William Giles Lectureship
Mississippi State University
Michael D. Griffin
Administrator
National Aeronautics and Space Administration

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Thank you Rick (Rick Gilbrech) for that very generous introduction and President Lee (Charles Lee) for your wonderful hospitality. And I thank all the students, faculty members, administrators and friends of this great institution for your warm welcome. President Lee, I'm honored to present the William Giles lectureship in recognition of your predecessor's outstanding service to this institution, and his leadership in strengthening the school's dedication to teaching, research, and service.

In coming here today, I am reminded that 35 years ago in February, a long-time Mississippi resident, Air Force Major Stuart Roosa, orbited the moon in the Command Module Kitty Hawk, while his fellow Apollo 14 crewmembers Alan Shepard and Edgar Mitchell explored Fra Mauro crater. Roosa, who passed away in 1994, often ended talks about his experiences by reminding his audiences, "Remember when you look up at the moon tonight, there are six American flags up there!"

In years to come we will have many more American flags on the moon, along with the flags of partner nations who will join us in this enterprise. Many of you could play a role in this dramatic expansion of humanity's frontiers in the 21st century, with the renewal of lunar exploration beginning 12 years from now, when we will send crews to the moon not just for 33 hours, as for Apollo 14, but for months at a time.

This is the subject I wish to address today; how American leadership in the exploration and development of space will impact your world in profound and perhaps unexpected ways.

With the President's announcement two years ago of the Vision for Space Exploration, a long-term plan to extend human reach back to the moon and then onward to Mars and other destinations, we at NASA have the unique privilege of carrying out an exciting program of exploration and discovery on behalf of the American people. These new capabilities will allow us to explore new places, expand our understanding of the universe and establish human presence in new territory when it becomes possible to do so.

But as much as some of us want to undertake this journey, there will always be others who call for our country to turn inward, to retrench and focus our energies on the pressing issues of the day. And since there *are* always pressing issues, why should we do this?

There are several rationales for space exploration that are compelling to different people for different reasons.

President Bush expressed well one of the core reasons for space exploration when he stated, "The cause of exploration is not an option we choose; it is a desire written in the human heart." The spirit of exploration is embedded in our human DNA. If it were not, the human species would still be confined to East Africa. And indeed, this genetic trait must be much more deeply rooted; most members of the animal kingdom range as far and wide as their physical adaptability allows. So, while exploration beyond one's known habitat is usually difficult and dangerous for an individual, it clearly provides survival value for the species as a whole, in the

longer run. And, in the very long run, this may indeed be the single most compelling reason for space exploration. Carl Sagan captured it nicely when he noted that if the dinosaurs had had a space program, they would not be extinct.

From a broader perspective, human civilizations and cultures also exhibit the desire to survive, grow, and prosper. History clearly shows that one of the great drivers of scientific and cultural advancement and innovation is exploration. It was 466 years ago that the Spanish explorer Hernando de Soto ventured westward across Mississippi's northern regions, to be followed years later by French colonists who built forts and communities along the Gulf Coast. It was during this historic epoch that other nations such as Great Britain, Portugal and the Netherlands which made a sustained commitment to exploration also prospered. Today, the American people are very proud of the United States' role in the history of spaceflight, a role that links modern America to our history as a frontier nation. In recent public opinion polling, 75 percent of Americans support or strongly support President George W. Bush's expressed mandate to extend human missions to the moon as early as 2018, eventually probe the mysteries of mars and search for the possible existence of life in the cosmos. This popular support is reflected in the substantial majorities of both houses of Congress that have voted for two consecutive years to fund this new vision for NASA. In the end, societies that commit to the frontiers of their time prove, in retrospect, to be among the leaders of that time. Space exploration is the frontier of our time.

