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WESLEY T. HUNTRESS, JR.
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is January 9th, 2003. This oral history with Dr. Wes Huntress is being conducted in Washington D.C. for the NASA Headquarters History Office Administrators Oral History Project. Interviewer is Rebecca Wright. This session will focus on Dr. Huntress' leadership role while with the Nation's Space Agency.

Thank you again for taking time for this project. We'd like to start with your early days at the JPL [NASA Jet Propulsion Laboratory, Pasadena, California], after you completed your Ph.D. at Stanford [University, Stanford, California]. You began there as a National Research Council resident associate. Tell us about this program and about your duties there, and then how your duties evolved at JPL.

HUNTRESS: When I first went to JPL, the idea was always to take a job there, and the best way to do that, apparently at the time, was to take a fellowship first, so that both I and the folks who wanted to hire me would have a year to decide if that was the right decision for both of us, and it certainly was. It was a program run by the National Research Council for postdocs to work at a NASA Center. So I applied and got one of those, and went to JPL.

WRIGHT: What were your first duties there?

HUNTRESS: I was hired as a scientist. So I was hired in the Science Division, and what they wanted me to do was to help develop at JPL this new instrumental technique called ion cyclotron resonance and apply it to the study of the chemistry of planetary atmospheres, comets and interstellar clouds, because it was a brand-new technique, and so that's what I did. So, my first

five years there was really developing this technique and making it work so that we could look at the chemistry in these astrophysical environments.

My goal while I was at JPL was to develop the science of what I called astrochemistry, which was chemistry in [the] interstellar medium comets, and interstellar clouds, with a keen interest towards what organic precursors were produced that would ultimately end up providing the chemical basis for forming life on a planet. That's what I wanted to do there.

Also what I wanted to do there was get involved with projects. If you go to JPL, for me it was hard not to get involved with projects. In fact, that's what attracted me there. When I first interviewed, they showed me Surveyor 7 on the surface of the Moon, and I got to watch them dig a trench on the Moon, and I said, "Forget academia. This is more fun." So that's why I went there.

I was there for twenty years, and I think my research group did quite well in becoming world-renowned in this particular area of astrochemistry and one of the big developers of the science of astrochemistry.

WRIGHT: How did your work at JPL prepare you for your next phase with NASA?

HUNTRESS: It was definitely in the projects. My last several years there, for example, I was pre-project study scientist, the U.S. [United States] pre-project study scientist, for the proposed Cassini mission [Cassini-Huygens Mission to Saturn and Titan]. The highest aspiration for a scientist at JPL was to become a project scientist for a mission. Why else would you be there? So that was what I aspired to, after having grounded myself in science and made my reputation there.

This was a particularly fun project because it was international, so it involved a lot of European scientists and getting Europe and the U.S. involved in this joint proposed mission. Plus, it was going to Saturn, one of the most intriguing planets in the solar system. It was going to go to Titan, which is the only moon with an atmosphere, and an incredibly interesting one

with a lot of organic stuff floating around in the atmosphere. So it was really an exciting project.

Working on that project, the interfaces involved with JPL projects, with NASA Headquarters, with the Europeans, that all prepared me, I think, quite well for going to NASA. I had no intentions of ever going to NASA Headquarters. That wasn't in my plan. It just happened. In fact, I was on a career path that I was very happy with at JPL. My last year there, in fact, I was a visiting [professor] at Caltech [California Institute of Technology, Pasadena, California], so I was teaching a course, brand-new course, in astrochemistry at Caltech. I'd been asked to develop this graduate course for Caltech. So I was a happy camper. I was on my way. This bolt [came] from [out of] the blue, and I had to make a career decision.

WRIGHT: How were you told of your selection?

HUNTRESS: One of the things I had been doing at JPL was, in fact, helping out programmatically in the Earth Sciences. I was in an Earth and Space Sciences Division, and while I really was a planetary scientist, you know, understanding what goes on on the Earth is important if you're going to understand how it fits into the rest of the planetary system, and so I'd been helping out since the mid-seventies programmatically in the Earth Sciences area, and so I worked out of a program office as well. I planned a lot of functions, but as a scientist, also as a section manager. I managed my own research group, and then I also had some programmatic functions that I did, one of which was I was recruited by the JPL management to help out in setting up an Earth Sciences program at JPL and interfacing with NASA Headquarters in JPL's management of its Earth Science program.

We ran a conference in Logan, Utah, back in 1975 or '76, and I became acquainted with a fellow by the name of [Dr.] Shelby Tilford, who was a new division manager at NASA Headquarters for Earth Science. In fact, I became the study scientist for the Upper Atmospheric Research Project. JPL and [NASA] Goddard [Space Flight Center, Greenbelt, Maryland] were competing for this project, doing joint studies in a very odd way. We were both competing for

this project, but we were both working on the study for NASA Headquarters. I was the JPL study scientist. This is in the late seventies.

[Dr.] Bruce Murray, who was director of JPL at the time, decided not to do it, and let Goddard have the project, which at the time irritated me quite a bit. But the folks in the Earth Science Division at NASA Headquarters, I developed a real good relationship with them, especially with Shelby Tilford, and he kept asking me. Every year I'd get a phone call from him asking me to come back to Headquarters. I said, "No, Shelby, I'm not interested. I really want to go off and do planetary work. I'm enjoying being involved with planetary missions. Earth is one planet. I like having the other eight. Thank you very much." This kept going on and on and on and on for roughly five or six years.

Finally, I was back here in 1987 for some function that I can't remember, and went out to have a beer with my good old friend Shelby Tilford, you know, find out how he's doing with his Earth Science stuff, and he says, "I'm going to make you an offer you can't refuse."

I say, "Certainly I can refuse it. I've been refusing you for years."

He says, "No, you can't refuse this one." He says, "I want you to be my deputy. I want you to be a Deputy Division Manager at NASA Headquarters."

So that opened my eyeballs, and I thought about it for a while, and I said, "What would happen to my career path if I gave up all this stuff at JPL that I'm very happy with and went to NASA Headquarters? What would be my career path?"

I decided if I did that, the way I'd really want to do it was use this experience with Shelby Tilford, who was a very good division manager, to learn how to be such a person, and then what I wanted to do is go manage the Planetary Division, because if I did that, I would be able to do all the things in planetary exploration that I thought needed to be done. And that is what led me to consider it seriously. Then, finally, I decided to do it.

Everybody at Caltech and JPL thought I was absolutely nuts. They tried to convince me not to do it. But I decided that this was an interesting opportunity, that career opportunities don't come by very often. When they do, sometimes taking the risk is worth it. In this case, it turned

out to be worth it. So I just gave up everything at JPL and gave up this gorgeous home we had in South Orange County on this beautiful lake, my wife's dream home. She never hesitated in spite of the fact she was living in her dream home. Pulled up her stakes. She's an L.A. [Los Angeles, California] person. And came back east, never lived back east.

It worked out well. I spent two years with Shelby Tilford. I learned how to be a good division manager, and when the Director of Planetary Division retired—that was [Dr. Geoffrey] Geoff Briggs—the current AA [Associate Administrator] at the time offered me the job. That was 1990, summer of 1990. Long story.

WRIGHT: Great story. Your duties changed, and you became now director of this new division, or not new division, but new for you.

HUNTRESS: New for me. Right.

WRIGHT: How did you set up your goals?

HUNTRESS: I knew before I even went what I wanted to do there. When I left JPL, I'd already formulated in my mind where I thought the Planetary Division needed to go, what directions it needed to go. I had participated as a scientist in strategic planning in the Planetary Division before, so, having participated in the planetary exploration projects at JPL, I was very familiar with all the projects and what the planning and thinking was at JPL and at Headquarters and within the science community, because I was a member of the planetary science community as well. So those three experiences all mixed together in my mind, and I had a clear idea of where I thought Planetary Division needed to go. So I hit the ground running when I took it over.

I had three principal goals. First was, in fact, to complete the reconnaissance of the solar system. We hadn't been to Pluto. Galileo was being constructed to go to Jupiter, and we had sold the Cassini mission. My last day before I went to NASA Headquarters, I was at

Headquarters selling the Cassini mission to the current AA for a new start and spent the weekend and showed up at Headquarters the following Monday. And, in fact, I was successful, because [Dr. Lennard A.] Len Fisk, who was AA at the time, did submit it for a new start in 1990.

