

Michael Lembeck ([00:14](#)):

Hello. I'm Michael Lembeck from the Laboratory for Advanced Space Systems at Illinois and I'd like to talk to you today about why space exploration is important to the United States. One of the hardest questions that is often asked of us rocket scientists is, why is space important? Even President Kennedy tried to answer that question some 60 years ago.

John Kennedy ([00:34](#)):

But why, some say, the moon? Why choose this as our goal? And they may well ask, why climb the highest mountain? Why 35 years ago fly the Atlantic? Why does Rice play Texas? We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they're hard.

Michael Lembeck ([01:03](#)):

Even these many years later, we still don't know why Rice plays Texas, but what kind of a space program should we foster and what to do next remains a recurring question. And one could argue that this is because we in the aerospace community have yet to articulate a satisfying answer. We talk about the survival of our species, about being made of the stuff of stars and about the romance of exploration. And we've talked about technological advancements in spinoffs yet I don't think the answer revolves around Teflon, Velcro, and Tang. It is a fact that the general public overwhelmingly supports the space program. Excitement was initially generated by daring feats of heroism undertaken by the first astronauts. We have since added to that support with the awe inspiring pictures returned by the Right Stuff Robots, the Hubble Space Telescope, and the Curiosity and Perseverance rovers on Mars, now joined by a helicopter called Ingenuity.

Everyone believes that space exploration is a good thing even if we can't fully explain why. Let me try to answer that question with another set of questions. Why do we visit monuments in other historical placements and walk around museums looking at paintings from hundreds of years ago? Why do we pay our hard earned money to sit in dark theaters watching films with subtitles that we can barely read? And why do we race the Barnes & Noble, or maybe to our Nooks and Kindles to buy the just released best seller? Why do we still spend many millions of dollars a year on iTunes or Spotify subscriptions? These questions are interesting ones and you all probably have good answers for them and I'd bet most of your answers are related to how you like to learn new things, understand your heritage, or just flat out want to break from the everyday world, and who doesn't today?

As a final justification, you'd probably say the words "because I enjoy it." And you'll spend money on those things, sometimes even when you don't it in the bank. However, not everyone is satisfied with a visit to the king Tut exhibit at the local museum. Many of us want to hop on a plane and visit the actual pyramids. When you want to take a vacation, are you just satisfied to go to a website, stare at pictures of wondrous far away places and only imagine what it was like to be there? Of course not. No, you want to go to that place and experience all that it has to offer. That's partially why we have a space program today and why space tourism is inevitable. But getting off our planet. At least till now, has required the financial resources of superpower governments beyond the reach of even our richest citizens. That means discretionary resources that would otherwise be spent on combating disease, terrorism, hurricane cleanups, and helping the impoverished has instead been directed into the wild blue yonder, or so it would appear.

Making that call to fund space exploration instead of focusing on earthbound issues is hard for some to do when looking into the face of an enormous deficit back here on planet earth. John Logsdon,

formerly of the Space Policy Institute at George Washington University, said, "Whatever the specifics of the proposed new path in space, it will have to rest on a convincing argument of why it is in the nation's interest to make and sustain such an expensive commitment, particularly one that inevitably involves risking the lives of more astronauts. Rhetoric about the inspiration of discovery and the longing understand is unlikely to be enough." Yet contrary to Logsdon's pessimism, America's appetite for discretionary spending in the civil space program has been steady since just after the Apollo Program spending peak.

We don't think too much about this expenditure so long as it stays in the \$20 to \$22 billion ballpark. And that's less than one half of 1% of the federal budget. And in this area, we outspend the rest of the world combined by a three to one ratio. Americans are incredibly forward leaning when it comes to funding journeys of discovery and we are mostly happy with the results. In fact, the annual NASA budget debate in Congress is more about how to spend the \$22 billion rather than if we should spend it. So maybe a better question to ask is, how should we be spending our space budget and at what pace should our future play out? In the past, when confronted with a promising frontier territory, the federal government has successfully taken the leading role in the development of the infrastructure facilitating expansion into that territory.

