NASA AT 50 ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

EDWARD J. WEILER
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is October 31st, 2007. We are at the Goddard Space Flight Center in Greenbelt, Maryland, as part of the NASA at 50 Oral History Project. We are speaking with Dr. Edward J. Weiler, Center Director. The interviewer is Rebecca Wright, assisted by Sandra Johnson, and also attending today is Mark Hess, Chief of the Office of Public Affairs here at Goddard. In preparation for the space agency's 50th anniversary, the NASA Headquarters History Office commissioned this project to gather the thoughts, experiences, and reflections from NASA's top managers. The information recorded today will be transcribed and sent to the History Archives in Washington, D.C., where it will be accessed for future projects.

Thanks again for providing us time on your busy schedule. We'd like for you to begin today by just giving us a brief background of how you got to this position.

WEILER: I got my Ph.D. in astrophysics from Northwestern University [Evanston, Illinois] in 1976, and my first professional job was at Princeton University [Princeton, New Jersey] as a research astronomer. My first boss was a guy named Dr. Lyman Spitzer [Jr.]. Little did I know at that point in time that Dr. Spitzer was to be known as the father of the Hubble Space Telescope, which he had proposed in 1946 and he was actively working on when I joined Princeton.

But that wasn't my first job at Princeton. My job was Lyman Spitzer was the principal scientist on a satellite called Copernicus, also known at Goddard as Orbiting Astronomical

Observatory 3. That satellite was operated at Goddard back in 1976, so I arrived at Princeton and was told I would be working three out of four weeks at Goddard, because my job was going to be one of the senior astronomers operating Copernicus for Dr. Spitzer and Goddard. So from 1976 to 1978 I learned a lot about the New Jersey Turnpike and made a lot of trips back to Princeton, but I was located, my apartment, was here near Goddard.

So did a lot of research and had a lot of fun learning how to operate satellites. That was my first experience with space. To begin with, I was a ground-based astronomer, all my college days and my grad [graduate] student days, but I learned about space astronomy back when space astronomy was in its infancy. In fact, Copernicus was probably the first true move to space for a lot of astronomers.

In 1978—I forget the month; it was probably the summer of '78—the Chief of Astronomy at NASA Headquarters, [Dr.] Nancy [Grace] Roman, walked into my little Princeton alcove here at Goddard and said, "How would you like to come to work for me at NASA Headquarters as a civil servant?"

I said, "Well, that's an interesting change in careers, from research astronomy to managing astronomy for NASA," so I made the decision to jump to the civil service and leave Princeton, and I joined Headquarters in October of 1978 as a Staff Astronomer in the Astronomy Branch, working for Nancy Roman.

Nancy Roman decided to retire a year later in '79, and eventually I was appointed to be the Chief of Astronomy, and, I might add, in the history of NASA, the first *male* Chief of Astronomy, one of my few claims to fame. I was the first male Chief of Astronomy, because Nancy had been in the job from the day NASA opened its gates. So I became Chief of

Astronomy, Chief Scientist on Hubble back around 1980. So my involvement with Hubble really started, in some sense, in 1976 working for the father of Hubble.

So I became Chief of Astronomy in 1980 or so, Chief Scientist on Hubble. Basically I was in that job through the launch of Hubble, through the bad days of Hubble. I could do a history on Hubble that would take six hours, because I've spent most of my career on Hubble, three decades now, basically.

But I was there in 1990 to discover—NASA has always in its history underestimated the interest in Hubble Space Telescope. Never failed to realize how much this agency will underestimate public interest in Hubble. We certainly did in 1990, and the press interest, the public interest in the launch, was just incredible. Astronomers like me, NASA people like me, who had never done an interview in our lives suddenly were on the *Today* show in the morning, the *Nightline* at night, and interview after interview. There were hundreds of reporters there. We had microphones in our face.

We launched the Hubble, and everybody was waiting for this flood of data. Of course, two months later we went from the top of Mount Everest to the bottom of Death Valley as we discovered we had a major flaw. For better or worse, I was elected to be the NASA chief spokesman for the flaw, and I got to do even more interviews. Every single day for about two months we had press conferences talking about the problem, here at Goddard Space Flight Center. Little did I know then—I was at Headquarters, and I was spending all my time at Goddard—little did I know then twenty years I'd be the Center Director.

So we got through that, and we made promises that nobody believed that we'd fix the Hubble. But we did. We met all the promises, and of course, the end of the story is the great

American tragedy became a great American comeback. You know, it's a great comeback story, redemption, so to speak; I call it redemption. And it's been getting better every day.

So to go on with the story, I became Director of the Origins Program. I was promoted to Director of the Origins Program at Headquarters in 1996, and I was Director of the Origins Program, missions like Kepler, missions like JWST [James Webb Space Telescope], or planet-finding missions, the search for life.

