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Wings & Things Guest Lecture Series

The Air Force in Space -- and on the Moon: The Flights of Apollo 9 and Apollo 15

Former NASA astronaut and retired Air Force colonel David R. Scott talks about his three space missions: Gemini VIII, Apollo 9 and Apollo 15.

Well, thank you very much and welcome everybody. It's a real pleasure for me to be with you this evening. This is a momentous period in aviation and space history, turns out that tomorrow is the 50th anniversary of Scott Carpenter's Flight the 2nd Mercury orbital flight and I am going off to New York to join Scott and a lot of other friends, but you know time moves on and a lovely place like this is where you can really learn about time and learn about history. Now I have enjoyed having an evening with General Hudson and his colleagues to learn more about what's here, but I have realized there is one special mission that's not here. And I can tell you about it now because it's been 50 years and certain things can be released after 50 years.

And it turns out that when I got in the space program they were just getting ready for the Gemini program, which was a two-seat spacecraft. And they really didn't know how to put a crew of two together in the spacecraft, they had Mercury and that worked okay, but you know often there are conflicts between people, personalities and things like that. And the shrinks get in there and start talking about, well how do you match people up. Well in the Mercury program, they had a lot of successes, and of course the first successful flight was a monkey named Ham. And then they got on to, well, they had Air Force, really great Air Force, Marines, Navy, whatever and a Mercury program. Well, we got ready for Gemini, they said, "Gee, should we try a couple of monkeys or a couple of men?" And they had this big committee meeting, even back then and said, "You know what? We should have one of each."

Now this was, it was a classified program, that's what I can tell you about it now because it was a black program right. So they decided that they would have a monkey and then they would have a human. Now to get the species as close together as possible they had a big discussion about what human. It was easy. They pick the Marine. So they trained this two, the monkey and the Marine, and they have lights on the panel for the monkey to perform and they had control for Marine and they get the training and they get launched okay, they get into orbit and the procedure is, every time the spacecraft goes over Mission Control, well Mission Control will call up through the spacecraft the procedures for the next maneuver. Now, of course, the monkey can't speak so they tell the Marine, you have got to relay it to the monkey, that's okay. So they come over, you know, and Marines are ready to go and monkey is pretty cool and they come over and they say and they call up and says, okay first instructions we want the monkey to roll the spacecraft upside down. So Marine says to the Monkey and gives him the signal with the lights and by golly, he does it perfect like that. Everybody is impressed, comes back around, the

Marine calls down, okay, Mission Control. So Marine is standing by here, Gemini X, what are my instructions. Stand by. MCC sends up some more signals to the monkey, says back it up and push it forward. Monkey does it perfect, perfect. Now all impressed with this monkey, spacecraft comes over, MCC again. Marine calls down, you know Marines, they get pretty you know every once in a while, says, okay MCC, this is Marine, I am standing by for my instructions. Marine, stand by one, are you ready to copy? I'm ready to copy. Feed the monkey. So anyway, that's how we got into the Gemini program.

So what I would like to do this evening is walk you through some of the programs that I have been very fortunate to be part of and it's mostly focused on Air Force and Space, and I got three flights: Gemini 8, Apollo 9 and Apollo 15, and both 9 and 15 were all Air Force crews. On Apollo 9 and I will expand a little bit more as we go along, Rusty Schweickart had been in Air Force, he got out of the Air Force to go back to school and was in the Guard, so Rusty was an Air Force pilot too. So I was lucky enough to get through my flights with some really good Air Force colleagues.

So I'll try and give you some background, some photos, and at the end of the discussion, it's open for questions, anything you want to talk about as long as you want to go, I will try to find the answers. We will talk early years, flying machines, Space Race, my three flights, questions and discussion, and then I will give you a few final thoughts.

Lucky boy from Texas, you know I was born at the right place at the right time and my dad was a fighter pilot. I was born at Randolph Field in 1932, and my dad pointed me through my career, and the bottom right is when I got into the flying school, had four wonderful years at West Point Flying School, and I always wanted to sort of drive a car, be a cowboy or something like that, and that's what fighter pilots do. Flying Machines -- you know when I put this story together for you tonight, I started putting in the airplanes I have been fortunate enough to fly. And you know again right place, right time, and I got to fly a lot of machines and there are a lot of machines out here that I was able to fly. And if I got into talking about, the airplanes I got to fly, we would be here all night I guarantee you because again I really had a wonderful career, I loved the Air Force, my dad loved the Air Force -- he was in 31 years -- and you know we were an Air Force family and there is something about Air Force, that just runs well in the blood.

On flying machines and the space program, we had basically 1, 2, 3, 4, 5, 6 kinds of flying machines. Upper left is the Gemini, a two man spacecraft, and then the Agena was the target vehicle or the vehicle with which we docked with the Gemini and interestingly enough we flew the Agena. And I will tell you more about that, but that was a flying machine as well. In the lower left hand side is the Apollo Command and Service Modules, the Orbital Vehicle, and in the center is the Lunar Module, a Lunar Lander, and it had two stages, it had a Landing stage and it had an Ascent stage, it went back up in the orbit. And on the lower right is the Ascent stage. So we had some, and NASA had some pretty cool Flying Machines.

Now let me give you a little bit of history and go back to the beginnings of the Space Race and show you all of the flights that were going on and the competition in the Space

Race which really drove the funding for the Space Race, especially for our side. If you look at the top and the bottom, there is the competition. On the top are the U.S. flights and the bottom are the Soviet flights. And you can see we are all very, very close up to 1967 when we both had a major failure. We lost a crew of Apollo 1 in a fire, and the Soviets lost their leading test pilot, a fellow named Komarov, when his chutes didn't open on the way back from a flight.