We can also observe that in the process of exploring space, we develop new technologies and capabilities that ultimately benefit billions of people here on Earth. Just as Project Apollo led to important advances in computing and electronics, the potential technological benefits from

a broader 21st century program will prove considerable. The technology development necessary to execute and implement our long-range exploration program will accelerate advances in robotics, autonomous and fault tolerant systems, human-machine interfaces, materials, life support systems and novel applications of microdevices, to name a few. Space exploration is a lens that brings a focus to the development of key technologies in a way that simply would not occur without the "demand pull" that arises when trying to accomplish the near-impossible.

With these reasons in mind, we believe that we can address our immediately pressing needs while, with a modest investment of our national resources, continue activities that fuel the growth of human creativity, innovation and technology development.

Allow me to paint for you a brief picture of the kinds of activities we will be conducting in the years ahead. Once we return to the moon, aided by a new generation of spacecraft, launch and cargo carrying vehicles whose propulsion systems Rick and his team will test at the Stennis Space Center, we must soon begin to learn how to obtain useful resources, such as oxygen, from the lunar soil. The astronauts, perhaps supported by research conducted by your academic departments devoted to agriculture, will be growing vegetables in lunar greenhouses. Our lunar pioneers will eventually deploy an array of small antennas on the back side of the Moon, which can be linked in phase to form the largest radio telescope ever built, free of radio noise from Earth. They will conduct geological exploration of the moon, finally establishing the origins of our Earth-Moon system. And other astronauts, elsewhere, will be readying a 500 ton spaceship for mankind's first voyage to Mars.

Meanwhile, at gravitationally balanced Lagrange points in the Earth-Moon and Earth-Sun system, large space telescopes will enable us to image Earth-like planets around other stars, perhaps even measuring their atmospheric composition, and to continue advancing our search for answers about the possible existence of life elsewhere in the cosmos. We will also continue to use robotic spacecraft to explore the dynamic worlds of our solar system, including Saturn's moon Enceladus, which the Cassini spacecraft recently discovered has a spewing icy geyser, a tantalizing indication of potentially life-supporting conditions existing close to our planetary home.

It is worth noting that you are the first generation in human history, the very first, to be alive at a time when there will always be people living and working in space. We have had a continuous human presence in space for five years now, with 12 expeditionary crews onboard the International Space Station for six months at a time. Our 13th Space Station crew, Commander Pavel Vinogradov and Flight Engineer and NASA Science Officer Jeffrey Williams, will lift off from Kazakhstan in two days.

It is not a stretch to predict that by the time many of you start your families, we will have established a permanent human presence on worlds other than our own. It is America's obligation to seize this moment.

This is the quest of our age. Going beyond the bonds of Earth is a challenge that will require the talents and skills of many of you who are attending Mississippi State today, including those in the fields of business, agriculture and public policy, as well as those of you engaged in the disciplines of mathematics, science, and engineering.

For those of you whose career path will include the space program, over the course of your career you will have opportunities to tackle some of the most rewarding challenges one

could imagine. We are embarking upon a sustainable, long-term, multi-generational program that will enable human beings to see and do things that have never been seen and done before. If

I were attending Mississippi State today, and were involved in a technical field, or just naturally drawn to the challenges of exploration and discovery, I would want to work in the space business because, because that is where some of the most exciting action will be in the coming decades.

Everyone here today will have their careers and lives profoundly influenced by space in the 21st Century. Those of you studying agriculture and forestry will make ample use of satellite remote sensing technologies. Those of you engaged in political science may have roles in shaping our space program and scientific research priorities. The architecture students among you may help us design permanent outposts and research stations on the moon and Mars. An endeavor of this complexity will certainly tap the skills and energies of those trained in management. And the space program will always draw upon the best technical talent Mississippi State has to offer.

