American Competitiveness:
NASA's Role & Everyone's Responsibility

Michael D. Griffin
Administrator
National Aeronautics and Space Administration

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I want to thank Calvin College and the organizers of the January Series for inviting me to speak here today, giving me a good excuse to escape from Washington, DC. It is wonderful to be here in the fresh, "cool" air of Grand Rapids. I especially want to thank Congressman Vern Ehlers for inviting me here, and his district staff director, Rick Truer, for being here today.

As many of you may already know, Congressman Ehlers is a key member of the House Science and Technology Committee, among his many other duties in the Congress. The Science Committee oversees NASA, and I testify before that committee on a regular basis. I first met Randy Brouwer, who introduced me, when he was an IEEE Congressional fellow working on Capitol Hill for Congressman Dana Rohrabacher, another senior member of the House Science Committee. During Randy's year-long fellowship, he was known for being thoughtful and conscientious. He has demonstrated it again today. Thank you for that kind introduction, Randy.

My only wish is that I could be as articulate in answering Congressional questions as the late physicist Robert Wilson, co-discoverer of the 3 degree K microwave background radiation that is the remnant of the fourteen billion year old Big Bang, and who, when asked before a committee about what value a new particle accelerator would have in promoting the national security of our country, responded: "Nothing at all. It only has to do with the respect with which we regard one another, the dignity of men, our love of culture… It has to do with are we good painters, good sculptors, great poets? I mean all the things we really venerate in our country and are patriotic about… It has nothing to do directly with defending our country except to make it worth defending."

Similarly, NASA's scientific activities in climate change research, monitoring our ever-changing sun and studying the physics of solar flares and their effects on our Earth, our missions to the other planets, moons, asteroids, and comets of our solar system, as well as our astronomy and astrophysics missions, like the Hubble Space Telescope, make our country worth defending. Further, I hope that the Space Shuttle, International Space Station, and our next missions to the Moon, this time to stay, are something of which we are all proud. These are the things which make our nation worth defending.

I recently read an essay written a few years ago by Michael Crichton, the author of many popular science fiction books, including *Jurassic Park* and *The Andromeda Strain*. In that article, Crichton highlighted the work of a privately-funded foundation called Space Camp, an intensive program for kids and adults to teach the physics and engineering of space flight. Last year, after 25 years of operation, Space Camp graduated its 500,000th camper. In his essay, Crichton tells the story of a ten year-old boy who was interviewed on TV after graduating from Space Camp. "Asked about the future, he spoke of colonies on the Moon, and trips to Mars. The reporter said, 'How are you going to get the Congress to pay for it?'" To which the young boy replied, "Maybe your Congress won't, but mine will." With your help, with American ingenuity and support, we are slowly turning this young man's dreams into reality.

At a fundamental level, NASA is in the inspiration business. We're about making our country worth defending, and I am extremely lucky and proud to be a part of this great enterprise.

It invigorates me to visit a college campus and meet the next generation of physicists and engineers, to hear about the latest research they are conducting, and to meet the young people who will go on to build our nation's new spacecraft and launch vehicles and discover new things about our Earth, solar system, and universe, or build our nation's next generation air traffic control system, or design advanced

aircraft to make air travel safer, cheaper, faster, and more environmentally friendly. I just met with some of the future professional engineers and scientists of Calvin College this morning and, as always, I really enjoyed the Q&A.

But the questions make me realize, increasingly, that I am two generations removed from the life and world of undergraduate education. And, sometimes, I am told that young people today are just not interested in NASA, in the space program, and that my generation cannot possibly understand the college students of today. After all, I grew up in the very different world of the 1950s and 60s. Today, we have satellite television with hundreds of channels and 24-hour news coverage, inexpensive jet travel, personal computers, cellphones and instant messaging, et cetera, so how could I possibly understand this new generation?

Now, I will readily admit to being clueless about a lot of popular culture, but despite that, I think the best answer I can give is, "You're right. My generation didn't have all those things when I was young. We invented them."

Now, some of you in this auditorium are of my generation, which grew up during the Apollo era of the 1960s, NASA's apotheosis. We watched science fiction movies and television shows that made us believe that we – all of us and not simply a few astronauts – could become space travelers. Arthur C. Clark's and Stanley Kubrik's masterpiece of science fiction "2001: A Space Odyssey" projected onto the screen of our collective human consciousness a future for us where, by now, hundreds of people would be living and working in Space Stations orbiting the Earth and towns would exist on the Moon. We would be journeying to other planets in our solar system, just as our European forebears came to America looking for new beginnings. This vision of our future proved illusory for our generation for two fundamental reasons: the limitations of our economic resources and of our technology. Neil Armstrong's "giant leap for mankind" was not a journey that could be sustained without a more concerted investment of time, resources, and energy than the nation was willing to provide after July 20th, 1969.