I got to fly Gemini 8 in that Race and it was a great experience, but it was a close Race. And after our disasters, both sides recovered and we got back into the Race again. On the top are the U.S. flights. I got to fly 9 and I got to fly 15, and the bottom are the Soviet flights. And you notice that just before Apollo 9, there were several unmanned and then a manned Soviet flight, and we found out years later that one of our main objectives on Apollo 9 which I will show you, we didn't know the Soviets had beat us by three months and we didn't even know it. So it was a mixed bag -- in the U.S. every thing is open and the Soviet Union everything was closed, but it was a very, very close Race.

Take a look at Gemini 8; I got the fly with one each Neil Armstrong, Ohio native, a great guy. We had a good time together; he was a good leader, a wonderful pilot and still a very, very good friend. We launched on March 16, '66, on a Titan II. People talk about these days some of the launch vehicles and making them human-rated so that they are safer. We launched on an ICBM and it worked pretty well. And up in the left center is the first picture I took in space, which is the airglow and it is just beautiful. You see all the colors of the rainbow on a horizon as the sun comes up or sun goes down. And this was just after we launched and we got into orbit and we are going into the darkness in Africa and I took that photo.

Then we did the second rendezvous, Gemini 6 had done the first one with Gemini 7, and we rendezvoused with our Agena Target Vehicle, and there is the photo I took at the Agena upper right and as we approached the first docking in space. Neil did the first docking and it was a really an exciting kind of thing, but it was really easy, I got to tell you, it was a walk in the park, but everybody was all, you know sort uptight and if you look carefully in a sort of right center, you see the cone, the funnel on the Agena vehicle has a whisker sticking out, a narrow band. People thought that there would be an electrical discharge between the two spacecraft because of different potential in the launch pad, and so everybody is ready for this big spark to fly and there were no sparks. And it was really smooth.

However, we had sparks later on in that after about seven hours in flight, we had a thruster that failed intermittently on and off. We had this big problem, and we got into a tumble with the Agena and we had to undock from the Agena, and we were off the range, the tracking range, with no communications with everybody. And I was able to fly with a guy who had a lot of experience in X-15, and the guy figured it out. And so we got out of this problem; we had to come down early and we landed.

I will you tell you another little story about Gemini. We used to have this competition, who can land closest to the aircraft carrier when you come back, see, so Neil and I, we

practiced a lot about that, we were going to beat the other guys because they got within three miles. We can do better than that. We still hold the record, 6,000 miles. We landed in the South China Sea, and it was a secondary zone and there was nobody there waiting for us and they did come and get us after about three hours and there we are in the USS Gemini, which is a wonderful spacecraft, but it's a lousy boat.

And that's another, rather long story. You know, 1966 was a pretty tense period in Southeast Asia. And as a sort of aside, one of the things I always like to remember or my colleagues and my classmates and my buddies who fought my war for me. In fact we all felt that way, that while we were doing these lovely things in space, we had a bunch of buddies over there in Southeast Asia taking good care of us. And we always appreciated and there are a lot of airplanes out here that participated in that conflict that were flown by a lot of my buddies.

So anyway, we got through the Gemini 8 exercise, and then I moved on to back-up crew on Apollo 1, which lasted for about nine months, and I was joined by James McDivitt and Rusty Schweickart, and we eventually became Apollo 9. And as I mentioned that Jim McDivitt was Air Force, Korea veteran, a great guy, a great pilot, test pilot, etc., and Rusty Schweickart was Air Force, went into the National Guard and was getting his master's at MIT when he was selected for the program. So we were pretty much an Air Force crew. And we flew the first real test flight of Apollo hardware spacecraft and software and computers in Earth orbit. And we had, we were the third Apollo flight, first was Apollo 7 which checked out the Command and Service Module. Then Apollo 8 went around the moon, a bold move that worked with the Command and Service Module, but our mission was the first fly to the Lunar Module and all three stages, both spacecraft. So it was what we like to call an entrepreneur's test flight. And it was just a wonderful mission; we had a great time, 10 days in orbit. We got everything done that we were supposed to get done. And we thought that if we have half of it done it would be a 100% successful mission, but we got it all done.

And amongst some of those things was a lot of work with the computer. Now I have to take you back a little bit, give you an example of what we were dealing with. And this is a computer we used to go to the moon. You can see that it was little; it was a box that had 36,000 words in it, that's about a page. Compared to today with a mobile cell phone which is well over 2 billion words, so we were working with a little tiny thing in terms of capacity, but the software was brilliant and it was a very effective device and it was designed such that once we left Earth orbit, going to the moon, we could get back if we lost communications with the ground. So there was enough programming in there to get to the moon and get home, or if we were on the lunar surface and lost communications, we could get home. So it was a brilliant little device.

On the upper left is the Lunar Module called Spider because it looks like a spider, and we didn't have fancy call signs in, we just used these for radio communications so we wouldn't be saying, "Hey, Apollo 9, this is Apollo 9." We had to have a call sign and below it, is a Command Module, Command and Service Module. And the upper part, the

Command Module looks like a gumdrop because when it shipped away from the factory it's wrapped in blue cellophane, looks like it, so we called it a gumdrop.

