

NASA AT 50 ORAL HISTORY PROJECT

ORAL HISTORY TRANSCRIPT

CHARLES ELACHI
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is April 23rd, 2007. We are at JPL, the Jet Propulsion Laboratory in Pasadena, California, to speak with Center Director Dr. Charles Elachi for the NASA at 50 Oral History Project. The interviewer is Rebecca Wright, assisted by Jennifer Ross-Nazzal. In preparation for the space agency's fiftieth anniversary, the NASA Headquarters History Office commissioned this oral history project to gather 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 can be accessed for future projects.

Are there any questions or anything I can offer before we begin?

ELACHI: No. We can get moving.

WRIGHT: Well, thank you again for providing this time. We'd like to begin by asking you to briefly describe your background and tell us how you came to your current position.

ELACHI: Okay. I've been at NASA now—well, at JPL—for thirty-seven years. I started as a part-time academic. I was a student at Caltech [California Institute of Technology, Pasadena, California] working on my Ph.D. Even before I came to Caltech I heard a lot about NASA. I mean, I grew up in the Middle East, went to undergraduate school in France, and I heard a lot about NASA and JPL. That's in the sixties and the early seventies. So when I came to Caltech

and found out that JPL is connected with Caltech and NASA, I applied to work in the summer my first summer here. Then I liked it so much that I worked part-time academic, and then I liked it so much that when I got my Ph.D., I continued working at JPL supposedly for a year, then for two more years, and thirty-seven years later I'm still here. [Laughs]

WRIGHT: You worked on a variety of projects.

ELACHI: Yes, when I first came to JPL, because my interest was mostly in microwave and radar instruments and so on. My first job at JPL was to work on what became later a Magellan mission, which is to image Venus using synthetic aperture radar. In the meantime, because that took about ten, fifteen years to get approved and then flying, ~~then~~ I got involved in the Seasat mission, which was launched in 1978, and that was the first Earth-orbiting satellite that JPL developed, or managed, and that had a series of microwave instruments, including an imaging radar, so that's why I got involved in that.

Then what was a major thing for me was when the Shuttle started flying—that was in the late seventies, early eighties—I was the PI [principal investigator] on the first instrument which flew on the Shuttle, and that was on the second Shuttle flight, on STS-2. That was the Shuttle Imaging Radar [SIR]-A, and that was the first time we actually used a civilian **space** radar to do a certain kind of geologic mapping and so on. Then that led to a series of missions of SIR-B, SIR-C, SRTM [Shuttle Radar Topography Mission] for Shuttle radar, terrain mapping, and so on.

So it led to my personal research, other than being the management responsibility, was doing through the series of imaging radars on the Shuttle, and then there was the radar on Magellan and then the radar on Cassini, which was selected fifteen, twenty years ago, but now

today we are getting the data from it fifteen, twenty years later. So that's kind of my background on the technical side.

But then through that as I was doing my technical research, also I got more responsibility in the management, first ~~having heading~~ the Science Division at JPL, then becoming a member of the Executive Council, overseeing all the instruments at JPL, and then after that leading to becoming the Director of JPL in 2001.

WRIGHT: Tell us how NASA has changed over that time in general, and then again for your level.

ELACHI: There are changes both on the positive and let's say not as positive side. On the positive side—again, I'm giving a perspective mostly from robotic mission, because that's where most of my personal experience.

On the positive side, if we look on how many scientific missions are flying today, it far exceeds what was flying fifteen or twenty or thirty years ago, and that has enriched a lot how we do science from space. I remember in, I would say, the seventies and the eighties, we used to be lucky if we have one or two mission flying at a certain time, particularly planetary or astrophysics mission. Now ~~we have probably like thirty or forty or~~ NASA has more than fifty missions which are flying.

So, in a sense, using space exploration, NASA made it become more as one of major tool for scientists to do their investigation, versus being a curiosity. Now it's becoming really part of the fabric in our country of doing exploration in science ~~is with~~ the kind of mission that NASA has developed. So that's a major plus that I think have really changed how we do space science

be it in astronomy or be it in planetary science or Earth observation. Now it's ~~routine~~ common that we're on *weather.com* and get the picture about the weather. That was not that common ten, fifteen years ago. So, really, I would say our whole way of how we do observation and learn about our planet and other planets have been changed fundamentally by NASA.

