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ROSS-NAZZAL: Today is September 11th, 2007. This oral history with Kathy Sullivan is being conducted for the Johnson Space Center Oral History Project in Falls Church, Virginia. Jennifer Ross-Nazzal is the interviewer.

Thanks for making time in your schedule to meet with me.

SULLIVAN: I'm glad it could work out.

ROSS-NAZZAL: This is great timing. I just wish it were a little nicer out.

SULLIVAN: Oh, I love watching rain, so that's all right.

ROSS-NAZZAL: Last time we ended by talking about your first flight, STS-41G. We were talking about media interest in the flight, and I thought we'd turn our attention to training for the mission. Bob [Robert L.] Crippen was in the midst of working on another mission.

SULLIVAN: We had an interesting setup coming into this flight. I've heard various things over the years, whether it was sort of a deliberate experiment around seeing how an experienced commander could handle a different training flow, or whether it just was happenstance of how

other assignment factors played out. A standard Shuttle crew of five was named, but Crip was the commander; Jon [A.] McBride was the PLT [pilot]; Sally [K.] Ride was the flight engineer mission specialist with Dave [David C.] Leestma and me as the other two mission specialists. Everyone except Sally and Crip were rookies—the PLT and two mission specialists.

When the flight sequence was first laid out, this was a science flight focused on other NASA payloads. So when this batch of assignments was first made, Crip was already working on or slated to be working on STS-41C, the Solar Max repair flight. The 41G flight, don't ask me exactly where in the calendar it was the very first time the manifest was laid out. Who could remember which version of the change you were looking at? We were slated to fly in mid to late '85.

The priority sequence went first to commercial cargoes, then military cargoes, and finally science cargoes or interagency cargoes. We were behind a whole bunch of PAMs (Payload Assist Modules), commercial upper-stage com [communication] sats [satellites], a number of DoD [Department of Defense] missions, and down there at the end of the rope with the science flights, which was kind of disappointing. I think that's probably also why Dave Leestma was on the flight, because he was being deep-selected out of his class to fly early.

No one likes having to wait longer. They listed a whole bunch of our class's flight assignments, and the good news was you're on a flight, and the bad news was, darn, it felt like it's a long ways away. That circumstance lasted until late 1983 or very early 1984 when STS-41B flew a two-PAM assist flight.

A whole slug of us TFNGs [Thirty-Five New Guys] were laid out on flights, and our flight, 41G, was back in the scope a fair bit until the PAM modules on the PALAPA and WESTAR satellites failed, and that was, I believe, STS-41B. As the agency and the customers

all looked at that circumstance, they said, "We're not going to fly any more of those until we know what happened." When you extracted all the payloads between STS-41B and our flight that had those satellites in those upper stages, it really forced a big rejuggling of the manifest. The upshot of that was instead of flying in early or mid-1985, this cargo moved way up to 1984.

That contributed to putting Crippen in the interesting position of being assigned to the Solar Max flight and having this one coming close on its heels. I might not be correct in terms of the actual sequence of all those events, and I certainly was not privy to all the administrative decisions, so I'm speculating about what all those factors were. But I do know that I went from feeling like it was a long way until we were going to get to fly, to suddenly working our way up the manifest into the late 1984 time frame.

When we finally got all lined up as a crew, Crip was still immersed in STS-41C. That was late '83 when the rest of us were named to the crew. Crippen was already busy training with the Solar Max crew, which was a pretty complex mission, and he was going to have to short-hop from an April 1984 flight into an October '84 flight.

Sally basically was a continuity link in a number of respects, both for Crippen and in very important ways for all of us rookies. We were new to training, we were going to be new to flying, and we hadn't worked with Crippen before. Sally could be a stable point and give us some perspective on all three of those things, which would help us know as we went through all the detailed process development and habit pattern development that comes with training, that we had minimal risk of having to undo some things that we would then have learned deeply when Crip showed up. Crippen also could know that he was going to have a minimal risk of coming in and having to buff some really bad rough edges off of the crew.

So we got under way. I remember I heard unofficially about the flight assignment through a phone call when I was still up on a backpacking vacation, and then officially probably four or five weeks later, so sometime around September, maybe October, of '83.

We jumped into the typical template of crew preparation things. It was all new to me. I thought, "This time through I'm mainly going to be sure I do the template," and count on Sally, who's been through it once, to maybe offer some advice to the trainers or to us about sequence changes or things that could be weeded out of the calendar. Mainly I was in the mode of, "Go through it once and find out what it's about, and the second time, if you get to go through a second or third time, then you've got a different perspective on it."

It's great. It's all the stuff you've been watching other folks do for a couple of years and waiting to get the chance to do. At that point in time there wasn't really a robust set of training hardware for anything other than crews right close up in the pipeline. If you were getting in the Shuttle mission simulators, you were close to flying. In the early days of our class there was enough pressure on the single-systems trainers and the less robust simulators that we didn't get much access to them until we were on a flight.