That's when I started my spiel for the search for life and how important that was, because I always thought NASA should be doing things that the American people might get interested in. I thought asking the question "Are we alone?" was something that a lot of people might consider interesting, or "How did the universe begin?" or "How did we get here?" I like those questions, because they're not science questions. They're questions that anybody on the street might be interested in at some point in their life.

So that was the whole theory of the Origins Program. It was built around four questions. How did the universe begin? How did we get here? Where are we going? And are we alone? We generated a lot of money with those questions. We generated a lot of new funding for NASA missions. That's how JWST got started, Jim Webb Space Telescope.

1998, Dan [Daniel S.] Goldin asked me if I wanted to be the Associate Administrator. I said no, and for two months as they were searching for another one, I changed my mind, because I felt maybe it would be better if I were the Associate Administrator than having to work for somebody I didn't know who it was going to be. So in October of 1998 I was made the Associate Administrator for Space Science by Dan Goldin, and of course, Hubble was under that, so I continued my responsibility for Hubble.

A lot of good things happened from ’98 to 2004. We were able to double the Office of Space Science budget over that period from two billion to four billion, primarily because we were having successes. When I became the Associate Administrator in ’98, one of my first acts was to go down to Kennedy to celebrate the launches of Mars Climate Orbiter and Mars Polar Lander.

What nobody told me was that we were launching two time bombs that were going to fail when you got to Mars. So six months later again I got to take the bullets for another international embarrassment, that is, the two craters on Mars called Mars 98. So I had to basically explain the problems and why they happened to the press, to the public, and to the [United States] Congress.

But in true NASA fashion we didn’t take that lying down. We didn’t go back to our caves and hide. We threw out the whole Mars Program that was left there by previous people, and Dan Goldin and others and myself and [G.] Scott Hubbard and Orlando Figueroa basically put together a new Mars Program, which I’m proud to say has led to four successes in a row now, Mars Odyssey, the two Mars Rovers that are still chugging away like the Duracell bunny, and of course, Mars Reconnaissance Orbiter, which is up there now. So we’ve had four successes in a row; that’s not bad after two craters, so I’m very proud of that accomplishment.

In 2004 Sean O’Keefe asked me to become the Director of Goddard and replace Al [Alphonso V.] Diaz, and he moved Al Diaz to replace me, so we did a sort of a trade between the Bears and the Redskins or something. So I became Center Director in 2004. Hubble is at Goddard, so Hubble is still under me. [Laughs] And I’ve been Director ever since.

So that’s a long answer to your first question, but you seemed to want a history, so I gave it to you.

WRIGHT: But it's a good one, so thank you for that. Tell us about the scope of your responsibilities here as a Center Director, and if you like, even compare that to the differences of being at Headquarters and having the whole program.

WEILER: It's actually very simple. In today's world Associate Administrators at Headquarters get to give out 4 or 5 or $6 billion, and Center Directors and their center people get to spend it. [Laughs] So it's deciding the programmatics of something versus implementing the programmatics. So Headquarters decides on the programs and what the programs are, what the so-called level-one specs [specifications] are, what the programs must deliver. Then it's a center job to basically implement those programs, get contractors, civil servants, working to build the projects.

So a Center Director has to worry about the institution, which is not the most fun job, of course, and that is keeping the lights on; keeping the gas on; keeping the roads plowed; keeping the buildings from falling down. That's one part of it. Hiring people to make sure that we can do the programs is another part. Training people so they can do the jobs Headquarters wants is another part.

Also, even though the AA [Associate Administrator] has program responsibility in terms of program success, Center Directors are what are called the head of the Independent Technical Authority. It's something that Mike [Michael D.] Griffin put in which is kind of a checks-and-balances system. That is, Headquarters is responsible for directing projects, but sometimes, hypothetically, they might want to save money here, reduce a test or something.

It's my job as Center Director and my engineers below me to say, "Hey, that's not the NASA way of doing business. That's too much of a risk." Then I have the responsibility of going directly to my boss, Mike Griffin, and saying, "Hey, your Headquarters Division Director or AA is pushing us to the brink on something, and we've got to discuss this." So then the two heads get together and decide.

So I think it's a good system, because it's worked for America for two or three hundred years; it's called checks and balances, three branches of government. So we've got two branches at NASA, the program side and the technical authority side. That's appropriate, because most of the technical smarts in NASA, the real engineers and scientists, are at centers—they're not at Headquarters—just by the sheer numbers. There are 1,000 people at Headquarters and 19,000 people at the centers.

So that's it in a nutshell, what a Center Director does, besides go to meetings and do interviews.