On the other side, I've seen NASA going up and down in what I would call bureaucracy, on how quickly you can get an idea approved. So I've seen eras where it was very quick. I remember after SIR-A flew and we got the exciting results, literally in a week we got the next mission approved, which was SIR-B. Well, that's unheard of now. Now we go through a lengthy process and so on.

But you could argue it both ways, that a lengthy process makes sure that we get the best idea, but on the other hand the spontaneousness that I saw before early in the NASA stage is not there now. Now there are attempts of doing changes in that area, to bring more spontaneous ideas and be able to fund them. But that's what I would say a change which is different than it was in my early days in the seventies and early eighties.

WRIGHT: Somewhere in the nineties Dan [Daniel S.] Goldin arrived and announced a faster, better, cheaper way of doing things. How did that affect your work, and how did you see how things changed here with that?

ELACHI: ~~No, clearly,~~ It affected the work in a major way, because up to that age the focus was more on very large mission which take very long period of time. So I think what happened when Dan Goldin came in is to really shake the system and say, "Okay, let's step back and think about

can we do things faster, can we take a little bit more risk and do more frequent missions, and so on.”

Now, a number of people would say, “Well, we did that experiment, and there were a few failures.”

But on the other hand, I would say, a lot of the missions flying now are the legacy of that era, and we see we have significantly more missions flying now. So I think there was a major positive benefit from it. I think people get too much attached to the acronym “faster, better, cheaper.” The way I would look at it is that it was an era where we were asked to look smarter, and people who took it literally of doing things cheap, probably there was a backlash in the sense of we found that many of the missions that we do at NASA are very challenging, and therefore cutting corners to do things cheaper was not a good idea. But on the other hand, trying to do things smarter and therefore really question ourself can we do something in a ~~more~~ different way, was a positive aspect of that era.

So again I think we need to say, yes, that era led to a couple of failures, but also it led to a large number of successes, and these have to be taken in balance. And we have to always remember that what we do at NASA, if we area always successful, then maybe we are not trying hard enough. Every once in a while, when you push the limit, you are pushing a new frontier; you are exploring something new ~~you do get setbacks~~ . Even if you try everything you know how to try or do, every once in a while there would be a failure.

Yes, we have to sit down and look at it and say, “What do we learn from it?” but that shouldn’t be a reflection that the way we are doing it was wrong. I wouldn’t say that that’s the case.

So sometimes people mix that with the “faster, better, cheaper.” The way I look at it, in all stages sooner or later you are going to trip when you are pushing the frontier and so on, so that’s not abnormal, of those things happening. The key thing is to learn from them and keep the boldness of NASA; to stay bold and keep pushing the limit.

WRIGHT: Can we talk a few minutes about your role as Center Director? JPL has such a unique partnership with Caltech. You’re involved, of course, with that aspect of it. Share with us how you manage and you operate to do all these different aspects on the academic side and on the technical side, and now, of course, the day-to-day operations of the things that you have.

ELACHI: Yes, I think that being the Center Director for JPL is the same like any other Center Director. I think the key role of a Center Director is, one, to make sure to translate the vision that NASA has overall, to translate it to what the Center people are doing, because most of the people at the working level they don’t sit down and every day look at what’s happening in the nation. They have a job to do.

So the key thing for the Center Director, the key role of the leadership, is to translate that and make sure that the employees see that there is a vision for them, and how does this individual work fit in that vision; make sure we hire some of the best employees and give them the environment to be successful; and then get out of the way.

A successful Center Director is not the person who will sit down and try to manage every detail micromanage things. I’ll be honest with you. I have no idea how these rovers on Mars work, but I do create an environment for the experts to sit down and work and be successful on

it. So I think our key role of the Center Director is really to create the right environment and lay out the right vision and keep communicating all the time to the employees.

