



AMERICA'S INVITATION
TO PARTNERSHIP
AT THE PARIS AIR SHOW 2019

The Mission Crew Interview

Walt Cunningham, Charlie Duke and Al Worden with Francis French



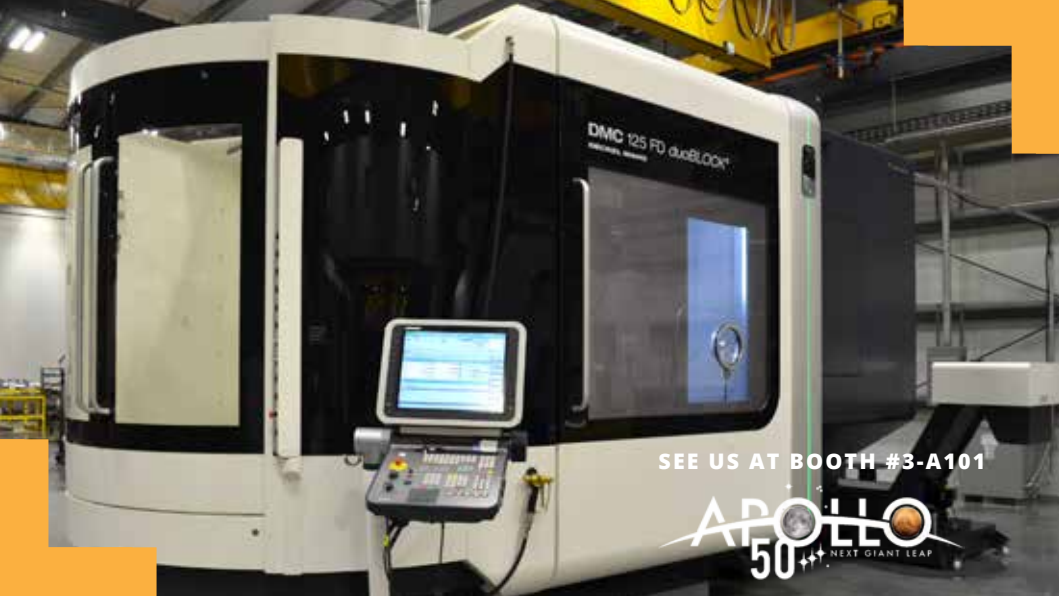
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Half a century ago this summer, the Apollo program landed humans on the Moon for the first time. Building on lessons of the past, and harnessing a famously massive workforce of more than 400,000 from some 20,000 companies and universities, the program took big, new risks to achieve its audacious goals. What was not new, and what resonates to this day, is the human spirit of discovery and commitment to excellence the Apollo program personified.

Apollo is not simply an accomplishment for the history books. It's a living example of how to do things right. From the people sweeping the hangar floors to the fighter pilots turned astronauts who sat on top of those rockets, Apollo is a timeless lesson in professionalism. When industry embraces the same spirit of teamwork and collaboration, engineering feats of similar daring and purpose are possible.

— Francis French

Francis French is a space historian and a regular presence on space-themed television documentaries.



View of the Earthrise from the moon, photo taken by Al Worden on the Apollo 15 mission

Welcome

From the NASA Administrator

As we celebrate Apollo 50 and man's first steps on the Moon, we are preparing to leave Earth's orbit for the first time since 1972 – to the Moon again, and eventually to Mars and beyond. President Donald Trump has charged NASA with returning to the Moon by 2024, and he has specified that we partner with industry and other nations to make it possible. The 2019 Paris Air Show affords a unique opportunity to showcase and strengthen the commercial and international partnerships that are critical to our future success. The participation of Apollo astronauts Walt Cunningham, Charlie Duke and Al Worden in the Apollo

50 Paris program produced by Kallman Worldwide, reminds us of the human courage it takes to explore space, and the unwavering commitment and cooperation required to sustain the effort. In the spirit of Apollo, we're all on a mission to pursue new ideas, innovations and sustainable partnerships at the 2019 Paris Air Show.



A handwritten signature of Jim Bridenstine in black ink.