WRIGHT: Tell us about your strategic vision for Goddard, and how does that compare to what's been historically associated with the center here.

WEILER: Well, Goddard was the first science center at NASA. In fact, it was one of the first centers at NASA. It opened in 1959. And it's been a science center ever since. It's always been involved in science, but it's not just a science center. To define *science*, it's Earth science and space science. Space science includes astronomy, solar physics, particle fields in space, space physics, and planetary science. Earth science, of course, is the whole Earth's system.

In addition to that, though, Goddard—and this is something that continually amazes me, because I worked at Headquarters for twenty-six years, and I come to Goddard and I find out things that go on at Goddard that I had no idea as a long-term NASA employee.

I had no idea, for instance—I always thought that astronaut communications, that's [NASA] Johnson [Space Center, Houston, Texas]. You turn on the TV, and astronauts are talking to Johnson. Not quite right. Every human voice coming back from space from an American space vehicle, all the way back to Alan [B.] Shepard [Jr.] and John [H.] Glenn [Jr.], has come through Goddard Space Flight Center, every single human space mission. We run the space communications system here at Goddard for NASA, so the backbone of the system is right here at Goddard, long before it gets to Johnson.

For instance, we run the Tracking Data Relay Satellite system, a system of seven very large satellites in equatorial orbit around the Earth, that basically is the backbone of our communication system for NASA and for other agencies. It's not just NASA; it's for some of the other—very important—other agencies.

We also do, as I said, Earth science and space science. Now, what am I missing, Mark?

HESS: You could always talk about the role we have with NOAA [National Oceanic and Atmospheric Administration], the weather satellites.

WEILER: Yes, this is a test I like to urge people to do when they're on a plane. Ask people who builds and pays for weather satellites, and I'll bet you a lot of people will tell you the weather channel. Right? I mean, after all, that's where you see the weather pictures, right? The weather channel. How many people know that Goddard has managed, built some, built some instruments

for, every single weather satellite ever launched by this country, all the way back to the Nimbus and TIROS [Television and Infrared Observation Satellite] satellites. I didn't know that, and I've only worked at NASA thirty years. [Laughs]

So I'm going around Goddard giving talks to my staff so that when their neighbors ask them, "You guys at NASA just burn up money in space. What do you do for me?" Well, do you think hurricanes are important? Do you think weather satellites are important? Do you think communicating with our satellites is important? Do you think global warming is important? That's all done right here at Goddard.

So I've hopefully fired up a few thousand of our people by giving them—I've just recently finished a series of twelve all-hands lectures on what Goddard does for the country, and I think a lot of people had their eyes opened. I'm ashamed to say an awful lot of people at Goddard, not just Headquarters, didn't have any concept of what we do for weather satellites, what we do for human space flight. So that's where we are now.

The future, I think NASA is on the verge of—I think the country is on the verge of a reawakening in the importance of Earth science. I mean, duh, you know. [Laughs] People are starting to wake up to the fact that the Earth is changing. We can argue about how fast. We could argue all day about who's responsible. That's not our job at Goddard. Our job is to collect the data and give it to the decision makers. That's what our job is. So in a nutshell, build the satellites, collect the data, and give it out, and hopefully people will do the right thing with that data. I think we're going to see more and more future in Earth science here at Goddard.

A big chunk of our future is in the James Webb Space Telescope. I think it's no overstatement to say that Hubble has been the most successful scientific program ever launched by NASA, if not by this country, ground or space. I don't think too many people in the public

would disagree with that. I think James Webb is going to be even better than Hubble, because if nothing else, it's ten to a hundred times better in terms of sensitivity. So I have a feeling James Webb is going to be our next Nobel Prize, and it's going to be looked at by—it's our gift to the next generation. Hubble was a gift to this generation of kids. JWST is going to be the gift to the next generation of kids, of explorers.

In terms of the President's [George W. Bush] Vision—this is another thing that amazed me about Goddard. Too many people here would come to me and say, "What's this new Vision? Goddard has no role in this. We're a science center."

Not only do we have a role in it; we're building the only piece of hardware that's going to be launched before this President leaves office. Is that a role in the Vision? I think so. We're launching the Lunar Reconnaissance Orbiter [LRO], and more importantly, we're building it here at Goddard, inside the gates in Greenbelt, Maryland.

What's Lunar Reconnaissance Orbiter? Well, again, I like to put things in simple human terms. If you're going to a place you haven't been to in thirty years, a lot of new roads, a lot of new interstates. What's the first thing you do? You get a map. In so many words, that's what Lunar Reconnaissance Orbiter is. It's getting a map of the Moon, because even though we've been to the Moon six or seven times, and we've driven SUVs around—the lunar vehicles—we still don't have a digital map of the Moon.