But rather than looking back wistfully on past greatness, I would rather learn from such history in order to understand our present and predict our future in space exploration. NASA celebrates it 50th birthday this year, but that does not mean we are due for a midlife crisis; it means that we have reached a milestone to recognize and celebrate, and then blow out the birthday candles with the wish that we be refreshed and renewed in our approach to the problems we face today and are likely to face in the future.

We have been exploring space now for fifty years, but it has only been fifty years. By way of comparison, human beings have been conducting transoceanic voyages for a thousand years or so. So, in only the first fifty years of spaceflight, it is actually quite remarkable to realize that NASA's robotic spacecraft have ventured to almost all planets in the solar system, four have actually left the solar system, and that twelve men have walked on the Moon. We are in the midst of constructing the International Space Station, which will be larger in wingspan than a football field and weigh about what the first Mars ship will weigh. Its development is the largest task ever performed by the civilian agencies of the United States or our international partners; only military coalitions have undertaken larger efforts.

Yet despite the achievements of our nation's first fifty years in space, the history books a thousand years from now will note that the United States of America was not the first country to explore space. Those books will name a nation that no longer exists – the Union of Soviet Socialist Republics. Those books will show that the Soviet Union launched the first man-made object into space, *Sputnik*, in October 1957, and that they launched the first astronaut, Yuri Gagarin, in April 1961. I was a young boy, eight years old at the time of *Sputnik*, growing up around an Army base in Aberdeen, Maryland, and I can still remember vividly the fear and embarrassment our nation felt at that time. It was on the front page of every newspaper, in the largest possible typefont. The idea that the United States could be beaten to space by any other nation, not to mention by our supposedly-backward declared adversary, was for almost everyone a galvanizing event. Nikita Krushchev's November, 1956 admonition – "We will bury you." – reverberated in our collective consciousness. Sputnik shifted the arena of international technical competition to the new frontier of space, and it mattered greatly.

One of the national leaders who recognized the importance of *Sputnik* was a young Congressman from Grand Rapids by the name of Gerald Ford, who in 1958 volunteered to become a member of the House Select Committee on Astronautics and Space Exploration. This committee has in the course of fifty years evolved into the House Science & Technology Committee of which Dr. Ehlers is now a senior member, but more importantly, this Congressional committee and Congressman Ford in particular was important in the drafting of the original Space Act legislation which founded NASA, bringing together

laboratories and field centers from various other branches of the federal government, including the Army, Navy, and the civilian National Advisory Committee on Aeronautics.

When Gerald Ford became president sixteen years later, he saluted the landings of the twin Viking robotic explorers on Mars, saying on the occasion of the first landing, "Our achievements in space represent not only the height of technological skill, they also reflect the best in our country – our character, the capacity for creativity and sacrifice, and a willingness to reach into the unknown." In the summer of 1975, President Ford also spoke via telephone through NASA ground antennas to American astronauts Tom Stafford and Deke Slayton and Soviet cosmonaut Valeriy Kubasov onboard the Apollo-Soyuz spacecraft 140 miles overhead. In the span of only a few years, America went from being behind in the Space Race to putting twelve men on the surface of the Moon. We also went from a competition to the beginning of a partnership with the Soviet Union, and our collaboration continues to this day. Partnership with other spacefaring nations has become a vital element of the United States "soft power" appeal, and over half of all NASA science missions, with over fifty spacecraft operating in space today, involve some form of international collaboration.

Today, two hundred miles overhead on the International Space Station, NASA astronauts Peggy Whitson and Dan Tani are living and working in space with Russian cosmonaut Yuri Malechenko. With the Space Station, NASA and our fifteen international partners have maintained a permanent human foothold in space since October 2000 – over seven years, and we are still learning the hard lessons of how to live and work in space 24/7/365. We are in the midst of Space Station assembly with the Space Shuttle between now and the fall of 2010, and hope to launch the European *Columbus* module in two weeks with Space Shuttle *Atlantis*, commanded by Navy Commander Steve Frick. The *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.