Jim Bridenstine
Administrator, National
Aeronautics and Space
Administration (NASA)

From the Producer

We look to the past to enlighten the future. Apollo 50 celebrates the extraordinary achievements of America's astronauts and 400,000 engineers, scientists and technicians who changed history together. At the 2019 Paris Air Show, their collective effort inspires an international conversation about the future of space exploration, with extra insight from three who flew. In our role as organizer of the USA Partnership Pavilion and producer of the Apollo 50 Paris program, Kallman Worldwide commissioned space historian, Francis French, to interview our Apollo 50 Paris Mission crew. Their conversation on the following pages illuminates the life

lessons of these lifelong explorers, and helps light the path for man's continuing pursuit of discovery on Earth and across the universe. I hope it contributes to your appreciation of the positive impact space programs have had on society, and the need for continued support of public and private initiatives dedicated to aerospace exploration and commerce.



A handwritten signature of Tom Kallman in black ink.

Tom Kallman
President, CEO,
Kallman Worldwide Inc.

Walt Cunningham's
official NASA portrait



Meet the
Apollo 50
Paris Crew



In flight during the
Apollo 7 mission



In Walsall,
England, 2015

Walt Cunningham Lunar Module Pilot, Apollo 7

A Marine Corps fighter pilot, Walt was a civilian scientist by the time he was chosen by NASA in 1963. He was on the backup crew for the first planned Apollo mission, Apollo 1, in 1967. When the Apollo 1 crew died in a launch pad fire mere weeks before their planned launch date, Cunningham had two very difficult duties. He had to work as part of a team to aggressively identify and fix the problems that caused the fire, and help get the Apollo program back on track. He also had to ready himself to fly the first Apollo mission, which ended up being named Apollo 7. Launched into orbit in October 1968, Apollo 7 was a great success. The

fixes the Apollo spacecraft had needed were near-perfect. Flying just a year-and-a-half after a major tragedy meant that NASA's aerospace industry partners had to work as fast-moving teams to make this possible. Just nine months after Walt Cunningham's Apollo test-flight, Apollo 11 landed on the moon.



To learn more about
Cunningham's career,
read his memoir
The All-American Boys.



Charlie Duke's
official NASA
portrait



At Texas
A&M in
2015



Saluting the American flag
on the moon during the
Apollo 16 mission

Charlie Duke Lunar Module Pilot, Apollo 16

An Air Force fighter pilot and test pilot at Edwards Air Force Base during its golden age of testing new jets, Charlie was selected as an astronaut by NASA in 1966. Working as a CapCom in Houston's Mission Control during Apollo 11's moon landing, his is the famous voice from news clips confirming that Neil Armstrong had landed on the Moon. Duke would have his own opportunity to land on the Moon three years later, as Lunar Module Pilot on

the Apollo 16 mission with Commander John Young and Command Module Pilot Ken Mattingly. During three days on the surface, he explored for many miles using the innovative Lunar Rover electric car.



Duke's book, *Moonwalker*, co-authored with his wife Dotty, recounts his excitement of exploring the moon.



During
Apollo 15
preparations



Al Worden's official
NASA portrait



At The Paris
Air Show 2017

Al Worden Command Module Pilot, Apollo 15

After a career as a leading Air Force test pilot both in the USA and England, Al Worden was selected by NASA as an astronaut in the same 1966 class as Charlie Duke. His mission, Apollo 15, was the first extended scientific exploration on the Moon. Worden spent three days orbiting the Moon alone, operating a suite of scientific experiments to map the lunar surface and learning more about it than any preceding mission. On the return flight, midway between

Earth and Moon, he made the first ever deep space EVA, becoming the first person in history to be able to see his home planet and its moon from a point in space just by turning his head.



His memoir, *Falling To Earth*, recounts his moon exploration in vivid detail.

What lessons of Apollo are most relevant to the aerospace industry today?



Duke: I found in Apollo that teamwork was very, very important. Everybody was focused on their job, focused on their goals, and their commitment was 110%. I met people in various positions, from engineers to technicians to the floor sweepers, and I'd ask them what they were doing, and they'd say, "I'm sending a man to the Moon." So it was a total commitment to them.

that should stop your business: you accept it, and push on. You can work to improve things all the time. I encourage people to be willing to stick their necks out, and that doesn't mean I am encouraging people to do lousy work. Be safe, but also do not let the problems you are having difficulty solving hold up whatever you are trying to do moving forward.