Everybody's got a digital camera, but that's recent technology. We do not have a good, high-quality map of the entire surface of the Moon. In simple words, that's basically what LRO is doing for us. It's paving the way for our future astronauts to go make a permanent presence on the Moon.

We also are responsible in the Vision to running the space communication system for future lunar travelers, which is appropriate, considering we've been doing it for fifty years. And we have other bits and pieces of the Vision in terms of avionics, subsystem electronic components for the lunar landers that humans will use eventually. So that's another part of the vision for the future.

Our vision is we have a major role in the Vision. We're not necessarily building rockets or space capsules, but we're building a lot of the infrastructure to support those.

I don't know. Have I missed anything?

HESS: Well, my favorite line that you use is that the Vision talks about the Moon, Mars, and beyond, and beyond is a big place.

WEILER: Yes, the President—I know he said this, because I was in the audience in the first row, looking at him in January of '04. He specifically said, "Moon, Mars, and beyond." Now, because when you're trying to achieve a goal, you have to concentrate on the first part of that goal, you hear a lot of talk at NASA about the Moon. But the Vision is more than the Moon. It's Mars and beyond.

Goddard tends to—its science—besides the Earth and some Moon and some Mars, most of our science astronomy is the beyond, and last time I checked, beyond is a really big place. So do we have a role in the Vision? I'd say so. A few hundred billion light-years, cubic light-years, but whatever.

WRIGHT: When you joined Princeton as a research astronomer, as you mentioned, you were based here back in '76. How has NASA changed since that time in general and then in your specific area of expertise?

WEILER: Well, let me speak first to astronomy. Let me speak to the specific and then go to the general.

Astronomy, space astronomy and space science, was in its infancy in the late seventies. We had the OAO-3, which maybe involved ten or twenty astronomers in the country. A few years after I got here we launched IUE, the International Ultraviolet Explorer, a Goddard project, which involved thousands.

I saw in my own field, astronomy, which is probably the oldest scientific field in human history, because the Greeks were astronomers, I saw it go through a renaissance. Everybody was a ground-based astronomer when I was a grad [graduate] student. Now there probably aren't very many people who would identify themselves only as a ground-based astronomer. Almost all astronomers on Earth now use one of our space missions.

NASA has really transformed a science, astronomy, into a space-based scientific field. I won't say all the important science in astronomy is done in space, but most of the discoveries are made by the Hubbles and the Chandras [X-Ray Observatory] and the Spitzers [Space Telescope], etc., and that will be certainly true with James Webb. There's no question ground-based astronomy is an important part of that, but space astronomy tends to be the one that leads the field in terms of where the problems are.

So if NASA wanted to take credit for only one thing, there's no question in the science area that we've transformed the field of astronomy. You can't open a textbook today in

astronomy, not just in the United States, anywhere on Earth, whether it's in Chinese, Arabic, or Japanese, every other picture is going to be a Hubble picture or a Spitzer picture or a Chandra picture. We've defined the science, and I don't think I'm overstating one iota.

Also true in space physics; space physics by its nature is done in space. [Laughs] Solar physics, NASA brought solar physics to the American public. Until about ten years ago the average American would think that, "The sun, well, that's that big yellow ball that never changes and why do I care about it, as long as it keeps pumping out energy."

Well, Dan Rather and CBS news decided to put one of our small satellites called TRACE [Transition Region and Coronal Explorer] (on television); it looked in the ultraviolet and extreme ultraviolet region, and there the sun isn't a nice, constant yellow ball. It varies by factors of a hundred, because in those wavelengths and energy regions, you see the storms that are going on. Sometimes those storms get all the way to the Earth, and that does affect our daily life, because it knocks out power grids; cell phones and Blackberries go haywire. Suddenly the sun became part of our daily lives, and NASA did that for the American people, showed that the sun does have an effect on the Earth.

Earth science, we wouldn't be where we are today in terms of understanding that our planet's changing if it weren't for what NASA has done in the field of Earth science. You get a different view from space. Of course, philosophically, probably one of the most important pictures ever taken was taken by an Apollo astronaut who took a picture of that pale blue dot out in the distance, the island in space. Philosophically, that will be a picture that probably is in books hundreds and thousands of years from now, if we're still on this planet, and not annihilating ourselves.

I forgot the question.

WRIGHT: It was how has NASA changed in your area as well as generally.

WEILER: Okay, so—oh, how has NASA changed versus how has NASA changed something else.

WRIGHT: That's a good question, both sides, yes.