On the upper right, we did the first extravehicular activity, or the first Space Walk, in the Apollo program, and the objective was for Rusty to go from the Lunar Module to the Command Module in case the docking tunnel was clogged and we couldn't get through the docking tunnel. So he was demonstrating this transfer, and I in the bottom, was in the Command Module, and I opened a hatch so he could come in. So I set everything up so he could come in. So what we were going to demonstrate, we thought for the first time in history was a transfer. Three months earlier, the Soviets had transferred two guys. So they were running the Race pretty well at that point.

Then we get to Apollo 15 when I came back from Apollo 9, I was assigned as a backup crew on Apollo 12 and assigned with my two colleagues with whom I flew on Apollo 15, Al Worden and Jim Irwin. Al and Jim, both Air Force, both test pilots; they came in a class behind us. And again I got a superior crew, really, really good guys and we had a big mission too. Turns out that by the time we got ready into Apollo 15, a lot of things had changed and a lot of new hardware and equipment came aboard and our experience in the Air Force and in test pilot school enabled us to accommodate all of the new things. But one thing that we had never done before -- we had to go to the moon and we had to find valuable samples, scientifically to help understanding what the moon is. None of us had ever had any geology, we had nobody even had been a rock hound, so we took a lot of geology, and actually it was rather fun. About every month we go out for 3 or 4 days to some different part of mostly North America and Hawaii to study geology and learning terminology and learn how to collect samples, and I'll show you some of the results, but here we are on a field trip. On the left is with our favorite professor, a professor from Cal Tech named Lee Silver who was a marvelous guy and really taught us a lot. Jim Irwin and I, when we trained, we simulated out in the field with backpacks and cameras and radios, simulating what we would be doing on the Earth, and our philosophy was do everything on a Earth that you need to do on a moon but do it before you get to the moon if you possibly can.

The lower is the Rio Grand Gorge, part of our objective was to explore a region around a canyon or a gorge so we were taught, how to look at things and how to evaluate them. So on the 26th of July, 1971, we departed the Earth on a Saturn V, monster machine, lovely machine, never had a failure, there was never a loss of any Saturn launch vehicle. Werner von Braun built it and I always thought it was his dream, after launching a thousand V-2s, he finally got his Saturn V and it worked. We went to this spot on the moon which was sort of on the inside of the right eye of the man on the moon when you look at it at night in an area called the Hadley-Apennine, which is a rim, on the rim of the largest space on the Moon, the Imbrium Basin and it's a mountainous area. And the spot we landed you can see in the lower left and a better picture of it on the right and it shows the approach path over the moon, and if you have ever had a chance to fly an approach path this one was rather interesting. The normal angle for an airliner to come in and land is about 3 degrees. When we went to the moon, the earlier flights landed in an angle of about 14 degrees, but when they looked at Apollo 15, we couldn't get over the mountain at 14 so

the increased our glide path to 25 degrees. And we actually flew through those mountains, and the one on the right was 15,000 feet high, and the one on the left was 9,000 feet high and we went in between the peaks. And fortunately the people who planned the trajectory got us at the right height at the right place. And we landed in this little area near Hadley Rille, set up Falcon Base. And our Lunar Module's call sign was Falcon. The reason was we are all Air Force, the Air Force Academy's mascot is a Falcon, so let's us attach ourselves to the Falcon. On the right is Hadley Base with Jim Irwin saluting our flag. We were very proud to plant our flag at Hadley Base; it was a very nice moment, and we were very appreciative to have had the opportunity to do all these things.

On the left is yours truly working with one of the scientific experiments which was a drill. We drilled 3 meters into the soil to collect a sample, a Core 2. On the right here is yours truly working on the side of a mountain. And you can see that it's a steep slope, it was actually about an 18 degree slope and the material on the side of the mountain is very lucent, very soft, it was very difficult to work with. It's also very dirty. It's really dirty and you get this lunar dust in everything and it grinds on the connectors and it permeates the material in fact none of the suits that came back from the moon have ever been cleaned back to pure white. They all retain a certain amount of grey.

We had the Lunar Rover, the first Lunar Rover, which was another great machine. And I look at it as the flying machine. In fact when it was designed, it was designed by a bunch of people who had airplane experience and how do you drive on the moon? Well the space suit is just too big and cumbersome; you can't put a wheel on it. So what did they put on the Rover, a stick like an airplane stick. And what did they do for we pilots to make it really easy, well you keep it simple. If you want to go forward, you push the stick forward. If you want to go backward, you pull it backwards. If you want to brake it, pull it backwards. If you want to go right, you tilt it right; if you want to go left, you tilt it left. So it was quite comfortable transitioning from an airplane to a Lunar Rover.

We then got into our, let me go back and hit that one. Upper right, we had some interesting experiences on the moon, Jim and I. We were on the moon for three days, all the while Al Worden was in lunar orbit by himself for three days. Full of experiments, we had a big set of cameras on a Service Module, a lot of work to do, but Al had to take care of home for us around the moon for three full days and he did a brilliant job. In the upper right, Jim and I were exploring the side of the mountain and we saw this boulder and thought it looks a little green; we better take a look at that. So we drove up to it and because of the slope and the material, I hopped off and I put my tongs on the boulder to take a picture, and in the background Jim had just hopped down to stop the Rover from sliding down the hill and if you look at the left rear wheel it's off the ground. And the Rover is very light on the moon and that thing was starting to slide. Fortunately, Jim was quick, Jim was a great handball player, beat me all the time. So he got down there and stopped it. In the lower right, or the lower left, you can see the tracks on the side of the mountain. You can see where the Rover digs in and we couldn't actually traverse the side of the mountain with two of us in the Rover. Jim had to walk, I was commander, I drove, right, Jim walked to get across.