Cunningham:

I watch what commercial companies are doing and occasionally get to talk to some of those folks. They

want to make sure that people flying in new vehicles are very, very safe. That is a great thing to be hoping for. During the test phases, however, the attitude that we had when we were fighter pilots, and test pilots, we understood that it was a part of life to stick our necks out. To not be afraid to take that risk. You're going to have setbacks, but don't let that deter you. It is not something

“I made sure the little lady who sewed those zippers realized how important she was!”

Duke: NASA

and the independent contractors we worked with had teams that were responsive

to problems, and responsive to the inputs from all the levels of the team. I think that focus was really important – it put upon everybody that I was associated with how important their job was. For example, we went to Dover, Delaware, for suit checks – back then the spacesuits were all tailor-made – we had two zippers in our spacesuit. I made sure the little lady



Deke Slayton, Director, Flight Crew Operations (I) at the Manned Spacecraft Center, Houston, briefs Apollo 7 Astronauts Walter Schirra, and Walt Cunningham



Astronauts John Young, Eugene Cernan, Fred Haise and Charlie Duke, await deployment tests of the LRV qualification test unit at Marshall Space Flight Center

who sewed those zippers realized how important she was! And so it was that kind of interface that was important, from the astronaut corps and from management. And it paid off. I see that in some of the aerospace programs that are underway right now, and I encourage it.

Worden: It's important to have a specific goal, to draw people together to achieve that goal, instead of being an organization that is just looking out for itself at the expense of results. Everybody has to be focused on the goal, and that is what I think made Apollo so successful. It drew people together from all over the world, not just in the USA but from all over, to see that goal accomplished. The Apollo program demanded excellence, and that's what it got.

Duke: Apollo was probably to me the most exciting program I'd ever worked on – the national goals, the commitment, and the support we were getting from the

“Everybody has to be focused on the goal, and that is what I think made Apollo so successful.”

public. So I think that the things that I learned that are applicable 50 years later are the importance of thorough planning, doing a lot of “what if this happens, what if that happens, how can we design this to be more reliable, more efficient, more easy to operate.” Then once you get the plan, prepare to execute the plan.

Planning and preparation are really important, and the execution generally goes well. If you have a bump in the road, it is generally easier to modify a well-thought-out plan than it is to just be sort of helter-skelter about it. In that way, I don't see any difference in what is needed today in these high-tech programs and what we did in Apollo.

Given those specific operational insights, what would you say is the greater guiding spirit of Apollo?

Worden: The spirit of exploration is not just an American spirit. It is a human spirit. I happen to believe myself that in a cooperative arena, with all the people in the world, we're not going to be able to get to Mars as a single country. I think it's going to take the cooperation of everybody. We are going to go back to the Moon, and find out what the Moon is all about. We're

going to find out where it came from. Why do we want to do that? Because we want to know about our own planet's history. The next step is going to be Mars, and we're going to find out

whatever Mars has to tell us about who we are, where we are, and what it's all about. I see the Mars project as being similar to the Apollo project in that the goal is going to be the most important thing, and it's going to allay all the fears that we have of other countries and other people trying to do things – if we do it cooperatively. I think that's going to be a very big thing.

Cunningham: I think a lot of that exploration and spirit will be down to commercial companies now. Money from

government is in no way comparable to what it was back when we were really trying to push the borders of exploration out. I'm looking forward to doing some thinking about how both government and commercial companies can do that kind of collaboration best when I am at the air show, because we're going to be talking a lot to those folks when we are there. The

“The real skill companies need is to do real-time analysis: be smart and nimble and ready to deal with the unexpected as it happens.”

key, as I have said, is that you've got to be able to be organized about it, but you've got to not quit pushing forward on the basis that it's risky. Anyone can do after-

the-fact analysis – the “if only we had” stuff. The real skill companies need is to do real-time analysis: be smart and nimble and ready to deal with the unexpected as it happens. After any setbacks, recommendations from outside reviews and reports can be very important. But they don't have to be followed blindly. Stay sharp, question things using intelligence and common sense. You are closer to the subject than others, and may be able to make fixes better than outside opinion.



How can the lessons of Apollo inform conversations at the Paris Air Show?

Worden: I think maybe the most important thing is – for once, let’s get rid of any arrogance. Let’s get rid of the self-fulfillment kind of ideology. Let’s go into things in a spirit of cooperation. Now, I know that goes against the grain of things, because if I own a company, I want my company to be the best, and I want my company to get all the business that it can get. But I think, when we are talking about international collaboration, you’ve

got to back off a little bit, and say, who is the best one to do that job? It may not be you. It may be somebody else. I think we have to get all of that into programs that emphasize cooperation, between countries and between manufacturing programs. I think it’s a spirit of cooperation that is awfully important; we don’t want to be fighting each other when we are all trying to do the same thing.