WEILER: How has NASA changed? That's a tough question, because I can't think of any obvious ways. NASA constantly changes, but it's like a sine wave. Centers have more power; centers have less power. Headquarters has more power; Headquarters has less power. It changes because it's a human organization, and we get new Administrators every one, two, five, ten years. We get new Associate Administrators. We get new Center Directors. Despite what some people might think, people are different. They have different personalities. They have different ways of managing and leading.

So NASA has gone through many, many changes, but the changes haven't been crazy. They've been little things like where is power and control centered or not centered, and who's in charge of this versus who's in charge of that. But as an organization, in terms of an engineering and science organization, our goals really aren't that different. They're to push frontiers. They're human space flight. They're to push scientific frontiers on the science side. They're to support the nation's weather satellite program.

I had never been asked that question before, and obviously, I haven't got a good answer for you, because I don't really see that much of a change.

WRIGHT: This might be a question that you have, and you have actually talked a little bit about it in different parts, but people do ask why is NASA here and what's its impact. So can you give us your answer?

WEILER: If NASA wasn't here, we'd have to create it. NASA's prime role in our society is not to allow what happened to the Romans to happen to America. What do I mean by that? The Romans went through a period where they went out exploring; regretfully, conquering, too, but primarily exploring. They went into northern Europe. They even got as far as Britain. And they established colonies.

But then they stopped, and they kind of moved back to Rome; and then the center of attention was back to Rome and let's make life better. Let's have parties and coliseums and lions and shows. Instead of looking outward, they started to look back inward, and there are many other examples of this in human history. When a country has no frontiers, it atrophies.

NASA is America's way of pushing the frontier. We don't have frontiers anymore in the United States. We're kind of at the level of the oceans now. I hate to quote *Star Trek*, but space is the final frontier, and humans need room to expand, both physically with their bodies, and with their minds, with things like Hubble and JWST. If America loses its frontiers, we won't be speaking English here much longer. Just a thought.

WRIGHT: A good one.

WEILER: I like to learn from human history, and those—what was the famous saying? Those who fail to learn from history are doomed to repeat it. [Laughs] I really believe that. And by the way, what's not changed about NASA, which is why I'm still working here after thirty years, many of us could make enormously larger amounts of money outside of NASA. Why do we stay? Because of what I was just talking about. We feel that we're doing something that might be remembered in ten years, fifty years, a hundred years, or ten thousand years.

The line I like to give people who are thinking of leaving and going to work for the other world out there, that world that makes money, "Yes, as a young engineer at NASA you can probably go off and go work for some cell phone company and make a lot more money. You may make a major breakthrough. You may make the first cell phone that broke the 4-ounce barrier. You may make the first cell phone that's 3.9 ounces. Great accomplishment. But think about that. And you may make a million dollars for it."

A hundred years from now when your granddaughter asks, "What did my grandma, what did she accomplish in her life? What is she remembered for?"

"Your grandma made the first 3.9-ounce cell phone." Of course, ten years later there was a 3.8 and then a 3.7 and then a 3.6, and of course, now you're not using cell phones anymore.

Or you could stay at NASA. You could stay at NASA, and maybe at JPL [Jet Propulsion Laboratory, Pasadena, California], or Goddard work on the first mission that's got a big enough mirror or enough resolution to look at a planet around another star and see the lights come on at night, thus proving intelligent life in the universe for the first time in human history. "And that's what your grandma did." How do you want to be remembered to your granddaughter?

That's what's not changed about NASA. If that ever gets lost from NASA, if that spirit of frontier, of pushing the boundaries, ever gets lost, then NASA will cease to exist and should cease to exist.

WRIGHT: On a more personal basis, which I guess is the same as professional basis for you, what are some of the lessons that you've learned working with NASA?

WEILER: Always ask dumb questions. [Laughs] I like to give quick answers. I wish I had been dumb enough to ask the following question before we launched Mars Climate Observer. [Wright laughs.] "Are you sure that the contractor is using the same units that you are at JPL?" [Laughs]

Yes. What a dumb question, right? Of course we're all using the same physical units, metric or whatever.

I've learned a lot of lessons like that, and I'm visiting lecturer at a lot of leadership courses, and you won't believe the reaction I get when I talk to these young leaders. They'll ask me questions like, "What have you learned?"

I say, "Ask dumb questions."

There's this thing at NASA—it's not just at NASA; it's in human society. It's called group think. You saw it in the [Space Shuttle] *Columbia* [STS-107 accident] report and other things. People sit around a table and they all—people like to agree. They really like to reach consensus, and that's really dangerous when you're doing things like we're doing at NASA.

So asking dumb questions, pushing the envelope, being devil's advocates, those are really, really important lessons that I've learned and try to use. I drive Project Managers nuts

with questions I ask, and sometimes you hit a home run. You ask a question they hadn't thought of, or they had assumed was answered and you find out it wasn't. So that's one lesson.