So what I wanted to do was to complete the exploration of the solar system. We had been to every planet except Pluto, and so I wanted a Pluto mission, and I wanted a solar probe mission so we would visit the extremes of the solar system, the Sun and Pluto. Wanted to do that.

The second thing I wanted to do was to initiate programs to try to develop the technology for detecting planets around other stars. And the third thing that I wanted to do was to develop a program for low-cost planetary missions. The problem was, in the decade of the eighties, there was not a single launch of a planetary mission, not one. Eleven years. And all the money was being put into two big projects, Galileo [Mission to Jupiter] and Magellan [Mission to Venus].

So the problem is that there would be years when no data was coming back at all from the solar system. Then there'd be this big pulse of activity for a few days, and nothing. And that was unhealthy. So what I wanted to do was to find a way such that there would be data coming back from the solar system continuously, as continuously as possible. And the only way to do that was to have a larger number of smaller, less expensive missions, so that you could launch more frequently and have spacecraft operating at planets as continuously as possible. That was a brand-new way of thinking about doing solar system exploration, and it took a while for it to become accepted.

WRIGHT: How did the scientific community respond to this program?

HUNTRESS: They liked the idea, but they were concerned about low-cost planetary missions. *(a)*, they weren't sure they could be done, and, *(b)*, the community had become very used to piling everything they could on one mission. That increases the scientific scope and scientific depth of a mission and can make it a very comprehensive study, but also makes it incredibly

expensive, because all of the requirements that puts on a spacecraft. I mean, a spacecraft has got to be big and very capable.

So the community had gotten used to this way of doing business where they treated each mission as if it was the last bus out of the station, which it often was, for a long time. So they all wanted to pile on. So to break that mode of doing business and say, "No, no, we're going to break it up into smaller missions, and we have to be disciplined and very focused on each mission and a smaller number of instruments for each," that was not something they were used to, and they weren't sure it was going to work, because if they didn't get theirs, when were they? You know, that kind of a thing. So it took a bit of convincing.

And also, this was not popular at JPL, which was the only place where missions were being done at the time, because they saw this as a threat. In many ways, I presume. One was, well, what if you didn't get all these missions? They wouldn't have any. They liked the idea of doing one big mission at a time, and then the next big mission at a time, and the next big—they were set up. That's how they were organized, and that's how they liked to do business, and the idea of doing a larger number of smaller missions in parallel just didn't resonate with them. So it was difficult to get them in that mode.

Plus, it was a big organization, and the way that they fed their people was to have them all working on these big missions, and they had no concept how to break them up and work them on smaller missions. It was just a threat.

I had trouble with JPL, because when I asked them for concepts for lower-cost missions, they kept coming back with the same price. I remember asking for a lunar orbiter mission. What would it cost to do a lunar orbiter mission? The science community had defined what the next step in lunar exploration was. The Moon's close. It's got to be relatively cheap. What would it take to do this lunar orbiter mission? The answer came back: 450 million bucks. Wrong. Too expensive.

What if you broke it up into a number of smaller spacecraft and distributed your risk amongst these spacecraft and distributed the instruments among those spacecraft? What would

each of those spacecraft cost? They said, "Well, we can break it up into three spacecraft, and each of them will cost 150 million bucks." Let's see. The sum of that's 450 million bucks. Wrong answer.

So that was right about the time when Mike [Griffin came to NASA and] when the Agency was getting interested in putting a lunar program together and was doing SEI [Space Exploration Initiative], what was called SEI. I had been working with DoD on the Clementine Mission at the time. DoD was very interested in lower-cost missions. So we were working with them. DoD wanted to send a spacecraft to the Moon and to an asteroid to test their technologies. These were mainly instrument technologies, but also smaller spacecraft technologies launched on the Titan 2. And this would ultimately end up to be successful. So the idea was to extrapolate from that for NASA science missions, and how to do them less expensively.

So we got involved with JPL. This is how we got involved with this lunar stuff, how to get JPL to do it less expensively, and we just couldn't get them to do that. So this fellow Mike [Griffin] was running the SEI Program at NASA Headquarters, and he, much to my chagrin, was given the lunar robotic program. It was taken away from the Planetary Division. But SEI never came to fruition. It was unpopular with Congress. It was unpopular with the Administration. So that eventually disappeared. But in the process of doing that, Mike got bids from folks outside JPL on how to do this, and so I took a cue from that when I decided how I was going to go about the process of making a program of less expensive missions.

I had inherited a study that had been done by my predecessor Geoff Briggs. My AA, when he brought me on, said he wanted me to look into lower-cost planetary missions. So I revamped and revitalized this study, and what I did was, I had a science study group and I also had an engineering study group, and I brought in the Applied Physics Lab [APL] and a couple of people from NRL [Naval Research Laboratory], institutions which had done low-cost missions. Not planetary, but low-cost missions. APL, in particular, had done low-cost missions. I put this group together and turned them loose, and said, "Figure out for me how one can do lower-cost missions."

I had people on that group who did big missions, and people who do little missions, so they could argue it out as to how it was going to be done. We finally came up with a plan for how to go about doing it. I even got a science group. They were a mechanism by which to get the science community on board. The engineering group was a mechanism by which to get the implementing organizations on board, and I gave both APL and JPL studies to do, competitive studies. "JPL, give me a proposal for a lunar mission. APL, you give me a proposal." No, it was asteroid missions, missions to an asteroid. "APL, you give me one."

That's probably the least expensive, least challenging mission I could think of for planetary, because getting to asteroids is real easy, near-Earth asteroids, energetically very easy. Now I wanted a hard one. Landing on Mars, that's hard. "JPL, you give me a study for that. APL, you give me a study for that."

When I got the results, boy, it was clear who knew how to build low-cost missions: APL. I mean, there was just no doubt. But I didn't quite trust them to do the hard one. So I gave APL the Near [Earth Asteroid] mission, and I gave JPL the Mars Lander mission. It ended up being called Pathfinder.

The reason it worked at JPL was because they hired a maverick to do the study, somebody who was a bit of an iconoclast. He was a project manager, but he was a bit of an iconoclast at the lab. He put together a group of young kids who didn't know it couldn't be done, and he did the mentoring. He gave them the responsibility, and it was treated like a skunkworks, which was not something JPL was used to, and they made it work. It was a delight to see happen. But it ended up being an anomaly at JPL. The older folks there, the more conservative project managers, the ones who had done the Voyagers and the Galileos, they never liked this. They thought it would fail, never liked the project, didn't like this way of doing business. Ultimately, unfortunately, after those Mars failures in the late nineties, JPL reverted back to their old ways of doing business, which was unfortunate.

So the only way to really keep this thing going is through competition, and APL is the competition. What came out of it after all of this was my plan to stabilize planetary exploration

instead of this binge-and-purge way of doing business as opposed to a constant diet, was to establish program lines. The way they did it before was sell this big mission, and then when you're ready, sell another big mission.

So what I wanted to do was establish program lines, like Explorers. Astrophysicists had [an] Explorer [line] where you didn't have to get a new start every time. There was a line in the budget for [the] Explorer [Program], and NASA made the decision as to what new starts they wanted to put into it, and Congress didn't have to make that decision, thank goodness. All Congress had to do was to be happy that the line was being successful. So I wanted to establish that line. So the way I wanted to go about doing these low-cost missions was to establish a line of them so that we could be assured that they would be continually coming down the line and not be interrupted by Congressional idiosyncrasies.

So when [Daniel S.] Dan Goldin showed up, I was all ready with this Discovery Program. In fact, it had already been submitted in the budget for that year by Len Fisk. Len Fisk liked it. He was my AA at the time, and we submitted it, and then Dan Goldin showed up. Dan didn't get along with Len; fired him. I got a call in Munich [Germany], at a planetary sciences meeting. "I'm firing Len. You're the guy," which really scared me. I mean, I had no ambitions to be an AA. I was very happy as a division [director]. I liked what I was doing in Planetary.

