HUBBLE SPACE TELESCOPE OPERATIONAL ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

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The questions in this transcript were asked during an oral history session with James Jeletic. The text has been amended for clarification and for publication on this website.

GAINOR: Okay, it's May 19th, 2017, and we are at the Goddard Space Flight Center in beautiful, sunny, downtown Greenbelt, Maryland. I'm Chris Gainor, and I'm here with Jim Jeletic, who is the Deputy Project Manager for HST [Hubble Space Telescope]. So, I'm going to start off by asking you to tell me about your life with Hubble; how you got into it, and various jobs you've had, and we'll start the discussion there.

JELETIC: Okay, so, back in the late 1990s, I was a branch head over in the Flight Dynamics Division, responsible for all of the software. And there was a major reorganization within Goddard, and at that moment in time, based on the changes in the responsibilities that you would have, and the changes in the organizations, I decided to take that as an opportunity to do something new.

And so, I wrote down all the things I like to do, all the things I don't like to do, why I came to NASA, what my passions were, and it all married to one place, and that was the Hubble Space Telescope project.

So, I came over, and at the time I talked with Ann [C.] Merwarth and Preston [M.] Burch, and said I was interested in coming over and abdicating my branch head position. And they were interested in having me, and they said they would get back to me shortly with a position that I might be interested in and would be fruitful for them as well. And then Ann Merwarth announced her retirement.

And so then, of course, I was like, "Uh-oh." And Preston said, "That's not a problem." Then I got a phone call that said that Preston, who was Ann Merwarth's deputy for the operations project would become project manager, and that Ed [Edward O.] Ruitberg would become the deputy science manager, and therefore the Science Operations management position that Ed had would become open. And would I be interested in having it? And of course, that was right along the lines of what I wanted. It was much more science related, as opposed to all the engineering-related work I had done before. It allowed me to work with the international science community, and so I took it. That made me responsible for the Space Telescope Science Institute contract, and responsible for the guaranteed time observer grants, and responsible for the budgets that were associated with all that work, and also allowed me to work the servicing missions, from the more technical aspects. So, I would get involved basically in the role of monitoring through our command and control system, monitoring where we were in our command plan, listening to the voice loops with the astronauts and know where we were in the whole timeline of events for that particular day, and make sure everything was going off as planned, as far as the commanding the telescope if there were any problems. And I did that for the management team.

GAINOR: Did you have a special interest in science before? I guess, with an engineering background, you would have a certain amount of that, but were you an amateur astronomer when you were a kid or anything like that?

JELETIC: No. I had a love for astronomy, but we couldn't afford a telescope back then. Actually, telescopes got cheaper as time went on. So, I never had a telescope, but I was always totally enthralled by the space program because I was an Apollo kid.

I remember I was seven when I watched them walk on the Moon. And in fact, I'd gone to bed, and my parents came up and said, "Jim, I think you want to wake up and see this."

I was, with no hesitation, I came down and watched them walk on the Moon. It was a great excitement, and it just always carried on with me. I always wanted to work for NASA, but I never had formal training. I had a course in astronomy in college, but it wasn't anywhere close to a degree, because my degree was in computer science and engineering. So, I came to NASA right out of college and worked in the Flight Dynamics Division for my first 13 years.

GAINOR: And you did have interactions with Hubble from time-to-time, right? I think I dug up some memo you did years and years ago.

JELETIC: So what I was hired for, for NASA, was to work on computer graphics. And at that time, computer graphics was very, very young. For the most part, what you saw was XY plots, and strip charts and that. There was not a lot of graphics. So they brought me onboard to do computer graphics, to figure out all this engineering data in a manner that would make it easier to understand. Part of that was to develop a 3-D system that allowed you to actually display a spacecraft, driven in real time by the telemetry from that spacecraft, or the shuttle (in the case of the shuttle), and you'd put up a 3-D model of the shuttle with a real Earth image under it, and an accurate star chart, and accurate locations of the Moon and the Sun and planets. One of the first missions that that system supported was the Hubble Space Telescope mission. So we were preparing it all for that. Of course, the [Space Shuttle] *Challenger* [STS-107] accident delayed that, but that was how I originally got involved with the Hubble Space Telescope.

GAINOR: Alright, well tell me about what happened when you started working here. Was there anything that surprised you when you started here?

JELETIC: At Goddard or at Hubble?

GAINOR: At Hubble.