Whether it was the establishment of the first outpost in Fort Dodge, the construction of NAVAIDs across the country to support air mail service, or the interstate highway system, Uncle Sam has been there to pave the way. Of course, much of that infrastructure has helped establish the mechanisms for stimulating local economies. Without modern transportation systems, governance and economic opportunities would've expanded much more slowly across our great land. Clearly, some sort of our infrastructure will also be required to expand into the space frontier and to accrue the benefits that it may offer. Despite 40 years of experience in flying Apollo, the space shuttle, and the International Space Station, we are barely beyond the right flyer in space travel sophistication. Even with today's technologies, we still find ourselves constrained by the physics of overcoming Isaac Newton's law of gravity.

Gravity's closest friend is friction and both make it difficult to travel the relatively short distance of 62 miles straight up into space. But we are getting there and at a tremendous rate. From the time of Da Vinci until the Wright Brothers, we struggled to get just three feet above the ground. Today, you can't quite just walk out your front door, catch a cab to the space port, and take a flight to [inaudible 00:06:53] on the moon, but we are at least thinking about it. The infrastructure for air mail service promoted the growth of commercial air transportation often for the benefit of the wealthy looking for off the beaten recreation spots. Likewise, NASA's space infrastructure investments will be leveraged in the future. NASA itself has established a market opportunity in the International Space Station and is now attempting to foster commercial cargo and crew transportation options, getting out of the way where it can.

So while wealthy individuals may soon engage in personal exploration of low Earth orbit, or even the moon, is there justification for the expense of going even further, say, on to Mars? How fast should we try to accomplish this goal? How would a faster program hold up when there are victims of natural disasters, terror, and poverty all around us? How can our government representatives divert limited resources from these problems to making smoke and fire just 62 miles high? Even Andrew Carnegie once said, "Pioneering don't pay." Today we might say, "Pioneering don't gather votes." The historian Frederick Jackson Turner argued in the late 19th Century that many of the distinctive characteristics of American society including inventiveness, inquisitiveness, and individualism derived from the existence of a frontier. But is that enough to justify the expense of putting footprints on the Red Planet tomorrow? Probably not to the Speaker of the House.

Earlier, I mentioned that infrastructure was going to be required to accrue the benefits of space exploration, but benefits are still waiting to be gathered. The exploitation of the discoveries made along the way are highly dependent on serendipity, personality, and timing. Real hardcore, leave your neighborhoods kinds of exploration have always depended on the benefactions of Kings, Queens, and Presidents. What really motivated these enlightened leaders to part with their discretionary budgets? Did Spain solve all of the world's problems before Columbus set out from Europe to sail to the New World? No, but Columbus suspected that cash might be found on the other side of the sea.

Certainly, not all of our problems on our early East Coast were solved by our forefathers before they headed to the other coast on the left. What rationale did Lewis and Clark use on Jefferson to petition off some of the fledgling nation's budget earmarked for the defense of our independence? They explored at a measured pace while keeping an eye on British and French Canadian hunters. Fur trading outposts in the interior also come to mind. Unfortunately, space does not yet have some of the same connections to commerce that pass mercantilism did. Where exactly are the suspected profits to be had from space? Surely, we've had profitable communication satellites pushing satellite television signals to cell phones in some parts of the world. While commercial and market driven space, tourism is more exploitation than commerce in the general sense of the word. Commerce comes after discovery.

We still need to discover the means by which space will support commerce of some kind. Putting a safe infrastructure in place to make those discoveries appears to be a good correct first step. And the pace we are moving at is also pretty good, historically speaking. Remember that we live in a more enlightened time where fear of nuclear war is less of a threat, where we're enjoying more freedoms with greater wealth and health than any time in history. It's from that position that NASA receives its discovery endowment. And then, what will happen after we make those inevitable discoveries? Analogy may help us here. What has become of those early frontiers opened by Columbus and fellow explorers by Lewis and Clark? Well, look around. Most of the easy to get to, over the horizon, around the corner types of frontiers are now covered with parking lots. That's right, parking lots, Walmart parking lots.