So when I came back, one of the things he wanted me to do was to cancel Cassini and institute a program of low-cost missions. If you know Dan, you don't tell Dan no. That's what Len did. You don't last that long.

So my first real duties as AA were, (*a*), prevent him from canceling Cassini, and, (*b*), getting him excited about this Discovery line of missions. When he made me AA, I was actually able to hand him something he wanted already, the Discovery Program. He wanted some low-cost planetary missions. "Dan, here they are. All have been well studied. It's actually already up on the [Capitol] Hill being proposed." And so he adopted it.

The Cassini story is something else. So that was the beginnings of "better, faster, cheaper." That was his invention, those words, but it was the Discovery Program that made it

real, and that congressional season we got the Discovery Program. We got both the Near [Earth Asteroid Rendezvous] Program, and the Mars Pathfinder mission out of it.

That was a long ramble. Sorry.

WRIGHT: No, it was great information. It was one of the points I wanted to bring up with you, is the fact that you were already prepared for a new methodology at NASA before that methodology was announced, and with great timing.

HUNTRESS: That's right. I mean, I was fortunate enough, because Dan was a good visionary, but he was also very difficult to get along with, and I think I managed to establish myself well with him right away because I had what he wanted when he wanted it. That made him happy.

WRIGHT: Would you like to talk about how you saved Cassini at this point?

HUNTRESS: Dan came into the Agency with a preconceived notion, and it was based on a proposal he had made to Shelby Tilford several years before, for a system of Earth-orbiting satellites, called the Earth Observing System. Shelby had a program for a comprehensive satellite program to observe and understand the Earth. These were big, comprehensive, very expensive satellites, launched on Titans, Titan 3s, very massive, very comprehensive, large payloads for a really comprehensive attack on the planet. It grew out of his UARS [Upper Atmosphere Research Satellite] success.

Goldin had come in from TRW [Inc.] and made a proposal for a series of lower-cost satellites, and it didn't go over with Shelby at all; because this was not the way Shelby wanted to have it done, so [it] got pretty well dismissed. That really ticked Dan off. So when he came into the Agency, he had this built-in notion about getting rid of what he called the Battlestar Gallacticas, and it came out of this EOS [Earth Observing System] problem he'd had. So he wanted to get rid of the planetary ones, too. He couldn't get rid of Galileo. I mean, that was

already on the way, but Cassini was in development. He could get rid of that thing: "They're spending too much money at JPL on this $5 billion project. Trash that thing, and let's use the money for lower-cost missions."

I didn't think that was a good idea, because a huge investment had already been made. Most of the money had been spent. In fact, it was a great mission. There are other forces that determine what gets done by NASA. There's the Administrator; there's the President's Office of Science and Technology Policy [OSTP] associated with the President's Office of Management and Budget [OMB]; and the U.S. Congress. So the only way to save Cassini was to get those forces involved, which is what I did. There was risk in that, but it worked. Eventually, OSTP and OMB said, "Look, we've made this investment. It's a good one, and we believe in the science," and the Congress delivered the same message by putting it in the budget. So Dan stepped back from that, because it wasn't going to be very productive or politically useful to pursue. So that's how we did it.

WRIGHT: It was quite a risky move on your part.

HUNTRESS: Oh yes, but that's what an AA has to do. The program has to come first, and even at risk of losing your job. That has to be first, and that's the way I operated. So I went through several risky incidents, but simply based on that.

There were two other principles. One was that these missions had to do the best possible science. That was determined by the science community. And, they had to be something that the public would be interested in. They had to have this element of public interest, because they're paying the bill. So I wanted all these missions to have public excitement in them, and sometimes that was at odds with what the scientists wanted to do. So a lot of my dialogue with the science community was on this issue. "The program has to be exciting to the people who are writing the checks. It's not just your program; it's also the public's program." That was another principle that I tried to work.

WRIGHT: Sounds like you were introducing them to several new aspects of a new culture.

HUNTRESS: Yes, exactly. The science community came around pretty much to that culture, I think, after a while, because they saw the value in it. The value was, (*a*), they got more missions; (*b*), they got to choose their own missions. The way in which missions got chosen before was, the Agency would have this sort of strategic process that took a long time, and it resulted in these big missions that the science community could apply to for their instruments, but ultimately, the missions were chosen by the Agency and a call was issued by the Agency. "Give me some instruments, okay?" The fact that the science community had a role in narrowing the field in what kind of missions got chosen, that was fine. But there was a lot of good ideas that got dropped out in that process.

Missions were essentially chosen by JPL and by NASA Headquarters. [Discovery] gave them the opportunity to choose their own missions outside of any strategic long-term strategic context. "I've got a good idea. I can propose it." So one of the great things that came out of Discovery was the innovation. The kinds of exciting, innovative concepts that came out of that program were just amazing, and that's what the science community liked. The science community likes competition. That's how they live, and they saw what competition did to increase innovation in the program. So that's why you see now, even JPL has to compete for missions, even the larger ones now.

So the science community came around to it fairly quickly. JPL still, I think, although they compete well, their whole history shows that they are excellent in competing, is still pretty uncomfortable with it.

WRIGHT: Regarding the Discovery Program, how were you able to choose those programs? What criteria did you use to take the innovative concepts and turn them into reality?

HUNTRESS: What we did was institute a two-level process. The first thing we did was we had to establish the program and show that, yes, you can do low-cost missions. So the first two missions were directed by me. I chose them. I chose a hard one and an easy one and directed who would do them, gave them to APL and JPL, just to prove they could be done. It was obvious these were going to be successes.

Then we competed. We had already decided how that was going to be done, and the first thing we did was do a science selection. [Issue an announcement for the flight opportunity and] ask the science community for mission concepts. "Mr. PI [principal investigator], you go out and you get whoever you want to get to help you, your science team, your industry team, and a NASA Center and put together a proposal for how to do this mission idea that you'd like. Then we'll review them and choose which ones we think are best on the basis of the science in the mission. Then we'll give you some money to develop a concept, and we'll have a down selection."

So the idea was to choose maybe half a dozen on the basis of science, give them some real money, 350,000 or half a million, I can't remember how much, so they could develop the concept further, so we could do a really good, comprehensive technical review of the concept to see if a set of peers in engineering and the technology areas believe they can actually pull it off, and not just technically, but managerially.

Did the PI choose the right people? Does he have a project manager who can really make this work for him? Scientists are terrible at doing that stuff. He's got to have the right kind of people. So he had the right team, and that process seemed to have worked, because all the missions have been successful except one. So that whole process was invented by the original Discovery team folks who put together the proposal before we sold it to Congress.

WRIGHT: Let's spend a few minutes talking about those accomplishments and, if you'd like, even the disappointment of the Discovery Program. Of course, the Mars Pathfinder is one that did touch the American public as well as the global public.

HUNTRESS: Yes, that's right. I think that taught us—that put the real stamp of approval on what I really thought we needed to do, which is to do things that are exciting to the public. One of the things we did back then, which was different, was we insisted that the data, including the images, not just go to the scientists, but that they also go in parallel on the Web. The Web was a new thing at the time. So with some reluctance, the science team agreed that they would do that, and the JPL publicity folks agreed that they would do that, reluctantly, also, because these were going to be raw, unprocessed images. That experiment worked enormously well. I mean, when those images came out on the Web, the whole world was watching. I think it showed, (*a*), the popularity of robotic exploration, and it showed that the public really was keen on what we were doing. I think the Discovery Program has been an enormous success. It's the thing I'm most proud of. The idea of establishing mission lines is something else I'm proud of, because it's continuing. Another Discovery-like line [has] been approved, which is New Frontiers [Program], about twice as expensive. But that's become the way of doing business.

And, (*b*), instituting competition, because competition proved out to be the only way to get innovation and to keep costs down. It's the only thing that's ever worked.

Discovery has been an enormous success, and I have no disappointments in it at all, except for this one loss that we've had, but that's the business we're in. It's a risky business, and that's going to happen.

WRIGHT: As part of your vision, you were involved with the strategic plan that cast a twenty-five-year view of the Space Science Program. Based on what I've read, you and hundreds of others spent two years of effort trying to put that plan together. Tell me how you were able to accomplish that and what were your goals and expectations of that plan as you were developing it.

