of the United States, Russia, the countries of the European Space Agency, Japan, and Canada, working together on the largest task ever performed by the civilian agencies of the United States or our international partners. And on November 2nd, we celebrated seven years of permanent human presence in space onboard the International Space Station. The partnership that brought it about has endured tremendous hardships, most especially the loss of the Space Shuttle *Columbia*, and stands by itself as a monumental international accomplishment. The ISS will indeed pay dividends as an engineering

and research laboratory as we push outward in Constellation, the successor to Apollo, back to the moon, and then on to Mars and other destinations in our solar system over the course of the next decades. But eventually, the ISS hardware will fail, or the questions we can pose with it will have been asked and answered. Eventually, and so that it does not become a danger, it will be reentered into the Pacific.

Thus, one day the International Space Station will be no more. But I believe that the most important legacy of the ISS endeavor will one day be seen to have been the partnership itself. Together, we are learning the hard but essential lessons concerning how we can carry out the largest and most complex endeavors human beings have yet undertaken.

I do not say this lightly. The Station rivals the Apollo program in cost, and in my opinion easily surpasses it in complexity. When completed, it will be longer than a football field, four times larger than the Russian Mir space station, and five times larger than the 1970s Skylab. It is truly one of the great engineering wonders of the world, akin to such feats as the Great Wall of China, the pyramids of Egypt, the Panama and Suez canals, or the sea walls of Venice.

Last month, Space Shuttle *Discovery* delivered the Italian-built Harmony module to the Space Station, along with Italian astronaut Paolo Nespoli as part of the assembly team. It was the most challenging ISS mission undertaken thus far, and it was completed brilliantly, including for good measure a contingency spacewalk to effect repairs to a torn solar array. Next month, Shuttle *Atlantis* will launch the European *Columbus* laboratory module, assembled in Bremen, Germany. *Atlantis* will also deliver German astronaut Hans Schlegel as part of the assembly team, and leave French astronaut Leopold Eyharts on the Space Station, replacing U.S. astronaut Dan Tani.

Human spaceflight has been accomplished only by the United States, Russia, and China. India has announced its intention to develop such capabilities, joining this most exclusive club of spacefaring nations. Having visited several space facilities in China and India last year, and having met their aerospace engineers, I must say that I am very impressed by the methodical, disciplined approach that these nations have taken in developing their space industrial base and capabilities. The national economies of both countries exceed in scale the economy

of the United States as it existed in the early 1960s when America set out to undertake the Apollo program in accordance with President Kennedy's vision for our nation's future on "the New Frontier". So if they wish to send their own astronauts into space, it is simply a matter of national will on their part, of choosing to do so.

But, rather than fostering a new rivalry in space, it is my hope that China and other countries will join their own programs to the United States' effort in Constellation, returning together to the moon and exploring space to our mutual benefit. In this regard, China's anti-satellite weapon demonstration last January was a step backward. We can all hope that it will be the only such step.

Last September, Japan launched the *Selene* mission to the Earth's moon, and NASA has an agreement with the Japanese Space Agency to share the data collected from that mission. China also launched its first lunar mission, *Chang'e*, last month. I want to applaud their recent announcement that they would provide the data collected from this mission to researchers around the world, in accordance with common international practice. We recently established a new Lunar Science

Institute at the Ames Research Center in the heart of Silicon Valley, California. Our goals with this institute are to use state-of-the-art information technologies, like Google's recent partnerships with NASA, to create new virtual and international collaborations for lunar research and to spark the growth of a lunar science community.

We will use the data collected from these spacecraft, from India's *Chandrayaan* as well as NASA's Lunar Reconnaissance Orbiter and LCROSS missions, all planned for launch next year, to produce a detailed map of the lunar surface and its resources, as well as to better understand its gravity field, to search for evidence of polar volatiles, and to define radiation hazards so we can mitigate them for human missions beginning in the next decade. We will need such data to carry out our nation's plans to build our first outpost on the new frontier of the moon.

We are actively seeking out other countries in this journey to explore the undiscovered country of our moon and other worlds. Today, over half of our fifty-plus operating robotic science missions incorporate some form of international collaboration. These include a wide range of missions to other planets and moons in our solar system, as well as

comets and asteroids. They include Earth science missions enabling the study of climate change by a community of international researchers for which NASA is, by far, the greatest contributor. And they include heliophysics missions like Ulysses and SOHO to help us to understand our own sun, and – of course – great astrophysical observatories like the *Hubble Space Telescope*.

Space exploration, whether human or robotic, is the grandest and most technically challenging expression of human imagination of which I can conceive. Throughout my professional career, I've wanted nothing more than to be a part of it. And I think it is in our nation's best interests to work together in this unique human endeavor, to learn from each other, as different countries and cultures, how we go about solving the unique problems presented by the exploration of space. My training in physics tells me that the problems and constraints are the same for all; the rocket equation does not change when expressed in another language. But my training and experience as an engineer has taught me that the vagaries of human ingenuity and creativity can yield many different solutions to problems bounded by a given set of constraints.

Collaboration offers us the chance to reap a rich harvest of ideas and solutions germinated in different intellectual soil.