We are using the Station as a laboratory testbed for technologies, techniques, and lessons that will enable future colonies on the Moon and trips to Mars, and we are also developing materials and conducting research which will benefit us here on Earth. For example, Peggy and Dan recently activated a Microgravity Science Glovebox experiment called InSpace. The purpose of this investigation is to obtain fundamental data of the complex properties of a class of smart materials termed magnetorheological (MR) fluids. MR fluids are suspensions of small (micron-sized) superparamagnetic particles in a nonmagnetic medium. These controllable fluids can quickly transition into a nearly solid-like state when exposed to a magnetic field, and return to their original liquid state when the magnetic field is removed. The relative stiffness can be controlled by controlling the strength of the magnetic field. Thus, due to the rapid-response interface that they provide between mechanical components and electronic controls, MR fluids can be used to improve or develop new brake systems, seat suspensions, robotics, clutches, airplane landing gear, and vibration damping systems.

Last year, a convention of the American Medical Association endorsed NASA's efforts in human spaceflight, in going to the Moon, Mars, and beyond, because the technologies and techniques we have developed for doctors will "undoubtedly yield both projected and unanticipated biomedical breakthroughs." The AMA resolution listed several NASA contributions to their work, including LASIK surgery, laser angioplasty, dialysis machines improvements, and digital cochlear implants.

One of the success stories from NASA's work to develop such countermeasures is against painful kidney stones. In microgravity, the human body compensates for the reduced stress on the skeleton by releasing calcium from our bones, making astronauts more prone to developing kidney stones. In order to prevent the formation of such stones, astronauts have been taking potassium citrate, and NASA is conducting experiments with a new generation of pharmaceuticals with companies like Amgen to test other ways to prevent or reduce osteoporosis-like bone loss as well as deteriorating muscles.

Last September, Elias Zerhouni of the National Institutes of Health and I signed a Memorandum of Understanding to conduct even more joint medical research onboard the Space Station. On the next Shuttle flight, STS-122, NASA astronauts will test a drug called midodrine with the help of NIH researchers to hopefully reduce dizziness caused by a drop in blood pressure after our astronauts first return back to Earth from the zero-g environment of space.

Again, our goal is to develop and test new capabilities onboard the International Space Station that cannot be tested anywhere here on Earth, and that will not only enable future spaceflight missions to the Moon, Mars and beyond, but also benefit life here on Earth.

NASA simply cannot carry out this ambitious goal of exploring the solar system alone. We will need international collaborators, commercial companies and venture capitalists, and other agencies of the

United States government. It will take American know-how and can-do attitude. It will literally take "the best of the best of the best" to turn this goal into a reality. In my usual clueless fashion, I had failed to notice – until receiving a question from a member of the media – that Peggy Whitson is the first women to command the International Space Station. Peggy has a Ph.D. in biochemistry, studying at Iowa Wesleyan University College and Rice University in Houston, Texas. She is a veteran astronaut, who previously lived and worked for six months onboard Station in 2002 as the Science Officer. And yes, NASA's naming convention here with "Science Officer" pays homage to Star Trek's Mr. Spock. However, pointy ears are not required for this job.

Peggy is literally one of "the best of the best of the best", because less than 1% of those who even apply to become astronauts are selected. Over the years, NASA has received approximately 41,000 applications from prospective astronauts, while only 321 individuals have been selected. NASA is in the process of taking applications and screening for the next class of astronaut candidates even now, and we plan to announce this selection early next year.

Times have changed from the NASA of the 1950s and 1960s, and they should. The stereotypical buzz-cut test pilot or white male engineer like me are no longer representative of our agency. NASA depends upon the ideas in our people's heads for our success, not upon the package containing them. And while I do indeed care about the egalitarianism of society, I am also being pragmatic. For America to continue to be pre-eminent in the world economy, to be the world's leader in innovation, science, and technology, and to be a leader on the frontier of space exploration and aeronautics research, NASA will need the best ideas, hard work, and dedication from ***all*** those who would like to be involved with this most exciting enterprise of our time.

To explore space, we will need people, energy, and resources, so let me address the facts and some common misconceptions about how much the American taxpayer provides for NASA's budget. America's annual investment in NASA is less than one penny out of every federal dollar spent. Let me repeat: If you looked into your wallet or purse and pulled out a dollar bill and a penny, the entire federal budget represents that dollar while NASA's budget is less than that penny. To be more exact, NASA's current budget is 6/10ths of one percent of every federal dollar spent. This is somewhere in the realm of what engineers like me call rounding error. However, when polled, the average American believes NASA's budget to be much higher than it actually is, 24% of the Federal budget, comparable to that of the Pentagon. In fact, NASA's budget this year is $17.3 billion, the Pentagon's operating budget (not including supplemental appropriations for our operations in Iraq and Afghanistan) is $459 billion, and the overall federal budget is over $2.5 trillion.