In my mind, a leader is a failed leader if he or she try to do everything themself. They are successful leader if they lay out the vision and when they charge, everybody charges behind them, and they don't have to force them or threaten them ~~or do anything for~~—but **have** people **who** are so inspired **and passionate about what they are doing**. And the goals of NASA are so **exciting that it is** easy to make them inspirational—or relatively easy—so it was relatively easy to do that.

So, really, the role of the Center Director is to translate that inspiration and make sure all the employees are as inspired in doing that, and that they want to work harder; they look forward to coming every day to work, and they don't have to be threatened in any way, form, or shape, by laying them off or firing them or something like this **if they make an honest mistake**; and create that kind of an environment of free thinking within the framework of the rules the experience that we had from past missions.

I think that's the key role that I play here now. The connection with Caltech, as you mentioned, has certain advantages, and certain issues. One thing which I'm very grateful is that NASA really treats JPL like any other NASA Center, even that the employees are Caltech employees, ~~the two~~ **we** are treated like any other NASA Center, except when it comes to some legality. We're still on a contract on this thing.

One advantage we have with the connection with Caltech is the exchange and the intercourse. We do a lot with the university, very distinguished university; getting faculty to be involved in our work; have a lot of interaction, particularly because they are close, interaction with the students. Also it gives us a fair amount of flexibility in the hiring and layoff.

Now, layoff might sound something negative, but the way I look at it more if somebody is not striving at JPL, they are better off for them and for JPL for them to go somewhere else. So having that flexibility, where we are not restricted by the civil service rule, really have played to our advantage. It makes it more flexible for us to reshape the kind of talent that is needed to achieve the job that we are doing now and we are doing in the future.

One thing I think, again going back a little bit to the change I've seen, is that in the early days of NASA we used to do a lot of hands on across the board. Then I think we went through a period where a lot of reliance became on the contractors. And now I think we are trying, in general, we are trying to bring more capability to be in-house capability across all of NASA. Fortunately, [NASA] Goddard [Space Flight Center, Greenbelt, Maryland] and JPL, we kept a lot of in-house capability, but I think at some of the other NASA Centers that had been lost partially, and I think now it's trying to be revived again, and I think that's the right thing for NASA to do.

WRIGHT: You mentioned a few minutes ago about translating NASA's mission and finding ways for your Center to become part of that. Tell us about how your mission and your strategic plan is meeting that, and then if you can, talk about how possibly that it changed from when you first came on board as Center Director in 2001 and maybe how it was impacted by President [George W.] Bush's mandate with the Vision for Space Exploration.

ELACHI: Yes, but at the beginning you were talking about international?

WRIGHT: How you translate the vision, NASA's vision, into what you're doing here.

ELACHI: Oh, what we do at JPL. When we look at the President's vision, it basically lays out a spectrum of things that need to be done, including from getting human beyond Earth's orbit to getting back to the Moon and so on, exploring planets, looking at neighboring solar system. So one thing I see which surprised me, is that the vision was broader than what now people—now people talk only to go to Moon and Mars, but the vision was much broader than that, and the vision was for robotic and human, even though now everybody keep associating it with the human program.

I think the vision is much richer when we capture what President Bush, at least in the words, I guess, intended it, which is a close working relation between human and robots to explore and capitalize on the positive things from both elements, looking at neighboring solar systems and see if there are other Earth-like planets. So when you come to see what a place like JPL is doing, I think a lot of those elements fall in the kind of experience that JPL is bringing to the table.

In the case of robotic mission, we do a lot of those between us and Goddard. In the case of the human, I think they are looking at the future. The human exploration of the future is going to be different than the past, for in the past everything was done by the humans. I think in the future, robots have evolved significantly, and we should look at robot as an extension of the humans. By doing that, I think we'll have a much richer program.

So what JPL will bring to the table is how do we capitalize on that robotic element working with the human element. It could be by doing scouts ahead of the human. How do robots do things which are too risky for the human to do?, or to do things that the human will enable more things for them to do by having robots support them, be it in construction of

permanent stations on the Moon, or being able to explore beyond in a cliff or in a crater or something like this.

So we need to get a little bit away from the mindset that, gee, this is being done by astronauts. Well, it should be done by astronauts with robots going with them. You just have to look at what young people today think. They think very differently than us. When I talk with young people, they say, “Yeah, astronauts are important,” but for them a robot is as much as a human. They are accustomed to capitalize on robots to this.