I think if you go look at the training flow now, you'll find a whole different pyramid of training devices and a rather more formulated approach to taking folks who are still in their early training or in their pre-crew training and being able to give them more robust building blocks, than I recall getting when our class went through. You jumped up a big step when you dropped into crew training and suddenly were in all the single-systems trainers and the more complicated high-fidelity trainers.

Whatever I'd read in books was the extent of my time on the trainers until 41G. I guess we're probably mostly learners by doing; I sure am. I could have sat and read a workbook

200,000 times, but my deep sense that I now get what this means and know what to do with it tends not to really jell until I actually do something with it. It was this really neat huge acceleration phase. I had done some work in the water tank in EVA [Extravehicular Activity] suits.

Actually, I'd only ever been in old Apollo A7LB suits, as I'd gotten plucked into a couple of engineering test and development runs. A typical practice—if you're honchoing the effort on any engineering design or development in EVA—is to get the basics worked out but then go grab some other folks who either are or might be someday EVA-trained and throw them in the tank too. It's a way to make sure that you've not inadvertently built in something that's very particular to you; that you've not over- or underestimated the challenge or the ease of the job for someone stronger, weaker, taller, or shorter than you.

I had a chance to get plucked in on a couple of those in the early years, and I had been working on the Cape [Canaveral, Florida] end of things as space suit integration crew member. I think that started with STS-5, which would have been the first Shuttle EVA but a suit failure halted that walk. So I'd been around the suits. I'd been around vacuum chamber runs. I was pressure suit qualified because of my WB-57 work, so that was becoming a domain I really was pretty keen about. I was delighted when I heard that the flight assignment included getting to go do a spacewalk.

You know, especially for the first flight, I can only characterize all of those months of training as a blur. It was drinking from a fire hose, crazy schedules, sort of high velocity, lots of things going on, very eclectic; it's the world's coolest high-speed eclectic interdisciplinary training environment I can ever imagine, that I've ever been in and I'm sure ever will be in.

The particulars I remember are not so much from the training as from the different crew exercises. I vividly remember lots of goofing around in our office suite together in the summer of ’84, because it was an Olympic summer. It was the Los Angeles Olympics, and Dave, Sally, and I in particular followed a lot of the events pretty avidly. We really admired that kind of accomplishment, so we’d come in almost every day just amazed at what someone had done or pleased with the US result or whatever the particulars might have been.

Joan Benoit Samuelson won the marathon—the first ever woman to do so—and we thought, “How cool is that, and I wonder if she’d like to come to our launch. I wonder if we invited the athletes to our landing, do you think we could meet them?” Just that interest in other people who took on a really, really huge, grand challenge. We were watching them go through their equivalent of the launch, mission, and landing process while we were still training, and I think that just resonated with all of us.

My primary assignment was what’s called the OSTA [Office of Space and Terrestrial Applications]-3 payload that integrated Earth sciences pallet, which included a synthetic aperture radar. The radar had a lot of investigations centered on my original academic training, basic classic geology, and also some centered on a dimension of my postgraduate training in oceanography.

One big part of what I did was make myself a co-principal investigator on a couple of the investigations underneath that payload. Went out and spent a fair amount of time at JPL [Jet Propulsion Laboratory, Pasadena, California] with the OSTA science team at various planning meetings.

They were doing a number of site visits to, in particular, western USA desert environments that they really were using as radar test beds. JPL has used a couple of key sites in

the West—Death Valley [California] would be one of them—as a test bed for the basic science of radar. It's a place you can get to easily. It's very, very dry. It has a lot of different geological materials in a fairly small environment. From a basic research point of view, researchers could potentially understand how microwaves of different wavelengths interact with sand, gravel, clay, hard rock, or consolidated silt on a dry lakebed. They could get that correlation with mapping and then improve the algorithms that process radar images. The goal would be to someday give a pretty direct decoding from the signals the radar actually measures directly into geologic properties instead of going through a bunch of interpretive steps.

So I went off on a lot of those trips for a variety of reasons; to know the team, for one. There was some tension within NASA, I think a Headquarters-JPL-Johnson tension, over whether the OSTA experiments as a group were complicated enough that someone from the JPL science team should fly as a payload specialist, or whether this new critter called a mission specialist, who was designed to be the proxy for complex science teams could handle the payload. Could a mission specialist really do that?

There's probably some cascade through history that resonates all the way back to the Apollo Program, of scientists feeling hard done by because the lunar program came along, and it's mainly an engineering project. They stole your science; they handed it to some flight test engineer, and said, "Don't worry. He'll do it," if they take any at all. So scientists didn't get to go, didn't get to be the scientist, and maybe the guys did a good or a poor job. For people who are passionate about field science, the field site was the Moon and the fact that they didn't get to go was a really crummy proposition. So I suspect there was sort of a heritage of that argument underneath this tension.

