

**JOHNSON SPACE CENTER ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT**

LEROY CHIAO
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is September 19, 2011. This oral history interview is being conducted with Leroy Chiao, for the NASA Johnson Space Center Oral History Project in Boise, Idaho, on the campus of Boise State University. Interviewer is Rebecca Wright, assisted by Jennifer Ross-Nazzal and with Clay Morgan.

Thanks so much for finding time in your busy schedule to sit down and talk with us this evening.

CHIAO: Oh, my pleasure.

WRIGHT: We'd like for you to start today by telling us how you first became interested in being a part of the NASA community.

CHIAO: I grew up in the sixties, and so I was an eight-year-old kid when Apollo 11 landed on the Moon. Even before that, though, as far as I can remember, I was always interested in airplanes and rockets and building models and things like that, but it really was the Moon landing that captured my imagination and made me say, "Wow, I want to do that. I want to be like those guys." So it was something that was in the back of my mind. Of course, everybody back then wanted to be astronauts, all the kids did, but it really did stay with me. I thought about it, but it

wasn't my main focus. I knew from an early age that I liked technology. I liked technical things, and I was gearing towards studying engineering.

It really was when I was getting my bachelor's degree at University of California, [UC] Berkeley, and I was studying chemical engineering, and I came back to, well, what do I want to do? Do I want to go work in a chemical plant? Do I want to go work in a university? And I said, "Well, no, I still would really love to be an astronaut."

Of course, being an astronaut, it's not something you can just plan on doing. It's not like saying, "I'm going to go to medical school and become a medical doctor." So the path that I took was to continue with engineering. I was going to get advanced degrees anyway. I played with the idea of going out and working for while, but my father actually convinced me to go all the way through. He said, "If you don't go do it now, you'll probably never do it." So I did go through and get my Ph.D., went down to Santa Barbara [California], UC Santa Barbara, got my master's and Ph.D. I pursued this career that was interesting to me, but also qualified me to apply to NASA.

WRIGHT: Did you do a lot of background checks or had you contacted the Astronaut Office prior, to know how to steer that path?

CHIAO: Not really. This is back in the day before the Internet, really. It was before it was widespread, and certainly before I was on it. Well, actually the very first time I applied was 1986. I was still a graduate student, and I knew I didn't quite meet the requirements because there's like X number of years of work experience plus X number how many degrees do you have, and I hadn't gotten my Ph.D. yet, because I got my Ph.D. in '87. If I added up and

stretched all my summer jobs and kind of fudge it, maybe I qualified. So I actually did apply in '86.

In fact, I had my application package and was working on my application package when the Space Shuttle *Challenger* [STS 51-L] accident happened, but it didn't slow me down. Just like any of the rest of the country, I was following that, shocked, and trying to figure out what was going to happen in the future, but I went ahead. Two weeks later I completed my application. I did send it in. That application got returned to me with a nice note that said, "Thank you for applying, but you don't qualify yet. You haven't met the qualifications, so finish your degree and reapply." So I did that.

The next year, the following year I did get my doctorates, and I started work at a company called Hexcel Corporation. I was doing aerospace materials processing work; honeycomb, carbon fiber, epoxy composites. Then from there, after about a year and half, I went over to Lawrence Livermore National Lab doing the same kind of work, thick section composite materials. It was at that time, in February of '89 when I was at Livermore, that I said, "Okay, I've got my doctorate now, I've got some work experience, I think I qualify now, so I'm going to go and ask for another application."

I sent the application in, and I have to say, and like I said, those were the days before Internet, so I was at the right place at the right time. I didn't know that NASA was putting a class together that year. I just figured I'd catch whatever cycle there was, and I was probably not—well, I would say I was not very knowledgeable about the process. All I knew was that I was going to put the application in. And, of course, what amused me about the application was, it was a standard form for federal employment, and then in the spot "Position Applied For," I just

wrote in “astronaut.” And they wanted to know how much money I wanted. “What is your expected pay?” I’m like, “I don’t know. Standard astronaut pay.” [laughs]

Then, of course, a very long medical evaluation form, and as was back then, everything was paper. They needed paper transcripts. I remember having to send off to the universities to get them to ship transcripts to NASA. So I put my application in. That was February of ’89, and then over the summer I got a call out of the blue from the Astronaut Selection Office by Duane [L.] Ross. His office called me. One of the gals in the office called me and said, “Well, you checked the box that said ‘Don’t contact my current employer,’ but we’d like to contact your current employer.”

I said, “Yes, you may contact my current employer. I must have missed that box.”

So they said, “Thank you.”

Then I didn’t hear anything else. Okay, that’s interesting.

Then in September of ’89 I got a call, just a call out of the blue again in the morning. “Hey, it’s Duane Ross. We’re looking at your application and we’d like to invite you to come and interview.”

I said, “Oh, that’s great.”

He said, “Well, can you come next week?” He woke me up, actually. It was still early in California.

Just without thinking, because I had tickets to the Reno Air Races, I said, “Well, I’ve got tickets to the Reno Air Races. Could we do it the next week?”

He hesitated and I realized what I’d said. He says, “Yeah, we can reschedule you for the following week.”

I went, “No, no, no, no. Actually, next week’s fine. I can come next week.”

He said, “Are you sure?”

I said, “Yes, I’m sure I can come.”

So I went down to Houston [Texas]. I’d never been to—well, let’s see. Had I been to Houston? I think I had as a little kid, really small, like age six, seven, around then, because I remember going to Six Flags but I don’t remember if it was the Six Flags in Houston.

Anyway, I arrived, and, of course, it was September, so it was still warm and humid, hot and humid. I remember back then coming out of the airport, just being amazed. I got on the shuttle bus and went down to—what was that hotel called that was next to NASA?

WRIGHT: The King’s Inn.

CHIAO: King’s Inn. That was it. I remember getting the key to my room and going in there and opening the door and there’s just this musty mildew smell, because, of course, they turn all the air conditioners off until you get there. And a big cockroach went running across the bed. I said, “Welcome to Houston.” [laughter] Ah, boy, so that was fun.

Then I remember we started right out the next morning—I think it was Sunday, might have been a Sunday morning—with the standardized testing, the psychological battery, and all that stuff. Then I remember we had to write an essay, “Why do you want to be an astronaut?” essay. Back then it was still typewriters. Well, there were some computers. I actually wrote it out longhand while I was there. They didn’t tell us beforehand we had to write it, so it wasn’t that I was being slack about it. I wrote this essay and I made it one page. I just fit it all into one page. Actually, Duane told me later, he said, “You got a gold star for that.” He said, “Some

people have come in here and written literally fifty pages of why they're the ideal astronaut candidate and why."

I went through the interview, as you know, mostly a medical exam, and poked and prodded everywhere. Even the docs, Richard Jennings was there, the head of the clinic back then, and he even admitted to us that, "This is what we love because we get all these people coming through and willing to do anything we want them to do." He was joking with us.

We got through all that, and then the actual interview, as you know, was only an hour long. They had that T-table—well, I don't know if they still do that. They had a table set up like a T and they put you in one of the corners of the T, and so there's always somebody behind you. It was only one-hour long, and it's a conversational interview. I remember people just looking at my applications and papers and asking me, "Oh, how did you like doing this?" Or, "What did you do over here? Can you tell me more about that?" And after an hour, "Okay. Thanks." So it was an interview that I had no idea how I did. I guess it was okay, but, you know.

Then there was PT's [Cajun] Barbecue. At the end of the week there was a party over there, and I figured that's probably where the real selections are made anyway. But I got a real kick out of the whole experience, got to spend some time with John [W.] Young, who was on the committee. Just getting to meet a legend like him was really a thrill.

Then we waited, waited and waited until January. Seemed like forever from September to January, but I got some indication in that as soon as I got back to California, like in a week, they started a background investigation on me, so a guy from the Office of Personnel Management showed up and started. I said, "Well, I'm in the process for a Q clearance [US Department of Energy security clearance] here at Livermore."

He said, “Nope. You’ve got to start all over anyway.” Went and talked to my same neighbors and asked them all the questions. So I thought that was a good sign.