And those parking lots are filled with cars, cars driven by real people with real jobs, spending real money, motivating our economy. And that economy provides the means to pay for the parks for our kids to play in. It pays for our national security and it pays to fix those damages caused by tornadoes and hurricanes when they happen. And some of those people in those parking lots even work in aerospace, making real salaries in places like Houston, Los Angeles, and yes, even in Chicago, Rockford, and St. Louis. I didn't see a Brinks truck with all of the money being spent on the space program tucked into the very last space shuttle cargo bay and rocketed off into space never to be seen again. No, a good chunk of the space program's budget was spent right here on earth by aerospace engineers at the former Western frontier now occupied by our local Walmarts.

After we have the infrastructure to reliably get off the planet, we will make those inevitable discoveries on the moon and beyond and those discoveries will be followed closely by opportunities for commerce and some parking lots and maybe a pub or two. You see, in the old West, the hub of activity in frontier towns really was the saloon. Tomorrow, the lowly pub may once again help foster a burgeoning economy in some far away places. Imagine you're one of those future explorers or perhaps a space tourist coming into Lembeck's Pub on the moon. You put your five lunars on the bar and I promise I'll pour you one of the finest Tang Mimosas this side of the Pleiades. Eventually, I'll need to clean up my bar so I'll take two of those lunars down to the Sea of Tranquility Walmart to buy some paper towels. The kid stocking the shelves at the Walmart, well, he's going to take one of those lunars and go see Jennifer Aniston's daughter in a movie at the theater next door.

You get the idea. The moon becomes a place to send goods from earth, a trading post. An economy will be built and wherever trade occurs among dissimilar cultures security is enhanced. So maybe we can begin to answer the benefits question. We can tie together the existence of infrastructure to discovery, to commerce, to tourism, and maybe even to national security with one big bow. Now, look up. Not long ago we celebrated 20 years of continuous human presence in low Earth orbit. Our former enemies are now our friends and indeed roommates on the International Space Station. Space is no longer a place where we demonstrate our superiority, but rather a place to demonstrate harmony and cooperation. We completed the build out of the international components of the Space Station and met our international partner commitments. We've already dismantled some of the missiles pointed at each other. Rival has become comrade, and a couple of tourists have already shown up.

Now, look east. Has China learned from their history of looking inward, wrapping their borders with the Great Wall? Are they now looking outward to reproduce the successes that we have enjoyed over our past 200 years. In the 1400s, they owned the resources to explore globally, but chose to use their fleets to protect their borders, not sail past them. As they lean forward now, are we going to turn our backs and let them take the mantle we have carried proudly for the past 60 years? Our first exploratory steps into the New World, the Wild West, and indeed 62 miles up were motivated by security concerns, an expression of national pride and a desire to profit from developing markets. Exploration and discovery almost always leads the transformation of seemingly uninhabitable places into engines of enterprise, commerce, and sustainable growth.

A fundamental goal of our space program has been to advance U.S. scientific, security, and economic interests through robust expeditions of expansion. When we go to the moon, we have a pint at the pub and celebrate our latest discoveries. We celebrate the economy with a capital E. We reduce tensions with our neighbors and we generate new resources in the form of capital required to tackle the pressing issues back home. So maybe space is important because of Teflon, Velcro, and Tang after all, but not because they are rightly or wrongly denoted as being spinoffs or technological advances of the space program. No, tomorrow new Teflons and Velcros and Tangs will follow the new discoveries enabled by a burgeoning transportation infrastructure and they will ultimately be important because we can sell them and protect our country with them. And that, in a small capsule, is why space expiration is important to you and me and the rest of our neighbors here on planet Earth. In the future, when you drop in on Lembeck's Pub on the moon, where the drinks are just out of this world, tell the barkeep the United States sent you. Thank you.