I don't remember being given really formal direction about "become a co-investigator," but clearly an integral part of the assignment was really master this payload, master the relationships with the investigating team, and demonstrate that mission specialists were capable of understanding the science. We had mission specialists from a number of different fields; we've got enough diversity of science folks in the corps that we can put someone on a complex payload who's got a relevant background. That plus the competency and the training regime should be able to produce a really good mission scientist that can serve those teams well. We followed one Spacelab mission (STS-9), but that flight had two payload specialists, so we were a little bit of an icebreaker case for this job model of mission specialist as proxy.

It all served me well. I knew a bunch of folks on those investigating teams, because I had kept fairly good contacts in the geology circles, and remote sensing had always fascinated me. My own PhD work had been remote sensing of the sea floor with acoustic and geophysical instruments from surface ships, so this was the space analogy. And who had not been fascinated by every satellite picture you'd ever seen starting from the dawn of the space age?

They became a pretty good close group of working buddies, and as one tends to do, I was involved in all aspects. I was out at Ball Aerospace, where the antennas were built. I was at all the different universities and laboratories where the different instrument packages were being built. This was one of the first pretty complex large structures that was going to unfold in the payload bay, this three-panel antenna, so getting to watch it in action, participate in the testing, and be sure that I knew as much detail as possible about how it behaves, not just what someone wrote in a book for me, was important.

The other really fun discovery—well, it was sort of a discovery. I'd been part of helping earlier crews work up checklists and procedures, and I had built some of the procedures for

checking out cargoes at the Cape. It was really, really an additional dimension of fun to get assigned a payload, like the refueling system payload that I worked on with Dave and the OSTA-1 payload that I had the lead on. Start with a spiral binder of blank pages and know that this was going to turn into a flight checklist that we were actually going to write together. To write it and to go back out to a test environment and check it out; to be working with the guys in the simulators, which I didn't have much perspective on at this early stage of this first flight.

Sally was indispensable at helping both Dave and I figure out how do you drive the interface with the simulator and the payload, because on both the antenna and on the refueling system, we knew more. We, the crew, knew more about how the hardware actually tended to behave than the folks that were charged with writing the models for the simulators.

The whole evolution of really getting to know the hardware as intimately as we did that we now were going to fly, not just hardware I was going to install at the Cape for someone else, but this is stuff we're going to take in orbit was exciting. To get to go to all the places it's being tested and watch it, see it with the teams that were there, to write the books together and then start driving that towards flight checklists.

My favorite story of all of that training and integration actually comes from the SIR-B [Shuttle Imaging Radar-B]. There are two on-orbit stories that root in all of this. One is the first day that we were deploying this sandwich antenna; the whole sandwich was clamped down, so the first step was release the clamps, and then the next was drive each of the two hinges in sequence until you had this nice long planar array.

It was all set up on a set of switches on one of the aft panels, and there was a fairly complex set of feedback switches that would confirm the latches were unlatched. Until those signals were received, you couldn't drive the antenna leaf. So all these interlocks make sure that

you astronaut-proof it. "Don't let the dumb crew drive this motor before you drive that motor. *X* has to happen before this motor can operate, and *y* has to happen before that motor can operate."

We're there. It's time. We've deployed the ERBS [Earth Radiation Budget] Satellite. The next big thing is to get the radar antenna unfolded so these guys can start taking data, and this has everybody's full attention, (a) because it's big and (b) because it's mechanically complex. Crip's is right over my shoulder, because it's his payload bay, and he wants to be sure the Orbiter can go home in good shape in ten days.

Dave was my backup on this, so he's reading the checklist, and I'm doing response. We start the switchology to unfold this thing. We release the latch that holds the sandwich of layers together, and the whole packet of layers just starts hopping on its mount. When we compared notes later, we realized the phrase that flashed through all five minds—I think Jon may have been up forward working with the autopilot. The four of the five minds that were looking out in the payload bay instantly had the same thought flash across our minds, "Tacoma Narrows Bridge."

This is not the sight we wanted to see. Tail end of day one on orbit, first deployment of this antenna. I don't even remember that anybody was saying anything, other than "Oh, my god." It was just one of those aghast moments where everyone's brains are trying to catch up with their eyes and make some sense out of "what are we seeing?" and then quickly get to "and what do we do about it?"

I'm watching the indicators on my panels that show me whether these *x* and *y* and *z* interlock switches were set or open. They're flapping, because this whole thing is hopping up and down on the switch.

And I just—this was more intuitive than conscious, and happily it was correct intuition—at some moment I realized when the package landed, I could start driving one of the leaf motors. So the next time the package landed, and the *x* interconnect switch was done, I started driving one leaf open.

That turned to be, happily, the right response, because there was just a little stored energy. The sandwich stack had probably not seated as far down as they thought, and they probably just pushed on it to seat the latch on the ground, not thinking that when we let it go, all of that stored energy was just going to oscillate on that hinge with no friction to damp it out and no real way that you could damp it out.

So I was correct in my intuition and the switch I picked to start driving when it next landed; it steadied right back out and unfolded the rest of the way just fine. For a while there were eight big, wide eyeballs and gaping chins there. So that was one of the training exercises feeding forward into our flight.