Then in January, I think it was January 16th of ’90 when the selections were made, and I got a call that day at work from Carolyn [L.] Huntoon, actually. Don [Donald R.] Puddy was the head of the committee that year. I got a call from Carolyn Huntoon, which was probably not good news, and indeed, she did tell me, “Well, thank you for applying, but you were not selected.”

I said, “Okay. Well, thank you very much.”

I talked to Duane later that afternoon and he encouraged me to reapply. “You have a strong application.”

So that night I went and planned out the research I was going to be doing over the next year and the work I was going to be doing. I was circumspect about it. I was disappointed, but circumspect.

Then the next morning the phone rings and wakes me up again early in the morning, and it’s Don Puddy on the line. I thought, “This is weird.” He said, “I understand you had a good talk with Carolyn Huntoon and Duane Ross yesterday.”

I said, “Yes, I did, and I’m disappointed, but I’m still as enthusiastic as ever and plan to reapply, and hope I can come into another class.”

And he said, “Well, how would you like to join this class?”

I said, “I would love to join this class.” I really didn’t know what had happened, but accepted, and so he rang off pretty quickly.

Then later on I called Duane’s office, talked to him, and I said, “Well, can you tell me what happened?”

He said, “Well, a spot became available.” And that’s all I’ve ever learned. Actually, I should get Duane out for a couple drinks tonight and see what really happened.

But anyway, I went from one extreme to the other emotionally. I remember coming to NASA and, I guess I came down and found a house, then moved in. I guess I moved down in early July. I guess it was just before the July 4th holiday of 1990. So that was the start of my NASA career.

WRIGHT: It’s good to start in summer. If you can make it through the summer then you’re ready for anything.

CHIAO: Yes, right. [laughs] I remember it was my eighth summer, I think, before [the heat] didn’t take my breath away. After I’d been there eight years it finally was, “Okay, it’s summertime. I remember now.”

WRIGHT: Share with us some of the early training as you prepared and learned more about what you would be doing for your first mission.

CHIAO: Yes, it was an exciting time. Back then the training for an ASCAN [Astronaut Candidate] was a year, because we weren’t doing ISS [International Space Station] yet back then. It was [Space Station] Freedom, and it was still being developed and there was no real training going on, so we were learning about Shuttle, NASA. We came in, the thirteenth group of astronauts. We were twenty-three of us, I think, and, of course, the standard mix of military test pilots, a few medical doctors, a few engineers like me, and a couple of physicists. We all

came together and started training, classrooms, field trips, these bonding experiences, learning to fly. I was already a private pilot. I'd learned to fly in graduate school, actually, taken out a student loan, gone down, taking plane lessons at the local airport, and so it was a thrill to be able to get to fly the T-38s [Talon, jet training aircraft]. That was one of the benefits, I think, of the job.

It was interesting being in that mix of people, because most of my career I'd been around other engineers. Military pilots, they were of a certain—most of them were engineers, but they had a different kind of a mindset, a different feel about them. So it was a good mix. I think we all had a good time.

We called ourselves the Hairballs. I actually came up with that name and that was our unofficial name, and if you look at our unofficial patch, it's got a black cat on it. The reason that we did that was the '84 class was called the Maggots, and they were a very popular class, and so I tried to think of the grossest thing. Since we were the thirteenth astronaut group, a black cat seemed about right, and so that's what I came up with. I've still got a few of those patches lying around somewhere in my house.

After a year we got our Silver [Astronaut] Pins, which I always thought was funny because it was almost like the master's degree. If you're going for a Ph.D., you get a master's degree. A lot of people don't do it, but I went ahead and filed the \$50 filing fee and got my master's degree along the way. The Silver Pin was kind of the same. We had to actually buy our own Silver Pin. It was only \$15, but you get this pin and you're never going to wear it because nobody every wears the Silver Pin. I still have it somewhere. So after the year we went through that.

I was surprised at the lack of ceremony at NASA. There was very little ceremony at the time, and still, I don't think there's much ceremony. I don't know if it's always been that way back in the Apollo days and previous, but there certainly was no ceremony for us finishing our one-year training.

I remember one day we were still in Building 4 North back then and sitting around in the Monday meeting, in the pilots' meeting, and there was a stack of space flight medals, the framed space flight medal plaques or diplomas. Dave [David C.] Leestma was the deputy chief then, and at the end of the meeting—he was running the meeting because the chief was somewhere else, and he said, “Oh, by the way, I've got these space flight medals up here. If you haven't picked it up, come and pick up your space flight medal.”

I was a new guy, and I was like, “Wow, that's kind of weird.” [laughter]

WRIGHT: Tell us about some of the first assignments that you had after receiving your Silver Pin. Were you allowed to maybe suggest some of the areas that you wanted to go into to get more expertise?

CHIAO: Yes, we had a wish list and you could write down your top three choices of jobs in the office. I knew they were always looking for warm bodies in the SAIL, the Shuttle Avionics Integration Lab, because a lot of times, most of the times you ended up working really long hours, but it was good experience because you get a lot of time in the cockpit and running through procedures while you test the flight software and all the changes, run the new batch through the new drop-through to make sure everything's going to work right. I actually put that down as one of my choices; it was not my top choice. I think everybody who was a mission

specialist like me put down EVA [extravehicular activity] first because everybody wanted the chance to do EVAs back then. It was before we had ISS going, so EVAs were few and far between. I didn't get that. I put down I wanted to be a Cape Crusader, too, an astronaut support person over at the Cape [Canaveral, Florida] to follow the orbiters through their processing flow.

Just by the fact that I'd put SAIL down got me SAIL. That was one of my three. I think it was probably my number-three choice, but that's what they gave me, and so that wasn't very well thought out by me. But it turned out to be a good job. I was over there usually pulling double shifts. We really didn't keep accurate time cards. In fact, we were told by the front office not to keep accurate time cards because we were putting in for too much overtime. It wasn't overtime. What was it called? Night differential pay. It was just a few dollars, but it was, "Well, it doesn't look good for us to do that." So we were basically told to falsify our time cards, just check forty hours if the box says forty hours. But most of the time I'd work at least three double shifts and one single shift a week. You had to work till the work was done at night and that typically wasn't until midnight or so, and then get up and you might have a training class in the morning at eight. So you get home, get some sleep, and start your day doing training, and then in the afternoon you start your shift working SAIL. So this is why SAIL was so unpopular, because you really were working very long hours.

I was a single guy back then. In fact, I was a single guy for most of my astronaut career, and so I guess it wasn't as big a deal. Well, it was a big deal to me at the time, but I didn't have a family that was needing me, so in that regard I guess it was a little easier.

But I learned a lot. I learned a lot doing the job. Did that for—let's see. How long was that? Was that one or two years? Gosh, I'm trying to remember now. I'm sure it's on my

NASA bio how long I was there. It seemed like it was longer than a year. It was supposed to be a year, and I think it might have been closer to a year and a half.

Then my next job I didn't put down at all, and it was a crew equipment job. That was also a good educational experience. I learned a lot about how the NASA system works, how these control boards work, and the little things that seem like it should be easy but it's actually difficult. Crew equipment is everything from dental floss to tools. Not EVA tools, but tools you use in the cabin. So it was interesting; cameras, everything. My big victory was some crew members wanted to fly cotton sweaters, and the Materials Safety people didn't want to allow cotton sweaters because they considered it a fire hazard. They were already mad at us because we were wearing these 100 percent cotton polo shirts, Lands' End shirts that all astronauts wear on the ground and in space. They said, "Well, the agreement we had was that you'd wear your Nomex flight jacket over it most of the time."

And I'm like, "Well, I don't know anything about that. I'm a new guy." So there was a big fight about these cotton sweaters, and they wanted to spray them full of flame-retardant material. Of course, that made the material really sticky and gooey and just smell bad. We stuck to it and we finally got it approved to fly these cotton sweaters, and I just had to shake my head that here I'd studied and got my doctorate and I had been doing this research on aerospace materials, and here I am now, this is what I'm doing and I'm fighting for sweaters.