And then there is a Lunar Module about the time we departed. Again we spent three days on the moon, we had 18 hours outside and three EVAs, we went to three different areas, driving a Rover and actually it was quite a camp out experience. Everything worked like it should have worked, we slept very well, we slept in hammocks. Again because we had to be on the moon for three days, we decided that unlike previous crews, we would take our space suits off. If we assumed the Lunar Module is going to keep pressure, can we have to accept that, take our space suits off, we slept on our underwear and hammocks and had really pretty good sleep. So it was a marvelous system. The whole system that was designed during that period was absolutely incredible, I look back and I say, you know everything worked, but it was a wonderful culture. Few people realized that at the peak of Apollo, there were 400,000 people working on the program. Every single one of them was part of the family and every single one of them was dedicated. So when you get to the moon and you get going in the geology, which we really enjoyed, you forget about space suits and backpacks and all that stuff because you know there are 400,000 people taking care of you and watching every second. So it was a very comforting experience and it was just a great period of time for the culture that was developed.

Some of the samples we found -- again we had a brilliant teacher and another part of being part of the program at that time, you got to work with the best of everybody. I mean everybody, all 400,000 people in every job, were the best, totally dedicated and we learned a lot of geology, and we enjoyed doing it and it paid off at the end of the day. Amongst the many samples, we brought back around 130 pounds of rocks and soil. One in particular that we were trained for -- the moon is mostly, as you see it from the Earth, volcanic. You know there are three types of material geologically on the Earth: Sedimentary material, which accumulates with water deposition; Volcanic, which comes out like volcano; and Igneous material, which is formed solidifies deep in the ground. We were looking for what many people thought was the original lunar crust which was Igneous crystalline crust. Nobody had found anything like that, but lo and behold Jim and I got to this crater on the side of the mountain and we both spotted at the same time, this brilliant little rock which was crystalline and it was sparkling in the sun, it has what they called twinning in it, the crystals are in pairs and they flash in the sun and even though it was covered in dust, we knew right away, we found what we'd come for. And we picked up this piece of an orthosite which is 4.2 billion years old, and it was indeed part of the original lunar crust before everything got covered with volcanism. There it is back in the lab and we were quite proud to find it and people say who found it? We both found it exactly at the same time.

And then we go along and we find other things. We found another rock which looks pretty benign there in the left picture. And we picked it up, and Jim and I were always proud of having learned the terminology of geology because it's quite different from engineering and airplanes because you have bretches and you have basalts and you have an orthosites and all these things and we picked up a rock and we would take turns, identifying it so our professor would be hearing us on the Earth. And so I picked a rock up, I said, hey, oh it's your turn, Jim, and I give it to Jim, Jim looks at and he says no, Dave, no, no, no it's your turn, you're commander. I said, but Jim you know you have

been at this for long time, and he said, Dave, you are commander, it's your turn. So I said Jim, that all I can call is a green rock. And he said, yeah, Dave, it looks a little green to me. So we moved on quickly because we didn't have a name for that dude, and it turns out when we got back to Houston, the couple of days after the flight we went to the Lunar Receiving Lab and looked at all the samples we brought back and we were feeling pretty good. And we get to this one big nitrogen container in which is this rock. I tried to move past quickly and Lee Silver, Professor Silver, stopped me and said, hey, Dave, don't you want to know what that is, I thought oh God, I fluked the exam again. I said, oh, Professor Silver, what is it, and he said, well, we have been looking at that for two days and about the best we can come up with it's a flyable green plod. And it turns out that 38 years later a professor researcher at Brown University has some new analysis techniques and that's one of the beauties of progress in science. And he looked at this rock very carefully and he looked at this little green glass spherical because the rock is composed of about 50% small green glass sphericals, about a millimeter in size and 50% soil, dirt. So these little sphericals, he could look in very closely and it contain water, so we actually found water on the moon, and that's because we didn't know what this bloody green rock was.

And then there were lot of other interesting samples that we saw. We were driving back to the Lunar Module after the first day and you get caught up in what you are doing when you get out in the field like that because it's really fun. And we are behind schedule and we keep telling Mission Control, hey, you know we would like to do ... No more geology! Get back to the Lunar Module; you're running out of time. And so we were driving back and we had trouble with our seatbelt. When you drive the Rover on the moon in 1-6-G it really bounces, it really bounces. So you have to have your seatbelt, really, really tight. So we are driving back and they are hustling us to get back in the Lunar Module and I looked out on a plane which is pretty much bright grey, light grey and I saw a single black rock, pure black with no dust on it, black, black, and I thought, oh, I got to have that baby. And I thought they will never let me stop, so I nudged Jim -- you know when you work with the guy that close that long you have signals and we had signals. And Jim knew that I meant I have to do something and he should start talking. So I called down Mission Control, I said hey, MCC I got a problem with my seatbelt I got to fix my seatbelt and they said, well, okay, stop for your seatbelt but not long, so old Jim, he starts talking about the geology in the near term in the far distance in the mountains and all, duh, duh, duh, duh, you know. So all of a sudden as I am fixing my seatbelt, my suits get lost, off the Rover and my suit goes over to this rock and my tongs with which I pick up rocks, my tongs stick in the ground and I was reaching up and my camera took a picture. So I decided I might as well bring it back so I put it my pocket, I never said a word till I got back. And again going through Lunar Receiving Lab, all of a sudden we come up to this rock, and they called it the Seatbelt Basalt.