The other one had even more of an amusing, to me, preflight root. There's the normal operating checklists, the sequence of steps you're planning to use to link up with all the different operations that are built into your flight plan. Then there's what's called the malfunction procedures checklist, which is the flow chart that you use, basically, to remind you and guide your logic if you've observed a signature that wasn't expected. Again, we played a central role in writing these at this stage of the game. On a payload like this, a one-timer, part of my job as the lead crew was to be right in the middle and intimately involved with writing those lists.

Well, this was very dull to the JPL guys. In fairness, they had to get their own console procedures written, participate in training, and get everything else done. They were focusing mainly on getting everybody ready to do the nominal taking of the data, the things they wanted

done. This pesky kid from Johnson kept coming out to California and saying, "I need this flow chart. We need to finish these flow charts."

Maybe on some level there was a bit of passive resistance about my role as mission specialist, "If my guy was going along, we wouldn't need these flow charts. It's just because you don't know enough." I think it was just the flood of events. We're getting down to where my checklists are going to freeze. They're going to go into production, and nothing is going to change. There are all these little logic flow diagrams that trigger your actions based on different observables. Is the temperature greater or less than the value? Is the switch in the on or off position? And similar kinds of things.

So there were a few of them, probably four or five of them, that particularly had parameters that came from within the instrument—the temperature of an optical recorder, voltage at a certain point. I could tell as I went through them, and I could tell as I sat and talked with folks, that the numbers that were in my procedures at all those branch points were not quite yanked-out-of-the-air numbers, but not really very thoughtful numbers.

Maybe there's a manufacturer's recommended operating number, but not really a thoughtful consideration of, "If this instrument's in orbit for the only time it's going to get in orbit, and it's your last day to take da da da, is that really the temperature that you would shut down at?" What do we really know about how it operates? The operating team, I think, just hadn't made themselves sit down to that point.

I finally put my foot down and called the PI [principal investigator], and after a big, long integrated simulation—everyone's in town for like three days—I told them, "None of you guys are flying home until the middle of the next day. We're going to break at one o'clock or two o'clock. Y'all are going to be at my house at six o'clock. I'm feeding you, we're doing

malfunction procedures, and no one leaves my house until they're done." I just trapped them in my house, and I nailed them down on key points. I had identified the key places where I was most certain that there were fairly bogus numbers, and then started playing scenarios on them.

I remember specifically this one malfunction procedure about the one recorder that recorded things on a filmstrip. There was a temperature sensor wired to our caution and warning panel to go off at a certain level. In our flow diagram, if the buzzer went off, you came to the flow diagram, and it had you check the temperature more carefully, then go to a "turn it off" direction if it was one value, and go to a "we don't care" direction if it was another value.

I started hammering them on that number and playing scenarios like, you know, "Really, no kidding, what does this number mean?"

"Well, it means there's not a 200 percent probability that the film was perfect."

I said, "Okay, fine. What percentage do you really care about?"

"Oh, you know, we'll take 2 percent."

"If you're in a lab and you're running the optical recorder, what's the temperature that you're actually scared you're going to burn the lab down?" We just played games like that to flesh out other numbers.

We widened the range. I don't remember what the first numbers were. We widened the range on that parameter by something like a factor of two, but I also could tell that was about as much time as we could put onto that argument. We had others to do. It was clear from the discussion that even the new number on the high-temperature side was actually nowhere near anything that would jeopardize the hardware. It was still a very, very cautious number.

I had learned a lot, and we had a more robust checklist. So we let it go at that. We got all of them done; put the requirements in the list.

So it's like day four or something on orbit, somewhere in the flight, and Sally, Crip, and I tended to sleep up on the flight deck; Crip sort of lolling in his seat, and I liked to be up by the aft windows. Sure enough in the middle of the night, the caution and warning alarm goes off, and we all wake up. I hear my commander saying, "That's yours."

I float up, and I look at the site map for where we are in orbit. I looked at the parameter, I looked at where we were, and I thought about all the site objectives, which I now knew pretty well by heart. This is in the olden days, so I think not all the TDRS [Tracking and Data Relay] Satellites were up. So we actually were not in contact with the ground. We're seeing this; the ground is not.

He said, "So what have you got? What do we do?"

I read the checklists. I said, "Yes, it's the optical recorder temperature; it's tripped the high limit. The high limit is only 100. That's well shy of anything they're actually worried about. They've got one of the highest priority passes coming up in *x* number of minutes."

He says, "So what do we do?"

I said, "I'm going to raise the limit to here. That will let the pass run. We'll come up AOS [Acquisition of Signal] and into ground coverage again. They'll see that it tripped. They'll see that we raised the limit. Mission control will force them into new discussion of what the limit ought to be, and they'll set the actual limit that they need to operate with for the rest of the flight. But there's no jeopardy to the instrument. There's no jeopardy to the recorder, and this is a high-priority pass."

So that's what we did, and that was fine. I went and checked the next morning, and they had doubled the limit again. [Laughs] That was the right answer. That's what my enforced pizza party at my house got me.

ROSS-NAZZAL: Who were you working with out at JPL?