A curious crowd
watched the launch
of Apollo 7



How can industry engage new audiences to support innovation in aviation?

Duke: I'm confident that the percentage of the general public who already fly realizes the importance of aviation in their careers and in their lives. And I know that percentage of the population is growing. We have an efficient aviation industry that is viable. Take a look at the cargo industry. I think people are beginning to realize how important aviation is through delivery of packages. Everybody shops online, and they want their shopping items the next day, and so a viable cargo package delivery system is important. And you want it to

be on time, and so you see the importance of an airplane schedule that is reliable. Not many industries can say, "I'm going to get you from San Antonio to Atlanta in two hours and thirteen minutes and you will arrive there at a specific time." Yet airplanes do it regularly, day after day. You can't get on a train and do that. You certainly can't get in your car and say you'll arrive at such an exact time. So I see people are getting to realize the importance of it more and more.

Apollo accomplished what seemed impossible. How would you advise aerospace companies to confront “the impossible” today?

Worden: Well, when you say something is impossible, what you really mean is that it might take us a little time to get there.

The Apollo program was so well managed back in those days, major contractors gave

out contracts to subcontractors all over the country, and even all over the world. The very first experiment that was conducted on the surface of the Moon came from Switzerland — a solar wind experiment unfurled when

Neil Armstrong and Buzz Aldrin first got out. So it was a worldwide effort. These subcontractors who bid into the overall envelope of the total program did their thing well, and integrated their devices. It was very successful, and that is because of the management that was in place at the time, I believe.

The most important thing that came out of the Apollo program is the technology

that was developed to get us there. And that is a worldwide phenomenon. The United States was ahead in that kind of technology in those days, and that made the U.S. rather successful in the

“We need to bring people together in a spirit of cooperation, and highlight the fact that we’re all on basically the same mission together.”

world in commercial products, based on the technology that came out of the Apollo program. I think other countries have picked up on that technology since, and we’re all kind of in a competitive mode these days with that kind of technology.

And that’s why it is so important that we operate cooperatively with other countries and other overseas manufacturing facilities. We need to bring people together in a spirit of cooperation, and highlight the fact that we’re all on basically the same mission together. We need to work together to see that mission is accomplished. I think that’s what Apollo was all about, which is an important message to share at the Paris Air Show.

What about the next generation? What's your advice for future astronauts and engineers?



Cunningham: I tell kids to apply themselves, and then be perfectly willing to stick their necks out, and that's not just physically — be willing to stick their necks out to move ahead. Don't get to the point where they're focusing on everybody in their class being equal. I think they need to focus on being the best they can, and be willing to pay whatever the price is to move ahead. If you are resigned to just being like everybody else, that's what you're going to be. And that's not what's going to move our society forward.

Duke: I think whether it's engineering, or being a pilot, or management, there are probably several different avenues you could go. The production side of airplanes, the design of these airplanes, it's exciting to these kids. My grandson, who calls me Granduke, says — "Granduke, I don't want to fly the airplanes, but I want to design them and build them." So it's important

to encourage these kids to get interested in STEM programs that will benefit all of the industrial and scientific side of our economy. Everybody wants to get a degree that has an opportunity for a job. And with the shortage of pilots that we see on the horizon due to the growth of aviation, it's going to be a very viable career. My son decided he wanted to be a pilot in college. But he was studying medicine at the time. So I said, well, you finish your career there, but go into the Air Guard, and you can become a pilot, and after that you can use your medical degree. But he got to that stage of being a pilot, and the doctor part just floated away, he was having so much fun in his career. So there's proof that an aviation career is dynamic, both on the engineering and the operational side. And I think the testimony that companies can give of very satisfied employees is a real positive way to spread the message.



Al Worden speaks with young audiences at the Paris Air Show 2017

Cunningham: The way I see it, it's got to come from within the individual. Not just somebody telling you to do it, and therefore you do it for that reason. It's got to make sense to you to do it. You've got to be able to form your own career moving forward, and you've got to have that feeling, that you have to push yourself to do it.