Heidi Bjerke ([15:44](#)):

If anybody has a question, I have made it possible for you to unmute, or you can put your questions in the chat. I have a question. What do you think about some of the commercial opportunities that are coming up? Do you think that's going to really be the way the future's going to go, that NASA is going to take a back seat to not just the small launches, but to the bigger ones too?

Michael Lembeck ([16:10](#)):

I think it very much is going to play a major role. Commercial folks tend to do things a lot more efficiently than the government can. There's no real difference between them, it's just the way the business is conducted. Contractors have been building NASA exploration vehicles for 60 years. Now, these folks have used that owned knowledge and improvements in the process to go out and develop new systems that the commercial folks are fielding today. So I think we will see a new approach, a new way of doing business in space, and definitely a reduction in costs so that we can actually do more.

Heidi Bjerke ([16:46](#)):

Thank you. And we have a question here. With a change in administration, what do you think will be the future of Space Force?

Michael Lembeck ([16:56](#)):

Well, it appears that the Space Force is going to stay on the track that it was originated on. I think there was broad bipartisan support for it in the beginning and under the Biden administration I expect it to continue. And while I try to promote the positive aspects of going to space, the diplomatic pieces that we've encountered and enjoyed on the space station, that's not to say there aren't folks elsewhere in the world that don't agree with our philosophies that would like to take us to task for them. So I think the Space Force is a necessary element and will continue along the path that it's been put on.

Heidi Bjerke ([17:32](#)):

Okay, thank you. We also have question, how do you think NASA can stay relevant in the future?

Michael Lembeck ([17:39](#)):

That's a very good question. I think it will stay relevant much the same way that Queen Isabella was relevant to Columbus. NASA will be able to act as a smart buyer, work with the commercial folks to provide them with insight and oversight that NASA has gained over the last 60 years, but at the same token, be able to spend its resources more efficiently, not by paying for government systems, but buying the commercial systems to go get the work done that NASA's chartered to do.

Heidi Bjerke ([18:13](#)):

Thank you. Have you read Buzz Aldrin's books about the future for space exploration that he's promoting?

Michael Lembeck ([18:22](#)):

Yeah. I've actually had the opportunity to work Buzz in the past when I was working on one of the original lunar module designs for Northrop Grumman. We brought Buzz in to talk about what it was like to fly in the lunar module, what things he'd like to improve and see done better. And since he's gotten out into his post-government jobs and work, he's been a very big proponent of going on to Mars and it's just really good to see that he's out there still kicking and encouraging folks to move forward with exploration.

Heidi Bjerke ([18:59](#)):

Yeah. He's been pushing a lot of stuff at education conferences I've been to for the last several years and things. He has usually a big group there pushing that on to Mars things and some of his books and stuff have been giveaways. I know he's a great proponent of education along with it.

Michael Lembeck ([19:16](#)):

Absolutely.

Heidi Bjerke ([19:17](#)):

His books are an interesting read about life in the Apollo era and things like that, but then also connecting them to today. After Mars, what is our next destination, is the question?

Michael Lembeck ([19:30](#)):

Well, there's several that are being discussed. First up, out of the box will be Europa. The Europa Orbiter is in production right now at JPL. Should be launched within the next three to four years. There's a lot of talk of sending a quad copter off to Titan and doing some exploration there in that environment that could be a precursor to life, and all of the ocean worlds and Enceladus, Europa are going to get a lot of attention because of the amount of water that may be below their frozen surface and the possibility that, that has evolved some sort of life there. So I think we're going to see a lot of focus on the ocean worlds after Mars.

Heidi Bjerke ([20:19](#)):

Thank you. We also have another question. How practical do you think is Musk's claim to put humans on Mars by 2026?