From this small investment in NASA over many years, new engineering and scientific capabilities built originally for our nation's space program are now pervasive in our lives, critical to a range of activities that create and provide value. Since the 1960s, NASA pioneered research in high bandwidth satellite communications which helped lead to the development of high-definition satellite television with 24-hour news, entertainment, and sports anywhere in the world.

Forty years ago, engineers like me used three pieces of wood and a piece of plastic – the slide rule – to make calculations. Thirty years ago, 1000 transistors could fit on a silicon chip; today, it's 1.7 billion. The cost of such chips has dropped by a factor of 100,000. Few people know that the development of the first microprocessors was born of a competition between Fairchild and Intel in the 1960s, to build components small enough to fit in NASA's Apollo spacecraft.

We built weather and climate change monitoring sensors and satellites that, along with the fundamental research and applications from this data, improve our daily lives. Working with the Air Force and Navy, NASA improved precision timing techniques with atomic clocks that enabled the development of GPS, and a consumer market of over $20 billion in sales this year. In every GPS satellite, there is a small correction to its atomic clock to compensate for the effects of special and general relativity discovered by Albert Einstein.

In partnership with the FAA, NASA is developing the concepts, algorithms, and technologies to increase the airspace capacity in the United States in a safe, equitable, and efficient manner. A key question here is how to best address where, when, how, and the extent to which machine-level automation of air traffic control functions can be safely and effectively applied throughout U.S. airspace. NASA is also not limiting its research simply to the airspace, we are also looking at ways to improve the efficiency in the use of airport gates, taxiways, and runways while balancing the requirements of safety and environmental concerns. Researchers from across the United States have used NASA's aerodynamics

laboratories, wind tunnels, and know-how to help develop every single jet fighter aircraft used by the Air Force and Navy and to test new, commercial jet engines and lightweight composite structures.

Again, my generation didn't have these things when I was young. We invented them.

Sometimes our contribution is not to create new technologies, but to integrate various existing capabilities in innovative ways. Last fall, NASA used its air and space capabilities to aid Californians during the terrible wildfires that ravaged Southern California. Our Earth-observing satellites helped monitor the spread of those terrible fires. We also sent an unmanned aerial vehicle equipped with unique IR sensors to fly over the fires. The Ikhana UAV, which is operated through a cooperative effort between the Ames and Dryden Research Centers in California, peered through heavy smoke and darkness, found hot spots and flames, and transmitted the sensor information to a computer server at Ames, where it was combined with Google Earth maps and then transmitted to operations centers to provide firefighters a much better understanding of the situation, aiding disaster managers in allocating firefighting resources. The quick turnaround made a difference too. Information gathered from piloted airplanes currently must wait for the aircraft to land before it can be transmitted, while the Ikhana UAV sent the data to fire incident commanders only minutes after acquisition. Eventually and in concert with other agencies, we at NASA hope to have an entire network of sensors which will provide information about natural disasters at every scale, from the ground up to space, aiding responders and hopefully saving lives.

In another example, NASA is helping the poor countries of Central America with SERVIR (Spanish for "to serve"), a high-tech satellite visualization system that monitors weather and climate, helps to track and combat wildfires, improves land use for city planning and agricultural practices, and helps local officials respond faster to natural disasters. Meteorologists and disaster response experts in Central America use SERVIR to see where rain will fall, where flooding will occur, the location of forest fires, hurricanes, tornadoes and pretty much anything nature can dish out. Most recently, NASA research brought together radar imagery and other satellite data to help the Dominican Republic's government respond to extensive flooding in the wake of Tropical Storm Noel. The SERVIR project along with other acts of kindness and charity by the embedded NASA team has been such a success that one of our researchers, Dan Irwin, actually found himself being nominated to be the mayor for the small town of San Andres, Guatemala. Dan respectfully declined, but he was touched by the vote of confidence. NASA is now working with the State Department, NOAA, and other agencies to help provide capabilities like SERVIR to other regions of the world, like Africa.

Again, NASA is bringing space capabilities to bear to improve people's lives and even to save lives, but it will take far more than NASA funding to open up the new, exciting opportunities we hope to continue finding when we explore and exploit the vantage point of space.