Worden: I think that it's very important to see who the role models for those students are. They do have role models, and in the U.S.

many of the role models may be people like sports figures, that kind of thing. I think it's important that we challenge these young people to do the things that

are going to be important to humanity down the road instead. And that's why the science, technology, engineering and math courses are so important to these young people. Exploration is one of the biggest things going for us today, and it takes an engineering design person, it takes somebody in the hard sciences, to be able to put together a system that will allow us to get to the Moon, get to Mars and come back. I think it's important that we single out some of the more outstanding young people in the STEM courses, and give them

extra acknowledgement, in some way, with special experiences. It's not just that those small groups of students are going to get an unusual experience they'll remember

“I think it's important that we challenge these young people to do the things that are going to be important to humanity.”

Charlie Duke and his T-38 aircraft.



for the rest of their lives, they are also going to go back and talk about it to everybody else, and that's going to start a wave of STEM learning.

That's going to get us back on track, and we'll end up with trained people who are going to be able to design the systems that we need.

Duke: I didn't even know you could fly airplanes out of the Naval Academy when I got there. And I remember one summer, I was home in South Carolina, early in the jet age, back in the 50s, and I'm riding in this convertible, and I look up and I see this contrail in the sky. And I said, man, I'd like to make a contrail! I mean, just that sight motivated me to go into aviation, and

“I didn't even know you could fly airplanes out of the Naval Academy when I got there.”

it was cemented really strongly when the Naval Academy then gave me three rides in what we called the Yellow Peril, a bi-wing seaplane with open cockpit.

We flew around

Chesapeake Bay, and man, I was hooked at that point. So there are opportunities, if you take advantage of them, that will help direct you to your likes and dislikes, and you can sort of zero in on where you want to go in your career. Be open to nudges in one way or another, and take advantage of those opportunities.

Cunningham: I started out in probably as poor a family as you have known, certainly one of the poorest that I can think of back when I was growing up. I started working



when I was nine years old, cleaning out a lady's house that they were building. In those days they built them with spaces underneath the floors, and had to get them cleared out. Because I was small, I would make a little bit of money. But here's the significant factor: I don't remember it ever causing me to be concerned. Or to think that I was having it too tough. I always thought, I'll have to work hard to get past that stuff. It was an internal motivation. I don't recommend putting that kind of stuff in everybody's life, but if that is what is in your life don't let it make you negative. You've got to be positive about what you can accomplish.

“Growing up on a farm, and doing all the farming myself was a big factor in doing whatever I did next in life.”

Worden: This may sound strange, but growing up on a farm, and doing all the farming myself was a big factor in doing whatever I did next in life. On the farm you learn a sense of responsibility, and you learn a sense of achieving something

that's not going to be achieved if you don't do it. You grow hay in summertime, so your cows have something to eat in the wintertime. You can't wait until October and then decide it then has to be done; you've got to plan ahead for it.

I think that's one of the things I learned — planning ahead, scheduling, and doing the right things at the right time, so that in the final analysis, you've got everything in order when you need it.



The farm also taught me that it was the last place I wanted to live out my life. So I put myself in a situation where I had to be challenged, and I had to really stretch hard to get where I wanted to go. And because of my farm background, I was very willing to put in the effort and the time necessary to make that happen.

I also believe that people have different strengths. I happen to be a hard science guy. I enjoy the math, and I think that's what led me into pursuing engineering in college. It could have been different, but I happen to like that kind of training. I could have been a musician, I started out that way, but I decided that the engineering thing was better suited for me in the long run. So I put all these things together: the fact that I grew up on a farm where I was responsible for everything, the fact that it taught me discipline, and that it taught me

goal orientation, to get things done.

Basically I pursued the dreams. And once I found out that I really loved to fly, and I was quite good with the aircraft systems and knew how to do that, then I found my niche. One thing I needed more than to fly an airplane was an engineering background, which allowed me to not only fly airplanes but also analyze them, and determine what was good or bad about them. So that's how I went, and of course

when I had all of that, NASA had an opening for me. So, you never know. You go through college, you go through life, you do all the things you have to do, and at the end of them all if you've done well, you find that a lot of other doors open, and

that's what happened to me. I think I just followed my dream. And I think if young people do that, and really work hard at it, they're going to be successful in life.

“I just followed my dream. And I think if young people do that, and really work hard at it, they're going to be successful in life.”

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