So we need to get into that mindset that it’s really a teaming effort between the humans and the robots, which will allow us to achieve, I think, what’s the future exploration, and that’s where places like JPL, Goddard, and [NASA] Ames [Research Center, Moffett Field, California] can play a significant role, even if we don’t have astronauts here.

WRIGHT: How are you creating strategically that vision to meet those goals? For instance, how do you feel like your budget will need to expand or shift in order to meet those types of goals?

ELACHI: Yes. No, It’s redirecting, really. Now, clearly, everybody says we’ll need more budget. That’s the traditional thing to do. But the fact of life is we have a limited budget. So the question is how do we use most effectively those budgets to achieve those goals, and by laying out some specific goals and saying, okay, we don’t need to do everything, put priority on some of the goals, capitalizing on the technology that is needed. So it’s a question of how do you expand your funds or the funds that you have. As I said, clearly, you can always use more funds, and you can be more aggressive.

The way it has to be done now is basically to move as fast as you can afford, so make sure you are streamlined so you are using your funds as effectively as possible. Always relook at your processes and the ways you are doing things and always ask the question, “Is every piece contributing to this?” If not, maybe to push it out or delay it. So that’s, in a sense, how you have to make that judgment on a continuous basis.

WRIGHT: Are there programs that you would like to add if you did have a budget increase?

ELACHI: Yes. I mean, there are two nature of programs if there are more budget. One area, which I feel has been kind of put aside for a while, is the technology area. NASA has to stay as a very advanced technology organization. Unfortunately, with all the demands on NASA of phasing out the Shuttle, building the CEV [Crew Exploration Vehicle], keeping the [International Space] Station, and keeping a strong science program, I think that technology has gotten a backseat, and that’s unfortunate.

But we need to keep it viable so we don’t come ten years from now and see that we’re still using the technology of today. So I think that’s one area where I think it’s unduly suffered from it. Again, when you do priority, there were other many choices when you have limited budget. But I think that area has really suffered.

The other one is clearly there are always lots of scientific ideas of looking at neighboring solar systems, exploring the solar system, that additional funds would have been able to do that.

The third one in the area I’m familiar with is the whole issue of global change and what’s happening to our planet. There is concern that many of our assets are getting older and older,

and if we really need to keep a full understanding of what's happening to our planet, we need to renew those assets in space, or develop new capability or new technique to do that.

So I would say at this stage with the kind of the capabilities that NASA can provide to the nation, be it in exploration, human or robotic, scientific work, and Earth observation, I think that NASA is underfunded, and I hope that the administration and the congressional aspect of our government really see that I think NASA can contribute significantly more to the dynamism, or if you want, to be it the economic or technological or educational capability of our country, that I think NASA really deserves a significantly higher budget.

Now, again, we can argue, "Well, we have more Medicare and Medi-Cal and all of these things," and I acknowledge that, but I think the return on the investment which will come from investing in the high-tech organization like NASA or NSF [National Science Foundation] or NIH [National Institutes of Health], I think is very important for our economy, and therefore I think we'll be making a mistake if we don't invest more in organizations like NASA.

WRIGHT: At one point in JPL's history you did a significant amount of work with the Department of Defense [DoD]. Do you find that JPL will enter that role or move into that role more?

ELACHI: ~~No~~, In general, in all our history, the amount of work we are doing for non-NASA customers range from about 5 percent to about 15 percent, and went up and down depending on the times. I don't envision it to be any more than that, because we are basically a high-tech but also an open organization, like all of NASA, so there is a limit to what we can do for DoD.

Having said that, it turns out that the Department of Defense has basically the same technological objective as NASA has. We use the same kind of technology for different purposes. NASA is for scientific and exploration; Defense is for defense purposes. But when you look at telescopes, they are similar. We use them to look up; the DoD uses them to look down. Focal planes are very similar. The antennas are very similar. Telecommunications are very similar.

So I think what we found out, there is a lot of commonality, and in some places if DoD is willing to invest in those technologies and they are of benefit to NASA, we think that's the right thing for us to do here at JPL, and we have been encouraged by NASA Headquarters to do that, because after all, we all work for the same government. [Laughs]

WRIGHT: That's right.