Oh, and unwaxed dental floss. Somebody didn't like waxed dental floss, so I had to go fight to get unwaxed dental floss, and I learned that meant that they had to roll the dash number on the parts list, they had to certify the unwaxed dental floss and probably had to do a flammability test at White Sands [Test Facility, New Mexico], even though it should be less flammable than the waxed one, and that all this stuff that goes into bonded storage. It's a new

part, and each container of dental floss would be about \$600. [laughs] So, interesting times. Education.

WRIGHT: Very much for learning how that system worked.

CHIAO: Right.

WRIGHT: Were you able to work with some of the astronauts that had already been established?

CHIAO: Yes, very much so, in both the SAIL job and the crew equipment job, because in the SAIL job I got trained up by the guys who were there working already and they, by and large, were experienced astronauts who were about to fly. They had been in the office for several years, for a few years. The crew equipment is the same thing; I actually had to go work with the flight crews, and now I've got flight crew members telling me, "No, I want this. Go get it for me." Sometimes it worked, sometimes it didn't. I'd have to either be the bearer of bad news or fight with the NASA system and maybe get it worked out. Now, I had to use my own judgment, too, whether this was something that was reasonable and was worth going to fight for. But, again, it was weird to take a step back and think, okay, this is what all my education is being used for. [laughs]

WRIGHT: The assignments that you were doing, were you also undergoing other training?

CHIAO: Yes, the scheduler, Erlinda [L.] Stevenson, who'd been around for even well before I showed up, and, of course, who just very recently was, unfortunately, laid off at the end of the Shuttle Program, just a few months ago, she was the one that did the schedules. Back then she did them all by hand; they weren't computerized. She figured out you'd have to turn in a pre-schedule of the following week of things you had so I'd know what shifts I was working in SAIL. I'd block those out and then she'd fill up the rest with training classes. Once you got a little smarter on it, you'd start blocking out a little bit of time for yourself; otherwise you'd just get really slammed.

A lot of it wasn't really training. A lot of it was simulator time where they needed a crew to test something, but it might be a sim [simulation] that ran all the way until midnight or two a.m. And then you were scheduled the next morning at eight to work another shift of something else. You quickly learned to try to be a little clever on your pre-schedule, not just turn in a blank one.

WRIGHT: At what point did you learn you were going to be able to be a crew member on a mission?

CHIAO: I got assigned to STS-65. Oh, boy, that was a whole other thing. I was doing EVA training and I think I was showing some proficiency at it in the water tank. I was one of the later guys assigned in my class. Dave Leestma was the deputy chief at the time, and he pulled me in his office one day and he said, "I just want you to know that we appreciate the work you're doing and you've shown proficiency in the water tank, and so get ready to go do some EVAs." He basically was telling me I was going to get assigned to the first Hubble Space Telescope

servicing mission, and I was really quite excited about that. I guess he probably wasn't supposed to tell me, but he kind of did tell me, just as a nice gesture.

I was very excited about that, and my classmate, one of my classmates, Eileen [M.] Collins, she had heard through the grapevine that she was going to get assigned as the pilot on that flight. So we were both at the Cape doing something. I think she might have been an ASP [Astronaut Support Personnel] and I was just down there. Anyway, we were both really happy and having a beer or something. Then I started hearing rumors that the crew for that flight was going to be changed, and I didn't know what that meant.

It turned out that—probably from George [W. S.] Abbey, because he was still very much running things back then—the idea came up that, no, we wanted all veteran flyers on that mission because it was so high profile. They didn't want any rookies on it, at least on the EVA team. So I was wondering what was happening and I didn't really know, but there was an announcement that, “Hey, there's a special meeting,” crew announcement meeting, basically. I went to the crew announcement meeting and found out at the crew announcement meeting that I was not on that crew, and that was quite a disappointment.

I have to say that was hard to swallow, because I had worked hard and I had shown proficiency and I had been told I was going to be on that flight, and then for political reasons or visibility reasons, I guess, they wanted to be able to say that it was an experienced crew if something had gone wrong. They didn't want anyone to be able to say, “Why did you put rookies on that flight who had never flown before?” In hindsight, okay, I can understand that, but it was very disappointing at the time.

Then I did get assigned to a crew. I got assigned to STS-65, which was a Spacelab flight, and that was okay. Because it was a Spacelab flight, it was a long training flow, and they were

typically a year and a half or even two years, or close to two years of training as opposed to a typical Shuttle mission, which was one year of training. It was a double whammy that I didn't get the Hubble flight. I was assigned late, didn't get the Hubble flight, but then I got this flight which was going to be farther out. Looking back in hindsight, it was all fine, everything worked out great, but in the moment, I had to remind myself that, "Okay, you can't be too disappointed, because you got assigned to a space flight, and you're going to get to go fly." So it was okay, but it was just a roller coaster of emotions up and down during that time.

WRIGHT: Then, of course, joining in 1990 and getting to fly in '94, to us it seems like it's a short amount of time.

CHIAO: Well, yes, it is. Now, you look at these poor guys now, yes, definitely. At the time I guess it was around average. People around my time were flying in three and a half, four years on average or so.

But on STS-65, Carl [E.] Walz flew with us. He was my classmate and he was flying a second flight, so he had already flown over a year before, his first flight, and then he was flying a second flight with us. Actually, that wasn't a problem at all, because Carl and I are friends. I was happy for him. But that just showed you that at the time—it doesn't sound like a long time now, but at the time it was a little bit on the longer side of getting to fly your first flight.

But the mission itself was very rewarding. Getting up in space, of course, was the culmination of a boyhood dream to get out and to actually get up there and look back at the Earth for the first time, and being really surprised by how bright the Earth limb was, the sunlight coming through the atmosphere, just different shades of bright fluorescent blue that usually don't

show up on the photographs because it gets washed out by the reflection of the sunlight on the clouds.

I remember also the moment of liftoff. Well, first of all, we didn't expect to fly that day on the launch pad. We went out and the weather forecast the day before said it was really bad. Even that night [there was] lightning, thunder, and the TAL [transoceanic abort landing] sites overseas were a bad forecast, but they said, "We're tanking anyway."

In the morning it was, "Well, weather forecast is still lousy but it's improving a little, but still it doesn't look that great."

So we were totally in the mindset of, "Okay, we're going to get suited up and go out, strap in, and then probably in all likelihood come back, eat a hamburger and sit around for another day or two." But we went out there, strapped in, and they got through the nine-minute hold and they decided in the nine-minute hold, "Okay, well, we're going to count down to T-minus five just before APU [auxiliary power unit] pre-start, so if there's a break in the weather we'll be ready to go."

We come out of the nine-minute hold and we're counting down, and as we approach five, we hear the calls from inside saying, "Okay, Cape weather's just gone green and TAL weather's gone green, so we're going to keep counting." Suddenly it's like, "Wow," and we got everybody's attention. So we counted right down to zero and launched. Ken [Kenneth D.] Bowersox had told me a few years ago when he flew—he was in the class before me—because I was talking to him, he and I shared an office with Ken [Kenneth D.] Cockrell for over a year, and he said, "You know what I felt at liftoff for the first time?"

I said, "What?"

He said, "Relief."

I said, "Really?"

It was hard to understand at the time, but I felt the same thing. At liftoff I felt relief. Because people often ask me, "Were you afraid during launch or scared?"

I said, "No. No." I said, "The only thing I was scared of, especially the first time, was that something was going to keep me from getting that chance, either a medical problem or you get in a bad car accident, or something was going to keep me from getting to go." As soon as those boosters light, you're going. [laughs] It was also, it sounds funny, but I had this stress of knowing all my family and friends were there and they'd be disappointed if they didn't get to see a launch. So, I think at the moment of liftoff it was a moment of relief.

The ride uphill was really interesting, because in the simulator, of course, it's always chaos and alarms and lights and you're working different problems and trying to keep everything going so you don't crash and burn, but on the real launch day, nothing's going wrong. Everything's real quiet and almost peaceful.