JELETIC: So, at Hubble, it was interesting how big the project was, without any question, because we had hundreds of people building the instruments out West. We had the people at the various universities that were involved in the instruments, such as University of Arizona [Tucson], [Ball Aerospace, Boulder] Colorado, we had a lot of people from JPL [Jet Propulsion Laboratory, Pasadena, California], we had a test bed down at Marshall [Space Flight Center, Huntsville, Alabama], and of course the whole army of people that are down at Johnson [Space Center, Houston, Texas] that supports the space shuttle flights as well as the launch at Kennedy [Space Center, Florida]. So, it was surprising to me, how big it was. It was truly a delight to me, the diversity on the team. Especially having a lot of the European Space Agency [ESA] around, so I enjoyed getting to meet them, and knowing them, because it's a different culture, and I had enjoyed the few times I had the opportunity to go over to Europe. So, I think that was a large surprise.

Another thing that was a large surprise was the amount of work you had to do for a servicing mission. Because then you started getting involved in it firsthand, and you saw all the simulations that have to occur. And of course, even behind the simulations, you have to have simulators. You have to develop, and you're not doing it with the astronauts. People have to pretend they're the astronauts for internal simulations. It was a huge, huge effort, on top of building all the hardware.

GAINOR: That's right. And I think the support hardware kind of gets forgotten.

JELETIC: Yeah, oh yeah.

GAINOR: The stuff that just sits in a payload bay during the missions.

JELETIC: And Preston can tell you better than I can, but they developed a new carrier for Wide Field Camera 3 [WFC3] known as the SLIC [Super Lightweight Instrument Carrier]. But the idea behind that was that it would reduce the weight, which then allowed us to carry more stuff aboard during servicing missions. So, even though we'd done all these servicing missions all along, you were still making modifications to all that support equipment and building new support equipment to handle new requirements.

So, all that was fascinating. I also loved the fact that I would go to a baseball game, and during the National Anthem, on their screens, they would go through all these little videos of different things that are America. And one of the things you always saw was the Hubble Space Telescope, and to sit there and think, "Wow. I'm part of that." So, that was pretty cool.

GAINOR: You got to miss the time when it was in "Naked Gun 2½."

JELETIC: Yeah. I missed that time. Lucky for me, I wasn't part of that.

GAINOR: Which servicing missions were you involved in?

JELETIC: I was 3A, 3B and 4. I came on just after 2.

GAINOR: So did you really have to scramble when the decision was made to split [Servicing] Mission [SM]-3 into two missions?

JELETIC: It was a scramble because you were redoing everything, and you didn't have a lot of time to redo it. What you were going to put in this mission, what you were going to take out, and then you had to redo all the mission timeline. And of course for everything on the mission timeline, there's a whole set of commands and verifiers that had to do with the instructions that you send in the spacecraft to make sure it's operating the way you want it to. So all that was fascinating. And some of the things that we were doing back then were really, truly challenging and risky, such as replacing the power control unit. You're shutting down the whole spacecraft, and as the video we did on shutting it down showed, no matter how well you plan, no matter how well you think about all the possibilities that could go wrong, there's one that you didn't think of. John [M.] Grunsfeld's suit leaking after we had started shutting down the whole spacecraft, and then him having to come in, and you're losing a couple hours, and all those shutdowns were based on how many hours we would have of margin on the temperatures, as they got colder on things that we had heaters on. You know, that was one you just never planned for. You just never thought you would start shutting it down, and right away, half-way through that, you would have to abort.

So, that was a fascinating one. And then of course, replacing the 486 [computer]. I mean, so, you're basically replacing the brains of the spacecraft, just like with the PCU [Power Control Unit], you don't like to shut anything down, because you don't know if everything's going to come up, as planned, (and of course in that case, it did). You don't want to pull the computer and then hope everything boots properly and actually controls everything and monitors everything. You're doing this on the ground. You're doing a ton of testing (don't get me wrong), but you just never know what the gotcha is going to be. But that one worked flawlessly as well. So, that was great.

GAINOR: Yeah, because that's one of the most amazing parts of the whole thing—the success in the servicing missions—and of course, it took a lot of work to make it look so easy. It's one of those cases.

JELETIC: Yeah, well then there were some gotchas, like on SM-4 that we worked through. So the first one was when they couldn't get the bolt to break, to come loose for taking out WFPC2 [Wide Field and Planetary Camera 2]. And that was just that we didn't realize the torque settings that we needed. And then there was, of course, the handle that wouldn't come off. And then there was the gyros that didn't fit.

But to the engineers and the managers and all that who worked those types of things, they had the plans and they had the ability, even like with the handle that wouldn't come off, to run over and do some tests and think in real time to figure out what they could do, and of course the solution was pretty simple: just pull harder. But you want to make sure that's going to work. So they were able to have the apparatus and that all ready to roll so that they could do that.