Another lesson is never—it's tempting to always want—a lot of people at NASA really live in a world that I call [Microsoft] PowerPoint nirvana. They like to dream up new missions and make viewgraphs and sell new missions. Sometimes they forget that to get those new missions, you've got to be damn sure that the ones you're building now are launched and don't fail, because we're always just a hair away from being punished by OMB [Office of Management and Budget] or Congress. I saw it on the Hubble with the spherical aberration. I saw it on Mars 98. Be darned sure that you're not shortchanging today's mission for that beautiful viewgraph of the future.

That's a lesson I've learned. I wish a lot more people would learn it. Make sure you aren't penny wise and pound foolish, because you ain't going to get that new mission if you aren't sure that that other one succeeds.

Mike Griffin said this just a couple of weeks ago at a senior management meeting. The Mars Science Lander, the nuclear rover we're going to launch in '09, has to be successful. Forget the Vision; if that's not successful, people are going to notice. That's a huge mission. It's hugely important. It's like the Hubble mission coming up in August. We've got to succeed. We've got to fix Hubble one more time, because if we do that we're going to get a lot of kudos, and people will notice.

So don't be penny wise and pound foolish, even though those PowerPoint viewgraphs are looking really tasty, really tasty. The hamburger on your plate is probably more important than the steak in the future. There's a quote.

WRIGHT: [Laughs] Since you were talking about fiscal responsibility, how about budgets? Do you feel, based on current budget trends and past budget trends, that your center will be able to meet those expectations? Or your budget will meet those expectations?

WEILER: I think so. Yes, well, I don't get to set the budget. The ~~very highly intelligent~~ people at Headquarters get to set the budgets for us. We get to recommend budgets. That's what the role of Headquarters is to set the budgets, and, of course, OMB has to approve it, and then ultimately Congress is the ultimate authority on budgets.

I think we're doing pretty well. We're stable. We're not getting fat; we're not getting lean. JWST is fully funded. Hubble is fully funded now. If the President's budget is accepted by congress, the Global Precipitation Mission, which is a critical mission to understand hurricane strength, is going to be fully funded. Our civil service workforce is fully funded now for the next five years.

So we're in a stable situation. Our institutional budget is very, very Spartan. We're not exactly building new buildings and flying private jets here at Goddard, but we're getting by. There's nothing I can really complain about at this point.

WRIGHT: Speaking of new buildings, I understand you have one that's coming online.

WEILER: First one in five or six years. It's a new Science and Exploration Building.

WRIGHT: And very green.

WEILER: And very green. It's going to be the greenest building in Goddard. We're a very green center. I'm very proud of this. Half of the natural gas we burn here is actually produced by trash, garbage.

We made a contract many, many years ago with a local dump. [Laughs] They stopped dumping in the dump, and they covered it up, and we hooked gas lines into it. Of course, dumps, when they decay put out methane, which, the last time I checked, is natural gas, which a gas furnace loves to burn. So half of the natural gas we burn here is basically free, and it's produced by decaying trash. So we're very proud of that.

We had to cut through a forest to build a new road here. We planted two trees for every one we took down. We do as much as we can. We don't use fertilizer here. The grass grows or it doesn't grow; it depends on whomever controls those things. So we're pretty proud of our environmental effort here at Goddard.

WRIGHT: One of the recent trees planted, you had a little help from the Queen of England [Elizabeth II].

WEILER: The Queen, yes.

WRIGHT: It would be remiss of us to talk about your history here without mentioning the visit from the Queen of England.

WEILER: Yes, well, once every fifty years we entertain guests like the Queen of England. Just a couple of weeks later we had Lucy Arnaz and Marvin Hamlisch visiting us. [Wright laughs.] Don't ask me how these things get arranged, but they do.

I tell this story, because I was responsible for the two Mars rovers, and the last seven minutes of a six-month journey to Mars is going through the atmosphere, when a lot of things happen; parachutes come out; rockets burn. Hopefully they don't blow up. [Laughs] A lot of things happen. We used to call that intense period of planning "the seven minutes from hell." I thought that was the worst thing I've ever seen in terms of something laid out, planned, in my career, until the Queen decided to come to Goddard.

Then suddenly we've got two hours from hell squared, because we've got the British Secret Service, the American Secret Service, the British embassy in Washington, the British palace in London; ~~worst of all~~, Headquarters. They're all telling us what we had to do, and everybody was a boss, and we had forty-two leaders and no troops. So somehow we pulled that all together. Some of us had to exercise some authority at the appropriate times and tell people they weren't in charge.