HUNTRESS: One of the things that was clearly important was strategic planning. I think the

Office of Space Science [OSS] invented that, and had been doing it in the eighties. Len Fisk was one of the folks who really did a lot of strategic planning. I learned about its value from him. And it was clear that the people to whom we were marketing the program, whether it be the Administration, whether it be the Congress, or be the public, they weren't going to give us any money unless we could tell them what we were going to do. "Where is it going to lead? Where is all this going to? Suppose we give you this project, this billion-dollar project today. Where is that going to go? What have I got myself in for here? So where is this leading?"

So that's why strategic planning became important. It was also important to get the science community behind what the Agency planned to do, because the science community was the community that was going to sell it to Congress. The science community is very politically active, and they have credibility with the Congress. So they're the ones who are going to be able to sell this program to the Congress, because they'll lobby for it. But they had to understand where it's going, too, so they can see where it's going.

So the idea was to get the science community involved with the NASA community to do long-term strategic planning. So the idea was that NASA would do the long-term thinking about what we could do in the future based on what technologies we had, what kinds of missions we could do, bring the science community on board to figure out what the science program, what the science priorities are, match those things up to create a long-term plan, and then use the academy as the Good Housekeeping Seal of Approval. "Yes, you guys did good." "No, you didn't do good, and here's what you need to do." That kind of stuff.

So that was the general process. So each three years, we would produce a new strategic plan that focused on the next five years that remained, but had a view out [to] about a decade, and we did that every three years. These were very useful in marketing the Space Science Program, whether it was planetary or whether it was astrophysics or space physics, because the Administration could see where we were going. Congress could see where we were going.

The only deficiencies in these strategic plans were that they didn't have strict prioritizations in them. This is the plan that the community thinks is the most important to do,

but we didn't say, "You've got to do this program first and that program second." That was the only deficiency in them, the only criticism we really got about them.

WRIGHT: One of the challenges of the strategic plan is that you just weren't doing it for the Office of Space Sciences. Part of the strategic plan was also involving the other enterprises at NASA. How were you able to accomplish with the other groups—

HUNTRESS: That's what Dan Goldin did, in fact, was insist on strategic plans from the other enterprises, and then have that become part of a massive strategic plan. That was Dan Goldin's innovation. For the most part, the plans were developed top-down, kind of a top-down process. But the AAs were intimately involved in that, so they could tailor the top-down process so that their enterprise plans would fit into it fairly well. The highest-level objectives were clearly defined by this executive committee, which the AAs were a leading part. So that way it would all be coherent.

But the enterprise plans themselves were pretty independent. What I did was use this as a means to try to get the Human Space Flight Program and the Office of Space Sciences programs more closely tied together. My goal, selfishly, was to get more science into the Human Space Flight Program and to try to get the Human Space Flight Program to be based more on science than it was, because it was really based more on engineering requirements and programmatic kinds of ideas, and I wanted to try to get some more science into that.

One of the deals we tried to work was that when we did our first Mars missions beyond Pathfinder, that we would try to carry experiments on those missions that had Human Space Flight goals. It kind of worked. Where it fell apart was that the Human Space Flight Program, because of having trouble with [the International Space] Station, never ponied up the money for the instruments. So it turned out that the Office of Space Science had to pay for those instruments, and that created a lot of problems. It was regarded by the folks in Space Science as being baited and switched. So that created a bad feeling in the Office of Space Science, but it

didn't prevent the good things from happening. That was how it was when I left, so I don't know. Hopefully, they're still doing it. There is an instrument on [2001 Mars] Odyssey, which has Human Space Flight goals, which is the radiation monitor. So hopefully it's still continuing.

I really do believe it's important for both those enterprises to work together on a systematic and science-based plan for exploring the planets, with both robots and humans. It's in the best interest for both of them. And humans, I don't think, will ever get anywhere beyond where they are now without having a good scientifically well-based rationale for where they're going, and full participation between robots and humans, both, in a sensible, systematic way.

WRIGHT: How about your work with the Mission to Planet Earth Enterprise as well?

HUNTRESS: Yes, that's what I did with Shelby Tilford. The two years I was with Shelby was, in fact, developing the Mission to Planet Earth plan, and I came to it with my experience in the Upper Atmospheric Research Satellite. That was my training ground for NASA's strategic planning, because I was strategic planning for Mission to Planet Earth. That was my training ground for strategic planning, for project development in NASA, and working with the Centers, and I believe in it. I think it was an important thing to do. It changed its flavor a bit, and the way in which it was being accomplished, after Shelby left, because the Agency couldn't afford those big, expensive missions that had come out of it. But nonetheless, it's been restructured like everything else. Cassini had to be restructured, AXAF [Advanced X-ray Astrophysics Facility] had to be restructured, and [they have] done well.

WRIGHT: With your previous association with Mission to Planet Earth, at least when you were doing your strategic planning for the OSS, it must have been somewhat easier for you to weave in Mission to Planet Earth activities as well because you were already familiar with that.

HUNTRESS: Yes. Sure.

WRIGHT: In the strategic plan, there were metrics. How were you able to come up with the metrics, and then how well did you meet those metrics?

HUNTRESS: Metrics in science are hard, because you cannot predict discoveries. What science is about is acquiring knowledge and making discoveries, and you can't plan those. You can't tell somebody from OMB, "Eighteen months from now, I'm going to discover a planet around another star." You just can't do that. And that's what they want.

I have to say that my relationship with OMB was terrific. The fellow who ran the program was Steven [J.] Isakowitz . He and I developed a very good relationship. I don't think I would've been able to have made the accomplishments I did, if it hadn't been for the fact that Steve Isakowitz and OMB felt that what I was doing was the right thing.

But development of metrics such as that were very hard and so we had to do proxies. So, to try to satisfy the system, [we developed] two proxies to evaluate current performance. One was a metric which was, "How many of the 100 most important scientific discoveries of the past year were done by the Office of Space Science?" And there was a magazine, *Science News*, which is a British-based publication, which did that every year. So we counted, and we went back into the past. How many of those were ours? And we could plot them up and see how well we were doing.

The other was an integrated one, which was, we picked a very popular textbook on the science beyond the Earth, planetary science and astrophysics and everything. And how many pages in that textbook were the result of NASA discoveries? Of course, it takes a while for the different editions of this book to come out, a couple of years, so it integrated over the years of the program. So we would look at each edition and count the number of pages relative to the whole volume, which were describing discoveries and science done by NASA, and we plotted that. And you could see the increasing number.

You could see, for example, when Voyager flew past Saturn, you could see this big jump

in the number of discoveries. You could see individual events. When Hubble [Space Telescope] came along, you could see the big jump in a number of discoveries that came from NASA. And then how they got integrated into the book. We kept getting an increasing fraction of the book until when I left, I think we had more than half the book.

So those were the metrics that we used to demonstrate past performance. The hardest part was being able to tell OMB what we are going to discover with this mission in two or three years. That was hard. We could not do that. So we could only state what goals we had that when a mission was done, did we meet those goals or did we not? That was the only way we could do that, and that's always going to be a problem in science.

WRIGHT: While you were there, you were also establishing a task group for science data management so that it could be reviewed and managed.

HUNTRESS: I don't know much about that.

WRIGHT: Okay. So much of your work involved so many people, scientifically, engineering-wise. Can you talk to us about the different types of networks of partnerships between NASA and the community?

HUNTRESS: Yes, absolutely, because none of this would get done without those people. People are what make it happen, not institutions, and so it was really important to have a good staff. I had to have a really good, close-knit staff, since we were downsizing the whole time I was there as AA. I went from 144 to 68 people, and that was hard. And to maintain a good crew of people—and I had a great crew of people. I couldn't ask for a better—and maybe I'm bragging here a little bit, but if you were a person at Headquarters, the place you wanted to work was Code S [Office of Space Science]. We were doing fun stuff.

You had to have the science community on board. You had to have OMB on board. You

had to have the public on board, Congress. So you had to network with all of these communities. Even in the science community, there were four competing communities. There was the planetary guys, the astrophysicists, and the space physicists, and then later the biologists. So you had these competing communities that you had to more or less try to satisfy. That was the biggest challenge, I think, of the job, was to keep those communities on board with what you were doing, because funding is so fragile that any dissension generally ruins the whole thing. So that was the big challenge.

