NASA AT 50 ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

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INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is September 10th, 2007. We are in Washington, D.C., at NASA Headquarters to speak with NASA Administrator Dr. Michael Griffin for the NASA at 50 Oral History Project. The interviewer is Rebecca Wright, with Sandra Johnson and NASA Chief Historian Dr. Steve [Steven J.] Dick. In preparation for the space agency's fiftieth anniversary, the NASA Headquarters History Office commissioned this oral history project to gather the thoughts, experiences, and reflections from NASA's managers. The information recorded today will be transcribed and placed in the NASA archives located here in the Headquarters Building in Washington, D.C., where it will be accessed for future projects.

We thank you again for taking time from your busy day to speak with us. We know that you became Administrator on April 14th, 2005, and prior to accepting this position you were head of the Space Department at Johns Hopkins University Applied Physics Laboratory [Laurel, Maryland]. Would you share with us the reasons why you chose to leave that post and return to NASA as its top manager?

GRIFFIN: Well, really there are specific reasons and more general ones. More generally, this was a position I had been aiming at to shape my career since I was really no more than a teenager, if that. I was interested in space from the time that I was five years old, which—I was born in '49—which would tell you that was several years then before Sputnik.

I became interested in space when I was in the first grade and my mother gave me—the first book I ever remember receiving from her was a book called *A Child's Book of Stars* [by Sy Barlowe], which she retained for many, many years and actually the crew of the Space Shuttle *Discovery*, the [2005] Return-to-Flight mission, STS-114, Eileen [M.] Collins and her crew flew that book for me, and it now hangs in my office. But I was so fascinated by the scientific material in that book, most of which is now known to be false, that, I really, at the age of five, became enamored with space and just didn't ever want to do anything else.

Then I remember when Sputnik [I, Russian satellite, October 4, 1957] launched a few years later being the only kid in my third-grade class who knew what it was and why it was important. I remember explaining it to my teacher.

So at a later time when I was certainly nothing more than an early teenager, it occurred to me, I could see that —I saw things differently than other people. I saw bigger pictures. I saw how things connected and related, and I began to feel like a leadership position was something that I could aim for, and I used that goal to shape my career. I really did.

Now, by the time I was actually selected to be Administrator, I would tell you honestly—I was 55 at the time and going on 56—I would tell you that I would not have just accepted the position of NASA Administrator merely because it was offered. I was at a prestigious university laboratory in a very comfortable situation and enjoyed it; something I enjoyed quite a lot.

So if we had been following the plan that the agency was following prior to the loss of [Space Shuttle] *Columbia* [STS-107] and President [George W.] Bush's announcement of the Vision for Space Exploration, I honestly don't think I would have been interested, because it's a substantial financial sacrifice and an enormous personal sacrifice. I see my family way less often

than I want, and I pursue my hobbies with less vigor than I used to. You give up a lot to accept a senior position in public service.

But I think and have thought for decades that the proper purpose of the United States civil space program is pretty much along the lines that President Bush announced in January of 2004. The President got it right, and given a chance to help bring that about, I would take it, and I did take it. So that's the more general reason, but the very specific reason was that this was a place I wanted to be at this time and for that purpose.

WRIGHT: What do you believe so far has been the most challenging aspect that you've encountered since moving into this role?

GRIFFIN: Well, probably the most challenging aspect of it is overcoming the loss of credibility that NASA encountered, frankly, following the [Space Shuttle] *Challenger* [STS 51-L accident] and throughout the Space Station era and then into the loss of *Columbia*, where, as you well know, the commission that investigated the loss of *Columbia* found disturbing similarities with regard to the management decision-making process that cost us *Challenger*. And the development of the Space Station and, as an agency, our inability to control cost and schedule and all that has not been our finest hour. So NASA's credibility was, I would say, at an all-time low when I took over the agency.

I have way more external advice than I need or want, most of which has to be paid significant attention. I have way more scrutiny by the OMB [Office of Management and Budget] than any prior Administrator. I have relatively junior staff exercising significant control over both budget and direction at NASA, because NASA is not trusted any longer in the upper

reaches of the federal government. I have way more scrutiny from congressional staff than has ever been the practice in the past. With our most recent authorization bill, I think we owe the Congress something like 55 or so reports in any given year on various aspects of what we're doing.

We have organizations like the Government Accounting Office investigating our decisions on a launch architecture. When I was young, NASA's word on what the launch architecture needed to be was *the* word. Others were not judged to have the appropriate credentials to be asking those questions, and yet now they are. Now, they're no smarter than they were then, but NASA is viewed as being less smart. Getting us out of that hole to where we have the technical and managerial credibility to make those decisions and to be seen to be making those decisions is probably the biggest challenge we have.

WRIGHT: You are the eleventh Administrator at NASA.

GRIFFIN: Yes, I think counting Jim [James C.] Fletcher twice. Right.

WRIGHT: Yes. How does your leadership style differ from the ones that have come before you?

GRIFFIN: I don't know that I can answer that one, Rebecca. You might need to ask other people that. I can't self-assess. I don't know how to give you a fair assessment of what I do or how I do it. I have my own innate characteristics, but I think you'd have to get others to compare and contrast me with prior Administrators.

WRIGHT: I remember hearing that one of your most recommended books is one that was about Jim [James E.] Webb and his leadership style.

GRIFFIN: I was nineteen when Webb left the agency in '68, but even as a teenager I paid a lot of attention to Webb's management style and tactics, and more so later on. I certainly am an admirer of Jim Webb's. He did an awful lot of things right.

WRIGHT: Would you like to share some of those and how you've possibly put some of those in action here?

GRIFFIN: Well, Webb was a guy who very clearly, in the light of history—and Steve Dick can comment on this. But Webb was a guy who listened to an awful lot of different people, many of whom did not agree among themselves, but that was okay, and nor did they necessarily agree with Webb. Very clearly, he didn't mind that. He was comfortable with argument and a certain amount of dissent, knowing that he had to make the final decision, because that was his job, but he seems, in light of history, to have been somebody who was comfortable hearing from a very wide range of people, whether they agreed with him or not, before making a decision, and that's a characteristic I try to employ.

Webb was someone who understood, and very explicitly understood in his makeup of the Administrator's Office, that he himself did not bring all the necessary skills to the Administrator's Office to do the job. The job is a very big job. It is technical. It is scientific. It is political. It is managerial. Webb brought several of those talents and brought them in abundance, but he didn't bring them all.

So he augmented himself with Hugh [L.] Dryden as his Deputy, a very esteemed aeronautical scientist from the early days of aircraft flight, and Bob [Robert C.] Seamans [Jr.] as his Associate Administrator. I've characterized that position at NASA as being like the Chief Operating Officer, which I think is accurate, and Bob was and remains a good manager.