NASA has formed a strategic partnership with the founders of Google to carry out various scientific endeavors, like the Google Moon mapping software, the use of their Gulfstream V to carry out scientific missions such as the campaign to monitor the Quadrantid meteor shower earlier this month, and supporting Google's offer of a prize purse of up to $30 million for the first privately-funded and -developed lander/rover to touch down successfully on the Moon and carry out various experiments. I also hope to open up the International Space Station as a National Laboratory to commercial ventures like our work with Amgen and other pharmaceutical companies.

My hope is that more people will be able to experience and benefit from space exploration and scientific discovery, and even make a profit from it. That is the American way. Likewise, it is also my hope that NASA will be able to spur on and leverage the capabilities which the commercial sector builds and be able to harness the improved intellectual capabilities coming from our nation's universities and high school students. This is important. It matters greatly to our nation's future.

That is why, along with Congressman Ehlers and other members of Congress, I am gravely concerned when I read statistics about how, on average, U.S. students are lagging behind their counterparts in other countries in their knowledge of math and science. According to a recent report which measures the skills of 15-year-olds in math and science across 30 industrialized nations, American students are trailing many potential competitors, and sometimes trailing badly. On average, U.S. students placed below standards in science, well behind Japan and Korea, but also trailing Ireland and Iceland. American 15-year olds did even worse in math, trailing many nations in Asia and Europe.

These troubling trends were best explored by a recent report "*Rising Above the Gathering Storm*" by the National Academy of Engineering. One of the first paragraphs in the report captured the situation well, so I will quote it at length: "Having reviewed the trends in the United States and abroad, the committee is deeply concerned that the scientific and technical building blocks of our economic leadership

are eroding at a time when many other nations are gathering strength. We strongly believe that a world-wide strengthening will benefit the world's economy – particularly in the creation of jobs in countries that are far less well-off than the United States – but we are worried about the future prosperity of the United States. Although many people assume that the United States will always be a world leader in science and technology, this may not continue to be the case inasmuch as great minds and great ideas exist throughout the world. We fear the abruptness with which such a lead in science and technology can be lost and the difficulty of recovering a lead once lost – if indeed it can be regained at all."

This is a sobering assessment. This report also cites some alarming statistics. Fifty years ago, almost twice as many bachelor's degrees in physics were awarded in the United States than in 2004. Last year, the United States produced more undergraduates in sports exercise than in electrical engineering. About a third of U.S. students who plan to study engineering when they entered college switch majors before graduating; they probably are not switching to mathematics or theoretical physics. Today, there are more software engineers in Bangalore, India than in Silicon Valley. In 2000, 38% of all U.S. science and technology Ph.D.s were conferred upon foreign-born graduate students, most of whom return to their home countries.

I hope you agree with me that America's economic growth is driven by technological innovation, and that societies which foster such innovation become leaders in the world. So, as NASA begins its next fifty years, I am deeply concerned about our nation's "bench strength" in carrying out our mission of space exploration, as well as other technical endeavors. We still need "the best of the best of the best" in more than just the astronaut corps. *This is rocket science.* The alarming statistics I have quoted have broad implications for the United States' ability to maintain economic and technological leadership in today's world.

Specific to the realm of spaceflight, I am concerned that America's real and perceived leadership in the standing of the world's spacefaring nations is slipping away. As Admiral Hal Gehman noted in his report of the Space Shuttle *Columbia* Accident Investigation Board a few years ago, "previous attempts to develop a replacement vehicle for the aging Shuttle represent a failure of national leadership."

That is also a sobering assessment. We have only recently begun developing the new *Orion* Crew Exploration Vehicle and *Ares* rockets, which will ferry astronauts to and from the International Space Station and, more importantly, allow us once again to go beyond low Earth orbit to the moon. We plan to retire the Space Shuttle in 2010, after nearly 30 years of experimental flights. However, with current budget projections, NASA's new human spaceflight systems will not come on-line until 2015. With an operational stand-down like this, I am gravely concerned that even more highly-skilled engineers will simply exit the field altogether, as happened at the end of the Apollo program. Worse, between now and then NASA will pay over $700 million, and possibly a good deal more, to the Russian Space Agency to support the International Space Station with their *Soyuz* and *Progress* crew and cargo vehicles. Other countries, like Malaysia and South Korea, and certain wealthy individuals are already paying the Russians for trips to the Space Station. So, fifty years after Sputnik, and thirty-five years after the last American footprint on the Moon, I must ask the question: who is currently the recognized leader in spaceflight?