SULLIVAN: Charlie [Charles] Elachi was the principal investigator. He's now the director at JPL. And Diane [L.] Evans was—I won't recall her position. I think she was just a project scientist on one of the experiments at that time. She's still at JPL, the deputy director or one of Charlie's key lieutenants. JoBea at the time—Cimino was also on it. The other guy whose name I'm trying to remember; it will come back to me.

There was a really, really sharp guy who was the digital data recorder guru at the time, he was just amazing. Very young; very smart guy, who subsequent to that spun off that digital radar recording technology into a highly successful company of his own and has just done fabulously well. It was a really neat group of folks. Jim [James W.] Head, planetary geologist, was on board doing some investigations, again sort of cross-calibrating radar signatures over Earth features with those observed on Venus. He'd make sense of those signals. Hal Masursky, I think, was still involved.

It was a neat group of folks to go out into the field with. I had a great time. I think we all really did have a good time. From where I sat, the mission specialists debate, if there was one on that one—other than desire and prerogative—I think on a competency and delivery level, we more than delivered on that proposition. It was a pretty neat thing to get to be involved with.

ROSS-NAZZAL: You brought up a couple things that I was curious about. You had two payload specialists on board this mission.

SULLIVAN: That came much later.

ROSS-NAZZAL: What was the reaction among the astronaut corps about including people who weren't officially astronauts on missions?

SULLIVAN: I think the reaction was probably about as varied as folks in the astronaut corps. It's not homogeneous by any means. I've often wondered if the guys who were astronauts—Mercury, Gemini, Apollo vintage astronauts—before our class arrived, if they didn't feel some of the same sort of thing about the arrival of mere PhDs and other crazy people into the astronaut corps when we showed up.

There's been at least one book written by one of my classmates that suggests that some had some of those feelings. They were pretty sure what the definition of "astronaut" was, and at least initially, they were pretty darn sure that people like me (women) didn't fit that definition. They were affronted that this great title they had earned was now being discounted and given to other folks, and maybe worried about what a burden we would be on them. I think there's probably a variation of that that's stronger and weaker for different people.

My own experience with the payload specialist question in the 41G time frame had all of those dimensions. One of the guys who was a payload specialist was an American who had not cut the mustard in our selection. He'd been a candidate, but he hadn't made the cut. He goes and flies before almost anybody in our class. He flew on STS-9. Some our guys had flown, but a whole bunch of us hadn't.

So, you make a choice. You can tie yourself into knots over, "I won out over him in the heat to be an astronaut, but he gets to go fly before me. I don't like this, because I want to fly

first; I want to fly soon; I want to fly a lot. I'm not happy that anybody gets to go in front of me, really." That's present, and it's kind of shallow, small, and silly, but it's also very human when you're working that hard, investing that hard, and competing that hard for something you care about that much. Very natural human reactions to at least feel and be aware of.

So payload specialists had flown. The first two flew on the Spacelab 1 flight. Those were guys who had been closely associated in very rich detail with the instruments on that set of cargoes for a long time, and I think in that case and now obviously on my third flight, I thought I saw a really good pairing of someone whose primary expertise was the instruments and learned a little to a fair amount about the Orbiter with someone whose primary expertise is the Orbiter and learned a little to a fair amount about the payloads.

You put one of each of those guys together as a pair on a shift, and you've got a pretty good package of great depth and the ability to really work effectively at that interface. It struck me as a strong analogy to the working dynamics I'd experienced on oceanographic ships. I was scientific party; I wasn't ship's company. I knew lots about my investigations and the equipment I was bringing aboard and, because I always liked to learn those things and it's who I am, I always tended to know a reasonable to fair amount about the ship.

But I sure didn't know how to handle the ship like the chief mate, and I didn't know how to work the deck like the boatswain, and I sure didn't know all the ship's wiring and tolerances for system loads like the chief engineer. You either fight about that or you make a good partnership out of it, and I'd always liked crafting those partnerships on the research cruises.

The guys who came aboard our flight late, very late in the game, again I'm—you always want to check me on dates.

ROSS-NAZZAL: I can always check.

SULLIVAN: Yes, check the date. But it was late.[1] It was well inside all milestones that you've heard other crews go through. You know, L (launch) minus six months, these responsibilities drop away. L minus three months, these responsibilities drop away. At this point in time no one changes anything. All of those things that are in place to let everyone stabilize and get some focus were waived to add the payload specialists to the flight. A Canadian and Australian attached to the Office of Naval Oceanography as a civilian are added to the flight.

We had our mission patches. We had our crew photos. We are way down the road. The patches are made. They're not even just designed; they're made. They told us how many thousands of them they've already produced, and now we've got these other two guys.

On a human and a crew level I'd already been through the experiment of training as a quartet without a commander; we had confidence in how we were approaching it, but there still was some tension of, "Is this going to work?" Crip has now joined us, and it's proving out to be okay. He's adapting well. Those of us that didn't know him, our rapport is growing. I really felt like we were coming together as a crew. This is probably around the June or July time frame.