DICK: So would you say you've modeled your top management after that?

GRIFFIN: I've modeled the construct after that, because I believe that it works. Now, I bring a different set of specialties than Webb himself brought

DICK: He came from OMB [Office of Management and Budget].

GRIFFIN: Well, he did come from OMB, but more than that, he was the Washington political insider. My Deputy Administrator, Shana [L.] Dale, is as skilled politically, having served time on both the [Capitol] Hill and in the White House, as anyone I know. Shana knows how Washington works better than I will ever know it, and I'm nearly always guided by her advice on how to handle the Washington politics. Our Associate Administrator, first Rex [D.] Geveden and now Chris [Christopher J.] Scolese, are people with broad experience at the Centers and at Headquarters, but whose day-to-day skill is in institutional and project management. Those are strengths I have as well, but I don't have the time to exercise them on a daily basis. My strong skill areas are technical. I like to think that I bring as much technical credibility to the Office of the Administrator as has been done.

So I liked Webb's style in explicitly recognizing that he himself didn't bring all the skills necessary, but that he could construct a team which did, and I've tried to do that. The job is not all about me. It's not all about the Administrator. It's about getting good decisions out the front door, and that strikes me as a Webb characteristic. So there are some areas where I was very appreciative of his accomplishments. I thought he was a landmark Administrator.

WRIGHT: Yes, he was. As you were talking, you shared some of the decisions that he had made that certainly are still impacting the agency today. What decisions do you feel you've made so far that are going to help provide a successful management structure for NASA as it starts its next 50 years?

GRIFFIN: Well, I think one of the crucial decisions I've made that actually returns us to an organizational pattern that one of Webb's AAs [Associate Administrator], George [E.] Mueller, espoused during the Apollo era, and that is the matrix organization, where the responsibilities of the Project and Program Managers and the institutional managers, the Center Directors and mission support folks, are clearly separated. That separation between project and program, and institution, which comes together only in my office, is, I think, a crucial feature of a system with built-in checks and balances.

The *Columbia* Accident Investigation Board cited us, NASA, for a lack of independent technical authority, and indeed they were correct, because basically all authority was vested in the line structure of programs. The Center Directors reported to the AAs. In that construct there is no path for independence.

In the Apollo era George Mueller organized the Human Space Flight Program such that the Center Directors were his Board of Directors for the technical and managerial aspects of the program. But the Project Managers, Sam [Samuel C.] Phillips for Apollo and the Apollo Spacecraft Program Manager, first Joe [Joseph F.] Shea and then George [M.] Low, the key Program and Project Managers did not report through the Center Directors. They did not report through the Center chain of command, so there was an independence there between institutional imperatives and programmatic imperatives that I think is absolutely crucial, and I hope it's not lost when I leave.

Now, the Center Directors don't like it. They didn't like it in Mueller's time, and they don't like it today. The Center Directors would prefer to be handed a suite of programs and then to be the chief executive in charge of the implementation of those programs. But that leaves NASA Headquarters in the position of managing ten little NASAs, each with their own full and separate authority, and while that may be beneficial for a given Center Director, it's not beneficial in terms of the conduct of the programs and projects that we do. It mitigates against a corporate NASA where we can take advantage of capabilities across the whole agency, and it completely mitigates against having any sort of independent technical authority.

So that's a change I have made that I hope will stick. Now, far be it from me to suggest that I invented matrix management. I did not. Even George Mueller, to whom I referred earlier, didn't invent it. It was invented in the late forties and early fifties in conjunction with the task of trying to grapple with large aerospace programs, such as the B-29 development and early ballistic missile development. It was first published as a formal theory of organization in 1956 in a journal called *Machine Design*, of all things. So the approach has been around for decades.

As I say, Mueller didn't invent it. He merely applied it, and it was applied at NASA during our best years. After Mueller left the agency in 1969, that organizational structure survived for about a half an hour afterwards, at which point the Center Directors took over and restored things to the way they preferred them to be. That didn't mean it was right, and I hope I've made enough of a big deal out of that that it survives me.

Other key decisions I have made, I like to believe that I have restored technical credibility to the upper ranks at NASA. When John [F.]Yardley was the AA for space flight and when George Low was the Deputy Administrator, when Hans [M.] Mark was the Deputy Administrator, when—I could go on and on. When George Mueller was the head of human space flight, there was no doubt. When Len Fisk was the head of science at NASA, there was no doubt that, whether you agreed with them or disagreed with them, and I've disagreed with some of those individuals, there was no doubt that they had top-level technical credibility. No one doubted it. It was not even a question.

So it was quite clear that when a George Low or a George Mueller spoke, that those in the field further down the hierarchy would follow. They might or might not agree, but they would follow. When those gentlemen spoke on the Hill or to the OMB, there was no doubt that the listeners were hearing the voice of authority.

In the last 20 years we had gotten away from that, in my opinion. We had gotten to a point where many people were selected for top management positions at NASA because they had had a great military record, because they were friends of other top managers, because they had done esteemed public service elsewhere, but not because they had great technical credibility or knew anything about the space business.

When I came on board, we had several people at NASA whose first job in the space business was at the top. I don't know of any rationally managed organization where your first job in the business can be at the top. You don't start life in the space business as a Center Director at NASA. You don't start life in the space business as an Associate Administrator at NASA. That's where you get to after a long and distinguished career in the space business.

Now, notice that I don't say "a long and distinguished career at NASA." That's good; that's a good thing, but the space business is broader than NASA. There is a robust and thriving military space business, of which I have been a part personally. There's a robust and thriving now commercial space business, of which I've been a part.

So I think we, NASA, do ourselves a favor if we have some interchange with other parts of the space business in our personnel selection, but to bring someone to NASA because they were a great carrier pilot, or ran a great fighter wing for the Marines, or had an esteemed career of public service in another agency is foolhardy. Those people are then in a position of making, by the level of authority they're given as very senior managers, they're allowed to make decisions that they don't have the background to be making.

So I like to think that I've fixed that, and I hope that serves as a model for the future. I hope that it does. It needs to be.

I've made certain choices about our post-Shuttle space flight architecture. I've returned us to a simpler design for getting people into low-Earth orbit. For 30 years NASA has made—35 years, since the decision to do the Shuttle—we have made getting into low-Earth orbit just about the most complex possible thing we could do, and it should be among the simplest possible things. Our future lies out beyond low-Earth orbit. I have seen to the crafting of the simplest possible system I could envision to get people back into orbit to replace the Shuttle.

Now, I've been praised for that by some and criticized by others who think that it's too retro. We've done that before. It could be more sophisticated. All those things are true. But to me those things are a virtue for their truth. We shouldn't be spending all our money, all of our effort, all of our time, figuring out how to get people into low-Earth orbit. We should do it in the simplest way possible, because our future lies beyond, and we need to save our resources, people, money, and time, for those other things.