As we at NASA learned during the Apollo program and are re-learning in Constellation, the operation of complex, integrated space systems requires revolutionary thinking in their development and management. Accordingly, we need to develop new manufacturing methods with the ability to operate to a higher, more precise standard of excellence. This *is* rocket science, but it is also art, and the industrial capabilities we create as we learn to master this most difficult art ripple throughout our economy. So it is to our mutual benefit to understand how the other spacefaring nations of the world solve the problems posed in the course of mankind's efforts to master spaceflight. We all have much to learn, and we can learn best by doing some of these things together, each of us making our individual contribution, so that all may benefit in direct and indirect ways.

I've lived through this experience. When we initiated the Shuttle-Mir program in the early '90s, many of us at NASA felt a bit put out. It was easier to compete with the Russians than to cooperate with them!

But we learned over time, and through shared experiences, to trust them to a far greater extent than we had imagined we could. We learned that different doesn't mean bad. We now defer to the ISS partners in regard to their design standards, delegated safety panels, and remote mission control centers, and we and the Russians have learned to trust each other enough to alternate ISS design reviews and mission commanders with confidence. We're better than we were because of what we have learned that was new to us and "old hat" to our partners.

For these reasons, and where we can feasibly promote it, collaboration on the space frontier is the right thing to do, from both an altruistic and a national interest perspective.

That being said, we must recognize certain realities. The United States is firmly committed to ensuring that certain key space and missile technologies, which we possess and others do not, not be used against us or our allies. That priority is higher for us than partnership in space endeavors, a fact that must be understood by all parties involved in any prospective collaboration. I recognize the bluntness of this statement, but I believe that each of us, as spacefaring nations, must respect each

other's national priorities, and speak openly and honestly with each other if there are differences which hamper our ability to collaborate.

The other major limitation on collaborative programs is the universal constraint of budgetary resources. NASA simply cannot afford everything that our many partners, domestic and international, would like us to do. It is clear to me that partnerships work best when all partners have "skin in the game", each contributing resources toward a common goal that is greater than that which could be easily afforded by any single partner. I believe that such relationships work best when conducted on a "no exchange of funds" basis. For example, NASA is contributing two sensor payloads to India's Chandrayaan spacecraft. NASA teamed with the French Space Agency on CALIPSO, an Earth science satellite for which we built the laser radar sensors. France integrated the spacecraft, and NASA launched it. The reverse will be true for the *James Webb Space Telescope*; design and integration will be conducted in the U.S., but the observatory will be launched on a European *Ariane V* from French Guiana.

I must admit that this view of partnership is not universally shared. On many occasions since assuming my role as Administrator, and especially in connection with our efforts to define and implement Constellation, I have been asked about opportunities for “partnership”, when what was really being sought was American investment in the aerospace industries of other nations. To me, partnership cannot be a synonym for “helping NASA to spend its money”. We at NASA need partners, not subcontractors.

However, there are always exceptions. Soon after my return to NASA in April 2005, I was faced with the choice of continuing to pay the Russian Space Agency for crew and cargo transport to the International Space Station, or de-crewing U.S. astronauts. I regarded this, and still do, as an unseemly position for our nation. We are in this position because, for the better part of a generation, the nation failed to step up to its commitments to build a crew rescue system for the ISS astronauts and a replacement for the Shuttle. In the words of Admiral Hal Gehman, Chairman of the Columbia Accident Investigation Board,

“previous attempts to develop a replacement vehicle for the aging Shuttle represent a failure of national leadership.”

The Russians developed, and have operated for many years, their *Soyuz* and *Progress* spacecraft. When the Shuttle fleet is retired in 2010, there may be no alternative other than to use *Soyuz* for crew transport and rescue. While I do not relish the idea of paying Russia some \$900 million in U.S. taxpayer funds through 2011, and possibly more in later years, the alternative – removing American presence from the ISS – is worse. This reliance on Russia, paying them for their increased support of the International Space Station partnership because of America’s inability to meet its partnership commitments with American hardware, is one reason why this nation must now invest the time, resources, and energy in developing a new U.S. system for crew and cargo transport, and why we must bring these systems on-line as soon as possible.

If we are to partner effectively in future exploration endeavors, we must establish clear principles for such partnerships. The story above illustrates one of those precepts; to me, it is clear that America cannot partner from the rear. That is not the posture of a great nation.

But however it is done, working together in space helps all of us to realize our common humanity. It shows us that what binds us together is far more important than the issues that separate us.

This certainly can be difficult to keep in mind. Fifty years ago, Americans looked into the sky with fear and trepidation at a small metal orb that was circling our Earth, *Sputnik*. Many Americans felt vulnerable to Soviet missiles, fearing that if the Soviets could place this small satellite in orbit, then they could also strike anywhere in the United States. No other adversary had ever produced such a threat to the American homeland and, protected as we were by two oceans, no one in 1957 had ever imagined that anyone ever could. Nikita Krushchev's November, 1956 admonition – “we will bury you” – reverberated in America's collective consciousness.