You can feel that we're coming together as a crew. I'm still a rookie. I feel like I know what I know and where I am on knowing stuff. But I don't know the milestones. "Is it supposed to look like this at this point in time? Is it supposed to feel this way? Should I feel twenty times ahead of the game on this?" You don't know. I didn't know how to interpret the milestones and signals I felt, saw, and interpreted, so I just kept charging ahead.

[1] NASA announced the inclusion of Paul Scully-Power as a member of the crew on June 29, 1984. The agency listed Canadian Marc Garneau as a crew member at that point, but JSC released no announcement when he was officially named to the flight. http://www.jsc.nasa.gov/history/roundups/1984.htm

Here come two guys out of the blue. One of them, the ONR [Office of Naval Research] guy, had sort of been around astronaut circles for a while, but he's now on the crew with some set of tasks to do. We're the NASA crew for this flight. At the end of the day we're going to be responsible for mission success. We're going to feel responsible, if we're delivering full performance and success, for everything that's on our mission, period.

I thought to myself, "The fact that some of the experiments were added way late, and some of it is allegedly going to get done by you (the PSs), we'll find out if you can do it. But if you can't…" it sort of implicitly felt and was taken, certainly by me, "whatever they added with you in obligations were added to the crew's obligations. All those obligations will be met before we get home. Either you'll do them or somebody's going to cover for you, which is how a crew operates." We'd cover for each other if one of us were sick for a day or two and so forth.

I just went through all of the vagaries, uncertainties, and blur of marching down this preparation path for a flight, and just getting to this point, where I felt like I can see this now. "I think I can see the last stretch of this road, and okay, this is going to be okay." Bam! [Gestures] "Here's two new guys, a list of stuff that's got to get done, and nothing is taken off the rest of the crew obligation list." This is just all additive. "Go get it done."

It was disruptive. It was uncomfortable. I was personally just settling into this crew, and I didn't like to have to disrupt and reassimilate somebody else. I felt like the standing that we were building, that I was building with the whole JPL and Earth sciences community was pretty stable and jelling, and then here comes this other guy who's being advertised as "the oceanographer." Excuse me; I have a PhD in this subject. This guy has a bachelor's degree.

It was just an uncomfortable moment. I did not in all respects act as my best and higher self, I would have to say. I hope I didn't throw any public tantrums; I don't think I did, but I probably didn't.

ROSS-NAZZAL: I didn't read about any incidents.

SULLIVAN: It was not all around comfortable, and I think we were all at some degree miffed at being discombobulated; a certain typical Headquarters-to-field center-organization blow up. I was a bit miffed and probably thought that "the big bosses at HQ waive anything they want anytime and never worry about what happens on the front lines."

I'll bet my folks at COSI [Center of Science and Industry] said that about me a few thousand times when I was CEO [Chief Executive Officer], so that's just kind of the normal "looks different from where you sit" kind of thing.

But, there you are. We've now got them on our crew. We had to learn each other and get to know each other. Just like with everything else on the flight, one or the other of us is going to jump in and know what the other one's doing so we can back each other up and be sure we get it all done. Marc Garneau and Paul [D.] Scully-Power are two very different guys with two very different sets of things to do.

The other thing was this was the first time seven people were going to be on an Orbiter. It was the first time without a Spacelab module—with everybody working inside the crew module. So you really didn't have anything like the logistics, stowage, and crew coordination challenges as we were about to face with seven people inside the crew module. "We haven't

thought any of that kind of thing, and launch is how many days away?" Those kind of factors were present. "We're doing this why? How come we've got to do this?"

The funniest thing that I remember, probably one of the first really good all seven people laughing together we had about that was somewhere probably around our dry countdown. We're all down at the Cape for the TCDT [Terminal Countdown Demonstration Test], and there were a lot of other training events around that that the whole crew was supposed to do. Somebody had rented for us a very new automotive creation called a minivan. This is the first year of Toyota minivans. It's Florida. It's August or September. It's hot.

We finish one of these evolutions, and we all pile into this van. This is cool. We hadn't seen one of these before. Crippen's starting up the engine, Sally's playing with the front air-conditioner, and the rest of us are in the back. There's side-seat air-conditioners, there's a built-in cooler, and there's all sorts of stuff. Switchologists that we all are, we're all goofing off with all of these gadgets.

In short order Crippen has the motor going. The main air-conditioner is on high. The rear air-conditioner is on high, and whatever blower or air-conditioner fed the cooler is on. Crippen puts the car in gear, and there is not enough torque left in the motor to move the car with seven people in it. We start selectively powering off compressors until we had enough torque to move the car. That might have been the time that Crippen really first realized what he was in for with this crew of seven. At the time they both came aboard, that's my main recollection.

Marc Garneau, early on, put it best of all. He was just, as Marc is, clear and candid but gracious about it. I don't even remember if all of us were there or some of us were there. He's a Navy guy, and I think being an operational Navy guy gave him an additional appreciation of this. He could imagine if he were sitting in our seats (the professional astronauts), it would be

upsetting and disconcerting, and that he'd be annoyed at least to have to deal with this disruption. He couldn't change any of that, he hadn't created it, and he couldn't make it go away. But he was now charged with some things for his country on this flight, and he was just going to go get them done the best that he could.