So that was a conscious decision. Some may disagree with it, but it was a conscious decision.

DICK: So can you give us your opinion then of the Shuttle era? Sometimes you've said things about the Shuttle era that haven't gone over very well.

GRIFFIN: Well, and you don't know me well enough, but you may gather a little bit that I really don't care whether they've gone over well or not. [Laughter] But people have been a bit mistaken. It's not about the Shuttle. My discontent is with the decisions that led to the Shuttle being an answer to a question which never should have been posed. The Shuttle answers the question of how do you get people and medium-weight cargo into low-Earth orbit when you're not going anywhere else beyond.

But that was a policy mistake. The decision to bring Apollo to a halt and beyond that, to dismantle the space flight transportation infrastructure that had been built in that era, that was a deeply flawed decision from the point of view of American strategic positioning in the world. We essentially ground-ruled out any space program that was going to involve flight beyond low-Earth orbit for humans. That was a mistake. Now, I've tried to be very clear about that. That

was a mistake promulgated by the [Richard M.] Nixon Administration from nearly their first days in office. I mean, Neil [A.] Armstrong had not been back from the Moon for three weeks before the last couple of Apollo missions were canceled, and then the next year after that Apollo 18 was canceled.

DICK: Of course, you have to put it in the context of the times, too, the Vietnam War.

GRIFFIN: No, I have clearly demonstrated in a paper called "The Next Fifty Years in Space," I have done a constant-dollar calculation. It's actually a rather geeky paper, but you should have it. I've done a constant-dollar calculation of what the dollars of the time would have purchased in terms of a human space flight program, had we simply utilized the equipment that we had already bought.

Now, it is true that we could not at the time carry out that space flight program and develop the Shuttle, and that's what I mean when I say the wrong choice was made. We had the choice at the time to fly half a dozen human crews to low-Earth orbit per year to visit a Skylab-like Station, as well as conducting a couple of Apollo missions per year every year, as well as conducting a cargo-only Apollo mission to the Moon every year. So we could have been in a position, using only the budgets we had at the time, of beginning construction work on a lunar base while pursuing a Space Station Program, had we only utilized the equipment that we had.

Now, again, I'll leave you with a copy of that paper, if you would. But it's carefully researched. The necessary stipulation is to believe that the OMB deflators that we are required to use are the correct deflators. But given that, the position that in constant dollars we could have had an alternate and very robust future is irrefutable.

DICK: But, of course, [Wernher] von Braun and others wanted to go to Mars. Was that too ambitious at the time?

GRIFFIN: No. We could have been on Mars by now easily, and the paper demonstrates that as well.

DICK: I was born the same year you were, and they were saying that humans would be on Mars in 1984.

GRIFFIN: Yes, and they could have been. And they could have been. See, what needs to be understood is that we spent $25 billion building and flying Apollo, and of that 21 [billion] was in building it, and 4 billion was in flying it. So we spent 80 percent of the money of the Apollo era building a capability, which we used to go to the Moon half a dozen times and then threw it away.

DICK: So why was that bad decision made?

GRIFFIN: Well, that I don't know. You, Steve, are the historian. [Laughter]

DICK: I wanted your opinion.

GRIFFIN: I can't get inside the mind of President Nixon and other policy makers at the time. I simply know that it is irrefutably true that even for the lower budgets of the time, because of the severe inflation that we encountered in the seventies, the Vietnam War, despite all of those things, in constant dollars we had enough money to conduct a very robust space program, had we chosen not to build the Shuttle. But the Shuttle was the logical outcome of a decision that was first made, which was we would cancel Apollo, and then the question was, well, then what, right?

So we as a nation allowed a very poor set of policy choices to be made. I think you'd have to cast a wide net through history to find such an unproductive ratio of expenditures in developing any new capability. In developing any new capability, a given society must undergo the design, the development, the construction, and then transition into operations, and to spend 80 percent of the money that was spent on the effort in design, development, and construction, spend 20 percent of the money using it, and then throwing it away, I think you'd have to look hard to find a society making such a choice, and I think it was a poor choice.

Now, I was saying so at the time, but I was, you know, in my young twenties.

DICK: Nobody listened.

GRIFFIN: Of course not. Of course not, and probably they shouldn't have. There were many others also saying that this is a poor choice, and they weren't listened to, either. As I've gotten older, received wisdom has tended to come more toward my position, but my position hasn't changed. The public perception has changed, that looking back on it, people say, "That wasn't the best choice."

DICK: So it sounds as if you think that knowledge of history and NASA history in particular can be useful for current policy.

GRIFFIN: There are two things which are really important when you're deciding policy, making policy choices for an entity like NASA, and I might include that the Department of Energy or National Institute of Health, any technical agency. One is you absolutely must have or must have people you trust who know the technical domain, because even God can't dictate that which is technically infeasible, and certainly no President can. Congress can vote what it wishes, but Mother Nature reigns supreme. So one must have a perception or have access to perceptions of technical truth.

Secondarily, one must understand history. One must understand history. There cannot have been a NASA Administrator who has read more history than I have.

DICK: Glad to hear it. [Laughter] I know you're interested in *The Secret of Apollo* [*Systems Management in American and European Space Programs*, Stephen B. Johnson] and Seamans' book [*Project Apollo: The Tough Decisions*]?

GRIFFIN: Well, I've read all the books on space, I think, that have been published, but more importantly, I've read more widely in history. I often use these historical references in my speeches. People think that what we do today is unique. We talk about putting crew on [International Space] Station for six months at a time as arduous duty, and we talk about

developing a lunar base with a six-month crew rotation or sending people on voyages to Mars that will last three years.

Unless I point it out in a speech, who today understands that on Captain [James] Cook's first voyage, wherein he discovered Australia, he and his people were gone for three years, with no communication home. By the time his crew complement was complete, he had 102 people on board and only lost 38 of them on that voyage, only lost 38 crew, and upon his return home was praised for his great economy in husbanding the lives of his crew. And we talk about a three-year voyage to Mars and making 99 percent certain that no one will die, I mean, who are we kidding? We've lost sight of history.

DICK: This gets into the whole area of risk in exploration, which maybe we can discuss at the end if we have time.

GRIFFIN: That's another issue. I'm sorry; I'm too long-winded for your questions.

WRIGHT: No. No, this is exactly what we're looking for. But you talked about history, and let me ask you, though, a little about the future. You mentioned that you get a great deal of external advice on how to make decisions. We know that the Vision for Exploration gives you an agenda of what needs to be done.

GRIFFIN: A template, yes.

WRIGHT: And you get external advice from other folks. How do you determine what the priorities are going to be for NASA, and what factors do you think over the next few years will change those priorities?