GAINOR: So, during these missions, were you here in the STOCC [Space Telescope Operations Control Center, Goddard Space Flight Center], or did you ever go down to Houston?

JELETIC: I was in the STOCC. There is a room that currently is the operations manager's office, and it was then, too. And that would be commandeered as the Goddard Management Team. So I would sit in there with the likes of Rodger Doxsey and Mal Neidner, and Helmut Jenkner of the Institute and ESA, and Ed [Edward] Ruitberg, Dave [David] Scheve.

So, those were the guys who, when you had a problem, the operations team would come in and report the problem and give us status on how they're working it, and decisions that had to be made were made by that group. So, it was kind of fun to be part of that because you were hearing all the ins and outs of what's the possibility going wrong, what are we going to do about it, and what information we need to make that decision. It was an exciting time.

GAINOR: So we all hear about what goes on in the [Mission] Control Center in Houston, so how would you describe what's going on at the STOCC during these things?

JELETIC: I think it's normally pretty calm. It's so well planned; everything is written out.

GAINOR: You have the place full of people.

JELETIC: You have over 100 people in that tiny area. In the one room you have all the engineers who are monitoring all their subsystems. The other room you have the flight operations team that's doing all the commanding. You have another room where you have the management team that's tracking all these different voice loops to hear what problems Johnson's having, what problems the astronauts are having, what problems some of our subsystem teams are having, if any. You have another room that's set up for the anomaly resolution team, so when we have a problem like the bolt or the handle that wouldn't come off, how are we going to work that? So they're all in there.

But for the most part, it's calm because we've done all these scenarios, we've been tested against all these different possibilities that could go wrong to make sure we're ready to handle them, and pretty much everything goes off without a hitch, until you run into one of those things. Then, there's a little more pressure because you realize you only have so many minutes that you have to come up with a solution.

GAINOR: And you would have full-dress simulations. I know Houston does them with all their controllers and all the astronauts. And did they have some where you guys were here in the STOCC?

JELETIC: We had a couple of kinds of different simulations. Some were internal, meaning that Johnson wasn't involved, and so we would go and run off of our simulators, throw everything at it that we could, and have people pretend they were the astronauts. Coming up with problems, installing things, not installing things. For everything we did, we had two tests for all the new hardware: an aliveness test and a functional test. And the aliveness test was, does it turn on or not. And the functional test is, let's make sure this thing works to a limited extent.

It's not like when you have the instruments, you're just kind of doing a few tests to make sure that for the most part everything works fine. But it's a long, few-months endeavor to make sure you bring the instruments online and everything is working, calibrated properly. But during that time, during the servicing mission itself, you have those two tests, and if there are some major failures, then the decision has to be made: are you going to pull the new thing and put the old thing back in? That never really occurred during the missions I was on, so that was the good news.

GAINOR: You had the situation when one of the gyros break.

JELETIC: So the gyro didn't fit. And the reason ended up being, after analysis, if I remember correctly, on one of the corners, there was a little bit more insulation put on than they thought. Therefore the insulation didn't allow the gyro to go in far enough to get the bolt through the hole, such that the nut could grab it. So what they did was they pulled off that one, and then they put on a spare set of gyros. Not the old gyros that we had taken off, but a spare set of gyros, which we always—again, contingency planning is you always have an extra set of gyros in case one of the sets of gyros doesn't spin up right or something.

GAINOR: Right. That was SM-4, right?

JELETIC: That was SM-4. But then we also did the joint simulations with Johnson. And there were many, many of the joint simulations as well. Now of course for SM-4, the challenge was before [the mission] was [to launch] we had the problem where one side of the Science Instrument and Data Handling System [SIC&DH] failed.

So, we ended up, even though we were ready, pretty much, to roll with the servicing mission, we had to stand down, and they took the test version of the SIC&DH that we had and brought it up to flight worthiness. Then we had it, then sim [simulation] and all that, and while you're simming that, you also have to sim all the old stuff because now you're getting stale. You don't want your team to be stale on all the procedures and challenges and that, associated with those other pieces of hardware that you were still taking up, even though you practiced them before. So, we had more time in simulations, probably than any other mission, is my guess. Then again, I wasn't here during SM-1 or SM-2. But we really had a lot of simulations that we did.

GAINOR: Right. How would the folks here at Goddard help the astronauts get ready for their work? They would come up here and interact with the hardware, but there might be other things that I haven't thought about.

JELETIC: Well, for the most part, it was servicing mission-related and hardware-related, and so it would be Cepi's [Frank J. Cepollina] group. And they would train them in the hardware, and train them in the techniques they're to use to replace it or repair it, whatever the case was for that particular piece of hardware. They would have crew familiarizations in which they would make them aware of all the different pieces, whether it be tools or actual hardware, and then there would be some training that would be done for those astronauts as well, on different things.