ELACHI: So if there are efficiencies where we don't have to duplicate, I think that's the right thing to do, and in a number of situations we've found that investment done by DoD and benefiting NASA, and in many places investment done in NASA and benefiting DoD. So having that flexibility of working for both organizations but not changing the nature of our work, which is really in NASA, or the culture that we have here, is very important.

WRIGHT: What do you believe is NASA's most important role for the nation at this point?

ELACHI: Well, the way I look at it is the top role of NASA is to explore, and our nation is well known to be a nation of explorers. I think what characterizes the U.S. more than any other place

in the world is the spirit of exploration that the United States has, and exploration comes in a variety of things. It could be exploring the West if we go to when [Meriwether] Lewis and [William] Clark; exploring technology; developing new ways of doing something; exploring the universe.

So I look at exploration in a broader definition. In some cases we do exploration to gain more knowledge. Sometimes we do exploration to do scientific discovery. Sometimes we do exploration for economic reason. Sometimes we do an exploration just to feel good about ourselves that the country feels proud of being a country which pushes the limit and looks at new things for human knowledge in general.

So that's where I think the contribution, although a lot of side benefit. There is side benefits of technology and economic benefit. But I don't think that NASA should be saying, "Well, our key role is economic benefit," or, "Our key role is to educate more people." I think these are the side benefits which are coming from our exploration. I think we do, NASA does, exploration to lift the spirit of Americans, and we feel good about it as an important nation and a great nation. [John F.] Kennedy said it in very—we do these things because they are very hard to do and will expand our sphere of knowledge.

But then people try to justify it on economic reason or financial reason or educational reason. I think all of these are side benefits. One example I give to young people is when the nation invested in developing the Internet, we had no idea that fifteen years later everybody is going to be on e-mail. We had no idea that that's the case. But the people had a vision. They said, "Okay, look, it's new knowledge, new capability. Let's go and invest in it," and then the side benefit came after, changed the way how we do our economy, how we communicate, the efficiency, and so on.

So I think we should not sit down and worry, “Gee, if I spend a dollar, am I going to get ten dollars downstream?” I think we should more say, “Look, if we invest a dollar in exploration, one out of ten might work, but then when the thing which work is going to probably change our way and really change our economy, and keep us at the leading edge of the economic prowess of our country in doing that.”

WRIGHT: Last year you were one of twenty selected as America’s best leaders by the *U.S. News and World Report* as part of the collaboration with Harvard University’s John F. Kennedy School of Government [Cambridge, Massachusetts], a very wonderful honor, and talking about those who have defined leadership, achieved measurable results, and challenged established processes, inspired a shared vision. What are some of the lessons learned that you can share with others based on your experience at NASA.

ELACHI: Yes. I was surprised when they told me I was selected one of the leaders. But what I told them, I told them, “Look, the kind of things that NASA does and the kind of people who work at NASA, and particularly working at JPL, makes it easy to be a good leader.” Because, as I said earlier, I said the role of the leader is to lay out the vision for the institution, to lay out the vision and then provide the environment to enable everybody to be successful, and to accept every once in a while setbacks and failures, but learn from them.

So one of the things I always say, and I got it from my Deputy, which he told me that in the military, good news is given by the captains and bad news are given by the general. In a sense, I’m expanding on that of saying, look, when there are successes, I put the project in the front. They are the guys who get the credit.

But when there are setbacks, I will step on the podium to show that, yes, I'm behind the troops. We tell them push the limit, take some risk, and so on, but I want them to feel also that when they get the setback, we are going to protect them. We are going to be there with them, of saying, "Yeah, we knew the risk. We acknowledge it. But we still felt that it was worthwhile to take that."

So it's creating that environment, I think, is very important, and that's what was quoted a fair amount in that article, that when we had a few years ago the Mars failure on it, my first reaction was not who to blame. That was completely—never thought of that. My first reaction was, "Okay, how do we learn from this and how do we dig ourselves out of that hole or that setback?"