GRIFFIN: Well, that's actually a question which contains the seeds of its own error. The NASA Administrator doesn't determine the priorities. I may get a voice, if lucky. I may get a voice in what those priorities ought to be. But the President wrote down what he wanted NASA to do. His OMB doesn't always listen, but that's the problem of top managers and staff everywhere. The Congress, of course, there's an old saying, the President proposes and the Congress disposes. Congress thought about all that for a couple of years and then voted on it and voted generally in accord with what the President wants.

Those are the priorities. The law of the land is that NASA shall manage its affairs in such a way as to return human beings to the Moon and establish a research base. That's the law. NASA Administrators have at best a minor-vote voice in setting priorities.

The relative balance between human exploration and science, or either of those two and aeronautics, and within science what will be done in science, is always a compromise, and largely a compromise between the various space community constituents who have opinions about what ought to be done and a budget which, of course, if the budget doesn't start over every year, every budget is a continuation of the one the year before. So overall, policies and priorities change only very slowly.

What I think the Administrator's role is is more a matter of seeing to it that the agency does indeed execute in a way that accomplishes those priorities, as handed to us by the President and the Congress. There's an old saying in career civil service that "Well, we believe in the

hereafter. We believe we'll be here after he's gone." [Laughter] I think the purpose of any agency head is to try to bend the organization to follow the priorities that Congress has voted and appropriated and that the President has stated.

In that respect, government service is very different from private sector, where in a private sector organization there is never any doubt that the employees are following where the boss wants to go, because there's not even time for that discussion. If somebody doesn't want to go where the boss wants to go, they're just not there anymore, and then we have the discussion about how well or how poorly they're implementing the objectives. But there isn't a question as to whether they are co-aligned with where the boss wants to go.

Government service is almost nothing except a question about whether or not the employees are co-aligned with where the boss wants to go, and usually, or I would say often, they're not. So that's the Administrator's challenge.

DICK: So can you give us an overview of the changes you've made to implement the vision, I mean, aside from the management ones you've already talked about?

GRIFFIN: Well, those were the changes. The management changes that I've made are the things I've done to try to implement the vision. When you have technical credibility in a management team and when you have a sensible architecture, that is my contribution.

I've changed how we do budgeting, as well. For a long time at NASA budgeting was done by the Comptroller, but the Comptroller is also the person who counts the money and moves it around. In the private sector the combining of the roles of keeping track of and moving the money with deciding where the money should go, or helping to decide where the money

should go, would be considered a conflict of interest and it's simply not allowed. It doesn't pass fundamental accounting standards for separation of duties, separation of roles.

I have separated them here at NASA. The people who now do the strategic budgeting for me and with me are not the people who are in charge of physically moving the money where it is supposed to be moved or keeping track of it. I think that has helped. There are any number of urban legends, and they may be not just urban legends, about people in the NASA Comptroller shop who made the decisions about what programs would be done and what programs wouldn't be done, just by controlling the money. It's always possible to do that, but it's much more difficult now.

DICK: Could you say a little more about how you came to some of the technical decisions you made?

GRIFFIN: Well, give me a decision, and I'll tell you how I came to it.

DICK: Ares, CEV [Crew Exploration Vehicle].

GRIFFIN: Well, a lot of these decisions nearly make themselves, if you start with the right premises. We're going back to the Moon, and we're unlikely in the extreme to be given enough money to have two different kinds of human space flight vehicles. We're lucky to get one. So if primacy rests on we're going back to the Moon, then the vehicle which carries people has to be capable of coming back from the Moon. That's a difficult technical challenge. A vehicle like the Shuttle, a smaller vehicle but shaped like the Shuttle, can't do it. The aerodynamic heating

rates and heating loads are simply too high with anything other than an ablative material such as was used on Apollo. So Shuttle tiles won't cut it.

Also, the penalty of carrying wings all the way up to the Moon and all the way back doesn't seem to justify itself. So without question, if we're going to the Moon, then we're going to be coming back home in what I'll call technically a semi-ballistic, a blunt-body type of arrangement. That means it's going to look something like Mercury, Gemini, and Apollo-Soyuz, one of that family of vehicles.

So if it's going to look something like that, then it was a reasonably logical choice—not the only choice—to model it after the vehicle where we have the most aerodynamic experience, and that was Apollo, the Apollo Command Module. So people say, "Well, gee, it looks a lot like Apollo." Well, the economics of not spending money to refine a new aerodynamic shape, even though others would serve, combined with the fact that it must come home at lunar entry speeds, give you something that looks like Apollo.

DICK: And you don't have to worry about foam falling onto the vehicle.

GRIFFIN: Well, that's another thing. Okay, now, you could have an Apollo-like shape, and it could be on a Shuttle-C type arrangement, or it could be in a variety of other arrangements. But one of the first things that I didn't like about the Shuttle when, as a young engineer in my twenties when I saw it, my reaction was immediately, "My god, they put the crew right down there amongst all the hardware. So they're not in a safe place, and they didn't give them a way to get off."

So I was going to have an escape system, and I was not going to have the crew in a position where if something happens to the other hardware, it would impact the crew module. It will be below them. Now, that's not a guarantee, but it's a lot better deal than being down in a place where, if a tank ruptures or if the stack blows up or if something falls on it—I actually never thought—as most people did not—never thought about the impact of foam coming off of a bipod strut on the Shuttle and impacting a wing. I'd be the first to admit that I missed that along with everybody else at NASA.

But generically, the idea of not having the crew module where it's in a place where if the hardware has a problem, that problem would impact the crew module, generically, that idea was one of the first things I noticed at the age of 23 when they rolled the design out. I thought it was the dumbest thing I'd ever seen. I just would not work on the Shuttle during the seventies and eighties; I just would not. I really did not like the design.?

Now, the other technical decisions about Ares and Orion, the Ares design uses a device, the first stage of the Shuttle, solid rocket; the first stage is a solid rocket booster. Well, the United States has paid billions of dollars and seven human lives to figure out how to make that thing work nearly perfectly every time, and we've now had, I think, 186 successful uses of that in a row, as I sit here, maybe 188; I'm losing track. It is at this point the most reliable piece of space transportation hardware yet invented.

So it seemed ludicrous to me not to use it in crafting the next system. So it's the first stage of Ares 1. We needed a new upper stage, but even had we used the EELVs [Evolved Expendable Launch Vehicles], Atlas 5 or Delta 4, we would have needed a new upper stage, because what comes with those vehicles wasn't adequate. So a new upper stage on top of the most reliable piece of space transportation hardware yet invented seemed like to me to be a

pretty good deal, as well as being economical. With our budgets, being economical in our designs was absolutely crucial. So if you follow those technical decisions to their logical conclusions, it's really hard to say that you would come up with a different answer.