Michael Lembeck ([20:28](#)):

Probably a stretch. He probably will miss that date, but not by much. I think he has the opportunity if he can get Starship working and off the ground to demonstrate some significant capabilities. I never bet against Elon, but I will bet against his schedules. They tend to be super optimistic, but I think he'll get there.

Heidi Bjerke ([20:55](#)):

And then a follow-up with that, should we get our technological act together on the moon first before Mars?

Michael Lembeck ([21:03](#)):

Absolutely. The folks that had the interior knowledge of how to get to the moon, as we mentioned, Michael Collins passing away today, just they've either retired or they're not around anymore. So there's a lot of things that you have to do to get ready. If you think about it, with the space station just a couple of 100 miles up, we have difficulty keeping it supplied in its logistics train just with food and water and oxygen for the astronauts there. Now you go three days away, the logistics train gets a lot harder and we need to figure out how to do that, how to keep a base supplied well, before we take off on something that could be six months to a year away like Mars. So developing the technologies, the operational skills, how to work at a distance away from your help that's on the ground, that's all going to be very important and worked out on the moon.

One other very important thing that the moon is going to hopefully give us is whether or not there's a threshold for human beings operating in a reduced gravity environment. Right now, we know operating in zero G that astronauts really have a hard time going past about six months, and at one year of time, the human body is really ravaged by microgravity. Scott Kelly proved that on the twins flight. So if we can find that perhaps one-sixth G is helpful in keeping our bodies from decaying, if you will, we may be able to, as aerospace engineers, start to think about developing artificial gravity systems that would certainly make the trip to Mars much more palatable.

Heidi Bjerke ([22:40](#)):

Okay. Thank you. And we have another question. If when SLS is canceled, what do you think NASA will put forward publicized as the big project they're working on?

Michael Lembeck ([22:55](#)):

Oh, that's a really good question. Not many people know that in the appropriations language for the SLS, it is stated that if a commercial system comes online that has the same capabilities, the government will get out of the way and terminate the program. So if Elon is successful with Starship, that would be the death nail for SLS. After that, I think the program driven by the government will start to focus on what kinds of things has to be done at a lunar base to prepare us for Mars. The other thing the government's going to need to do is start to work on faster propulsion systems. Space is like an ocean, and you don't cross the ocean in a rowboat. We're going to need something that moves a lot faster, and nuclear energy, nuclear propulsion is probably the way to go, and in order to be able to take advantage of that, it really takes the resources of a government or even governments in order to develop such a system in a safe and usable fashion.

Heidi Bjerke ([23:52](#)):

Okay. Thank you. Let's see, are there more that popped? Why are Uranus and Neptune not a priority for space agencies?

Michael Lembeck ([24:04](#)):

Another good question. I think primarily because there's not a whole lot going on, on those planets. They are so far away from the sun that the energy that reaches them is very small. They're gas giants. We understand them. There's not a lot of dynamics happening. What will be of interest, however, are their moons. Both of them have a large number of moons that would be worthy of exploring to figure out if life could be developing there. You think about it, when you go away far away from the sun, it's pretty cold out there, but if you're on a moon that's being tugged at, by its host sister/mother planet, you get thrashed around a little bit. And that thrashing heats up the interior of the moon. If there's water there or ice, those tidal forces will cause the ice to melt and you could have liquid water underneath it, and where there's water there may be life.

So I think we'll see eventually, as we start to reach some of these initial places, our priorities will change and we'll continue to move further out. Well, thanks for everyone for showing up and listening today. Hope you learned a thing or two and come back and listen to some more of these talks that happen every week. They're a fantastic opportunity to meet some experts in the field like Dr. Melville. And I think there's a whole bunch more coming down the road.

Heidi Bjerke ([25:30](#)):

Yep. We have next week Dr. Sunny White and we have Chris Miller from NASA speaking. So that's our next week, and that'll actually be our final one for the Spring Space Talks. Thank you again and have a good day. We won't keep you any longer, and I hope to see you next week.