When people said, "You should fire the people who—," I said, "Heck, the reverse. Those are the people gained a lot of experience, and they learned a lot of lessons."

I have to give credit to people at NASA, particularly Ed [Edward J.] Weiler. Ed Weiler took the same attitude of saying, "Look—," because I remember very clearly a press conference where people asked Ed Weiler, "Are you going to fire the people who did this?"

His reaction, "I'm not going to fire them. These are the best people in the world who are doing that experiment."

So I think creating that environment, that's what they acknowledge in the leadership is that a leader is not the person who will take credit for everything happening in the organization or say, "Look how good I am." This is a team effort, and the leader is the guy who really will energize an organization, pull all of them to work on that effort. As I said, it really is a credit for the whole organization, JPL and NASA, not only for me personally.

WRIGHT: You have extensive expertise in the technical field, academic field, and organizational field. Do you believe that you've learned different lessons and useful information by being in each of those fields, and that together it helps you define these areas?

ELACHI: No question about that. Yes, I think that was a very great help, because having a technical organization like any NASA Center, ~~or having NASA in itself~~, I think it's very important that you have the technical background and technical basis so, number one, you understand the challenges so you can ask the right questions, but also for the people who are working under you to respect your technical ability so they trust that you are making the right decision. But also when you manage an organization, you need to have management talent, people talent, ~~management talent~~, and so on.

So it's a challenging job being a Center Director, because you have to have the technical respect, but also you have to have the people judgment and the management judgment to be able to do all of that. You have to have the communication skill so you can communicate to the broader public what your Center or your organization is doing.

So having had that background being, one, a scientist and engineer, also being a Principal Investigator, and then I got a degree in business administration and a degree in geology in addition to my double-E [electrical engineering] degree. I think you need to have that broad bandwidth so when you are talking with the different I would say constituents, meaning your employees or the general public or people on the [Capitol] Hill and so on, that you'll be able to talk in their language. I think that's very important.

It doesn't mean that if you are a specialist, you are not valued; but if you are a specialist, then Center Director is the wrong position for you. ~~If you are a specialist, like John [C.] Mather,~~

~~who became a Nobel Prize winner, which is fantastic.~~ So I think people look at if you love being a scientist, you are great and important for the organization. If you love being an engineer, that's great. We need people like this, and you don't have to be Center Director to get the credit. Many people tell me you get even maybe more credit being the Project Manager or PI than being a Center Director, and that's great. We need all those talents.

WRIGHT: Especially the last few years there's been a lot of talk about the culture within the NASA organization. Could you share with us what your perception is of the culture here?

ELACHI: Sure. Let me put it this way. First, when people tell me we need to change the culture, no, I like the culture. However, having said that I like the culture, we need to keep evolving it, because the world is changing; we learn new things, and therefore we have to keep adjusting our culture to the new world and to the new challenges that we are facing. NASA is founded on, I think, one of the best cultures I can think about. It's being a bold organization, an organization with high integrity, an organization which pushes the limit.

That's what the Apollo Program started. The way I put it, we took something which is almost impossible, and went ahead and did it. I think that's the kind of culture we should continue.

Now, I think that for a while it became a little bit bureaucratic, but we need to sit down and keep changing it. So I think it's important when we say we need to change the culture is to make sure we protect the key positive things about the culture of NASA, but keep evolving it as we are doing different things, and to keep learning from our past lessons. The way I put it is that the rules that we apply today is just the collection of our past mistakes.

I think we need to be thinking in our culture that that's nothing wrong in having rules, as long as these rules are always examined, and say, "Are these adding value, and are these really still valid lessons of our past mistake that we have done?" And we shouldn't be embarrassed about having mistakes or past mistakes. That's how you learn in the technological world. That's how you learn is by sometimes trying, doing the best you can, and you find that it didn't work, then you try to do something different or something better.

So, again, what I would emphasize on the culture which I think has been at NASA, but we need to keep emphasizing it it's a culture of high integrity; a culture of openness that nobody is afraid of saying what's on their mind, particularly when it comes to technical issues; the culture of being bold and willing to try things which are very hard, but to do it thoughtfully. One way I describe it to the employee, "One way of standing tall is to have your head in the clouds but keep your feet on the ground." So you are anchored on solid technical background, but you are thinking beyond the box, what's outside the box. That's how you stand tall in an organization like NASA.