He explained, "I don't know what else I can say other than I've got things to do for my country, too, and that's what I'm going to try to do." So that's what we all did.

ROSS-NAZZAL: Were there ever any parallels made between you and Harrison [H.] Schmitt? I read that you were the first geologist to fly since Apollo. Was there any of that discussion going on?

SULLIVAN: Not in our crew. You know, where else there might have been, I don't know, but not in our crew. I have always been envious of Jack, because he got dust on his boots. I wasn't going anywhere that was going to put dust on my boots. Way too close to home to do so. Well, I could get interesting dust on my space boots if I wore them out in Death Valley, but not the dust that would count. The dust that would count has to me to be grayish-white dust or red dust.

ROSS-NAZZAL: Why don't you take me back to the day of launch and what happened from the time you got up until you were in orbit.

SULLIVAN: Day of launch actually starts the night before, at least it did for me. You've gone through all of these events, and you've really replicated them quite precisely during the dry countdown about a month before, with someone by your shoulder walking things through and

talking things through. At dry count you're just trying to get the pattern and remember key things.

Because I had worked at the Cape, I had seen lots of countdowns. I had seen the evolution with the crews, and I knew outwardly all the events, but as I was going through the dry count on my own and launch countdown, I was so absorbed in the details that we were about to go do. Having lived through it as a Cape Crusader on goodly portions of five flights, it was almost like I was now the focus of was this vague movie that I was moving through.

It was really pretty interesting. I wasn't thinking and working any of the details that I had been so aware of when I worked at the Cape. I was just on this other thread, and it was sort of strikingly different to me to be doing it rather than shepherding and orchestrating for a crew member. I always felt like there was somebody perched right on my shoulder reminding me, "Now, remember, this is what's going to happen," and I realize, "Yes, I know that. I remember that. I know that." Just an odd mix of very detailed and very vague.

For me, the night before the real launch was when I started to really be aware that I'm now going to go do a set of things in the next twelve hours, fourteen hours that I've watched and been a part of for five other Shuttle crews, and I just did myself thirty days ago. I'm going to do them again. On one level, it's going to be identical, very familiar, very simple, and on another level it's all different. It's almost amazingly, bewilderingly, kind of surrealistically different.

I change out of my day clothes and hop into my jammies to go to bed that night, and I'm consciously putting things by a kit bag. Thirty days ago I did the same thing, but the kit bag was on this bed again when I came back four hours later after the rehearsal, and I took it home. "Oh, that's right; I don't see this again until an abort landing site or Edwards [Air Force Base, California] if we divert or back here." It's almost like this tear opens up in the fabric of what

you've done and known before. You're walking off on one side of this bit of a chasm, and the whole rest of the world that you've always known is going to be on the other side of it, but you're doing things that you've done before. It just struck me as really neat. I'm doing exactly what I've done before, but all the outcomes are going to be different this time.

Go to bed, get up. I do the routine with the docs [doctors] and go in and do the ceremonial little breakfast and sip of coffee. Again I'm doing just what I've done before. The last time the TV crews weren't really there, or one TV crew was but not everybody. The last time the whole world was not actually really watching outside. The last time maybe I ate more breakfast because I was going to go do slide wires and a bunch of physical training.

This time I want to be sure I'm taking my best bet on how am I going to adapt to zero gravity. "Do I want a full stomach? Do I want a lot of liquids?" I don't know. I haven't done this before, but I'm going to place my bet and give it a shot.

All these events and all these actions are so familiar. You've watched them. You've been right alongside of them, even done them, but this time all the outcomes are different. That first time I just remember being so aware of that fact. The two tracks were separating, but I was unable to put any more detailed imagining onto what the new track was, because I had never done it before.

You march out from the crew quarters. We didn't dress in pressure suits then; it was shirt sleeves. You march out from your crew quarters to get in the van. Even at dry count they had some folks out there, but this time around Crippen and everyone else was even more thoughtful about, "How do we want to walk out;" you know, Crip go first, and who's next, and it was a little more like that. Sally or somebody shoved me up in the front and said, "You're the new thing on this crew. You get up here." Off we went.

You drive out to the launch pad. You've done that before, but now the whole causeway is different. You're the only vehicle out there, and the few folks that are on the van with you are the management folks, and one by one they get off. They never really did that before. You pass that last checkpoint at the launch control center, and there's nobody in this van except you and the one guy that's going to help strap you in.

You drive up the ramp to the launch pad, and you've done that before, but not ever actually at your own launch time. I always used to go out when I was at the Cape and look at the stack after they pulled the RSS [Rotating Service Structure] back. If you worked on the vehicle all the months leading up to a flight, it's like working in an electrical utility building, and inside a big structure with complex machinery inside a big structure until they rolled the RSS back.