I remember the vibration during first stage was a little more dramatic than in the simulator. I remember I was in the MS-1 [Mission Specialist-1] seat, so I was behind the pilot, but I could see the displays up front, but I could barely read them because we were vibrating pretty much during first stage. Then the solid rocket booster tail-off seemed a little more dramatic than in the simulator, and then there's a big bang as the separation motors fire and they separate. It was so smooth and so quiet that just for an instant I thought that the main engines had stopped also and that we were all about to crash, and my eyes went immediately to the main engine tape, saw that they were still three up and green and so we were still going. But it was such a dramatic change in acceleration and sound that I thought for sure that something had gone wrong.

I later asked Jim [James D.] Halsell, who was the pilot—he’s also a classmate of mine; we were on our first flight—if he thought the same thing, and he said he did. He said as soon as that happened he looked at the engine tapes, too, to make sure they were still running. Then get into 3G [gravity] throttling, and I remember I had my books, of course, they were all tethered, but I had them Velcroed on the wall. Under 3G throttling you start getting heavy, and I heard the Velcro of this one book start to peel away, and I thought, “Okay, it should hold. There’s a lot of Velcro there. And besides, it’s tethered.” I was going to reach out and grab it, but we were under 3G throttling, and the last thing I wanted to do was to bump a switch. I said, “I’m just going to leave it alone.” Sure enough it comes flying off and it just snaps the tether, it just breaks off the tether and goes “Bang!”

Bob [Robert D.] Cabana, the commander, said, “What was that?”

I said, “That was just my checklist.” I said, “Don’t worry. It was tethered.” And I look over and it’s gone. I said, “Okay, it was tethered.” [laughs] Fortunately, nothing bad happened out of that.

We get up to main engine cutoff and instantly you’re weightless. For me, it felt like a forward tumble, and then the full-headedness. But it was time to get to work, get the helmet off, get everything. Everything’s all planned out. I’ve got an extra bag here to put the helmet in, com [communications] cap. I was actually surprised how easily I adapted to zero-G. I had a little headache, dizziness, certainly, but I didn’t feel nauseous, and so I was able to go right to work.

My first job was to put the camcorder together and take video of the external tank as we separated from it, and then get out of my suit, and I really took to space pretty easily. But the weird thing about the first mission was we were a Spacelab flight with twenty-four-hour

operation, so my shift was due to go to bed as soon as we got through post-insertion and got everything set up. So four hours after launch, I'm supposed to go to sleep. [laughs] First time in space. I took a couple of Restoril, which was the sleeping med [medication] of choice back then. We had the sleep station because we were a twenty-four-hour operation, so there were the little sleep stations on the starboard side, and we slide the little door closed and you're in your own little phone booth.

I remember laying there in the dark just floating, zipped up in my sleeping bag and I was floating. I knew my orientation with the ship; I was lying on my back. I was so excited, it was hard to sleep, but I tried to calm down, and then the Restoril kicked in a little bit. But I still wasn't comfortable, and I remember thinking, "Well, I really feel like lying on my side. This doesn't make any sense at all, but I'm going to roll 90 degrees," and then I fell asleep.

WRIGHT: That's great. So you were able to work that through. You did have two shifts.

CHIAO: Yes.

WRIGHT: Explain to us about the team dynamics, how you were one crew, but yet you had these two different shifts, and how you worked and how the experiments worked as well.

CHIAO: We had a red shift and a blue shift. I'd have to say my first crew, we were not the most cohesive crew. We were shift-wise. I really don't want to blame anyone, but maybe it was the payload commander set up the rivalry from the beginning, the red shift and the blue shift,

because the mission specialists and the payload specialists were assigned first. So we went through this training with this dynamic of a competition between the two.

I think he meant it to be a good-natured competition, but it really wasn't a competition as much as they were—or we perceived anyway—they were choosing for themselves the good shifts. Like whenever we had sims, it seemed that the blue shift, we were always the 6 p.m. till 6 a.m. shift. But we're all professionals and we were able to work through that.

What it really did was it caused us to really bond well together on the blue shift. It was Carl Walz, Don [Donald A.] Thomas, and myself, we comprised the blue shift. Jim Halsell was part of the red shift because he was the PLT [pilot], but he was a good friend of ours and we told him, "You know, you really should be blue. You really don't belong with those red guys."
[laughs]

WRIGHT: The International Microgravity Laboratory [IML], this was the second time it had flown.

CHIAO: Yes, second one. Right.

WRIGHT: Did you have specific experiments that you were doing that were new or were all of them continuation from what was done before?

CHIAO: No, several of them were new. I don't remember exactly which ones were carryovers from IML-1. I think Biorack was. Biorack definitely was. We had a lot of new Japanese experiments that they had a whole aquatic assembly. I forget what it was called, but we had

some Japanese red-bellied newts, we had goldfish, and we had these little medaka fish, which are like little minnows.

Those were quite interesting experiments. The point of those experiments were to look at the inner-ear systems of the newts and of the goldfish. I'm trying to remember what the medaka fish, if they had—they must have had gravity-sensing organs too. But the newt experiment was interesting because the gestation period of a newt embryo was less than—there was significant development at two weeks, which was the duration of our flight. So we injected these newts onboard to induce them to lay eggs, and then we could study the development under microscope, take photos of the embryos as they developed.

The purpose of the investigation was to see if their otoliths develop normally with the control group on the ground, and, interestingly, they did. There was no difference in their development. The goldfish, some had both otoliths, some had both otoliths taken out, and some had one otolith taken out. Then they would change the lighting to see if the fish would adapt using their eyes, because the fish are used to the sunlight, and then figuring out with their balance system and their eyes to see which way is up in the water. It was interesting to see that the fish were able to adapt, but the ones with one otolith missing, they wouldn't go all the way over, and I never really found out why. I thought that was interesting.

The medaka fish were—I remember seeing a video after the mission, and they were back on Earth and they were all lying in the bottom of an aquarium. Then somebody put some food in and they'd struggle up there, get the food and they'd fall back down, because they'd forgotten in the two weeks of microgravity how to use their bladder system, the air bladders, to compensate and neutralize themselves in the water. Eventually they did learn again, but in the very beginning they were all laying on the bottom of the aquarium. I thought that was neat.

Another experiment had to do with jellyfish, these tiny little jellyfish. We had a group in zero gravity and then different groups that were being spun at different G-levels to see where the threshold was for their gravity-sensing organs. Because the way they eat is they go to the top and then they float down, and then they collect these bits of algae on the way down, and that's how they get their food. It was interesting, just watching the experiments, that it seemed at about one-third G, about .3 or so G, is when they started figuring out which way was up and down.

I remember on entry I was on the mid-deck for entry, and so as we're coming down, the guys on the flight deck were calling out the G-levels as we started entering the atmosphere, .1, .15, .2, and I was moving my head around and I still couldn't feel anything, and right around .3 is when I started noticing, "Okay, my inner ear is working again." I made the comment that, maybe we're not so far removed from the jellyfish.

WRIGHT: How well or how often did you communicate with the investigators?

CHIAO: During training, actually the training session for that mission was kind of grueling. Everybody else thought it was a good deal, and we thought it was a good deal, too, until we started, but we were basically two weeks in—started two weeks in Houston, two weeks in Japan, two weeks in Houston, two weeks in Europe, two weeks in Houston, so our body clocks were just totally messed up. We had to go to all these different investigators' labs to learn about their science, and also to the equipment manufacturers to learn about the apparatus, and then spend time in the simulators to learn how to operate it. So we were constantly on the road and constantly sleep-shifting.

Everybody thought that mission was going to be a good deal because you got to go to all these countries, but we were just, circadian-wise, we were kind of wrecks. And it's not like we got to do anything fun in these countries. We were just going from the airport to the hotel, to the lab, or to wherever we were working. Yes, they took us out to different places when there was a little bit of time or on a weekend, but really it was a pretty grueling time.

Back then, Dan [Daniel S.] Goldin had just become [NASA] Administrator. The week before we started our first international trip, he declared that no NASA personnel would fly business-class anymore, even though we were allowed to by federal regulations. So all those trips, except when we could beg our way up to the front, were done in economy class. Of course, it didn't matter much to Dan; he had the NASA jet he could use. But, boy, it was tough. I was pretty young back then, so I guess it wasn't too bad.