And they would also give us feedback on tools, for example. What worked, what didn't work? What would be better? And they would modify the tools then to make it more productive for the astronaut. And that productive thing is kind of twofold. One is that you want the astronauts to be outside as short a time as possible, so you want to make them as productive as possible. In that we had a six-hour EVA [extra-vehicular activity] limit, if we could get them inside in four hours, wouldn't that be great? But the real thing that comes out of that is, well geez, if we can do all that in four hours, what are we going to do with the other two? Let's figure out what else we can do on the spacecraft. So it wasn't so much saving time as it allowed us to be more productive with that six hours.

GAINOR: So it's kind of the project management. How do the folks in this office here interact with Cepi's people?

JELETIC: Back then? Today?

GAINOR: Well, in the period of the servicing missions? Were they kind of an independent fief, or how did you work that out?

JELETIC: Well, they're independent in that they're the ones building the hardware, and we're not doing that. But we had to understand all of the ins and outs of all that hardware because we would be having to change all the software down here and all the procedures.

So, there were all kinds of reviews that were conducted, and documents that we would review, where they might review what we did, in order to make sure everybody was on the same page with everything. And then of course the hardware, we'd have to update our simulators to be able to simulate the new hardware. So there's that type of thing that we were, I'll say intertwined, because of it. We needed them and they needed us to make it work once it was put on the spacecraft. So I think, for the most part, it was a very good relationship. They were under the gun a lot because it takes time to build hardware, and you have a servicing mission coming up, and you're driven by the shuttle schedule, and so you have to be done by a certain time. So I think they were probably under more pressure, time-wise, than we were, although we were always busy up to the last minute too, in the operations area with all the changes we had to make and all the sims that we had to do.

GAINOR: So for eight years now we've been kind of in the post-servicing mission era. How is that different?

JELETIC: So, it's a different feeling. There's the concern that we didn't have before, if something breaks, okay, we'll go up and fix it. Well, now we don't have that anymore. So it's really a completely different strategy. We saw this a little bit when they cancelled Servicing Mission 4 on us, and we went from getting ready to do another servicing mission to all of a sudden, hey, we only have a few gyros left and we can't go up and service it. What are we going to do?

So the mindset started with the cancellation of Servicing Mission 4, but now we very consciously take a look at how we operate pretty much everything, and is there a way where we can operate it where we can tax it less, so that it will run longer? And then there's a lot of things we do, a lot of look ahead type tasks to say, if something does break on the spacecraft now, how will we handle that long-term? The best example, and this actually came up for SM-3 when they split into two missions, we had the situation whereby we were going to have less than three gyros. So were we just going to be dead in the water? Or are we going to be able to do science? We came up with the two-gyro mode. Since that time (and we've now come up with one-gyro mode), we realize that one-gyro mode is almost as efficient as two gyros are. So, therefore, we wouldn't even use a two-gyro mode anymore. When we have less than three gyros left, we'll just skip down to one, right away. Well, that's just doubled your time that you would have *versus* two-gyro mode. So, we're always thinking along those line.

GAINOR: Ed Ruitberg was suggesting that having the new computer helped that along. That it was easier to do that.

JELETIC: Yeah. There's a lot of things that you can do when you have more memory and more processing power. The original computer was a 24-bit processor, if I remember correctly, with 64K in memory, and that memory was having problems in space after so many years. In fact, that was one of the things that I believe was corrected in the short-term in time for the comet Shoemaker-Levy impact. They ended up using the coprocessor memory and memory that went up with that instead of some of the memory they were having problems with on the computer itself. And they could cross-strap that memory. They were able to do that in time so that they were able to recover from a safe hold they were in, in time for the actual crash into the comet.

But when you went up to the 486, it's a much more straightforward and much more modern computer. There's programming in assembler language *versus* programming in C that you can do. You have a lot more memory space now because you went to 2 megabytes of RAM onboard, so now you can do all kinds of diagnostics. And a lot of these things became possible once we got the 486.

So even after all these years, we're still only using approximately, we'll say half the capacity, the CPU capacity of the 486 computer, and we're probably using somewhere around three-quarters of the memory. Now I say that with one caveat, and that is we're probably going to use all the memory because what we do is, for the additional memory, we just keep more diagnostics at a more detailed level just in case the spacecraft has a problem, then we have more information available to us. And that's one of the enhancements that we're doing to help make sure we can extend the life of Hubble as long as we can. We can get more information when it goes down. But if we needed that memory, we could reduce the amount of those diagnostics for how much time we collect them before it overwrites itself. So we take advantage of all the memory, but really, we were using about 70 percent or 75 percent for the normal, day-to-day activities.