Now, if you walk into it with a vested interest, such as "I need to sell more EELVs," then you won't reach the conclusion I reached. But I actually started out thinking the EELV would be the right path for getting crew into orbit and then decided that this other approach was better. So another feature is you need to be willing to change your mind.

The Ares 5 architecture, well, if you go back to a study that I led in '93 when I was the Chief Engineer at the agency—and I could furnish you with a copy of that as evidence—but I led a team that concluded that the proper way to deploy the Space Station was not on dozens of Shuttle launches but on half a dozen launches of something that looks exactly like what we call Ares 5 today, because you would have enough payload capability to put up several modules at a time, and you could put up approximately four to five Shuttle flights' worth of hardware on that vehicle for each launch. Had we done that in the early nineties, we'd be finished with Space Station today and probably back on the Moon.

So Ares 5 is a design I had carried around in my head for fifteen years. In order to go to the Moon, you need a vehicle, at a minimum, in the Saturn V class, 120 or more metric tons, equivalent to low-Earth orbit. Smaller than that and you get into the problem that you just can't carry enough to make the trip worthwhile, or else you have to miniaturize the people. Well, that isn't going to happen, so there's a floor on how small a vehicle can be if you want to go to the Moon, unless you want to do an extensive set of rendezvous in Earth orbit; half a dozen launches and rendezvous in Earth orbit, which is really rather silly.

So the Ares 5 is big enough to put about 130 or so metric tons in low-Earth orbit. It's over the threshold. It gives us a great growth path for Mars. We can put together a Mars-sized payload over about a year with four or five launches.

Rendezvousing with the Ares 1, it will allow us to go to the Moon with two launches, one for cargo and one for crew, and gives us a substantial capability over Apollo. It makes maximal use of Shuttle elements, the solid rocket boosters; the ability to craft large tanks that we use for the Shuttle, the Shuttle external tank technology. It makes maximal use of old Apollo heritage, the J-2, and also work being done by the Air force, the RS-68 engine.

So in cobbling together the Ares 5 basically what we did was to use every single component we could find that already existed so that we weren't wasting money that we don't have. Again, I think those decisions are very logical, and one would have a hard time overturning them if efficiency was one's goal.

DICK: Okay. That's been a nice overview. Go ahead.

WRIGHT: You mentioned Congress and about funding, and we read today an article in the newspaper that it looks like Congress is wanting to give a little more money to NASA than expected. But if you could direct an increase, what types of programs would you like to add to NASA's strategic vision for the future?

GRIFFIN: Well, I think we have enough programs. We're doing the programs we need to do. We do need more money than has been allocated to do those programs on a reasonable schedule. I think we're fundamentally doing the right things. We're not doing as many of the right things

as I'd like to see us do. So, for example, in human space flight we're doing in series a number of things that were done in parallel during Apollo. In our science programs we're doing things sequentially that we would like to be doing together, and we would do if we had more money.

But I really believe the agency is doing fundamentally the right things. Wrong things just don't survive the scrutiny of the National Academy of Sciences. There's the Office of Science and Technology Policy in the White House, the OMB, congressional staff, the NASA Advisory Council. There are so many external groups who look at what we do that if we were doing something fundamentally wrong, it just wouldn't survive.

Well, you've got to ask what the definition of *wrong* is, and I would say something wrong is being done if it has no real constituency out there among the taxpaying public. The definition of *right* is what our elected representatives are willing to support and vote for, because in a democracy that is how we make the determination of what it is that government funding will be spent on. There's nothing we're doing that doesn't have a very ample constituency behind it.

Now, some of those different constituents don't like each other. There are scientists who would happily end human space flight, and human space flight advocates who would happily reduce science to a trickle. But fortunately, neither of those extremes prevail.

So, Steve, you were going to ask a question?

DICK: Well, you may have answered this, but I was going to say how do you reconcile that with what you just said about the Shuttle? How did so many of these oversight groups let the Shuttle go forward when it was obviously the wrong thing to do, you say?

GRIFFIN: Well, but again, the Shuttle going forward was the second stage of a decision which said, first, let's end Apollo. I can't advocate that democracy is a perfect system; I'm not trying to do that. You and I were both young adults at the time, Steve. Clearly the democratically elected leadership of the nation thought it was okay to cease doing what the United States had spent an enormous amount of treasure developing a capability to do. That was okay with them.

They didn't see what I see as larger strategic implications of having the United States be the unquestioned preeminent leader in space. Now, that same democratically elected government understood that we needed to have strategically superior air power and a strategically superior Navy, and that we needed to have an industry which was the equal of any and superior to any other in the world. But they missed it with regard to space. They just missed it. So our systems are not perfect.

But, I'm very forthright in saying this was a flawed decision, in my opinion. It was my opinion at the time and has remained so. I think there are now more who agree with me.

DICK: Does that go for the [International] Space Station, too, the ISS?

GRIFFIN: Well, no. Having a Space Station is an excellent idea. Putting the Space Station up in dozens of chunks of 40,000 pounds or less each is rather silly. If we were going to put up a Space Station, the proper way to do it is first to develop the heavy-lift booster, and then put it up in more reasonable-sized chunks. Having a Space Station is not a flawed decision. I think that's a very useful decision. We've made a lot harder work out of having a Space Station than it ever needed to be, in my opinion.

WRIGHT: I want to switch the subject for a minute to robotics. Just recently *Spirit* and *Opportunity* woke up from their nap during a dust storm and are back traveling around Mars.

GRIFFIN: And they're doing quite well.

WRIGHT: And definitely have surpassed their length of service by a grand amount and have added to NASA's legacy of successful use of robotics. Tell us what you think the relative importance of robotic space flight is and how will this change the next years as part of the overall Vision for Exploration.

GRIFFIN: Well, I don't think it's going to change anything. For a very long time to come the human frontier in space is going to be well behind that of the robotic frontier, and in many ways it always will be. Our tools, whether on Earth or in space, our tools can see farther, can see in different spectra, can see more deeply both large and small than we can unaided. What is it that humans do that doesn't involve tool usage?

So to me our robotic scientific spacecraft are just an extension of the human being as a tool-making animal. We can send our tools. Today we can deploy our tools well beyond our own personal reach, and that capability is in itself a tool. The ability to remotely control our tools is itself a tool, and we make extensive use of it here on the ground, in the air, and in space, and I hope we will continue to do so. So our science frontier is enormously beyond our human frontier, and always will be.

In addition, we use robotic systems when—the bumper sticker version is when something is too dirty, dumb, or dangerous for human beings. We dislike to use human beings in

applications which are kind of disgusting. We do it, but we don't like it. We dislike to use human beings when a task is so repetitive that humans become bored with it; humans don't usually do it well. And we dislike to use human beings when a task is so dangerous that many of them may not survive.