But it was hard, because I remember at one point it seemed like we'd been training forever, and I told Don Thomas, "Hey," and we were in France. I said, "Today we're L-minus-400. We're 400 from launch now, today." We had already been training for quite a while, and we just both started laughing about that. I went back and I said something about that to Charlie [Charles J.] Precourt, who was also one of my classmates, and he started laughing because he'd already flown a couple of flights. I think he'd flown his second flight before I flew my first one. He laughed. He said, "I've never been L-minus-400 in my life."

WRIGHT: But he didn't get to work on all those experiments.

CHIAO: That's right. That's right. It was a very rewarding mission, because you come back and the scientists on the ground were so happy about the results that we had gotten for them, and very proud. It was rewarding that we had done the work that had made those folks so happy.

I remember one experiment, it was a German experiment. It had a cine camera, [16 mm] high-speed film camera, and, gosh, what were we photographing? I think it was a furnace for making metal alloys, and what we were doing is we were putting different heating rates on the samples and they were suspended using electromagnetic fields. We were able to suspend these things in zero-G and be able to control them with these fields, and then they'd melt them and then see what kind of structures formed.

In one experiment they used a cine camera. They used it to photograph high speed to watch it as it changed, as it was heating, and we ran out of cartridges. We did them all. But then they said, "Well, there's actually film onboard, and you haven't trained for this, but we want you to try to change the film out of one of the cartridges." It was for this one German investigator that we really liked.

So, I was in the film bag, and, of course, the danger is first you've got to feel your way around and undo the fasteners to open up this cartridge, and you're doing it with your arms inside of a light bag so that the film doesn't get exposed. You've got to take the old film out that's already been exposed, so you don't want to ruin that, get it into a light-tight cover, get the tape around it, and then open up the new film and then try to get that in there without [exposing it]. In either case, without ending up with a bunch of spaghetti. I was able to do that. They weren't sure that it was going to be doable in space, but I was able to do that. I remember him being so appreciative when we got back down to the ground and we were in Germany for the

debrief, and he was filling me up with a lot of good German beer because he was so happy.

[laughs]

WRIGHT: The mission was seen as a model for the Space Station. It was like a mini space station.

CHIAO: Right. That's the way I like to describe it, is it's a mini space station or a dress rehearsal for a space station, because, of course, we didn't have a station back then. We completed over eighty different investigations in that two-week period, which, by the way, is a lot more investigations than we conducted during my six-and-a-half-month Station flight [ISS Expedition-10].

WRIGHT: Then, of course, you had representation from the different countries.

CHIAO: Right. From all the different countries, yes. The European Space Agency, we had Canadian experiments and Japanese experiments. Russia wasn't a partner back then. Actually, interestingly, while we were training is when Russia was invited to join, so that was '94, early '94, I think, was when the administration chose what was called Option A. It was basically what became the ISS. That was when the Russians were brought in. Those were interesting times.

WRIGHT: If I'm correct, Bob Cabana was able to contact the mayor while you were on that flight. Did they do that through the SAREX [Shuttle Amateur Radio Experiment]?

CHIAO: He may have, with the SAREX. He was definitely red. [laughter] He and Ricky were definitely red. So they may have done that. It's ringing a little bit of a bell. Yes, he may have. I know he was attempting to, but I can't remember if he was successful or not.

WRIGHT: The other that I thought was interesting for you since you started out our conversation by talking about Apollo 11, it was the twenty-fifth anniversary.

CHIAO: That's right, yes, and that was a neat thing, because most of us had wanted to do this since we were kids. My generation of astronauts, we were around that age; eight, nine, ten, thereabouts. So to be flying on the twenty-fifth anniversary of the launch, landing and walk, and launching off the same platform and launch pad, just by coincidence, just the way it worked out. We were originally going to launch off of the other pad, but then we got switched. As we got closer, we got switched to the pad, just for technical reasons, that Apollo 11 launched from. So that was pretty neat.

WRIGHT: You've talked some about the experiments that you did, but were you also conducting experiments with yourself? I think I was reading about a mental performance test that you took, that the astronauts took at the beginning of the mission.

CHIAO: Yes, there were a couple of those PVTs, Performance [Verification] Tests. I remember there was a French one. There was a self-contained little box [with] a crude little LED [Light Emitting Diode] display and you had to try to control the little ball. It would flash these numbers you had to add quickly. I think the results of those tests were to induce a little more stress. It

was funny, because playing with that thing, you get a little wound up and you push on those buttons, and then it comes up with this message. It says something like, “Hey, easy on the buttons,” so you push even harder. [laughter]

I think there was Win-Scat [scatterometer]. I think there was an American experiment too. I’m trying to remember if it was that mission. I think it was on my first mission. There was a laptop-based experiment that I think the military used. I think they might have used it in SAC [Strategic Air Command], I’ve been told, for B-52 pilots to measure their alertness or how they were doing.

WRIGHT: Your mission ended up being fifteen days. Did you have time to look out the window much?

CHIAO: Yes, every chance we had looking out the window, and especially the first time. The thing about the Shuttle flights is we were flying at a time when it was all film cameras, and so you shoot pictures, but you have no idea of what you got, so you tended to bracket your exposures and do the best you could.

The neat thing about when I was flying ISS, is that, of course, it was all digital, so I could download and look at all my pictures every evening and sort through them and pick ones I liked and learn about exposures and what I was doing right and what I was doing wrong.

WRIGHT: Well, tell us about the reentry.

CHIAO: Entry coming down, I was on the mid deck coming down, so I didn't get to see any of any of the fire upstairs and the plasma or anything. But I remember I was in charge of getting everyone strapped in down there, then I was the last one to strap myself in. I had to work it how I was going to do that. I'd take some duct tape and tape the straps to where I could reach them so that I could get them down. So that was all okay.

And like I said, around .3G was interesting when I noticed [the] first awareness of the inner ear again. Then as we came down lower and went transonic, that's when the Shuttle just shudders and sounds like a freight train, just [demonstrates sound]. But, otherwise, entry was pretty smooth. You just slip in the atmosphere. Every now and then there's a little bit of a bump when the plasma comes around and there's a little disturbance, but, by and large, it's very smooth. It was only coming down close to landing when you go subsonic that you get that vibration as you go below Mach 1. Of course, it's windy. The shape is not very aerodynamic, and so you hear the wind.

Then after touchdown and wheels stop, that's when I started feeling—like I said, going up into space was not a problem, but coming down, I started feeling lousy. I remember there was a helmet bag full of water so we could all drink some water. In space, what you do is you hold the straw in your teeth and you just let the bag float around. So I let go of the bag and it plunked onto the ground, and I'd forgotten we were back on Earth. Then I remember when I stood up, when they got the hatch open and it was time to stand up, I unstrapped and I stood up and I felt so heavy. I felt about five times heavier than I expected. Like I said, boy, I sure didn't feel great and I was really dizzy.

It was warm, summertime, so, very hot. The heat suck-back was coming in the cabin, the cabin was heating up, and back then the launch-entry suits we wore had these neck bands to seal

in case you had to get in the water, and so it's very tight around your neck. So that's uncomfortable.

They got me out into the crew transport [vehicle], took the suit off, got into some shorts and a t-shirt and felt a lot better. As long as I was lying down, it was fine, and sitting down wasn't too bad, but standing up was what was provocative. So it was tough. I didn't expect to feel that badly coming back.

WRIGHT: How long did it take you to get back to what you consider normal?

CHIAO: We went back to the crew quarters, and, boy, I just felt lousy. Then the doc [doctor] came in and gave me a shot of Phenergan, and that made me feel a whole lot better. Of course, it also put me to sleep. I slept the whole flight back from KSC [NASA Kennedy Space Center, Florida] back to Houston and felt okay after that. Actually, I did get sick at KSC at the crew quarters, so that helped me feel better. Getting sick, that makes you feel better. Then I got the shot of Phenergan, made me feel even better, and sleeping for a few hours made me feel even better. So by the time we got back to JSC [Johnson Space Center], I was okay.