China has also emerged as one of the three spacefaring nations. China demonstrated an anti-satellite weapon against one of their own aging weather satellites a year ago, and launched its first satellite mission to the Moon last October. In 2008, the Chinese plan to launch 17 satellites and to conduct their first spacewalk following the Beijing Olympics this fall. China is investing heavily in building their space capabilities because they understand the value of these activities as a driver for innovation and a source of national pride in being a member of the world's most exclusive club. China today not only flies its own taikonauts, but also has plans to launch about 100 satellites over the next five to eight years. It should be no surprise, especially to those who have read Tom Friedman's book "The World is Flat" or John Kao's "Innovation Nation", that this environment in China is breeding thousands of high-tech start-ups.

The Chinese have adapted the design of the Russian *Soyuz* to create their *Shenzhou* spacecraft. However, the similarity between the two ends at the outer mould line; the *Shenzhou* spacecraft is both more spacious and more capable. They plan to conduct their first spacewalks and orbital rendezvous operations, and to build their own space station – admittedly simpler than ours – in the coming years. While they have not stated an intention to do so, the Chinese could send a mission around the Moon with the *Shenzhou* spacecraft, as the United States did with the inspiring Apollo 8 mission back in 1968. China could easily execute such a mission with their planned Long March V rocket, currently under development and reportedly rivaling the capabilities of any expendable rocket in the world today. I have no doubt that they will have it in use, as they plan, by around 2012.

I am pointing out such things, matters of engineering capability, because I believe that it is important to understand our strategic competitors as well as those with whom we wish to collaborate. We must also understand ourselves, and the framework of our real and perceived leadership in the world in a broader context than simply NASA's 6/10ths of 1% of the federal budget. As John Kao couches the issue, we are currently facing a "Silent Sputnik" where "many countries are racing for a new innovation high ground while our own advantages are showing signs of serious wear."

If you agree with me that our nation is indeed facing a "Silent Sputnik" moment, then this situation begs the question: why does it take a crisis to get our nation's attention? I am concerned that America's potential as a great nation is withering away due to benign neglect, apathy, complacency, and a lack of leadership. That is, we are ignoring the crisis because there is not a galvanizing moment like the launch of Sputnik.

Now I fully appreciate there are many distractions in our modern life today, possibly due to the 24-hour satellite news capabilities that NASA itself helped to create. Last summer, just prior to a Space Shuttle launch, I sat down for an interview with CNN just as one of their producers informed me that they had to cut away from their coverage of the Shuttle launch. There was breaking news of vital national interest from Los Angeles: Paris Hilton was going to jail. And NASA could not compete for the American people's attention against Paris Hilton. That was the moment when I realized how tough the NASA Administrator's job really is.

While I make light of this, there is a not-so-subtle lesson here, that our media and nation are not focusing enough on what matters most. Thus, I believe it is necessary for us – all of us – to discuss openly the founding principles that led us as a nation to embrace space exploration, five decades ago.

A former chairman of the House Science Committee, Congressman Bob Walker from Pennsylvania, framed the issue very well in a speech soon after the Space Shuttle *Columbia* tragedy five years ago: "For every generation, choices are made that lead to greatness or mediocrity." And I would ask that all of us, each and every one of us here today, consider our choices and decisions we make in how we spend our time, resources, and energy.

In this thought-provoking speech, Congressman Walker quoted from the great British statesman, Benjamin Disreali, who once opined that "nations go from bondage to faith, from faith to courage, from courage to freedom, from freedom to abundance, from abundance to complacency, from complacency to dependency and from dependency back to bondage." It's all a matter of what each generation, in its time here on Earth, chooses to do.

History books hundreds of years from now will note President John F. Kennedy's choice for America in 1962. "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too. It is for these reasons that I regard the decision last year to shift our efforts in space from low to high gear as among the most important decisions that will be made during my incumbency in the office of the Presidency."

When President Kennedy spoke those bold words and challenged our nation, NASA then had less than eleven hours of experience in human spaceflight under its belt in the Mercury program, but we had *The Right Stuff*. We did not yet have the Apollo capsules or powerful Saturn V rockets or lunar landers; we did not even have computers as advanced as the Blackberry I have on me today, let alone the power of the internet. We invented them.

"For every generation, choices are made that lead to greatness or mediocrity." Thank you for choosing to spend this afternoon listening to me.