Anyway, but it was a great experience, we had a good time, we learned a lot, and we found out that there is a lot of color on the moon. When you look at these very closely, the geologist will take what they call thin sections. They slice a very, very thin section of the rocks and then they look at it through high intensity light and by golly, it's really colorful, it's really colorful. And then after our green glass, on Apollo 17 they found

orange glass, and now they are seeing even more from some of the remote sensing. They're seeing olivene which is green. They're seeing spinels, and actually from the mineralogy reflectance, not the color of the reflectance and the frequency they are seeing spinel. Spinel was sort of like well, the crown jewel of England have a, they call it the black ruby in it and it's actually a spinel so think about it that way. So anyway there is a lot of color on the moon, there is a lot to be learnt from the moon still.

And finally I thought I would wrap up here as we got back to the Lunar Module on our last day where I, we had an opportunity to do something that we had been planning for a long time. Not very much time but we had a chance to try something, oh backwards, backwards, well what do you know about that? Forward, forward, forward, you know it's like these automatic airplanes, nope, nope, here we go.

[Video]

And there is a longer story behind that, while everybody tries to do something a little special when they go on these missions that are pretty much unplanned. So being an all Air Force crew, we would sit around after dinner and often discuss you know what can we do that would be useful, educational, scientific and a little fun and one of our colleagues, Joe Allen, who was our CapCom, who was a physicist came up with the idea of the Hammer and a Feather. Well, you have a geology hammer, naturally, and the question was yeah let's do that but where do we get the feather. Easy man, from the Air Force Academy because the Air Force Academy mascot is a Falcon.

So it turns out I had an old friend from the Air Force who happened to be a professor at the Air Force Academy, and I called him up and I said, hey, Leo, we got this problem, but we can't talk about it, we don't want anybody to know about it. So I explained what was going to happen and about two weeks later a contingent in civilian clothes from the Air Force Academy came down, and I was in my office in Houston and the secretary called up and said you have some visitors from the Air Force Academy. I thought, oh really? So in come these guys; they closed the door and they pulled out of their pocket two Air Force Academy falcon feathers. So on the moon is an honest to God Air Force Academy mascot falcon feather so when people go back they will know.

So anyway homeward bound, why I often show the picture on the left by itself and people say oh the moon. Yeah the moon is in the foreground but the thing in the upper part there is the Earth. And when you are on the moon, depending on the phases, why you see the Earth as either a full Earth, as it is on the right, or a crescent Earth, and this is the last picture we took before we headed back and some we had three days on the surface, three days on lunar orbit, six days we spent three other days around the moon, 175 pounds of rocks and soil, and we took 1,100 photographs on the surface and we didn't have any iPhones. We had the Hasselblad you had mounted on our chest with no range finder, no light meter, had to set it all manually, but after several years of practice, practice, practice, why they came out pretty well.

And finally I would like to sort of summarize of what we learned and the benefits of Apollo. National prestige -- we won the Space Race; the Soviets finally gave up even though they had a Lunar Module and I'll tell you little bit about that in a minute. Technological progress -- the architecture and all the spacecraft and a software we put together. Human space operations -- how do you operate in space? It is quite different from operating in the air because it's a whole another dimension and there is another level of risk but we know how to operate in space now. Management expertise -- as I mentioned we had 400,000 people managed by an absolutely superior group of managers to get all that stuff to the Cape at the same time, get it all checked out and put it aboard and have it launch on time. We launched on time almost every mission. Scientific return -- we now have consensus on how the moon was formed and that apparently the Earth in its early years was hit by an object the size of Mars and all that debris, the material flew out into an orbit, it accreted together that created the moon, so the moon is actually part Earth and part something else, whatever hit it. Educational spin-offs -- as you know, young people love to learn about this, love to talk about this, love to fly airplanes and I think that's one of the great benefits of Apollo. And then finally spin-offs -- all the things that came out of the program that we use now, a lot of things were enhanced -- Velcro, we used a lot of it, and of course one of the more memorable items that came out of the space program that got a lot of promotion was Tang, you know after 12 days, you really get tired of Tang.

So now I would like to open it for questions and discussion. Feel free to ask anything you would like and I will give you answers of sorts, but I have enjoyed your participation so far and maybe we can have some fun with some of the answers, okay?

FEMALE SPEAKER: So you are collecting the questions now, correct? Okay. So while they collect those, I actually have one that we can get started on.

DAVID SCOTT: Okay.

FEMALE SPEAKER: I was intrigued in your book about a story that you mentioned about meeting with some cosmonauts, actually before like back in the mid '60s. I didn't realize that there had been any interaction at all between the two groups and being part of the Cold War like that. Can you tell me what that encounter was like?

DAVID SCOTT: Yeah it was, yeah quite an experience. I got to know quite a few cosmonauts over the years, but in 1967 I'd flown Gemini 8, Mike Collins had flown Gemini 10 -- Mike Collins, Air Force. Mike and I were good friends and somehow we got selected to represent the U.S. at the Paris Air Show in 1967 and that's great and we got briefed by the State Department. It was a big display and it was going to be the first time the Soviet Union showed anything, it was the first time they showed their launch vehicle, they were going to have a big pavilion and a lot of attention. So we get this briefing by the State Department that says okay, you guys, be careful because they will do it to you in one chance, don't meet with them, don't talk to them, stay away from these guys. So you know State Department couple of Air Force captains and all that stuff. Yes, sir.