Now, we do all of those things, and the history of human civilization is a history of trying to fix that. So for our dirty, dumb, and dangerous applications we use robots, and in the exploration of the solar system we're going to continue to do that.

So I see it as those two things. One is the area where we really dislike to involve humans, even though we could, and the other thing being simply that the science frontier is so much farther than the human frontier that we don't want to miss out on those opportunities

For example, the Hubble Space Telescope is helping us to understand how the universe works. The discovery of dark energy and dark matter is right at the feet of Hubble. What is the value—I can't even begin to guess—but what is the value to human civilization a thousand years from now of having discovered that dark energy and dark matter exist, and how will they use that discovery? I only wish I could be around to find out. This is what we do here.

DICK: So you've made the case for robotic space exploration, and people say, "Well, why do you need the human then?"

GRIFFIN: Well, because if I want to do human exploration, it needs humans. It's self-justifying. It doesn't need anything more than that. Humans like to go where they can take themselves. The entire history of human civilization is of expansion out of East Africa. In fact, the entire

history of life is to expand into every niche and habitat that some mutated form of life can inhabit.

I'll never capture it better than Norm [Norman R.] Augustine put it when he was doing the 1990 study on the future of the U.S. human space flight program. In the introduction to that he made the remark that whether people—and I'm not quoting directly, but the essence of the quote is whether everyone can understand it or not, there is a difference between placing an instrumented package, at the top of Mount Everest, and climbing Mount Everest, and that he, at least, understood the difference.

You know, I don't think I need to say any more. Anyone who doesn't get that difference, he and I can't have a conversation.

DICK: But there are a lot of people who don't get that.

GRIFFIN: Fortunately, wiser heads have prevailed. The fundamental purpose of NASA as a space agency is to explore the universe that we can reach with humans and robots. That's the fundamental purpose, and it's an *and*, not an *or*.

DICK: I think you could argue, the premier agency for exploration of the world, couldn't you?

GRIFFIN: And that as well, but the world is part of the universe. We look down, we look up, and we travel outward. And all those things are important, and it is to me very narrow thinking, narrow thinking in the extreme, for any constituency to say, "Well, my part is worth doing, but these other parts are not worth doing." I could not more profoundly disapprove of that view.

DICK: You won't get any argument from me.

WRIGHT: NASA's foundation was built on NACA [National Advisory Committee for Aeronautics], and NACA was so much a part of studies that affected aeronautical research. What is that role now for NASA, and what do you see for it in the future?

GRIFFIN: I don't see nearly as big a role as I wish I saw. There is still much to be learned about flight within the atmosphere, flight within atmospheres. We're not going to do space exploration at any planet with an atmosphere, even a residual one like Mars, without a heavy investment in aeronautical research that has not yet been done. Right now we're limited to the *Viking* entry envelope in terms of our thinking about aero entry at Mars. That's silly. We should be well beyond that by now.

There is an enormous amount to be learned about flight within our own atmosphere, to doing it more economically, safer, more efficiently, more quietly, and in a way that provides better service to more people. We're not spending as a nation as much on aeronautics as I believe should be spent.

WRIGHT: Do you see that role changing at all for NASA in the future?

GRIFFIN: Only slowly. I'll just give you some budgetary facts, and I won't put any coloration of opinion on them. It is often said that human space flight "eats the lunch" is the phrase commonly used, of other enterprises within the agency. Well, during Apollo, to the nearest

percent, during the epoch in which NASA basically pioneered human space flight, human space flight was using about, during our first decade, right around 63 percent of our budget. Today human space flight consumes 62 percent of our budget.

During the Apollo era science consumed about 17 percent of our budget, and today it takes about 32 percent of our budget. During the Apollo era basic technology, space technology, learning how things work and making them, it consumed about 6 percent of our budget, and aeronautics consumed about another 6 percent of our budget. Today all of aeronautics and technology is 3.2, 3.3 percent of our budget. Then there was always an "other" category of cross-agency programs and things like that, that was about 4 percent of the budget.

The only conclusion one can draw from that is that over the years political priorities have shifted out of basic technology and aeronautics and toward science, with 3 or 4 percent of "other" being about the same today as it was then, and human space flight being almost identical today to what it was then. So we have as a political process decided that our space science investigations are of more value than are aeronautics and space technology development.

These things go in cycles, but they go in very long cycles, and I would not say that I see any immediate change coming in the near future. I don't see the political imperative out there to make such a change. We've evolved to this position over decades; it's been pretty continuous. I gave you the snapshot at the beginning and the snapshot at the end, and I didn't take you through the evolution. It's been pretty continuous to get there, and I don't see something yet which is going to alter it.

DICK: So speaking of budgets in a broader sense, during Apollo NASA had about 4 percent of the discretionary budget, I think—

GRIFFIN: Correct.

DICK: —and now it's about 1 percent.

GRIFFIN: About six-tenths of a percent.

DICK: Okay.

GRIFFIN: So your point would be what?

DICK: What is your thought on that?

GRIFFIN: Well, I actually want to make a couple of observations before I give you a thought on that. In 1969 for the first time the budget of the United States topped $100 billion, if I recall correctly, and I'm pretty sure I do. The NASA budget in 1969 was a number, I don't know, probably right around $4 billion. You can go look it up. So in that year we were 4 percent of the nation's budget.

But—and this is a crucial "but"—in 1969 almost none of the budget as a percentage and in comparison to today—almost none of the budget was anything other than what today we would call the domestic discretionary budget. That was defense, plus all of the other non-defense discretionary programs. Very little of the budget was entitlements—interest on the

public debt, Social Security, other things like that—very little of it. There was some, but on a percentage basis it was small.

Now, today our domestic discretionary budget, counting defense, is about 800 or so billion dollars, 800 billion and change, but our budget is 2.7 trillion. So—again, I'm rounding, and if you want to go back and get correct numbers and put a little asterisk in and say, "What the Administrator meant to say was—," then that's okay. But in round numbers our budget is 2.7 or so trillion, and in round numbers our domestic discretionary is just under 900 billion, 877 or some number like that billion dollars.

So the proper comparison is of 870-some or $900 billion to $100 billion, because the 1.9 trillion in entitlements, interest on the public debt, and other non-discretionary things didn't exist 40 years ago. Those categories didn't exist in terms of occupying any size in the budget. So today NASA gets 16 billion and change out of a $900 billion budget. That's a couple percent; it's not 4 percent, but it's a couple percent. We're not doing terribly badly in terms of the budget fraction of the budget that would be apples to apples, okay? We're doing very poorly in comparison to entitlements and interest on the public debt, which 40 years ago were nits.