But Jim and I, Jim Halsell and I, we were both really dizzy, and we get up on the stage at Ellington [Field, Houston, Texas] and we sit down, and he says, "Don't lean your head back." Because I tried it a little bit, and, sure enough, it just feels like you're just totally going over. So we got through that. It was fine. Actually, at that point it was just dizziness, really, because I felt fine and I was sleepy. I was just tired, didn't feel nauseous anymore. I ate a big plate of spaghetti and meatballs, and I just slept, slept for fourteen hours, I think. The next morning, I

felt great, except I was still a little dizzy, and it was the following afternoon that really the dizziness wore off. So it was pretty quick. It wore off pretty quickly.

WRIGHT: After you landed, the work that you did during the mission, did that conclude it or did you have follow-up work that you did with the investigations?

CHIAO: Well, we did our post-flight. Of course, you come down and you've got the medical exams at the different experiments that you signed up for. They'd bring you back in to test you, your balance and they run through the test or to do blood draws or whatever it is. Then we did what I call our victory laps. We went through Europe, went through Japan, went through Canada, and met the investigators and got debriefed on the preliminary results and what they found, and celebrated with them. So, yes, we would get some idea of what they were excited about. The German fellow—gosh, what was his name? [Dr. Johannes Straub] Professor [Straub], he was very happy. All the Japanese folks were very excited. Everybody.

Then throughout the year, one or two of them might actually send us something and send us copy of a paper they published, so it was always neat to see what they had found out, what they had discovered.

WRIGHT: Soon after, you were assigned to another mission.

CHIAO: Right. Pretty quickly I got assigned to my second flight, which was STS-72. That was a great crew. Brian Duffy was our commander. The crew experience was night and day between the two. We were a very cohesive crew. I flew with Koichi Wakata, who is still one of my best

friends. Actually, Duffy, Koichi, and I flew our next flight together as well, on [STS-] 92, and that was all Brian's doing. He picked us to fly with him again. That was also my first EVA, first spacewalk on that flight. Did one spacewalk with Dan [Daniel T.] Barry and one with Winston [E.] Scott.

Dan was an interesting guy. He was flying his first mission and he felt like he should have had my job. He thought he should be the lead EVA guy, he should be EVA-1, and he let me know it. [laughs] Which set up an interesting relationship. But still, the crew was, like I said, the crew cohesion was generally good. There was a little bit of friction between Dan and me for that reason, but we worked through it. It was okay.

But getting to do space walks was a surreal experience, going outside and seeing the Earth. I remember feeling that when I was outside for the first time and seeing the Earth with peripheral vision involved, really feeling like the Earth was a ball. Of course, looking through the window, you know it's a ball, but there's something about looking through the window and then being out there with an unrestricted view that really made it feel like it was three-dimensional for the first time.

We're instrumented when we go outside, and the flight surgeon told me afterwards, Phil [Philip] Stepaniak told me, "Yeah, when you got the hatch open and went out the first time, your heart rate spiked. So then it came down and you got to work." And he said, "Two days later when you went out on the second spacewalk, you opened up the hatch and you went outside and your heart rate didn't change at all." It was like I had already gotten used to it.

That was something I noticed, too, on the first mission, was that view was just so spectacular of the Earth, but then after a few days—and Don Thomas and I talked about this—it's still wonderful, it's still a wonderful view, but I'm used to it. It doesn't wow me. It is still

awesome, but it doesn't feel like, "Wow!" So it's interesting how adaptable humans really are, and you get used to things.

WRIGHT: Before your first mission you had done some training for the EVAs.

CHIAO: Yes.

WRIGHT: Tell us how that changed, preparing for an actual EVA. Now you weren't training to see if you could do the EVA. So share with us some of the training and how long you were in there, and how you were able to prepare yourself so that when you got out you'd be ready to do the assignments that you needed to do.

CHIAO: Yes, it's quite different. The so-called generic training for EVA, you're doing generic tests, like doors and latches, which is a rite of passage, actually, in case there's a problem with the payload bay door latch, you have to use these tools that are designed to get in there and manually crank them down, to crank the doors down to make sure they're sealed for entry.

I call it a rite of passage because what you're using in the water are the real tools, these metal tools that are very heavy. You're in the water, you're not in a weightless environment; you've got to find a way to support yourself and get these tools into place. The tools in the water are old and worn, and you've got to be real careful with them, otherwise they fall out and then you've got to start over. A lot of people can't do it because you simply run out of arm strength. The women especially have a lot of trouble with it because they don't have as much upper-body strength to begin with. So it became a rite of passage to be able to do these latch tools, especially

in the farther corners that were harder to reach. But it was something that I was always able to do.

I have this idea that because I grew up liking to tinker with things, I was working on cars in high school, so I was used to working in tight places and trying to get a tool up here to loosen this bolt or something, and you get into that way of thinking. Some people are just wired that way where you can look at a mechanical situation and figure out where you need to put your body to be able to do the task. I was always able to do that, which is, I guess, why I said I showed some proficiency at it.

Once you get assigned to an actual EVA, then, of course, you've got all these tasks that are planned, and so you work with your trainer to develop the timeline of how this is going to work. We had a lot of trouble with our first EVA—this is the one I was doing with Dan—getting things done inside of the timeline, and I should have been more assertive, but I wasn't at the time, but Dan wanted everything perfect. They had the mockup of the arm in the water, and it was actually driven so it could position you, and he wanted the arm to move him and do everything from end-to-end, and there were limitations. There were mechanical limitations to that. It was difficult for the arm operator to drive you into the right spot. So we got to a point where we were getting less than half of our tasks done. Mark [C.] Lee was the head of the EVA Branch back then, and he came in and he said, "No, this is not right. You guys, you're not doing this right."

Afterwards I said, "Okay, now we're going to do this. Now, here's what we're going to do. You're going to get out of the arm. They're going to position it where it's supposed to be, then you're going to get back in and then do the task. We're not going to sit here and drive from

here to here, because those times aren't real anyway. It's taking a lot longer in the water than it would in space."

So we were able to get through and finally get our timeline down where we could comfortably do it all. Once we had all that down and we could get it done in a shorter amount of time than was planned, we had the right amount of margin, then I knew we were ready to go fly.

The second EVA with Winston, we never had those problems, and I think it was because he was just an easier guy to work with and it was an easier EVA. The second one was less demanding. But both of those EVAs worked out very well. We did it and executed them in space in the allotted time. I think we went over ten minutes on the first one, and then we went under ten minutes on the second one, so it balanced out. But we were testing tools and construction techniques that were going to be used to build the Space Station.

One thing that we found, interestingly, was the electrical connectors, the plastic and the metal became very stiff in the cold in space. So one big lesson learned was the designers had to design enough extra slack in the cables such that you could get enough bend in it to get that connector, because the connector had to line up pretty perfectly to get mated together and then to be able to drive the bale and to latch them all up. So that was a pretty big deal.

We also tested the portable work platform. It was basically a folding cable tray. I'm trying to remember what it was called. But basically it was a hinged cable tray that would deploy to make connections between one part of the Station to another. You deploy these rigid umbilical. But they had fluid and electrical umbilicals in them, and so you would use them to bridge module-to-module on the Station. There were a number of them on the Station. We had to test this to make sure it was a valid construction concept that we could easily deploy EVA and make it work.

We had some toolboxes, tested the body-restraint tether, which was really a great tool, something you wear on your waist and it was a stack of balls with a jaw on it and you could attach the jaw to a handrail and then tighten up that stack of balls with a cable in the middle, so that you were semi-rigidly attached. You could still grab a handrail and move yourself around, but you could let go with both hands and use both hands to do whatever you needed to do because you were attached with this third hand.

That was a big timesaver because before the invention of that tool, which Mike [Michael L.] Gernhardt, another astronaut, that was his idea and he's the one that championed it and got it built, they wanted to use foot restraints everywhere, which meant you had to cart a foot restraint around with you. It's a big, heavy, bulky item. You had to be careful not to bang it into anything, damage it, and had to take the time to plug it into its socket and set it up. We ended up being able to eliminate that foot restraint for a lot of tasks, which saved a lot of time. But for the heavy-duty tasks that you needed both hands to really use muscles on something, you still needed that foot restraint, so we still would have to cart that around sometimes. But this BRT as we called it, body-restraint tether, really helped streamline a lot of our operations. So that was a big thing, a big part of our EVA testing, was to test that concept and show that we were able to do things with it. There were questions on whether or not we'd be able to do it.