GAINOR: Okay. I still have to talk to Preston about this, but we were going to talk a little bit about the time control moved over to the Institute.

JELETIC: Yeah, so there was a movement. In the world of NASA there's often a pendulum that swings from one side to the other and then goes back. And it just depends on what year you're in, which side of the pendulum you're on.

And at that time, there was a movement, a belief that if you outsourced operations, that you would gain benefit cost-wise. Now, that's a very simplistic view, but at the very highest level, that's what it was. So they wanted to outsource. And there were different reasons that came up, but Hubble decided that wasn't in the best interest of Hubble. One of the reasons is does NASA really want to have no control over the operations of its flagship mission? And the answer is no. So they wanted to make sure it was exempt from that. And in doing so, they also felt that there might be some synergies if we moved it up to the Institute. Said it might be some cost savings (although that would be little) but there might also be the fact that the Institute produces the command loads, and the weekly science schedule, etc. And commands that go with that get shipped down to us here at Goddard and we then uplink to the spacecraft. But we review all those things. So, wouldn't it be nice if the people who produce them and the people who review them and the people that uplink them, if they were all in the same room together? As opposed to have all the walls you have to throw it back over, back and forth until you get it the way you think it has to be. So we thought there were some synergies that could be had by doing that, so as part of that whole thing, the control center was moved up to the Space Telescope Science Institute and it was up there for several years. And we still had the backup control center here because we were still doing servicing missions and we needed it for doing servicing missions. There wasn't the capacity up at the Institute to handle that kind of staffing, given all the terminals that they can access in the rooms to seat them. So, servicing was still going to be held down here. So we were the backup control center for a while for day-to-day operations, but still the prime during the servicing missions.

GAINOR: This also brings up the other question. Of course, the control center, the STOCC looks a lot different today than it did 20 years ago because you've re-engineered it and reorganized it using our cell phones and other things.

JELETIC: Yeah. Over the years the challenge for any long-term mission is technology is going to change and it costs money. So you have to have this balancing act you do for when are you going to replace old hardware with new hardware? Now you can imagine, today we have the flat panel screens, but back at launch we had the huge, typical, deep-tubed display terminals. And in fact we started with, I think at launch, they had VAX mini-computers. Today we have UNIX workstations, and we have PCs that are clients to those UNIX workstations. So it's a completely different model.

You have to plan for when you're going to upgrade. On top of that, there's an obsolescence issue, so all of a sudden, the vendor no longer supports the operating system or the hardware for that. So you have to either move on and convert all your software and systems to new hardware or be left in the dark, and then have the chance that you can't repair something once it breaks.

So you have those things, and then in today's world there's another one that comes up, and that's IT security. You're pumping up patches all the time with new operating system capabilities or security patches, whatever, to make sure that you're secure in your facility and your data is secure. Well, again, the vendors, after so long they won't give you any more updates. So even when new viruses are being created, you don't get the patches to protect your old hardware from them. You're always in this boat. And because processors get smaller, and you went from the big terminals down to the little flat screens, and your technology changes, that's changed how the STOCC has looked over the years. We went from VAXs to I believe it was Silicon Graphics Unix workstations, and then we converted from Silicon Graphics to Sun Workstations, which were bought out by Oracle, if I remember correctly. And then, of course, once we went from the VAX to the Silicon Graphics, then we had PCs that were our clients to those UNIX workstations. So that's changed us over time.

Now the other thing that has changed over time in the control center is we no longer have servicing missions. So we don't have to see hundreds of people for 13-hour shifts. And we've gone to automation, so with automation now, you throw your cellphone into the loop. Now the spacecraft has smarts onboard, given the 486 computer, the new computer, because now it can monitor a lot more of itself than it could before. If it sees a problem, it'll generate an error message and send it down. Our ground system can trend information and monitor that things don't go out of parameter, out of constraints, and once that does, it can generate its own error message and then it creates a text message that gets sent to individuals that are on a call list if there's a problem. And then they have the ability on their cellphones through special software to look at a little bit of the telemetry that comes down, just to get an idea of what the problem is, and how severe it is. Then that would determine whether or not people have to come in—a lot of people have to come in, or it's just something small—maybe it's a ground system thing, a hard drive one. So, they can switch things around. They can't command, obviously, from their cellphones, but at least they can get an idea of what's going on. So there's situational software as well that allows us to monitor message boards and add as people are working different issues to stay abreast of it.