So what has happened to the country over 40 years is that political imperatives have shifted by an enormous factor. For every three dollars that are spent by the government, two of them are spent for entitlements and interest on the public debt, and only one of those three dollars is being used to buy things for people, as functions of government. So in that crowding out of budget which has occurred, NASA, along with other domestic non-defense discretionary functions, has been crowded out. But relative to, on an apples-to-apples comparison, the kinds of things we used to be up against 40 years ago in the budget, we're really not doing too badly.

DICK: The only thing I would say is that I believe the NASA budget peaked more like in ’65 or ’66 and had already started down.

GRIFFIN: It had started down by ’69. As I said earlier, we made an enormous investment for about four or five years to purchase for Apollo things in parallel that today we are purchasing in series fashion, and so I chose for the moment to draw a comparison between now and the late sixties.

Oh, by the way, I would also say that if you compare the inflation of the time, $100 billion in the late sixties is about $700 billion today, so the domestic discretionary portion of the budget in constant dollars is a little bit larger than it was back then, but not a lot. We’ve done a very economical job over the decades of controlling the growth of domestic discretionary funding. We’ve not done a good job over the decades of controlling the growth of entitlements and interest on the public debt. Those have mushroomed beyond any imagining from the time of our young adulthood.

WRIGHT: As you know, global warming has become a topic of intense discussion over the last few years, and NASA scientists have been seen as a source of resource information and data regarding this topic. How do you feel, or how will NASA be involved with the discussion of global warming in the next years?

GRIFFIN: Well, I hope in the same way that we have been. Our job is to gather data, build climate models, try to understand the data, publish the results. We’re not a policy-making agency and shouldn’t be. That would be, in my view, a severe conflict of interest. If you are

involved in the making of policy and in the development of the data and the models that contribute to that, there will inevitably be the question of are you coloring the results to match what you want the policy to be.

So our job is that of scientific research; gather the information, understand it, interpret it, build theoretical models to explain it, and then publish those results. I think actually we do it rather well. All the controversy on global warming and climate change generally, the enormous fraction of that data which exists in the world comes from NASA.

I personally think people have gone overboard in the discussion of climate change, to the point where it has become almost not legitimate to view it as a technical subject. It has almost acquired religious status, which I find deplorable. Science moves forward as the outcome of arguments. You develop your theories, publish your data, advance your concept, and others shoot it down, or try to. Scientific consensus evolves in that way.

When it becomes not legitimate to question the data, question the models, when anybody who doesn't believe as you believe is shouted down, then good-quality science suffers. We just had an incident where one of our researchers, Jim [James E.] Hansen, who is notable for his prominence in the media, but is also a good scientist, had to correct some of his data, his published data, on which years were the warmest years in the last century. It was a small correction in terms of the magnitude of the numbers, but a fairly large effect in determining which years were the warmest years. Jim has been criticized in some circles for doing that much more quietly than he published the original data.

I don't think anybody should be criticized for correcting their data. In the normal course of scientific work mistakes and misinterpretations are made. This is what is normal. When one determines that an error has been made, it should be fixed as rapidly as possible, but nobody

should be criticized for doing so. It should be regarded as routine and should be treated routinely. That is what life is like on the scientific frontier or, for that matter, the engineering frontier. When we develop new designs, we should not be surprised that they break. We have to correct them and fix them and move on. That is what progress is.

WRIGHT: You were speaking of how NASA doesn't make policy. When Congress created NASA, [Congress said] the policy of the country regarding activities in space would be devoted to peaceful purposes for the benefit of all mankind. Many times when elected officials talk about NASA and its worth or its value, they mention about how valuable it is for the efforts of national security. Do you find that NASA's role may be changing as the role of global terrorism emerges through the world?

GRIFFIN: Well, I don't really. When people talk about the value of NASA for national security, I see that in two ways, and both, I think are extremely important.

The first and most obvious way is that the technology we develop is part of the overall space business in these United States. NASA space technology is not colored differently than Air Force or NRO [National Reconnaissance Office] space technology or, for that matter, commercial space technology. It's all part of our industrial base in space technology, and NASA is a major and has been a major contributor to that. Since our military space systems are part of our first line of defense and certainly part of our ability to know what's going on worldwide, then in that sense NASA is a contributor and has always been, and I hope will always remain so.

There is a more subtle aspect to national security, however, where NASA plays an enormous role and that I think is not widely appreciated. I've used this point in speeches and

I'm going to use it again here, because I really think it matters. National security to me involves several different levels.

The first level is having enough military firepower, if you will, that you can defeat a likely enemy, and we've always—not always; the nation has fallen into periods where that hasn't been seen to, but we don't live in such a period and haven't since World War II. We were taken by surprise with World War II. We shouldn't have been. We have maybe made mistakes, but we have tried to see to it that we have an adequate defense establishment since that time. That's the first line of security. I've often said with tongue in cheek that the only thing more expensive than a good army is having the second-best army. So that's the first line of defense.

Now, the second thing is, and I'm drawn to a quote by our first President, George Washington, who said, "If you would have peace, prepare for war." The thrust of that obviously being if you are clearly strong and seen to be strong by other nations who are potential adversaries, then they will be measured in their actions, because they will know that if it comes to an actual conflict, you will be well positioned to deal with them. So that's the deterrence theory, which, as we've carried well in now to two centuries past Washington's original advice, and I think it was well founded.

Now, it seems to me that there's a third step in national security, and that step is more subtle. That involves being the kind of nation, the kind of society doing the kinds of things that make other people want to be your ally. We did that with the Marshall Plan in Europe at the end of World War II. We could have behaved as a conquering power squashing everything in our path, very, very Roman Empire-like. We could have done that. We could have behaved as the Soviet Union did at the end of World War II, amalgamating all of Eastern Europe into its grasp.

We didn't do any of that. We didn't do it in Europe, and we didn't do it in Japan. We behaved, by and large, in ways—certainly not perfectly—but by and large in ways that made former adversaries want to be our ally, and today Germany and Japan are two of our strongest allies. That was a level of wisdom on the part of our grandparents' generation that I think is not widely appreciated. In fact, I'm the only person I know who has said this is what we did, and it should be appreciated.

Now, space activity, civilian space activity that NASA carries out, is emphatically in this vein. The kinds of things we do, both for robotic science and for human space flight, encourage and entice other countries to want to partner with us in the doing of them. They are frontier activities and always will be, and they excite the human spirit and challenge the human imagination and the human mind, and others want to do that, too. When we can be a leader in those activities, it makes them want to join us.

There are many areas in which the United States has to do things that others don't like, as part of our global policy agenda. We should proactively look for things that go the other way, that make others want to join with us. Space flight is one of those things, and in that sense, to me NASA exerts an enormous role in improving our national security.

WRIGHT: Thank you. That's a great answer.

GRIFFIN: I mean, do you follow that argument?