So we get to the Paris Air Show, and I mean it's quite a scene, and of course they have their pavilion, we have our pavilion and we are told, but Mike and I are sitting there and thinking you know boy, I sure would like to meet those guys because they are fighter pilots too and there is a bond, you know, fighter pilots let's get together. So somebody told us that Friday afternoon, if we happen to go to the Soviet Pavilion, the cosmonauts might just happen to be there. So Mike and I we sort of winked at each other and said shoot, let's do it. So we went over and by golly they were there, Phil Tesla, who had flown and one of their leading engineers, and Bayaya, who was an Air Force colonel, met us when we walked in. Bahaya had his uniform on all the stuff, and of course by that time every photographer in Paris had heard about this, and it was the first time in public display that astronauts and cosmonauts would meet at the height of the Cold War Space Race. So they figured there would be some real fireworks. Well turns out there were but it was of different kind. We were surrounded by these mobs of photographers and Bayaya took charge and in Russian said, move out of the way and he lead through these mobs and people out to the ramp and they had one of their transports out there all set up inside, we went inside they closed the doors and the fireworks were vodka, lots and lots and lots of vodka. So we had a good time, they were really good guys we got back and they found out that man we have got de-briefed like you wouldn't imagine. It was a great experience.

CINDY HENRY, MUSEUM AEROSPACE EDUCATOR: What experiences and skills did you gain in U.S. Air Force flight test as a test pilot that directly benefited your astronaut career?

SCOTT: Well I think at Test Pilot School, the thing I really learned that I recall is precision, precision, precision. Whenever you do something, do the absolute best you can every time. Every time has got to be the best because they watch you closely there, they grade you closely there, and I learned that rather than fly plus or minus three to five knots in air speed, plus or minus a half to a quarter. And I think I learned precision, and also how to accommodate new aircraft and new vehicles and new hardware, but I liked it. It was a great experience.

HENRY: What power sourced power that Lunar Rover?

SCOTT: Lunar Rover was battery operated and it was battery charged. It had solar panels on top of the battery. When we drove it, we had a flap over to keep the dust off them, then we'd open the flap and it would recharge the battery during night time. When you are on the moon you don't have any night time, it's 14 Earth days of day light, but you have to close things down to have night time. And the Rover was another brilliant piece of engineering, in fact we left the instructions and the keys on the seat and who goes back and open the flap, charge your battery and it can drive off. It will work.

HENRY: Are the feelings and impressions you had when you first stepped on the moon, just as fresh today as when they first happened? Can you share some of them with us?

SCOTT: Well, you know time sort of dilutes things. It was really exciting. It's a fantastic place, especially when you study it and when you get there, it's just a wonderful experience. It's a beautiful, beautiful place and I have been asked that question ever once in while and they say people say well do you dream about being on the moon? My answer is only in the day time.

HENRY: What is your take on this Space X Falcon?

SCOTT: Space X Falcon -- I congratulate them on a successful flight. Good for them. They are doing some things that haven't been done before. I have been to their facility a couple of times; it is a very impressive facility, but they have a long way to go. Space is hard, space is very difficult, and I think they have made some great progress. I hope they make a lot more progress. I look forward to seeing how things go in the future, if they can achieve all of those things they are shooting for, if so that's terrific.

HENRY: The Falcon landed at a significant angle from the level. Did it settle after touchdown and did this angle pose a challenge at Lunar takeoff?

SCOTT: Yeah, it landed at an angle because I had one foot pad in a crater. One of the problems landing on the moon is at about a 100 feet, first thing is there are no markers, there are no scaling and craters are large small, shallow, deep, rough, smooth, whatever, and you have to find a place that's relatively smooth. So I found this place and you have to put it down, you don't have enough fuel to hang around very long, a minute or so, so you have to find a spot and land. And when you get to a 100 feet from the ground, you get dust, so you have to go IFR, you have to go into gauges, and I drifted a little bit and I put food pad into a crater, didn't bother anything, didn't hurt the machine, didn't bother us sleeping or eating, and on takeoff no problem because, I don't know, we were something like six to seven degrees, and you could actually land if you were going slowly at 25 degrees, so you could take off at a 25 degree angle and the ascent stage it worked just fine.

HENRY: Several people had a question about your Hollywood experience and working as a technical advisor to several different movies, and they wonder what it was like did they accept you as the technical advisor, do you think they really understood space flight and ...?

SCOTT: Well it was another break, yeah, I have been so fortunate to meet the right people and fly the right machine at the right time. I was living in California in Manhattan Beach, and I got a phone call one day from Jim Lovell, Commander of Apollo 13, who is a good friend. And he rings up and he says, hey, Dave, how are you doing? Fine, Jim. He says, you know I just finished a book. I said, yeah right, Jim, really good going. I hadn't read it yet. And he's ... I knew his story; I've been there, I knew, anyway ... So he said, you know, I am on a book tour and these guys out in the Hollywood want to make a movie about Apollo 13. Would you go talk to them and help them out? I said, oh yeah, I would be glad to, Jim, that's fine, that's fine. He said, well if its okay with you, I will have the director call you directly. I say it's fine. He said, in about five minutes? I said,

I'll be here, Jim. He says, okay. Five minutes later phone rings, I pick it up, I say, Dave Scott. Hi, Dave, it's Ron Howard. I said hello, Mr. Howard, sir. He said, oh, Jim says you will help us with the movie. Can you come over to the set tomorrow? I said yeah, yes, sir.