WRIGHT: Also did you retrieve a Space Flyer Unit?

CHIAO: Yes, we retrieved the Space Flyer Unit, SFU, a Japanese satellite. It was loaded with material samples that were being exposed to the environment to study the effects, and so Koichi used the robotic arm to grapple that and bring it into the payload bay.

We also deployed an American satellite, OAST [Office of Aeronautics and Space Technology-Flyer] satellite. It was a boxy satellite that we deployed, and then it flew around. I'm not even sure what its mission was. But then three days later we came back and grappled it and brought it back home. I'm trying to remember what it did. Might have been a sample mission, too, but I can't remember. Then, of course, the spacewalks were the highlights for me, but the main purpose of the mission was to bring that Space Flyer Unit back.

WRIGHT: Did you find that the training that you had done in the pool was sufficient for what you needed?

CHIAO: Yes, it was. It was totally different, but totally sufficient. What the pool allows you to do is to get your procedures in your head down, verify volumetrically that you can get to this worksite and reach this bolt, and fine-tune the choreography of, "Okay, I'm going to leave this tool here, because after I do this and do that, I've got to come back to this site and I need this tool again." Also it's important to plan into a spacewalk where you're going to take a little rest. "Okay, here I've got to wait for my partner to finish this, so I've got a few minutes where I can rest." Because working inside a space suit can be physically demanding under the pressure. It's moving your fingers, moving your arms takes some strength, and after six and a half hours, if you're doing some really hand-intensive EVAs, you can really wear out your fingers, and you've got to conserve that strength because you've still got to close the hatch, latch it up, and do all the operations to re-pressurize the vestibule and get back in. You don't want to wear out too quick.

WRIGHT: No, got to save some for the end. That's for sure.

CHIAO: Yes.

WRIGHT: Did you find the suit performed differently with the different temperatures and different tasks?

CHIAO: Yes, it was a little different. It was a little different not so much because of that, but because the water units, they're pretty worn in, so it's like a baseball glove. They're pretty soft. The suits that you use to actually go outside, they're pretty new and they don't have many cycles on them, so they're more stiff. So it's a little harder. So it's a little harder to operate in it because it's more stiff, but it's okay.

But the training really did prepare us for the EVAs. We had a few surprises, but it was nothing we couldn't overcome. By and large, the training prepared us very well.

WRIGHT: I guess training can't prepare you, though, for that first moment of being out there.

CHIAO: Yes, right.

WRIGHT: And having that freedom. Did you have a chance to take that all in?

CHIAO: Not really. You just glance at it and say, "Wow!" And every now and then when you're doing your spacewalk you take a moment to say, "Wow! I'm really out here doing this." It's a weird feeling to look inside the back window, see all your friends inside waving at you, but

they're only three feet away but they can't help you. If something goes wrong, it's up to you and your partner outside to help the other guy back in or whatever you have to do.

WRIGHT: Quite an experience. Very few people get to do that.

I thought before we move on to your last two missions, I'd ask Jennifer or Clay if they have any questions. Do you have anything that you'd like to ask about so far?

ROSS-NAZZAL: Sure, I have some questions for you. Tell us about the Astronaut Office when you first came in. You were a mission specialist.

CHIAO: Right.

ROSS-NAZZAL: My understanding is that it used to be very much a test pilot office. Would you tell us what your thoughts were when you were first selected?

CHIAO: Oh, sure. You know, obviously, in the beginning it was all test pilots from the first through the first several Apollo groups. There were two civilian groups, I believe, in the Apollo times, and there was a real pecking order back then. Less so in the Shuttle era, but it's still very much there, and I think to this day it's slowly changing. Well, it's changed now that the Shuttle's not flying. But when I was there and came in in 1990 through the whole time, it was very much a test-pilot-dominated office. Sure, we were friends with pilots and vice versa, but the mentality was—because the pilots were in charge, at the time the Chief of the [Astronaut]

office had always been a pilot astronaut, before. I think Peggy [A.] Whitson was the first one that wasn't, and the only one that wasn't. She's still Chief.

But Flight Crew Operations Directorates, there were a couple times there where an MS was in there. So the mentality was, well, if there's something really important, we've got to get a pilot to do it, if there was a position. Actually, the most telling decision made that showed that was when they created the XA, the EVA Project Office, and they were selecting which astronaut was going to be the first head of it, and they selected Don [Donald R.] McMonagle, and he was a pilot. Because this was something new, it was important, so of course a pilot had to do it, even though he'd never done an EVA. They said, "Well, he's had some training." So what? He's never done one. Why is he in charge of that office? There were actually plenty of mission specialists who had done spacewalks that were qualified, would have been more qualified to take that job, but they didn't give it to them.

ROSS-NAZZAL: Did you ever feel like you were like second-class, being a mission specialist?

CHIAO: Yes, it's funny because I'd never really spent a lot of time with military people before going to NASA, and then I spent a lot of time with them and became very good friends with some of them. And my friends would gripe. Rich [Michael R.] Clifford was one of my best friends, and he was an Army guy, and he used to gripe that, "Wow, the pecking order, the Army guys are always last."

I said, "No, there's one lower; civilians. We're the bottom of the bottom; a civilian mission specialist."

He said, "Yeah, you're right." [laughter]

ROSS-NAZZAL: You had mentioned one of your classmates was Eileen Collins.

CHIAO: Yes.

ROSS-NAZZAL: Tell us about the media interest for this class of astronauts. It's the first class with a woman pilot.

CHIAO: Right, had a woman pilot in it, yes, and so there was a lot of interest in Eileen. She handled it very well. She was well equipped for it. I had not met Sally [K.] Ride until we served together two years ago in the Review of U.S. Human Space Flight Plans Committee, the Augustine Committee, and actually I found her a very pleasant, very nice person. I'd heard that she didn't handle the media well, as being the first U.S. woman in space. I don't know if that's true or not, but that's just what I'd heard. But Eileen, I observed her and she handled it all very well. She was good in front of interviewers, in front of cameras, and she was a good sport about giving interviews and taking the interest in stride, and not being upset about it, saying, "This shouldn't be a big deal."

ROSS-NAZZAL: What was your experience with the media? Was there great interest in your selection?

CHIAO: Not particularly. Well, among the Chinese-American media there was. Some of the Asian publications, there was, but not nearly as much as there was for Eileen. Well, in fact, we

were selected, we were all reporting, it was our first day at work together as an astronaut class, and Ellen Ochoa was in my class, Bernard [A.] Harris was in my class. One of my classmates came up laughing, and I said, “What are you laughing about?”

He says, “Well, that lady over there from CNN [Cable News Network], that reporter from CNN said to her camera guy, ‘Okay, there are only three interesting ones: the lady pilot, the black guy, and Ellen Ochoa.’” [laughs]

ROSS-NAZZAL: Interesting that you said that. When we interviewed Kathy [Kathryn D.] Sullivan she said that, of her class, the '78 class, they said that there were twenty-five standard white guys and ten interesting people. And nobody was interested in those twenty-five white guys. Everybody else was more interesting.

CHIAO: Right, right.

ROSS-NAZZAL: You also mentioned George Abbey. As I understand, he had a softball team. Did you play on the softball team?

CHIAO: I did not. Our class was the first Shuttle class that George didn't select. Our class and the next class, the '90 and the '92 class, is when he'd fallen from grace. And then, of course, he made his comeback.

Actually, it was interesting. I never dealt much with George at all when I was at NASA, my fifteen years at NASA. Early on, when I was in ASCAN working in SAIL, John Young called me one day and he said, “Hey, I'm going to go out to California, Livermore [Lawrence

Livermore National Laboratory], and see what they're doing out there." This was when President [George H. W.] Bush 41 had called for a mission to Mars. NASA came back with a \$400 billion price tag, so it ended up not working out. But this is when Livermore came in and said, "Well, we can do it for 10 billion," or something like that. I can't remember what it was. Lowell Wood.