I had an advisory group, and the way I treated my advisory group—a bunch of the scientists representing all these communities—was I really took their advice. I tried to make them feel like that they were instrumental in helping me to make the decisions that I had to make. They weren't just a sounding board. They weren't just a means of communicating what I'm doing to the science community. I put my tough problems in front of them and asked them to help me with them. I felt like they were part of the process, and I didn't fear that. Lots of AAs would've feared that. "That's taking my control away." But I didn't fear it at all, because that's the way I'm going to get buy in. That's the way that I'm going to get Congress to approve things.

Then you had the National Academy [of Science]. You had them to keep them involved. I used them positively. This was the group that was going to say, "The science you're proposing to do is topnotch." That's the positive thing. So that was a challenge, but it was fun. You come across a lot of people, and you engage a lot of people, and you talk to a lot of people, and that's how you get the best program, by just listening to those folks, because it all integrates. It all gets integrated ultimately into your future planning.

WRIGHT: How about the international community? How were you able to involve them and keep them participating as well?

HUNTRESS: I got my potty training in that with Cassini, because that was an international joint

project. By that I mean NASA and ESA [European Space Agency] were both in the critical path, and that wasn't something NASA or JPL were really used to. Neither wanted to be at the mercy of some other international partner. [If] that partner failed the mission failed.

So I got my potty training and all of that, and I felt, and still feel, that there are some things that just you have to have. You're not going to get anywhere if you don't do that. We're not going to send humans to the Moon or Mars or anywhere if it's not going to be international. Ain't going to happen. And we're not going to be able to send comprehensive, expensive missions, even robotic, anywhere, unless they're international and people bring their best to bear on them, because it's too expensive.

Hubble was international, too. I'm not sure people know that. But ESA was a junior partner in that one. It was not quite like Cassini. ESA was a junior partner. They were supplying the solar panels. That's pretty important. So I really valued it. I tried to promote it. I tried to promote cooperation with the Russians when they became Russia, because they have a lot of experience and a lot to bring to the table, and I worked hard on doing that. I tried to promote joint missions, one I called "Fire and Ice." "Why don't y'all come aboard and we'll do the solar program. We'll do the Pluto mission together," or, "We'll do some Mars missions together." And it never worked because the Russians never had the money. They just couldn't bring what they could otherwise have brought to the table. They had no money, and I wasn't going to send them any. I didn't have that kind of money, and I needed to send it to our U.S. folks. I wasn't going to send them money. So that never really worked, unfortunately.

But the Europeans, I thought we had a good relationship. I had a good counterpart in ESA, Roger Bonnet, and I worked with them very well, and we got along very well, and Cassini was our star project. We both considered that as our highest priority, make that work. And so far, so good on that. Both Roger and I are gone. I have the impression that relationships have kind of deteriorated a bit, in fact, that international cooperation is not as robust as it was. I think that's unfortunate. But I think to do really very ambitious projects, we're going to need partners, real partners, and not on the model of the Space Station, which is where the U.S. tries to be the

principal partner. All the rest of them are junior partners, and just bring your stuff. My impression is that isn't working very well. So you have to treat them as equals and deal with them that way.

WRIGHT: You mentioned the Hubble Space Telescope Program, and that was part of your Origins Program that you instituted. Could you talk to us about that, about the Hubble, because there was a situation that you had to deal with, with the Hubble.

HUNTRESS: Yes, that's right. In fact, I inherited the first repair mission. Len Fisk did most of the work before he left, but the mission itself occurred under my watch. The first two things that happened to me my first year were the Hubble repair mission, which was successful, and the Mars Observer failure in August of [19]'93. Those were my first year, so I cut my teeth on both of those.

Origins grew in an interesting way. In the process of trying to construct a long-term strategic plan for the Office of Space Science, we tried to develop themes for going into the future, and trying to marry the various scientific elements of the Office of Space Science together in some thematic ways that would make sense. Origins, we had been discussing internally as a way to do that, because it brought in the astronomy, the astrophysics, the origin of the galaxies, origins of stars. And then it brought in the planetary program, origins of planets around stars, origin of life. That seemed to be a theme that could be wrapping things up, and we were thinking about that in our strategic planning process when all hell broke loose with ALH 84001 [Allan Hills meteorite].

That created such an interest in the Administration. Whether right or wrong, it created such an interest in the Administration about pursuing the search for life elsewhere in the solar system and beyond, that OMB asked me right after that happened, "Wes, can you give us a plan that would address the idea of looking for life elsewhere in the universe?"

I had it. "Yes, here it is, right there."

You know, it was an integrated program of looking for life on Mars with a set of missions that were already called Mars Surveyor, and it had the idea of going to Europa, because by that time the idea of a subsurface ocean had come out of the Galileo mission. It had in it the idea of looking for planets around other stars, because we had been going through a whole bunch of studies. Ever since 1990, that was one of my ambitions, remember, when I took [over] the planetary division. We had a bunch of studies on what kind of technologies, astronomical technologies were going to be [needed for] that. I had made an investment in the Keck telescope to try to develop optical interferometry as a means to do that in space, and test it on the ground in the Keck telescope.

So we had [an] idea of the space missions, space interferometers, that could detect planets and other stars. We'd been working on the idea of bringing biology back into the program as well. So I just wrapped all this up in a package and shipped it to OMB, and they loved it. We were in the midst of a budget process that August—must have been [19]'96. I can't quite remember. And OMB really liked it. There were internal battles, as there always are, in the budget process of how much money was going to get devoted to a new program like this. OMB wanted to give me a lot of money, and the Agency was not happy with that, because they wanted the money for Space Station. So there was a battle, a very nasty battle that year, and the result of it was that we got an Origins Program proposed, but not quite as robust as OMB was willing to give us.

But we got the program going, and again it was just a matter of having most of what was needed at the right time, and we were thinking ahead. So when the opportunity came along—kaboom!—we're ready. I think that's what characterized my tenure there, was thinking ahead, always thinking in the future, and having the future in mind and where we were going. So when the opportunities came along, we were ready.

I guess that was the same year we did the Vice President's study. The National Academy, which always does these studies for NASA, usually takes a long time, months or years to put together a scientific report for NASA. This time they did it in six weeks, because the Vice

President wanted a symposium on this. Boy, they really put it together quickly. We did this on December 11th, I think it was, 1996 or '95 or something like that. I can't remember the dates. I never did well in history.

Anyway, and he was supposed to be there for an hour. He was there for more than two, listening to this group talk about this Origins Program. That's what really sold it.

WRIGHT: During this time that you were developing and thinking ahead, what was driving the NASA Agency was Dan Goldin's "faster, better, cheaper" initiative. Was that a major factor when you began thinking ahead? Did you have to plot that in, or was that something that you naturally did?

HUNTRESS: No, it was already there. I mean, in 1991, I had put together a strategic plan for Len Fisk, and the strategic items in that plan, one of them was to have more data coming back from the solar system on a continual basis, using less expensive, more rapidly developed and flown missions. So when Dan came in with that notion of lower-cost missions, we were just ready for it. I mean, it was there, tailor-made. "Here it is, Dan."

I can't think of the question you asked.

WRIGHT: Many times when a directive comes down from the Administrator, that becomes the key factor in developing.

HUNTRESS: I think the directive actually, and the "better, faster, cheaper" came after Discovery, because in the Administrator's mind, he had this idea of lower-cost missions, but then he's handed this program of lower-cost planetary missions, and I made him aware of the Explorer Program, and I revamped the Explorer Program at the time towards the Discovery model. It was not run in the Discovery way. And so we revamped the Explorer missions and the astrophysics missions, so they were run exactly the way we'd run Discovery. So in the Administrator's mind,

"Okay. We've got this. How do I describe it?" This is better, and it's faster than missions coming out, and it's cheaper.

So that was his invention, the term. And they were certainly faster because they were developed and flown on a shorter period of time. They were certainly cheaper. The argument was always "better." Are they really better? I think they were better for the program, because we had more data coming back all the time. They weren't as comprehensive scientifically. Some would say that's not better. I would argue with that, because they had very specific objectives.