WRIGHT: Absolutely.

GRIFFIN: I wish more people did. [Laughter]

DICK: Or took it to heart.

GRIFFIN: Yes.

WRIGHT: On that same train of thought, we all know that NASA celebrates its fiftieth anniversary next year. Share with us what you believe to be NASA's impact on society in the past and now and even in the future.

GRIFFIN: NASA's impact on society, American society especially, is to do things and bring home things that are larger than life. NASA makes us look toward our future. People want to have a future. They want to have a frontier. They want to see and learn and imagine new things.

People want to feed their kids and have a roof over their heads and dress warmly against the cold and not be hungry and not worry about where their next car payment is coming from, and they want to have some leisure time. Yes, people want all those things. But they also want to look beyond that when they can, and NASA is the entity above all others in this country that brings that to them.

It's not for nothing that 40 years after we did it, television commercials are still showing Apollo Moon rockets. They've had 40 years of other stuff they could substitute since that time, and they don't; or even going beyond Apollo Moon rockets, beyond Apollo Moon walkers. Television commercials today are showing Apollo Moon walkers as part of their spiel. That's not an accident.

WRIGHT: Steve, do you have more that you want to add?

DICK: Well, I have a couple of questions just to wrap up, not following on what you just said, but anyway, I know you came to NASA at the tail end of the SEI, the Space Exploration Initiative. Do you have lessons learned from that experience?

GRIFFIN: I didn't come at the tail; I came at the beginning of it.

DICK: At the beginning? You must have even more lessons learned.

GRIFFIN: Yes, I was the AA for Exploration until it got canceled by the [William J.] Clinton administration.

DICK: So what year was that you came?

GRIFFIN: '91.

DICK: '91, okay.

GRIFFIN: I was the Exploration Administrator who was hired as a result of the Augustine Committee's recommendations. I guess the lessons that I would say are learned from that time

are that you've got to have the President and the Congress both in support. At that time we had the President's support; the Congress emphatically was not.

Today that's not so. The Congress has been hugely supportive of our program. You never get unanimity, but the Authorization Act, which passed in 2005, December of '05, was enormously supportive of our agenda. I have now Democratic committee chairs in both the House and the Senate. They are as supportive as were the Republicans.

DICK: So you're hopeful that the Vision for Space Exploration will go forward, past this administration.

GRIFFIN: I am, because of the points that I think Admiral [Harold W.] Gehman [Jr.] made in the *Columbia* Accident Investigation Board and the report that came out of that. I've said this, too, in speeches, but I think it bears repeating. If you look at I think it's Chapter—what—7 of that report, wherever the chapter is on rationale, the Gehman Commission—I'll give you the bumper sticker version. They make the point that for the foreseeable future, space flight is expensive, difficult, and dangerous. But for the United States, it's strategic, and it should continue. But if it is to continue, that the goals ought to be worthy of the cost and the risk and the difficulty of the enterprise, and that flying the Space Shuttle to and from the Space Station doesn't constitute such a goal. They were pretty explicit about that. You don't have to read between the lines to read those conclusions.

Well, in what I can only regard as a miracle of Washington policy, the White House listened. They responded. They proposed a program which goes logically beyond the Station, back to the Moon, on to Mars. Those are the pieces of geography in the solar system that we can

envision reaching over the next few generations. Now, our descendents will reach farther, but that's what we can see. So they proposed that, okay, well, that's what we should do. The Congress studied all that for damn near two years, from January of '04 to December of '05, and decided that, "You know, that's right," and they voted an Authorization Act, which basically tells us to go do those things.

I'm hopeful. I'm not confident, but I'm hopeful that the lessons of the past this time will be learned. We're not asking for more money. It would be nice, but for like 20 years the space program has been roughly fixed in constant dollars, and I don't expect that to change. What we're asking now is that we use these constant-dollar budgets to buy the right things. It will be more slowly than many of us would like, but at least let us spend the money in the right direction, and I believe that will be done.

DICK: Speaking of confident and hopeful, we haven't said much about commercial space. Are you confident or hopeful that commercial space in the future will have a greater role?

GRIFFIN: I hope so. We have to bring that about. The government can act to encourage commercial development or to discourage it. Now, at crucial periods in our history in aviation, the government took proactive steps to encourage the development of commercial aviation to satisfy government needs. All you've got to do is go back and look at the Air Mail Acts. Look at how we apportion cargo shipment of supplies into Iraq today. Much of it is done by contract carriers; operating at risk, but it's done by commercial carriers. Some is done by military carriers.

We grew aviation policy in the United States with the thought in mind that we are a capitalistic nation rooted in doing things that cause free enterprise to succeed. So rather than trying to suppress it, we tried to sponsor it. In space we didn't do that. We emphatically didn't do that. We made it the province of government employees, which was not in itself bad, but we missed the other part.

We have a logistics market to the Space Station. What I've done with our Commercial Orbital Transportation Services agreements or COTS agreements, what I've done is to say that the Space Station logistics market is open to free enterprise, and oh, by the way, here is some seed money from NASA if you can get your venture started. But we're not telling them how to do it. Of the two ventures we sponsored, one appears to be succeeding; one appears to be failing. We're going to cancel the failing one and use the money to start a new one.

I think that kind of activity on the part of government is essential if we want to have commercial space capability, and I think as a nation that we don't want to have no government space activity, but we don't want to have only government space activity, and we need to act in ways that bring about the commercial space development.

DICK: So what are the relative roles of government and commercial entities?

GRIFFIN: Well, it changes with time. I don't think a relevant role for a commercial entity can be to send a human being to the Moon today. But I think a relevant role for commercial space activity today can be send a human into orbit and can be sending supplies into orbit. I think that is well within the reach of the industrial space community today.

So it's not what are the roles. It's what is the attitude. The attitude should be to make available the power of government to offer its markets to commercial enterprise in a hands-off way to stimulate the development of that commercial enterprise. As the technology moves forward, the role of commercial provider can always increase, but not unless the attitude is right.

DICK: Okay.

WRIGHT: I have nothing further. Do you have any more?

DICK: No.

WRIGHT: Is there anything you would like to add, Dr. Griffin? Anything at the end?

GRIFFIN: I would like to add that you should call me Mike. [Laughter] "Dr. Griffin," I don't like that.

WRIGHT: Is there anything else that you would like to add, Mike, before we close out this afternoon?

GRIFFIN: Oh, I don't know. No, I answer questions. I don't pontificate. I try to answer questions. I hope I've answered yours.

WRIGHT: Very well. We appreciate the time, and we'll close for the day and let you get off to the rest of the business at hand.

GRIFFIN: Call me if you need me.

WRIGHT: We definitely will. Thank you very much.

GRIFFIN: You're welcome.

[End of interview]