So John said, "Well, I'm going to go out there and take a look at what they're doing. Why don't you come with me?" So I did, and we went and got briefed up by them, found out what they were doing. Then I flew with him to [NASA] Headquarters [Washington, DC]—George was there—and met up with Mike [Michael D.] Griffin, who at the time was the Associate [Administrator] for Exploration. So that was my exposure to George. Then I went back, and that was it.

I never had a meeting with him about it, but my next experience with George was when I was removed from the Hubble flight, and I was told through the grapevine that George was the one that said, through General [Jeremiah W.] Pearson, who was the Associate [Administrator] for [Office of] Space Flight back then, that Eileen and I had been removed from that flight.

What's interesting now is that actually I see George quite a bit now. Since I left NASA, there's a lot of overlap of things that we do together. In fact, he's at the [James A.] Baker Institute [for Public Policy, Rice University, Houston, Texas] now as [Baker Botts] Senior Fellow for Space Policy. He's very interested in China, as am I, so we've recently discussed that we're going to collaborate and maybe write some papers together on space policy for cooperation with China. It's interesting that while I was at NASA, even though he was the godfather and he pretty much held the sway of life and death over astronauts, I just kept my head down.

ROSS-NAZZAL: While you were talking about that first mission, I was curious. The U.S. has a very different work ethic, work environment from the rest of the world, and I was curious, when you went to all of these different locations to work with researchers, if you noticed any cultural differences in terms of working, or the way they worked, or the way they wanted you to work on an experiment.

CHIAO: Yes, very much so. Very much so. I really noticed that during my last mission with the Russians, quite a bit of difference in culture that runs over from training to engineering and everything else. But even on the first missions, the Europeans were more like us. Yes, certainly there are differences, but the Japanese were quite different. It was like, "Well, we've got the script and we're going to run with it."

"Okay, we've already got it. We know how to open this door. We know how to flip the switch."

"No, but we've got to do it again today. We've just got to do it." And there's a ton of people in the room. What do all these people do? And they're all there watching. They're all dressed up in these smocks with the flight hardware. It was maddening. It was like there were no changes allowed in real time. It was, "This is the plan. This is what we're going to do."

It was very much a cultural thing, and Koichi and I laugh about it, because that's what makes their society so structured and so orderly, is that everybody just sticks to plan even if the plan doesn't make sense right now. That made us laugh once. We went to a restaurant to eat lunch, and the special was you could get this and you could either choose bread or rice. One of

my friends, he was an engineer and he said, "I want both." So we order and he told the waitress, he said, "Well, I want both."

She goes, "No, you have to choose one."

"I want both."

"But you have to choose one."

He says, "I'll pay for the other one. I just want both."

And she just didn't know what to do. It's like, "But you can't. You can't have both."

[laughs]

ROSS-NAZZAL: Clay, do you have any questions?

MORGAN: I do. Your first mission, you were talking about the red shift and the blue shift.

CHIAO: Yes.

MORGAN: I've got two questions on that. First one, since half the crew is sleeping and half is working, did that give you a lot more space in the Shuttle?

CHIAO: Absolutely did. Absolutely did. Of course, half the crew was sleeping, half the crew was awake, and especially with three of us on blue shift, Carl was up on the flight deck minding the store, and Don and I were in the back in the Spacelab most of the day working away. Of course, we had com [communication] with each other through the intercom system we had, and we had cameras on so he could see us back there. But, yes, it was nice having that extra room.

But you also had to be quiet because the other guys are sleeping, so we couldn't joke a lot and be loud, unless you're back in the lab. If you're back in the lab, they couldn't hear you, but if you're in the actual Shuttle cabin, then you had to be careful not to wake them up.

MORGAN: Then here's the second question on that. Did the commander set it up so that you would eat breakfast and dinners together or did you eat in separate shifts for mealtimes? Or were you just grabbing snacks when you could for two weeks?

CHIAO: No, we actually did eat together because we had a little handover, like the going-off shift handed over to the coming-on shift, so what was going on, state of the lab, state of what was going on. So we had a little handover, and we would eat the meals, those two meals together, but it would be breakfast for them and dinner for us, usually. Not always. Sometimes it worked out timing-wise that it just didn't work for us to eat together. We'd still have our handover, but we would eat together during those shifts.

MORGAN: When you were training for that as red and blue, were you all trained together or were you training separately as a red shift and a blue shift?

CHIAO: No, we would train together. But then when we did the simulations, when we were actually going to do the twenty-four-hour-operation simulation for a couple of days, then we would actually do that, because then the flight control team would break into their two shifts too. This was just Spacelab, so it didn't involve the Shuttle. It was just in [NASA Marshall Space

Flight Center] Huntsville [Alabama] doing the Spacelab operations. That's where we always drew the short straw; the blue shift.

WRIGHT: You ended your second mission, but you didn't have a worldwide tour on this one.

CHIAO: No. Well, we went to Japan because it was a Japanese satellite that we brought back, and so we had a big victory lap in Japan, and Koichi was a rock star. They didn't have many—they still don't have many astronauts. He was a young guy, and a good-looking guy, and he had just gotten married, just before we flew, to Steffi [Stefanie von Sachsen-Altenburg], who's German, actually from Germany. When we were in Japan, she was there for just a little bit and then she left. I think she went to Japan when we were there. They got married right after the mission, so they had a reception in Tokyo and then she left. She went back to Houston, and we continued our victory lap.

I remember sitting in a restaurant one night, and we had part of our payload team with us, so it was Brian and some of the payload team and me. Koichi and Steffi, they were off somewhere else by themselves, visiting relatives. So we look out the window and there's a group of these people, young people outside, young adults, and they're bowing. I'm sitting next to the payload officer, Susan Beisert, and I'm realizing she thinks that I'm Koichi and that she's Steffi, and they're bowing to us, and they're waving and bowing. [laughs] Kind of funny.

MORGAN: Did you just go on?

CHIAO: Yes. [laughs]

WRIGHT: They're probably still telling that memory. "Yeah, we saw them!"

CHIAO: "We saw them," yes. Because they were on TV. They were on TV everywhere.

WRIGHT: That's great. Well, that was quite an interesting first six years of being nonstop. Did you have a chance to take time off, or did you just want to dedicate those first years to moving forward?

CHIAO: Well, actually, I did take a vacation after my first mission, with Jim Halsell, one of my crewmates. We flew a T-38 down to Colorado. Maybe it was Fort Collins. I can't remember. Anyway, he had it all mapped out. We went there, and had a long enough runway for the T-38, had services we needed, left the airplane there, got checked out in a little Piper Arrow, and then we flew the Piper Arrow down to Moab, Utah, and flew all around the canyons. We were going to go camping out there. We tried to get Don Thomas to come with us, but he didn't end up coming. But anyway, we had a ball doing all that stuff. Then we got there first night, and we were going to go camping, and we stopped for dinner, had some pizza and beer and said, "You know what? Let's go to a hotel." [laughter] So that's what we did.

Then we flew down to Lake Powell in a little airplane, flew all around Lake Powell. It was nice. It was nice to take a little breather. But that's about the only post-flight vacation I can remember.

WRIGHT: Sounds like you had many, many full days.

ROSS-NAZZAL: I did have one other question. It's related to the vacation question. Would you tell us about some of the social interactions that you had in the Astronaut Office and the relationships that you had in your class? I understand that until you get assigned to a mission, you and your classmates might do social activities.

CHIAO: Oh, yes, you definitely bond with your class because you spend your whole first year together. We were like a medium-sized class, I guess, twenty-three. At the time it seemed like a lot, but it was a medium-sized class, because some of the other classes later had thirty-some-odd people in them, some of them. So, yes, you definitely bond with your classmates, and then as you go and do your technical assignments, get assigned to crews, then you start seeing less of each other.

But it's just like any group environment, I think. You end up knowing everyone, but then you have this little group of friends that are closer that you have more in common with, and a lot of times it's the people that you fly with, because you train with them and you fly with them. So Koichi is one of my good friends. Brian Duffy's one of my good buddies, and I see him now fairly often, actually, through some business-related things. Don Thomas is a good friend of mine. We flew our first flight together.

WRIGHT: All right. Well, we'll stop for today [due to time].

CHIAO: Okay.

[End of interview]