So I think the argument will always be "better." In fact, we pushed it too far. And that was with the enthusiasm of Lockheed Martin [Corporation], who gave us a very good bid for those two Mars missions. But in fact, in practice we found the limits at that time to how far we could push that philosophy. We found the limits by experiment, which is unfortunate. The reason it's unfortunate is that because it caused that internal battle inside of JPL, which was working these Discovery-class faster, better, cheaper missions, versus the older style who hated that. So what happended was, the older guys won, and the institution reverted back to what it used to be, instead of adopting this new way of doing business. And so its costs skyrocketed after that. I mean, its missions are incredibly expensive now. I think that's unfortunate.

I forget where I was going.

WRIGHT: One of the things that Dan Goldin had mentioned about how you did your work is that you were able to assemble great teams at these field centers and at Headquarters.

HUNTRESS: Yes.

WRIGHT: When you were looking to assemble your teams, what were the criteria that you were looking for in these individual members?

HUNTRESS: Success. I looked for people who had had a trail of success. JPL is an incredible institution. I mean, it's a brilliant place, and they're able to do things that you wouldn't think possible. I discovered the same thing at APL, in a different way, just a totally different way of doing business, but they were also very good. So it's a matter of finding institutions that were good and finding individuals that were good, folks who had a passion for what they were doing, folks who had a record of accomplishment in what they were doing, and folks who wanted responsibility and had the passion to carry it out. That's what you look for. Those are the folks who stayed behind when we did the downsizing, and those are the folks out there at the implementing institutions, Goddard, APL, JPL—remained behind. We wanted to enjoy what we were doing and find folks who just enjoy what they're doing and have that passion and ability, just find those.

WRIGHT: In 1998, you departed from NASA, saying that after serving in that position for more than five years, it was "simply time to move on." What led you to that decision? How did you know it was the right time to move on?

HUNTRESS: I'll tell you a story. I knew when I left JPL and went to Headquarters, that that was a high-pressure environment. Not that what I was doing at JPL wasn't high pressure, but it was high pressure in a much different way, because you had the Congress to deal with, you had the Administration to deal with. It was highly politically charged.

When Dan Goldin came on board, it became clear immediately that he was going to be a challenge to work for. I had had some experience with people like Dan. I mean, Dan is a certain personality, and I'd had experience with somebody like him before, which has stood me in good stead, because I didn't make the initial mistakes a lot of the other people at NASA Headquarters made with him. I knew not to make them. And I got along well with Dan. I developed my own means to deal with him. Dan's a very intimidating person, and the way in which he works with his direct reports is to intimidate them, put the fear of God in them. Well, I never let him know I

was scared, ever. Never let him know I was off balance. So that kept him off balance. So that's the way you deal with him. I love Dan, and he is a great visionary, but he's difficult to deal with.

So I knew that this was going to be hard. You have a hard Administrator to deal with. You've got an Administration that doesn't give a damn about space exploration, and you've got a tough Congress, especially the new Republican Congress that just wanted to slash and burn. That was a tough situation.

The OSS budget was declining like crazy, and I considered it my job to reverse that. At the beginning of Dan's tenure, OSS and the robotic space program was at the bottom of his priority list. He gave us a list of priorities. Space Science was at the bottom. I said, "Man, we're in big trouble. So this is going to be hard."

So each year I would get a physical. I decided I would make it six months. Every six months, I'm going to get a physical. Get my blood pressure checked. I'm going to get an EKG [electrocardiogram]. I'm going to do all those things, blood test, because this could be physically tough. And I'm going to ask my family to watch me mentally. I asked my wife, my kid, I said, "Son, you watch Daddy. If he starts to act weird, just let him know." Because I knew I would never pick up on it.

But I thrived in this environment. I really enjoyed this stuff and really liked doing it, but I knew that it's something that you just can't do forever, that there's just physical and mental limits to doing a job like this.

So finally, I remember it was August of [19]'97. August is the worst month in the year. That's when you're battling within the Agency to put together the budget for the following year, for the President's proposal, and it's horrible because Space Science always was cut by hundreds of millions of bucks, and I had to fight my way back because we were low priority in the Agency. Space Station was always taking all the money, and we had to fight to retain our money.

It was August '97, and I was doing fine physically. Man, my heart was fine. My EKGs, the doctor says, "Hey, you're doing great. No problems." My blood pressure was always very

good. Never had any problem with my blood pressure, my heart, or anything like that. Physically, I was doing fine. But I guess mentally I wasn't. I came home during a budget battle one night, and I sat at the dinner table, and I was eating my dinner, and my son pokes me. He says, "Dad, who are you talking to?"

I said, "I'm talking to you."

"No, you're not." He says, "And you know what you're doing?" He said, "You're leaning over your plate. You're looking down at your plate of spaghetti, and you're talking to your plate."

What I was doing was, I was figuring out what I was going to say at the budget battle the next day. Okay. That's it. That's when I knew. I'm done. Time to go. And my wife said, "You know, you've been really kind of in your own world the last six months or so." Okay. It's time.

So I went out and tried to get other folks interested in taking my job, and I found somebody who was willing to do it. As soon as I did that, then I went to Dan, because I wanted to make sure that there was somebody who was willing to follow me, [in whom] I had a lot of confidence and felt good about.

So it was a January day. I went to see Dan. I said, "Dan, it's time for me to leave."

He says, "Why?" [loudly] He looked up, and he has this inimitable way of doing things.

I said, "Because it's time."

And he said, "Oh," and he never asked me another question. I think he knew. He must have known, because it was time. It was time. I had to get out of the situation.

But I felt good about it because I had turned the funding situation around. We had the Origins Program. The funding was on the rise. We'd established the Astrobiology Program. We had the Discovery line of missions. We had the Mars Surveyor line of missions. At the time we had an Outer Planets line, which had a concept study in it for Europa. We had a New Technology line going, and the program just looked terrific. So I felt good about what I had managed to accomplish. And six years was a long time as an AA. In fact, it was a record at the

time. That's all. It was time.

WRIGHT: I'm going to stop the tape for a minute, and we'll come back and talk about how you made your transition to your current job.

HUNTRESS: Sure. Okay.

WRIGHT: Before we move into your transition phase to your current duties, I was going to ask if you would expound some on your Mars missions, primarily the Pathfinder. Any other of those aspects that you would like to talk to us about in detail?

HUNTRESS: What's amazing is what came out of the Mars Observer failure in [19]'93. That didn't become the end of the Mars program; it actually became the beginning, because what came out of it was the Mars Surveyor Program, which is a program of a number of missions. So when we lost a single large Mars mission, what we got out of that was an indeterminate program of smaller missions launched at every opportunity. And that was the result of Dan and I trying to figure out what we were going to do after the loss of Mars Observer. Discovery was already on its way. That bird was already on its way.

So the discussion with Dan and I was, how are we going to recover from this? How can we distribute risk in addressing Mars in such a way that we don't lose all of our marbles all at once, like we did with Mars Observer? Of course, the model for that was the Discovery Program. The idea was, if we're really going to be serious about Mars being a planet most among equals in the program, and address the public's excitement about Mars, the best way to do that is with a continuing program of Mars exploration, a line of missions, not a single mission. Distribute our risk, fly at every opportunity, a smaller mission at every opportunity, recover the lost Mars Observer science by taking those instruments and spreading them out over a number of orbiters flown over a number of opportunities, and so if we lost one, we still had another one going. In fact, we came down to launching two per opportunity; the extent that we could. One

orbiter, one lander. And that was the beginning of Mars Surveyor Program.

The Administration liked it, the Congress liked it, and that's how we got the first set of Mars missions, beginning with Mars Global Surveyor, [and] that orbiter is still operating. It just happened at the same time that we were going to launch the first of the Discovery missions, Mars Pathfinder. So that would start the series, and every twenty-six months thereafter, every time Mars came around, we would launch two more missions to Mars. And that's how the program got started.

Mars Pathfinder was kind of my baby. If I had to pick a mission I was most associated with, other than the Cassini mission, it would have to be Pathfinder, because the concept for doing that was worked out by myself, and the idea of putting the [Mars Exploration] Rover on it was one of my ideas. And convincing the Office of Technology to pay for that Rover was something I had to do.