Not far from here, as he lived in and walked the streets of Georgetown, the junior senator from Massachusetts bore witness to the *Sputnik* crisis of fifty years ago. It spurred the creation of NASA and America's space race with the Soviet Union. John F. Kennedy was the first of our nation's leaders to fully appreciate the strategic importance

of space exploration. He recognized that the United States trailed the Soviet Union in human spaceflight, and he recognized its significance to the world's perception of America's leadership, saying:

“Those who came before us made certain that this country rode the first waves of the industrial revolution, the first waves of modern invention, and the first wave of nuclear power, and this generation does not intend to founder in the backwash of the coming age of space. We mean to be a part of it – we mean to lead it. For the eyes of the world now look into space, to the moon and to the planets beyond, and we have vowed that we shall not see it governed by a hostile flag of conquest, but by a banner of freedom and peace... In short, our leadership in science and in industry, our hopes for peace and security, our obligations to ourselves as well as others, all require us to make this effort, to solve these mysteries, to solve them for the good of all men, and to become the world's leading spacefaring nation.”

President Kennedy's insights have stood the test of time; certainly others in the world understand them, even as the import of that challenge to our nation has faded in the American collective consciousness. It has been thirty-five years since Americans Gene Cernan and Harrison Schmitt walked on the moon, in December 1972. Thirty-five years. Some young people today actually question whether we ever really set foot on the Moon, whether it was all a hoax. Thirty-five years ago, who would have guessed that such a thing could ever have occurred?

I have on many occasions offered the blunt opinion that America made a mistake of strategic importance when, in the early 1970s, we dismantled our nation's technical capability to build the Saturn rocket, Apollo capsules, and lunar landers, the means by which NASA met President Kennedy's challenge and defined his lasting legacy. The Space Shuttle we first flew in 1981 is an amazing machine with unparalleled capability. It is, however, limited to low Earth orbit by its very design. Now our nation must rebuild the capability to journey once again beyond low orbit, to see and explore the universe with our own eyes and hands, not just with robotic ones.

I will again quote Hal Gehman, in the report of the Columbia Accident Investigation Board: “The U.S. civilian space effort has moved forward for more than 30 years without a guiding vision.” That was a damning statement, highlighting a lack of leadership in space policy reaching to the highest levels of our nation for over a generation. Based on the policy debate that ensued after the *Columbia* accident, President Bush committed our nation to fulfilling our commitments to our international partners by finishing the Space Station, and invited them and others to join the United States in our return to the Moon and future ventures to Mars and beyond. The Congress codified this direction into law with the NASA Authorization of 2005, a copy of which hangs outside my office. In my opinion, this is the best direction NASA has received from the Congress in forty years or more, and is a palpable recognition that “space” is a strategic interest of the United States. And last month on the floor of the United States Senate, a large, bipartisan group of senators expressed their strong support for NASA’s mission and the challenges we face.

NASA is taking the first steps in this long journey by fulfilling our commitments to our international partners with the Space Station, retiring the Space Shuttle, and building the new *Orion* and *Ares* crew and launch vehicles to support the Station and return to the Moon. We are also encouraging and spurring a burgeoning commercial space industry in the United States with the Space Station. Combined, this is the greatest management challenge NASA has ever faced.

However, we are now beginning that quadrennial political season in Washington, and some space policy pundits and critics have begun to speculate that we do not have the national will to return to the Moon or to venture astronauts beyond low orbit, this time to stay. They argue that NASA's budget, a mere 6/10ths of one cent of every federal dollar, is too much. In their minds, Gene Cernan would indeed be the last American to set foot on the Earth's moon.

If that future comes to pass, then I will tell you flatly that we will have ceded our leadership on the frontier of space exploration to other countries through softness, complacency, and a lack of national will. If that happens, then America's best days are indeed behind us.

I believe that talk of retreating again to low Earth orbit merely foments pointless discord, setting aside, for the sake of partisan politics, the strategic foresight of what is important to our nation. Quite simply, for the United States to be anything other than *the* leader on the space frontier is a mistake of historic proportions. We are a wealthy nation, both economically and intellectually. Leadership in space cannot be taken from us; we can only let it slip ineluctably away by failing to recognize its importance to our national security, our technological superiority, our industrial base, and our ability to compete favorably on a global scale. If that happens, we won't live to know the cost of it, but our children and grandchildren will, to their detriment.

I would like to conclude with President Kennedy's advice on Nov. 21, 1963, almost 44 years ago, the day before he was assassinated:

“For more than three years I have spoken about the New Frontier. This is not a partisan term, and it is not the exclusive property of Republicans or Democrats. It refers, instead, to this nation's place in history, to the fact that we do stand on the edge of a great new era, filled with both

crisis and opportunity, an era to be characterized by achievement and by challenge. It is an era which calls for action and for the best efforts of all those who would test the unknown.”

President Kennedy’s challenge to NASA and our nation continues today. If we want to be a nation with which other nations will want to collaborate, we must continue to show the bold leadership and commitment to action called for by President Kennedy. The need to take these steps will be seen most clearly if we fail to take them. We can never allow that to happen.

Thank you.