Like if the U.S. Secret Service tells us to do something, we will do it; I don't care what Joe Blow at Headquarters or Jane Doe at the embassy says. There's a higher authority. They want to have horses with police walking around Goddard, that's fine. If you aren't going to get your friend to be next to the Queen, that's fine. [Laughter]

So anyway, it took two months of planning, and fifty people probably touched us at various different times. It was planned out to the second. I have never seen a schedule that is hours, minutes, and seconds. "The Queen will arrive at 10:05:00. The Queen will get out of her car at 10:05:10," you know.

I never believed this could be pulled off. I just had nightmares about this being a total disaster, in front of the cameras of the world. Because of the hard work of people here, at Headquarters, all over the place, this thing went off like—no pun intended—clockwork. She arrived within seconds of when she was supposed to. She departed within seconds of when she was supposed to. It just went really, really smoothly.

We had our local queens and kings. We had Senator [Barbara] Mikulski here; [Congressman] Steny [H.] Hoyer, our prince; Senator [Benjamin L.] Cardin; and then a couple of our counts, Congressman [C. A. Dutch] Ruppersberger and Congressman [Roscoe] Bartlett. So that was great, having our delegation here. Everybody had a great time. The villagers at Goddard behaved themselves—which I was worried about, too—except for two villagers who happened to be scientists, who thought they'd get a better picture by climbing a tree. The Secret Service didn't enjoy people up in trees with objects, so they escorted them downward. [Laughs]

That was just a glorious experience, and the greatest kudos were from the palace, that said the Queen and the Duke [Prince Philip, Duke of Edinburgh] thought that Goddard was the highlight of their American trip.

And the fact that they were all over, Williamsburg [Virginia] and Kentucky Derby; that was a good kudo. So I think Goddard did proud by Goddard. It did proud by NASA, and frankly, it did proud for the country.

So would I like to do it again? No. Fifty years is about the right interval. [Laughs]

WRIGHT: Okay, we'll mark that down for fifty years.

WEILER: We invite the next King and Queen of England, or Duke, whatever they call it. Fifty more years.

WRIGHT: Talking about those scientists and engineers, it's been said that Goddard has the largest collection in the nation—

WEILER: It does.

WRIGHT: —of those. How challenging is it to manage all these folks?

WEILER: Well, you can't manage scientists. The only way you can manage scientists is like herding cats. You just move their food. They will follow their food, yes, so you move their money around, and they'll follow it. That's an old saying about scientists.

It's difficult managing scientists, because most scientists come from the university environment, and we all know there's no management at universities. They're used to a university-type atmosphere, and the government is not a university-type atmosphere. It's more of a military atmosphere. Luckily, I'm one of the rare scientists who actually was in the military, so I understand what it means to have a chain of command and to follow orders, which is sometimes difficult to explain to my fellow scientists. But we manage. We manage.

Our engineering unit, we have 1,200 engineers in Code 500, which is our Engineering Directorate. I think that's larger than three or four of our centers, so it's a huge engineering outfit.

But that complement of 400 Ph.D. scientists and 1,200 engineers enables us to do something that, really, only one other center is capable of doing, and that's JPL. That is, JPL and Goddard are unique at NASA. We have the ability to formulate, conceive of missions, design missions, build missions, launch them, and operate them. A lot of centers have parts of that, but very few centers have the ability to do the whole thing and do the system engineering, as we call it, for the whole thing, end to end, birth to the end of life, basically.

That's a unique capability that very few places in the United States have. Other than JPL, maybe the [Johns Hopkins University] Applied Physics Lab [Laboratory, Laurel, Maryland], the [United States] Naval Research Lab [Laboratory, Washington, D.C.] , and Goddard. Mike Griffin has said this himself; very few places in the United States still have the capability of building spacecraft from the ground up and launching ~~,~~ them~~, –~~ inside their gates, and that's something this country needs to hold onto.

So I take that as an important responsibility as the Center Director, to keep our competence to do that, because that's not just a NASA thing. That's a U.S. government capability we need to maintain.

WRIGHT: Before we end today, I wanted to ask you about what you believe the relative importance of the human and robotic space flight, how they interact.

WEILER: Excellent question, and I'll probably give you a different answer than many scientists will give you. I don't understand the continual head-bumping that goes on between the robotic side of NASA and the human space flight side of NASA, and maybe because I'm in a unique position. I've spent most of my career, if not my entire career, involved with the Hubble Space

Telescope. The Hubble Space Telescope is a robotic scientific mission, the most important scientific mission the country has ever done, if not the world.

However, I'm also capable of pointing out to my science colleagues that none of that would be true. Hubble would be a piece of orbiting space junk if it weren't for the human space flight side, because the robotic side of the agency launched a mirror that was wrong. Hubble was built by the Marshall Space Flight Center and launched. It had the wrong prescription.