So, it's a different world. You don't have to have a laptop or computer available to you. You can be sitting in your car, or at the grocery store, and you can check your phone to see what the situation is and whether it's severe or not. Technology has been our friend. That's also allowed us to reduce costs because now we no longer have to be 24 by 7 operations in the control center. We can be an 8 by 5 group and go home in the evenings and rest assured that both the onboard systems as well as the ground systems will figure out if there's a problem and notify us if there is.

So all that being said, now that there's no more servicing missions, the rooms were rearranged as to what they're being used for, because we don't have all the same requirements as well.

GAINOR: Now some of your work—you've been talking about lots of engineering stuff, but you're also doing some of the stuff about outreach and publicity and interacting with people who come over to Goddard. Do you have any good stories to tell out of that?

JELETIC: Let me say this, I've always done some outreach. I've enjoyed trying to excite kids into doing engineering and science, just like I was excited as a kid. Of course I had the Apollo Moon landings to help excite me. We're hopeful that we have Hubble, and that can excite kids as well. So I've always been doing that. But around the year 2011 or so, there again, after the servicing missions were over, people moved on in life. Pat [Patrick L.] Crouse then became the project manager for Hubble and the deputy project management position opened up, and I was selected for that.

So with that came really the responsibility of being in charge of the outreach for Hubble. Now we have two major contracts, one of them being the Space Telescope Science Institute, and they have a large role in outreach, without any question. And they've led the outreach over the years, but especially with the 25th anniversary, there was this huge desire for all kinds of outreach that was being done. And let's say Goddard stepped up its game. And now we are doing all kinds of things. From live television interviews several times a year, to the community day where 20,000 people came on board, and actually the theme of the last community day, one of them was Hubble. So we had tours and demonstrations of the various facilities we have here.

So, a lot of that occurred. And included in that is the upgrade to the, I'll call it the aesthetics of the control center. Now when you walk down there, you see hardware that was returned from the spacecraft on exhibit with placards that are associated with it. You see the science images along the walls. You see the televisions that give us the latest press releases that we have and the latest videos that have been produced on Hubble, and I would say at least once a month or more, there's a new video that comes out talking about some of the new science or something historic about the mission. So all that had comes under my watch. We're working in concert with the Institute. They have their contract and their funds that they get from us to do it, but they do the press releases, and that, while we're working on the television side, we have a studio here at Goddard. So it's been a lot of good synergy between us and the Institute.

We have had a lot of fun people come through the control center, without any doubt about it. A couple of weeks ago we had the King of Sweden come through. That was fun. That was different. It was only 10 minutes, so I gave a five-minute tour, just showing what the spacecraft was and showing the missions operations room. Then John Grunsfeld, the astronaut, took over and he gave a demonstration of the tools and let the King put on some astronaut gloves. So it was a lot of work for 10 minutes of fun.

And including all the security arrangements that went with it. I had fun with Bill [William A.] Anders when he came. The Apollo 8 astronaut. He was not somebody that we had any clue was coming. It was a random call that we got from somebody at Goddard, said, "I have an astronaut that I'd like to bring through. Is there somebody that can give us a tour?"

So Pat Crouse said, "Jim, you want to take care of this one?"

I said, "Yeah, not a problem." Because I typically give about 75 tours, 100 tours a year on center, and most of them of the control center, so I said sure. So, he gave the person my name, and I contacted him. At the end of it I said, "Who's the astronaut?" Because there's a lot, there's an awful lot of shuttle astronauts, and I have to admit I don't know them all by name.

And he said, "Well, Bill Anders."

And I'm like, "Bill Anders? I know the name Bill Anders." I said, "Wait a second, Bill Anders?" And I looked it up, and sure enough it was Bill Anders of Apollo 8, who took the famous Earthrise picture. So, of course, I'm really nervous. It's just like, oh geez, I better make sure everything I say is completely accurate, or Bill is going to catch me on it. I don't want to say anything inaccurate. So he comes and I'm giving him a tour and I'm walking down the hall, and one of the pictures on the wall is the Cat's Eye Nebula. I'm explaining to him about how these concentric circles that he's seeing on the Cat's Eye Nebula are the outer shells of gas, most likely being puffed off as the star starts to reach the end of its life, and that's a typical thing they believe happens with stars but it's one of the first times we could see it at that level of detail.

And Bill says to me, "Well, Jim, how wide is that picture?" And I know he means, is it one light year, two light years? And I was thinking, geez, I know this answer, because I've given so many tours, and I cannot think of the number.

And I said to Bill, "Well, Bill, I have to admit, I can't remember. I'm going to have to look that up."

And he turns to me and he says, "Jim, you could have told me anything. I would have believed you."