So I go over to the set next day and Ron Howard and Tom Hanks and Kevin Bacon and Gary Sinise and Bill Paxton all sitting around, and they say hey we are going to make this movie on Apollo 13. How do you go to the moon? So anyway it was a wonderful experience, they're wonderful people, we spent a lot of time, I worked on their script, the actors, the set, the locations, the whole, the editing, everything, and I became very good friends, they became good friends, we got to know each other, took seven months to film and they are really, really great guys. I mean Tom Hanks is an absolute prince, he loves space, he loves the military, he has got, on the Web there is Apollo Lunar Surface Journal -- if you haven't seen it's marvelous -- and Tom's got everything printed out and white notebooks in his office on his shelf. And from that experience about another six months later, Hanks calls up and says how about lunch, went to lunch, he said we are going to do Earth to the Moon series, would you be technical advisor? I said you bet, absolutely. So I did the 10 series with them, and I tell you they work really hard, they are very serious that group; I used to think Hollywood was you know 3-martini lunches. No way, you know there are 14 hour days and they work hard and they did a great job and the accuracy of those films is just marvelous, they go to ... everybody did, it's another family, it's another culture, they wanted to know exactly what the digits on the computer said when Neil Armstrong was a minute from touchdown. Now what the computer looked like, what did the digits say? I mean they are really precise so it was great experience and another wonderful family.

HENRY: What did you have the most fun doing, you know in your Air Force career or NASA? What would you say you had the most fun at?

SCOTT: I had at the other night dinner actually and today. Flying the F-86, that was the most fun for me. I was a fighter pilot. I was stationed in Holland. We had a single Air Force Squadron under the operational control of the Dutch Air Force so we flew by Dutch rules. Marvelous experience and a lovely airplane, and I look back which airplane was the most fun for me, it was the F-86, the Sabre, the Korean veteran airplane, and it's the last one that really, really sort of danced. It was just you know, but all my breaks, my lucky breaks I will tell you, I have had a good time, it's been wonderful career. And it's neat to be here in this lovely place and look at all of these airplanes. As I mentioned, my dad was a fighter pilot so today we went out and Ray Morrison took me around, showed me the airplanes my dad flew; that's really cool. So you know this is a lovely place and I encourage everybody to come back. I could spend weeks in this place and one of the nice thing I see you do now is in front of the airplanes the displays have the story behind the airplane, that particular airplane or that type of airplane, what it did and who flew it, which I think is really great, something to learn.

HENRY: We didn't even have to pay you to say all that. How are the orbital pilots picked the ones that stayed in orbit around the moon? Were they psychologically tested for that or did they just draw the short straw?

SCOTT: Yeah well, in our day there was no big deal about all of this psychology stuff. I mean it was yeah it was there, but everybody got along, especially in flight, and I think you find that in Air Force too. When teams go out in combat, you know it's teamwork; the personalities disappear, don't they, Jack, they disappear; you work as a team.

I have a good friend of mine, one of my classmates who were on one of the missions in Vietnam flying an F-105; he is a close friend. In fact he wrote the book called a "100 Missions North," Ken Bell, he was the wingman and the leader took him into the hottest spot, got all shot up, got back home, leader got the Congressional Medal of Honor and the King got the Silver Star. The Air Force Cross, he got the Air Force Cross. So they worked as a team, and the leader leads a team and a team sticks together. It's the same way in space. We were selected by NASA as a group, when we got into NASA, there were no tests, no exams, once you got in, you are in, but everybody watched the performance, everything was open and our boss Deke Slaton, former Air Force, would select the crews and then pass them up to management, because management always gets the last voice and approves the crews and how people get selected was somewhat of a mystery which was a good idea because what we all learned early on, you compete as hard as you can in everything. You do everything you can do, and everything you do the best. So shoot, I used to go play handball a lot, a lot with Mike Collins; he beat me every time, I couldn't beat that guy but I worked as hard as I could to beat him, not anything acrimonious, you wouldn't hurt the other guy but the competition was there. And then everybody watched the performance and when we had simulations, there is a close circuit TV throughout senior management and they could watch our performance. So by the time it got to selecting crews, Deke would make a list based on his assessment of performance; management would approve it and away you went. And it was just sort of luck of the draw and it sense but no grades. Although there was one time that we did a peer rating and I always like to think back on this one by the time I got there, I was in the third group of 14 and there were 30 astronauts. And Deke got everybody on big conference room one day and said okay, guys, we need to do a peer rating now to see how you rate each other and we want each of you to select the first lunar landing crew -- three -- so here is a piece of paper and it will only come to me and I will destroy them after I look at them but I want you to put on this piece of paper for the three-man crew, two names; I know you'll pick yourself.

HENRY: In your book, you talk about a lot of close calls that you had throughout your career, and including being the backup for Apollo 1. We are wondering, is the fact that you cheated death what seems like so many times make the whole moon trip best, dangerous feeling to you or had you cheated death enough that you weren't worried at all?

SCOTT: Well, I wouldn't call it really cheating death; I call it proper training and understanding where you are and what you do and keeping cool and that sort of thing. In my era airplanes, there were a lot of problems with new airplanes, they were pushing fast post World War II get them out there and a lot of time I didn't have as much pre-conditioning if you will so we had problems and I had problems like everybody else had

problems and you learn to work through the problems. And I think experience gives you a situation in which you can handle difficult chores. And it's a good question because a lot of people are talking about new astronauts and where do you get new astronauts are there civilian astronauts or military astronauts or whatever and I have a relatively strong opinion on that because of my colleagues and the guys I flew with. Another thing that Deke used to say is that if you got put on a crew, and you don't want to fly with one of those people, don't fly with them, you know and that's the way it is. You have to trust the other person, you have to trust your judgment and their experience because it's an unforgiving things space, airplanes are unforgiving. You know aviation is like the sea; it's terribly unforgiving of any carelessness neglect. So you have got to pay attention to things and I think part of my experiences that helped me go to the moon were the problems I had with airplanes, follow the procedures, listen to your lead or your wingman or the ground, and just pick the right path, and then you get used to it and you say you go to the moon and you say I have got these 400,000 people. If I get in a situation which I can't handle and I need some help, I will call them and they are going to give me some help, so you get that comfort zone.