So in general I personally feel the culture of NASA, I like it, but we need to keep evolving it as the world change and we learn new things. We need to keep evolving that culture.

WRIGHT: You spent thirty-seven years with NASA. Why would you encourage a young person to take a career here?

ELACHI: Well, the way I put it to people is, "Where in the world can you go home that evening, and tell, 'Well, guess what? I just landed a spacecraft on Mars today'? Or, 'Guess what? I just brought a sample from a comet.' Or, 'Guess what? Today I just did a flyby of Europa,' or

something.” I don’t think there is anyplace in the world that you can say that, other than a place like JPL or a place like NASA. So I would rather spend my life doing discovery—that’s what I tell people—than going and say, “Well, today I wrote 5,000 code of software,” or, “I made my Blackberry one pound lighter,” or, “It’s consuming ten times less power.”

I would rather be the first one on doing that. I’m not saying negative about the other ones but I think that’s the kind which I find it very inspiring. I tell the young people “I’ve been thirty-seven years at JPL. I don’t recall a day that I didn’t look forward to come to work, because every day I learn something new. I don’t remember a day where I didn’t look forward to go back home and tell my family the exciting things I did that day.”

I tell them, “Look, if you are looking for a job and you are here just because you want a job, this is the wrong place. But if you want to be part of the team which is exploring the universe, this is the right place.” And I use it in a broader sense—not only JPL but NASA in general.

No, In general, I find young people are very excited about the kind of things that NASA does. Again, if people have different goals for like becoming a multibillionaire, yes, this is the wrong place to do that. They might go and start a new startup company. But, again, I keep saying, “Well, when I retire, I look backward and say, ‘Well, I did \$10 billion,’ or ‘I was part of a team which explored another universe or detected the first planet around a neighboring star,’ I would rather be the second one.”

WRIGHT: My last question for you is this project was created to gather reflections and thoughts and experiences, but also looking back is one thing, but as NASA gets ready to turn fifty, it has

the future in front of it. Where would you like to see NASA be in the next ten, fifteen, fifty years?

ELACHI: To me, I hope that NASA is always looked at as the agency of exploration, high-tech and exploration for the country—and I'm using “exploration” in the broad sense, scientific as well as lifting **spirits** and so on—and that people basically—that when we put a Station on the Moon, that NASA is the agency which enabled that. When we are going to be detecting life on other planet, that NASA is the agency which enabled that. When we start imaging what I call **friendly family** portraits of the neighboring solar system, NASA is the agency which made that happen.

So I think the key, what my hope is, NASA keeps the boldness that it has been characterized with, keep the high integrity that it has been characterized with, keep the openness that it has been characterized with, and keep the high-tech spirit that NASA has really created in this country.

When I talk with people from outside the United States, they look at the NASA logo as something very positive and very uplifting for them, because it reflects the positive things about our world. People outside look at the U.S., and you get a broad spectrum of opinion. “Oh, gee, the U.S. has got people in Iraq. The U.S. is a big bully,” or, “The U.S. is the only big power in the world, and they don't take our—“, you know, the small guy.

But then when you look at NASA, which is part of the U.S., that's always something positive. You very rarely hear somebody commenting negative about NASA. And I hope that over the next fifty years NASA is looked at by the world as a positive thing the United States does, which is increasing knowledge and do it in a positive way, like our collaboration with the

Russians on the Space Station; our collaboration with the French on TOPEX/Poseidon; you know, our collaboration with the Italians on Cassini; our collaboration with the Japanese on NSCAT [NASA scatterometer]; and all these missions.

People look at NASA as a positive agency, and I hope that that will be continuing over the next fifty years.

WRIGHT: Well, thank you. Is there anything else you can think of you'd like to add at this point, or any other comments you'd like to make?

ELACHI: No, I think we captured all of them.

WRIGHT: I think it was great.

ELACHI: The interview has been very good.

WRIGHT: Well, thank you very much.

ELACHI: Well, good. Well, thank you. Thank you.

[End of interview]