So lots of times the VIPs catch you off guard. Leonardo DiCaprio came on center this past year to do part of a documentary that he was doing. While he was here, I was asked to take his mother, step-father, and some friends around, so they came over, and while he was doing his filming, I gave them a tour. His two friends were asking me absolutely phenomenally great, detailed questions. And I had no idea who these friends were. And I'm like, "Wow! That's pretty good. That's a pretty good question. How'd you come up with that one?"

And he says, "Oh, you know, I'm interested in this stuff."

Well, at the end, after they left, I asked one of the persons from our office of communications, "Who were those two guys?" Well they were two actors, well-known actors: [Lukas] Hass and [Scott]Bloom. And Bloom used to be in, what is it, "Who's the Boss?" And the other guy is the actor that's in the movie [The Revenant]. The famous one that Leonardo DiCaprio just did where he's out in the wilderness. So anyway, he was in that movie and he was also the little Amish boy in "Witness" with Harrison Ford, where he sees a crime in Philadelphia and Harrison Ford has to protect him. So, the whole time, I'm sitting here with these Hollywood actors having no clue who they were. And they were just really into it and totally asking great questions.

So that's been a lot of fun. There's lots of people like that that I've had the opportunity to meet, as well as various reporters with the Washington Post and CBS, and it's been a pleasure. Some of these things, the highlights of your career, they may not be the technical highlights, but they give you some good stories that you remember later in your life.

GAINOR: So tell me what you think about Hubble. Where do you think it kind of fits into things?

JELETIC: I like to give statistics. So Hubble, to date (and again, this is 2017), has taken over 1,350,000 observations, and it has produced from those observations almost 15,000 peer-reviewed, scientific papers that have been published in prestigious journals. And those approximately 15,000 papers have been referenced in other scientific papers an astounding over

680,000 times, and that rate is growing by almost 200 citations a day. So the Hubble Space Telescope is the most scientifically productive spacecraft in the history of NASA. And many people argue that it's the most productive scientific instrument ever built by humankind.

So Hubble has, without question, secured its place in the history books. Now whether that's due to the science discoveries that have changed our fundamental understanding of the Universe, whether it's due to the exciting servicing missions that mesmerized a lot of people as they were following them, and all the excitement of the astronauts and the launches, whether it's due to overcoming adversity with the whole story of spherical aberration and getting that to work, whether it's due to technology transfer.

And I can give you example after example of things like advancements in mammography equipment for breast cancer, how it was used in the figuring out the sequencing of the human genome, and how its scheduling software is used in hospitals. All these types of things have bettered our lives. Or whether it's due to the fact that Hubble has become this cultural icon that everybody seems to love, and you see it everywhere you go, whether it's on stained glass windows in churches, the images from it, or whether you see it on television shows like "The Big Bang [Theory]," or whether you see the books that have been produced on it, or you'll see art exhibits in museums that have it, or you'll see it on the Google Doodle.

Whatever it is, it's a cultural icon. Or whether it's just due to the incredible images that everybody gets to share and that allow us to see the details of the Universe and the beauty of the Universe that we've never before seen. Whatever the reason, Hubble's secured a spot in the history books as one of the greatest missions that NASA has ever undertaken.

So, I'm thrilled to be part of that, and I think that if we do a good job, and the job that we're paid to do, that we're going to be able to continue to make it just as productive for hopefully well into the next decade. And again you never know because the spacecraft's definitely old, but we are still at the peak of its scientific capability and we still have redundancy in all of its critical systems. So, we are hopeful that we can keep it lasting well into the 2020s.

GAINOR: We talk often informally about a part of your job which is managing the contractors. There's Lockheed [Martin], but also the Space Telescope [Science] Institute. Do you want to tell me a little bit about that part of the job?

JELETIC: That's not necessarily the most fun part of our job. Working with the individuals can be a lot of fun, but a lot of that is doing a lot of paperwork that you're required to do when you have large contracts. In these cases, there's 100s of millions of dollars over the years, if not billions of dollars over the years to make Hubble click.

The way we work with both contractors are very different. The Lockheed Martin, we work with shoulder-to-shoulder, elbow-to-elbow every single day because we're all intermixed here down in the control center area. We're much more embedded in the work that they do; they're embedded in the work that we do, so it's a completely different relationship. It's a very positive relationship. People get along great without any question, and we have lots of insight into that work.