HENRY: Do you think that enough is done to inspire the next generation of explorers and is there anything else you think that we should be doing?

SCOTT: What was the first part of it?

HENRY: Do you think that enough is done to inspire the next generation of explorers?

SCOTT: No. I think you need a place like this. That's why it's such a wonderful place. You need to show the young people what's there and what they can do and their challenges and their opportunities. I don't think this country does enough of that. I try to do what I can do, you know I have been invited back to lecture at MIT and Brown. I lecture to grad students and have an opportunity with the young people and things like that. So I think that this country needs to do more and actually one of the best things this country can do is go back to the moon.

HENRY: Okay, I was told to make this the last question. Someone wants to know how difficult it was to adjust to life on Earth after having been on the moon.

SCOTT: Actually I found it relatively straight forward. It was a recycling. However, there was one interesting aspect of that, physiologically, physically you know you adapt, we were only there 12 days you know and that's not a long time. So physically we got back pretty quickly. Adjusting to all the folderol was a little more difficult. And not having time to rest was one of our main problems. On the first three missions that came back -- 11, 12 and 14 -- the crews were quarantined for a couple of weeks because of potential micro-organisms and bugs and stuff like that, they found out there is nothing on the moon. On Apollo 15 they scrubbed the quarantine; we didn't have a quarantine. And I actually wanted one so we could power down. You go full tilt for 12 days; I mean we went full tilt for 12 days, you need a break time. And we got back -- in fact I tried to get

Slaton to give us some of this, no, no you guys are take off do your things come back and do a deep briefing during the day.

So the first night I was home, got back, one of the neighbors wanted to have a party. Man, I will tell you, that is not exactly what I wanted, but they were great neighbors. So we had the party, but that kind of sort of adjustment was tough because so many things are going on and you really want to focus write your reports and do all that, but yeah we all adjusted we got past it all right.

A couple of final thoughts, one is she mentioned the book. I did have an opportunity to write a book and I leave you with a little story on the book. I met Alexey Leonov, who did the first spacewalk. I met him in 1973. When I got through flying Apollo 15, I was assigned to the Apollo-Soyuz test project as Special Assistant for Mission Operations, and I took the first group, a big group of engineers, to Moscow for the first technical negotiations after the political stuff was finished. I took 35 engineers to Moscow for three weeks. My host on the weekends, because I had flown, my host on the weekends was Alexey Leonov whom I had never met, but I sure knew who he was. And so on the first weekend, they took us on these rickety old Russian buses down to Kaluga, the birth place of Tsiolkovsky, their father of rocketry and I met Alexey on the bus.

Now this is the Soviet Union still, and everything is still secret. Before we went, we were briefed don't say anything to anybody; they bugged the rooms and all that stuff. And I figured you know this is really cloak and drag, the black stuff, and I wonder how Alexey will be because the other guys had been pretty good once we got to the vodka. We are on this bus and early morning heading down to south. So we have got to talking and his English is pretty good, my Russian was pretty nil. So we're sitting and talking about experiences and things like this. And I find out that when I was an F-86 pilot in western Europe, he was a Mig-15 pilot in eastern Europe, another interesting part of our lives together. And then he looks over at me and he has a twinkle on his eye, yeah Alexey always has a twinkle; he is a really neat guy. He says, do you mind if I tell you a political joke. I thought, in the Soviet Union? Okay fine, we do political jokes all the time. He says, well we are just passing the town of Borodino, and he says if you recall from your history, why at Borodino, we Russians turn back to Germans in the dead of winter. I said yeah I remember that one. And he said not too far from there, we turned back Hitler in the dead of winter. I said yeah, I remember that one too, wouldn't want to mess with you guys in the dead winter. And he says, well, he says, we know that you Americans are advising the Israelis, and you probably know that we are advising the Egyptians. I thought yeah, well, I did know that. He says not too long ago, the Egyptians came to us and said, you know what if the Israelis attack again, what do you think we should do? And Alexey says they told them it's easy, fall back to Cairo and wait for winter.

But he is a great guy and we still keep in touch and all that stuff. You know, it's a bond fighter pilots and fighter pilots get together, political things are important, but you get together with your own kind and your own culture, doesn't matter the language, you know, you can talk, even if you are just doing airplane thing. It's really great experience.

And then finally looking back, way back, Socrates said, “Man must rise above the Earth to the top of the atmosphere and beyond, for only then will he fully understand the world in which he lives.” Well 2,300 years later Congress had a hearing about Apollo and what was the significance of Apollo, and one of the gentleman at the hearing was a fellow name Norman Cousins who was the editor of the Saturday Review, and he reflected that the significance of Apollo was not so much that men set foot on the Moon but did he set eye on the Earth. And I think the message is we have to take care of the Earth and it’s very, very important. We are not doing a good job and I hope all of you think about that and think about taking care of our good Earth. Thank you very much.

[Applause and presentation]