It took the Johnson Space Center, [NASA] Kennedy [Space Center, Florida], and Goddard and Headquarters, working together with the contractors, to figure out how to fix this piece of junk that was up there and turn it into the great American comeback story. That was the ultimate merging of human and science. I can't think of a better example in NASA's history of the Hubble Space Telescope, in terms of ending that argument about human versus robots. It doesn't have to be that way.

If astronauts go to Mars, hopefully they're going to be doing more than just walking around. They're going to be doing incredible science. They might pick up a rock and see a fossil. That's science. You might call it human exploration; I call it both. Humans do science. Robots don't do science; they enable humans to do science, whether they're astronauts on Mars or whether they're scientists sitting here looking at the data.

So I think NASA would be better off if we could end—and again, it's human nature; there's always going to be, "Oh, you got my dollar. I want your dollar." The human space flight program and the robotic space flight program don't necessarily have to be at odds. They shouldn't be at odds.

I see a day where our robotic spacecraft are going to get so big that they're going to have to be built in space. I would predict that they're probably built by humans, not Klingons or

Romulans or other aliens. The last time I checked, the only people we have are humans. So if we're ever going to build spacecraft large enough or telescopes large enough to see the lights go on on a planet in another solar system, I see humans as either having to build those things in space or to maintain them or to service them or whatever, twenty, thirty, forty years out.

But to have that capability, we have to do the human program now, going to Mars, going to the Moon, and building up the infrastructure. We've got to build space capsules. We've got to build bigger rockets. The Shuttle clearly—you don't need wings to explore the universe. You need space capsules. So it's the right thing to do. The Orion and the Ares are the right way to go. They may look like pure human now, but someday they'll be used for doing science, I would argue. That might be a minority viewpoint among the scientists, but I lived it, so I have the right to talk about it.

WRIGHT: Well, as a final question, because our time is coming to a close today. You've been with NASA in one shape or form since 1976. Why would you, or would you, encourage a person to choose NASA as a career?

WEILER: Again, I go back to my—and it's not easy. When I joined NASA, it was easy to make that decision. The Russians were launching Sputniks [satellites]. My country was at the threat of Russia taking over the world. Everybody wanted us to be scientists and engineers. And what was competing with that kind of vision of the future?

Well, we had three television stations in Chicago. If you were lucky, you had a nine-inch black-and-white screen. You didn't have computers. You didn't have GameBoys™~~game boards~~. You didn't have the Xboxes. You didn't have virtual reality. There wasn't a lot of

competition out there. There weren't *Star Wars* movies or *Star Trek*. So it was easy to get inspired.

We've got a much tougher job now, because we have a thousand television stations. We can land on Mars virtual reality through Xboxes and things. You have computers. It's tougher to get young kids inspired by what we do. So it goes back to, again, the very basic human thing to get kids to think long-term. What do you want to spend your career on? If you want to make money, become a lawyer or a doctor, I guess, or a businessman or businesswoman. If you want to do something for culture, the human society, push the frontiers, then there's only one choice.

So it goes back to what I said. Is your goal in life to make the first cell phone that's 3.9 ounces, or is your goal to be part of discovering life for the first time in human history? You can only do that once as a human culture. You don't discover life the second time or the third time. It's only once when you prove you're not alone. It's only once you pick up that rock as an astronaut, "Hey, there's a fossil." Or you dig down a hundred feet into the Martian soil, and you pick up water, and there are little things swimming around in it.

That only happens once in a human culture. You could be part of that, or you can make that cell phone 3.9 ounces, and you make the choice. That's exactly the way I talk to young kids. We have a lot of interns come through here, college kids, high school kids. And you know something? I'm a great believer in body language. You're not going to reach all of them, but you can see the light turn on in a few of their eyes, and maybe you reached that person. Maybe you turned a future CEO [Chief Executive Officer]of Home Depot into the next engineer. If a few of us do that at NASA today, we're doing the right thing for the country.

How do you excite the next generation? I would argue—everybody has their own beliefs on how you get the next generation of explorers to come to NASA. I think it's to get kids to

think about the long term a little bit more and what do they want their mark to be. That's tough, because kids don't like to think about when they're fifty, sixty years old. They like to think about tomorrow.

So I know it's not easy; don't get me wrong. I'm not a Pollyanna. The lure of a million-dollar salary is a tough thing to fight against. But life is about more than money. It should be.

WRIGHT: Well, that's all I have.

WEILER: Okay.

WRIGHT: Is there anything else you'd like to add?

WEILER: No, I think we've covered most of the things I like to talk about.

[End of interview]