On the other side of the coin, the Institute, because they're 30 miles up the Parkway from us, that's different. They have different roles. They have roles where they're a contractor and they're providing products and services to us, such as the weekly science timeline and commands that we upload to spacecraft. There are other times where they're our partner and they help us determine how we're going to proceed with different things. And then they have a completely separate role that where they have the ability to lobby. And they can lobby Congress on behalf of the Hubble mission, and we're not allowed to. That's illegal, so if we believe in something we can lobby NASA Headquarters, but that's how the politics are, such that we influence the direction of things in a manner we think is the most productive for science and astronomy. They can handle things differently. They can go out and they can lobby the astronomical community, because they're basically embedded with the astronomical community. They're responsible for putting together a user's committee that meets with us every so often a year. They're able to lobby their senator and things of that nature that help influence Congress in making decisions, as well as the community, and whether they're going to ask their congressman to support or ask NASA's support from external pressures.

So it's very different how we work with the Institute. I know the stories, which were well before I was around, that there were a lot of difficulties working with the Institute. People at NASA didn't get along with the director. There was a lot of, I don't want to say fighting, but there was a lot of positioning for what the Institute was going to be responsible for, what they weren't going to be responsible for at the time. I think a lot of that clearly doesn't exist today. I think the relationship is very good. I think we get along well with them, but it doesn't mean there aren't times where there's some issue that's contentious between the two. But for the most part, I think that the two parties work pretty well together. There's obviously conflicts of interest, so when we talk budgets, we can't include the Institute because it's a conflict of interest for them. When you have multiple contractors, if everybody was involved in the budget process, then everybody would naturally want more money for the stuff that they want to do.

So that's where you have to draw the line. But otherwise, I think we get them involved a lot in the affairs of Hubble. And we get the Lockheed Martin group and all their subs involved in different affairs of Hubble that are along those lines. And I think that we've worked very, very well together and I think that relationship continues to grow in a positive direction.

GAINOR: Is there anything that I haven't brought up that you wanted to talk about?

JELETIC: I would say one other thing that comes to my mind, and that has to do with why Hubble's been as successful as it is, and there's two things that I've heard over the years from people. And of course, I see first-hand as well in my role as a science operations manager, now as the deputy project manager, and that is that NASA did two things really well. They provided ample funding for grants, so that all of the science coming down, there is money to analyze it and make the discoveries from it. It's not just, "Hey, we're going to get it in an archive, and when people have time, maybe they'll be able to pull it out and make some discoveries." There is an awful lot of money that goes in that direction. Right now (again, I'm just rounding some numbers), it's about $30 million a year that goes to the astronomical community to analyze that data.

Then the other thing that they did right was, they funded a full outreach program. All these things get to be shared by the public, with the public, and the schools, and the education system, and lots of times outreach is just an afterthought, or projects want to do outreach, but they don't have the money. This time Ed [Edward J.] Weiler set aside money to do outreach that wasn't allowed to be touched for any other reason, and that's how we've been able to do all these press releases and the museum exhibits for people to come and share in the images and things of that nature.

So I think that those two things are a huge reason why Hubble has been as successful as it is. And if you didn't have those two things, yes, we would have collected all the data, and yes, we probably would have made some of the discoveries, but I don't believe we would have made all of them, because people wouldn't have had the resources to make them. So I think we're happy about that.

The other thing I was going to mention is history. Which is near and dear to your heart, right?

GAINOR: That's right.

JELETIC: As Hubble goes on, we're doing lots of things on the history front. This is one of the main endeavors, and I think there are some people who came up with this and got this idea, including Harley [A.] Thronson, and that said, "Hey, Robert Smith did the book, but that stopped right after launch. Are we going to document this history of Hubble before all the players are gone? And so that just kind of rang a bell. Now I love history, but the project scientists, Jennifer Wiseman and also Ken Carpenter, I think it hit home with them as well, and Pat Crouse came onboard with it, and I think we said, you know, history is an important thing. The spacecraft won't be around forever, but the story of Hubble, we need to be sure that we capture for generations to come just like we've captured the data.

So I think that we've done a lot of things. I think this particular endeavor, which includes the archive that allow people to come and do their own research, I think it is extremely important. We're also tracking down all of the hardware that we returned from the spacecraft to make sure we know where that is, because those are space artifacts. So we're doing that type of thing, and I think it's extremely important. Since I'm a lover of history as well, I feel blessed that I'm allowed to be part of this, and that's one of the nice things about this job that kind of fell on me, and I was like, I'm fine with that.

So it allows me to learn more about the history of Hubble as well, before me and my days were here. And so by looking up all the documents for you and pictures or videos and telling you who you ought to go talk to to find out more about this, because I don't know anything about it, I think that's been a plus, and I think generations will know—they may not know they appreciate it yet. Or even be around yet to appreciate it, but I think the world will be better for it.

GAINOR: Well, thank you very much.

JELETIC: Well, thanks for interviewing me. I appreciate it.

GAINOR: Thank you.

[*End of recording*]