Indeed, we already are. We have called on a team of research engineers here at Mississippi State, led by Assistant Professor of Computer Science Ed Luke, to help NASA design safer and more efficient rocket-propelled vehicles of the future. Associate Professor of Computer Science Eric Hansen is helping us develop a new generation of roving robots that can "think" their way out of tight spots and secure valuable data while exploring the moon, Mars and other planetary bodies. And just last week, we provided Mississippi State's GeoResources Institute a $9.6 million grant to help us develop a stronger and more accessible Earth science research database for use by a wide variety of U.S. governmental agencies. We are counting on the Institute's Director David Shaw, Associate Director for Research Robert Moorhead and their

fellow researchers to use your school's impressive geospatial technology expertise to help build a computerized, one-stop data resource useful in addressing such diverse issues as climate

change, bioterrorism, transportation, and population trends. This grant builds upon a very productive seven year relationship NASA has enjoyed with the GeoResources Institute in helping us develop a host of decision-support tools that extend NASA's Earth system science research results for the benefit of society.

We also count among NASA's top performers many Mississippi State graduates such as Rick, who earned a bachelor's degree in aerospace engineering at Mississippi State. Former Stennis Space Center Director Roy Estess also received an engineering degree here. And our current Stennis Associate Director, Mike Dawson, received from MSU a bachelor's degree in Chemical Engineering.

Over at the Michoud Assembly Facility in New Orleans, where the Space Shuttle External Tank is put together, Mississippi State grad Mike Raybon was recently named "Engineer of the Year" for his superior structural engineering design and analysis work. Also at Michoud, Laurin Shows (*SCHAUZ*) Beech, who graduated from MSU three years ago with a degree in Biological Engineering, has been working on our External Tank Launch Integration team helping to conduct the many design reviews essential for flight.

If any in this audience are interested in joining the NASA team, I'm pleased to report that two days from now recruiters from the Stennis Space Center will be visiting your campus to recruit sophomores and juniors for co-operative education program vacancies. These co-op opportunities are primarily in the Center's Engineering and Science Directorate and in a variety of disciplines, including electrical and mechanical engineering, math, and physics.

We need talented young graduates to replenish our scientific and engineering workforce. Throughout NASA's history, our agency has shown the ability to implement large-

scale engineering projects, and to conduct our systems engineering work in ways not previously thought possible. But what we have ahead of us represents a challenge significantly greater than when we first went to the Moon.

We have learned a tremendous amount from the ongoing international partnership to assembly and operate the International Space Station, orbiting 250 miles over our heads. But, to go to Mars, we will need to learn how to assemble in low Earth orbit the 500-metric ton spacecraft that will take a crew on a multi-year voyage to Mars.

For voyages to Mars and beyond we will need to develop a new kind of expertise based more upon what was learned centuries ago from great journeys of exploration than upon what we have experienced in the first half-century of space flight. We will never venture very far from home if we are forced to bring all of the required propellant and other supplies with us from the start. We must learn to use local resources to reprovision our ships far from home. That is why we will challenge our engineers to develop rocket engines that can be fueled, for example, by a lox/methane mix, constituents that can be found in Mars' atmosphere. The requirement to live off the land will be crucial to our future in space, just as it was to Lewis and Clark and the Corps of Discovery as they made their way from St. Joseph, Missouri, to the West Coast and back from 1803 to 1806.

We must think expansively about how our astronauts in the new worlds of the 21st Century can grow food, construct shelters, supply power, and maintain their health. We will find

that all human knowledge and skill will be needed to advance space exploration. And in the doing of it, we are going to find that there are many things we don't yet know, and that we must learn. Every discipline will play a role, and every discipline will be challenged to expand the frontiers of its body of knowledge in order to contribute to this grand vision. We may even find a role for those of you studying Weed Management!

In conclusion, I'm convinced that in the ways NASA is attacking the challenges presented by the Vision for Space Exploration, we are setting the stage for a space program that will increase the opportunities we will all share to advance scientific knowledge and expand humanity's exploration horizons.

It is America's obligation to seize this opportunity to explore worlds beyond our own and help shape the destiny of our planet, for centuries to come. The human imperative to explore will surely be satisfied, by others if not by us. What the United States gains from a robust, focused program of human space exploration is the opportunity for world leadership in the greatest enterprise in human history. This is our destiny, and I believe that America must lead the way. Thank you again for inviting me to your beautiful campus today, and for your evident interest in the space program.