I really associated strongly with the team at JPL that put that mission together. This was my test for how small missions were going to work, and the test was [to] leave them alone. Give them the money, give them the responsibility, give them the money when they needed it, as they had proposed to receive it, and believe in their plan, give them the responsibility, and stay out of their hair. Don't impose review after review after review. That costs money. It diverts them from what they need to do. They can determine what they need to do and what kind of external reviews they needed to have, not me. And boy, did that work. That really worked. It was a success.

So I really identify with that mission. Of course, now we have a robust Mars program, and it's going to do lots of exciting things, and one of these days they'll find some bugs living under the ground there, some water below the permafrost somewhere, I think, anyway. It's going to be publicly exciting.

WRIGHT: On a personal note, tell us about where you were and what you were doing July 4th, [1997], when you saw your project come alive.

HUNTRESS: I was in [Theodore] von Kármán Auditorium [JPL, Pasadena, California], and Dan was there also, but he wanted me front and center. He said, "Wes, you go to the front of that auditorium, and you'll be right there under the lights. This is your baby. So be front and center."

So I was on the front row with all the reporters and the klieg lights on me and all that kind of stuff as we were watching it all happen. Of course, you get these little reports. "We've entered the atmosphere." Another report, "The parachutes opened." Another report, "The rockets have fired." Another report, "We see the first bounce." All this kind of stuff. It was a thrill, absolute thrill.

Finally somebody said, "Full stop," and I just screamed. I jumped up and screamed. There's a picture of me somewhere. In fact, my old friends from the East Coast sent me a copy of the *Boston* G*lobe*. There I was in this embarrassing picture just standing up screaming when this thing landed successfully.

Then I ran up to the building where the team was, and it was pretty emotional. A lot of tears. Of course, this young crew that the JPL had assembled, I remember one of them turning to me and saying, "Thanks for giving us the responsibility to do this." Broke me up. So all those folks are off doing good things, and it makes me feel good about it.

WRIGHT: You mentioned about a Mars rock.

HUNTRESS: Oh, the Mars rock. Yes. I guess it was maybe six or eight months before that story broke. One of my staff members came up to me in my office and said, "Wes, we've got this article submitted to *Science* magazine, and it says they found evidence for life on Mars, on one of the Mars meteorites."

I said, "Yeah, okay. We'll see."

He said, "What should we do about this?"

I said, "Has it been accepted for publication?"

He said, "No. It's in review."

"Don't bother me. That probably won't survive review. Come back when it survives review."

Then six months went by. Forgot about it. The guy comes back up, and he says, "Remember the article I told you about? It's scheduled for release on August 7th."

I said, "You mean it passed review?"

He says, "Yeah, it's passed review. It's scheduled for the August 7th magazine, and this is going to hit the fan. This is big news: Evidence for life on Mars from this Mars meteorite."

So I was flabbergasted. I'd written it off. "So can you get me a copy of it?" *Science* is very, very secretive about stuff. I said, "Give me a copy." I got a copy of it, and I ran up to see Dan. Dan went nuts. I mean, we were both excited. It was clearly circumstantial evidence, but the paper made a good case. So we knew this was going to be big news, and it was probably something the Administration couldn't ignore either.

So Dan says, "We've got to go over and see Leon Panetta [White House Chief of Staff, 1994-1996]. I've got to go see him, because this is something that's going to go right to the White House."

So we went over to see Leon Panetta, and we went into his office, Dan explained what this is all about, and Leon was really intrigued. He said, "This is exciting stuff." He says, "We've got to let the President know."

Dan brought something else up. He says, "You know, this is scheduled for release on the same day that the Republicans will be announcing their candidate at their convention, and it could push that off the front page. If you make comments, this Administration could be accused of trying to undermine the Republican Convention," and all this stuff.

Leon said, "Nonsense." He said, "This is important news the public needs to know."

And then the other question was, "The other question is, we have to keep this quiet because *Science* magazine has this policy."

He says, "That's fine. *Science* comes first. Follow the *Science* policy first," which surprised me. So then he says, "Wait outside my office for a few minutes, and we'll get back to this."

I wait outside his office, and he comes back in fifteen minutes. "Follow me."

Down the hall into the Oval Office, and there's the President [William Jefferson Clinton]. Obviously, he'd just gotten up. He was wiping his eye. Big man, anybody that knows him, impressive man. Big. He says, "What's all this news about Mars?"

We sat down in the Oval Office, and Dan described it to him. I had brought a picture of a Mars meteorite along in a magazine. He kept getting more and more interested in all of this. He said, "We've got to do something about this, but I think before we do, I want you to go see the Vice President, Al [Albert Arnold Gore, Jr.]. He knows about science."

He asked me for the magazine. I had a picture of the Mars rock. "Can I read that?" I'm going to tell him no? So I left it with him.

I went to see the Vice President. I spent about forty-five minutes in there, and he grilled us. Grilled us. All kinds of technical science questions. We answered them. He said, "Boy, this is really fascinating, Dan. We'll get together with you on how we're going to handle the release," and we left.

Of course, I think you know the story. The story was leaked through one of the staff members of the White House and his mistress, telling stories in bed, and she leaked it to get some money. So we had to call *Science*, the magazine, and say, "The story's out there; and we've got to have a press conference now."

So we had the press conference, and I think that press conference is a good example of the way the science process really works. What we do our best to say [is], "Here's the case these people have made for life on Mars, and this is a set of circumstantial evidence, and it's not proven, and here is someone to tell you what needs to be done in order to prove or disprove this. I'm going to show you both sides."

We showed them both sides. We showed that this is a process. It's like a trial. The jury

hasn't been given all the data yet. Here's some evidence. These folks have some evidence. We have to examine the evidence and try to present it that way. "This is not life on Mars. This is a case that someone has brought." I think we did that press conference very well. In fact, the case hasn't been brought. A case for the probability of life on Mars has been brought, but there is no case for life on Mars yet, after a critical examination of that evidence over the past five or six years. But still, that event marked an important point, a turning point in the history of the program. It enabled the Origins Program. It made more credible the possibility of life on Mars and elsewhere in the solar system, and I think brought the public back into the interest sphere of the whole NASA program. It was a turning point. Evidence for life on Mars or not, it was a turning point in the fortunes for planetary exploration and astrophysics, observations of planets around other stars and such.

WRIGHT: That event brought you in personal contact with the President and the Vice President. There had been other times that you had been in contact with Congress because you had been called to testify or you've been called to rationalize your budget. Could you share with us what that was like and how well those went?

HUNTRESS: Oh yes. I think that Congress was very sympathetic with Space Science, because I testified a lot and presented the program, especially during budget hearings, a lot. I always was careful to bring along examples of what we had done, visuals, if we could. I brought a piece of the Mars rock once. Pieces of hardware like rovers and things like that to show them what it is that we were doing, demonstrate for them what their money was buying and why they should invest in us. It was easy for Space Science. To bring a Hubble picture and show them the fascination [of what] was going on out there. And they're all fascinated. They may not have much knowledge about it, but they're all fascinated with it.

So I always got a sympathetic ear in Congress, and I always had a lot of support in Congress for Space Science. The issues were always more or less with the human side of the

program. So I always enjoyed being on the witness side of that table. It was fine, because I knew we had the bullets, so I never had any problem. I enjoyed it.

WRIGHT: How do you feel that your legacy is viewed by the academic and the scientific community?

HUNTRESS: I think positively, because one of the things in my tenure was to turn the whole enterprise around. We were headed for trouble. I mean, we were headed in the hole, and I turned the whole funding situation around, and I think turned around the way in which business was done. Instead of the occasional large mission, there's missions flying all the time, and there's interesting stuff coming back all the time. There's innovation in the program. There's more participation by the science community in the program, and there's more public participation. There needs to be more of that, because I only was able to just initiate that, but there needs to be more public participation. That's why I'm president of the Planetary Society, because I want to see more of that public participation in the program. It'll only make it stronger.

I think a lot of the science that came out of the program was terrific. I mean, Hubble was just fabulous. So I think, generally, my term as AA is viewed positively. I hope it is. I'm proud of it.

WRIGHT: One of the programs that we haven't talked much about is the New Millennium [Program].

HUNTRESS: Oh yes. Yes, yes. In talking with Dan about the vision for where Space Science was going to go, and what astrophysics could do, what astrophysical observatories could do; what sort of a planetary program we could have, Dan had this idea of sending thousands of spacecraft out there, just having a beehive of spacecraft out there somehow. But it was always

limited by technology. The Office of Space Science always had to rely on technology development either in its big programs, like Cassini, which would spend money to develop the technologies it needed, because it didn't have them, and that's why they're expensive, or from the Office of Technology, which was a separate office and had its own decision-making process, and not always in the best interest of space sciences as viewed from Space Science. If we were going to implement better, faster, cheaper; if these smaller spacecraft were really going to be highly functional and do good science; we needed new technology.

We were using old technology already, because it was proven and it was safe and it was comfortable. It was expensive, and it was big. We were in the PC [personal computer] era, and we were still flying tape recorders, things like that, which were ten, twenty years old. So to make these smaller spacecraft do the same job as the bigger ones for less money, we needed technology. And project managers were reluctant to fly new technology because it was risky.

So Dan and I figured the way to do this is [to] have a flight program, which is dedicated to flying and testing technology, so the program managers would use it in the science missions. We both got on his plane and we flew out to JPL, and we talked with [Dr. Edward C.] Ed Stone and some of the folks at JPL. I remember having dinner with myself and Dan and Ed Stone, and we just invented New Millennium. Dan and I flew back and put it in the budget. The rationale was straightforward and quite simple. DS-1 [Deep Space 1] was one of the first of the New Millennium missions, and it was a great idea. I'm disappointed it didn't continue.

What it did was, it brought the technology into the Office of Space Science, because Dan transferred the technology programs into Space Science so the customer for the technology was in charge, so that the customer could be assured that the technology that he needed—the customer being space science—was being developed and being developed for the future that customer envisioned for himself, rather than some other office. And that worked. That was beginning to work. I think, unfortunately, the technology was transferred back out again. New Millennium disappeared, and I think that's a mistake, because now a customer for that technology's no longer in charge of his own future, but I think Dan had it right in the beginning

So that was the origin of the New Millennium's Program, and I still think it was a pretty good idea.

WRIGHT: You did choose to leave in 1998, and you became Director of the Geophysical Laboratory for the Carnegie Institute of Washington, D.C. Tell us about your current position and what you hope to accomplish here.

HUNTRESS: I'm lucky. Knock on wood. I knew hardly anything about the Carnegie Institution of Washington before I left. When I told Dan I was leaving, I didn't have a job. I told him, "I want to leave by the fall, and I want to spend the next six months looking for a job."

He said, "Fine." Dan wasn't anxious to get rid of me. I handed up some names for candidates, and he could spend the time deciding who he wanted to follow me.

One of the jobs that I was looking at was as director of the new Astrobiology Institute out at Ames [Research Center, Moffett Field, California]. Ultimately, it turned out that was not practical, because, (*a*), I had funded it, and as the NASA official responsible for that, I couldn't go work in it unless I stayed a civil employee. I didn't want to do that; I wanted to leave the civil service.

I got a phone call in the spring from a woman who I only knew by reputation and by reading some of her Op Eds [Opinion Editorials] in the *Washington Post*, [Dr.] Maxine [Frank] Singer. She introduced herself, and she said that she was President of the Carnegie Institution, and she was looking for a director for one of their departments, Geophysical Lab, right in D.C., and she wanted to know if I'd be interested in talking to her about it.

I said, "Sure. Fine." Why not? Because it's right in D.C.

So I went to visit her at her home, and she described what the Geophysical Laboratory did. I first told her, "I don't think I'm a good scientific match for this. I'm an astrochemist, and this is really petrology."

She says, "Well, I think you might be."

She brought me up here to visit the campus. I thought the campus was very nice.

She says, "You talk to the scientists here." So I came up here for another visit, visited the scientists, and was fascinated with what they were doing, and it was clear that they were involved in trying to understand the Earth and its chemistry and geochemistry. There was a lot of very fundamental new and exciting work going on in high-pressure chemistry and physics here, and they had a fledgling group working in biochemistry. I guess you'd call it geobiology, really, and they had submitted a proposal to the Astrobiology Institute. The chemistry they were doing was something that I was interested in way back when I did my thesis at Stanford, which is prebiotic chemistry, and how do you go from chemistry to biology, and how do you make that transition.

So I was fascinated, so I applied for the job. They gave me the job, and I'm delighted. I'm an agent of change. Throughout my entire history at JPL, at NASA Headquarters, and now here, I'm an agent of change. What I'm doing with a department that's almost 100 years old, is taking it into a new area of geobiology, which is related to astrobiology, or the same thing. So I have the ability here to make a change in the future of scientific direction of this place. It's a wonderful place. It's too bad there's not more like it. It's a private institution devoted to fundamental research and science. There used to be more of them in this country, and it's unfortunate they're gone. Most of them were funded by corporations who decided the bottom line and the near term was more important than the long term. Big mistake.

But nonetheless, from the very top, the whole philosophy is that this institute supports individual scientists to do what science they want to do. So the most important asset of the institution is the scientist. So my job is to enable my science staff to do what they want to do, not what the federal government grant system will give them money to do. They don't need it. Their needs are all taken care of. We only get federal grants for more postdocs or for big pieces of equipment or something like that, or matching grants.

So our scientists here are encouraged to take high-risk, high-payoff science, because there's no real punishment for failure. They don't lose their grant, because they don't need them.

And my job is to enable them to do the best possible science, world-class science. It's real simple. So I'm enjoying it. Very happy to be here.

WRIGHT: You're also a board member of SpaceDev [Inc.].

HUNTRESS: Yes, I'm on the board of SpaceDev.

WRIGHT: Could you tell us about that responsibility in that company?

HUNTRESS: What a board normally does is to assist the president in running the place, but the reason I decided to become a board member with SpaceDev is because I like what they envision for the future. They want to be involved in the commercial development of space, but they want to be involved in a way that was different than other folks that I come across.

While I was at NASA, I had lots of folks come through the door and say, "We want to be involved in the commercial development of space. We want to send the first lunar mission, commercial lunar mission. All we need from you is to front us 85 percent of the money." That's not commercial; that's doing government business.

This guy, [James] Jim Benson, came in the door one day, and he said, "I want to do the first commercial planetary mission," and it was a particular mission near an asteroid. He said, "I don't want your money." He says, "I just want your assistance in finding my way through the NASA system to get support where I need it. I don't want you to front me the money."

Okay. Now you're talking real commercial, so I liked the idea. What he wanted to do is to take [the] Discovery [Program] another step in a sense. He wanted to build spacecraft that were very small, that would run on a standard operating system, and on low-cost, low-power parts that would have capabilities consistent with the most advanced of PCs today, that could be launched on small vehicles, that could be operated through the Internet. All the data comes back through the Internet. He had the right vision, and I liked that vision, a personal spacecraft. You

could even sell a personal spacecraft. You get a PC, you can have a personal spacecraft. That was the vision. I liked that vision. We're a long way from it, but getting close. So that's why I enjoy being on that Board, because that's where they'd like to go.

WRIGHT: Do you foresee anytime in the future that you will be mixing your current activities or future activities in working with NASA again?

HUNTRESS: I continue to do that, actually. Indirectly, sometimes. There was just a National Research Council activity to develop a decadal study for the next ten years of planetary exploration. I was on that committee. That was something commissioned by NASA.

I'm always ready to help out whenever they would like to use me, and I keep in contact with the folks down at NASA Headquarters all the time. I was three years on the governing committee of the Division of Planetary Sciences, so I've been in contact with NASA Headquarters in that capacity all the time and with the Planetary Society.

So I'm happy to be outside the walls of 300 E Street. I miss the program, but I can still stay involved. So that's the best of all possible worlds, I guess.

WRIGHT: Yes, it sounds it. Before we close today, is there anything else that you'd like to add?

HUNTRESS: No, I don't think so, but it's been fun talking about it all.

WRIGHT: I thank you. It's been fun listening to it all.

[End of interview]