I would always go out to one of the causeway areas just a couple of hours after rollback, and just sit there and stare at the view, because for the first time in all the months that you've been working on it, it's not an electrical utility building; it's a spacecraft. They've got the xenon lights on, and it's just this diamond sparkling. It lights up the whole dome of the sky, and the Orbiter just jumps out at you. It was just magical. Suddenly you could see this magic little thing that was going to race off the planet the next day. You'd never seen it that way before, and it wouldn't last for many hours, and then it would leave.

Now I'm driving up the pad ramp, and it just, to me, anyway, takes your breath away. The van starts up that ramp. It's the first time that everybody in the whole van can lean out and see not *the* Shuttle but *our* Shuttle, our cargo, our stuff, our gear, our turn. On every one of my flights, somebody said, as we went up the ramp, "Okay, guys, we've done this before, but this time we're not driving off the pad." This time we're not driving off the pad. This time we leave vertical.

It just continues this parade of things that are very familiar. You've done them before. You can do them in your sleep, but all the outcomes are going to be different this time through.

I used to love to get out on the swing arm, on the axis arm, around tanking time on the flights that I was supporting as a Cape Crusader, because the vehicle is just alive. Once the propellants are aboard, things are creaking and popping as they shrink down with the cold, and fluids are venting off everywhere, hissing through the different valves. I would stand out on the axis arm, absolutely mesmerized.

On some of my Cape Crusader flights I remember having the impression that this vehicle is alive, and it wants to leave. It just wants us to finish this stuff up, and it's like a horse in the starting gate. It's ready. It's full of energy. It's loaded, and if y'all will just pull the damn gate loose and let me go, you know, I want to go. I almost feel like you can hear the vehicle saying, "I want to go."

Now I'm standing on the axis arm and going to hop in and going to actually get to go. It's very real, it's very focused, it's very concentrated, and on some other level it's also surreal. The phrase that just came to mind is that great Gabriel Garcia Marquez' genre of magical realism. It almost is like that magical realism; it's both things at the same time.

We strapped in. I was on the flight deck for launch. Dave was down below. That was just a coin toss; I think we flipped coins. Paul and Marc were down below. We just get all strapped in, and there's not much for a crew to do for most of those two hours before launch. We joke, and I just went into relax and quasi-meditate mode. Follow the checklist, listen to what's happening, but only Jon and Crip really had anything to do, and that doesn't start till around twenty or thirty minutes before liftoff, and even then it's not that many things. Configure the computers, a little bit of flight control, environmental control, valve checks, power

switchovers, and the APU [Auxiliary Power Unit] start, and then just pop the visors down and go!

I don't remember feeling the engines gimbal on that one. My antenna was scanning for all the things I should be seeing and feeling, so I don't remember feeling engine bells gimbal on that one. I felt them on the other flights. From all the simulator runs, where you see one normal takeoff at the beginning of your training flow, and you see one normal takeoff the last run before you go to the Cape, everything in between has nothing normal about it.

As a rookie, you know the reason it's set up that way. You know that that's not likely what's going to happen, but still you're so patterned and so that's all you've ever seen. I just, as we went inside of twenty minutes, kept following all the milestones and thinking of all the different gremlins that have come up in all those milestones in the sims [simulations], and waiting with almost bated breath for each one of those markers to be behind us without someone having found something, without some indicator having tripped. It's kind of like—not to trivialize something more severe—but picking through a minefield. There are still mines ahead, but you start to know you've also left an awful lot of them behind, and you might actually get through this field.

No mistaking, no mistaking when you're finally going. When the solids hit, that is just a really, really sharp push in the back of your seat. Not bone-crushing and not oppressive, but solid, firm, abrupt, a very sharp start to it. Then it's like being embedded in a ball of energy. You know, huge, huge vibration spectrum, tons of noise.

Now, I was glued to the instrument panels, quite a peripheral role as the fourth person on the flight deck, but nonetheless, and probably as my rookie nervousness watching the panel. That was the interesting thing to watch. Looking out the front, I knew the sky was going to turn

to black pretty quickly, and we were launching predawn, so there wasn't going to be much light out the front.

Then it's all new. Those two tracks I've been talking about dividing, now I'm firmly on the other track, and this is all different than it's ever been before in just extraordinary ways. Again, part of me is just absorbing it all in kind of blur mode, and part of me is still following the checklist, hearing things go, and realizing where are we at. We're on speed. Things are good. Are things looking nominal? Nothing has gone off; nothing has gone wrong. Staging was nominal.

I remember it was probably around six and a half or seven minutes into the flight, so well up into second stage on the mains, just before the three Gs came on, so not the max G-force. It was just realizing this very firm push on the back of your seat, which, remembering your physics, if you can still feel your seat pushing into you, it's because you're still accelerating. To realize this is an impressive level of acceleration, and quickly after that realizing it's gone on a long time.

It's one and a half to two, two and a half, Gs most of the powered flight. If you've flown little airplanes, if you've flown jets, if you've flown a spiffy car and punched it off a stoplight, much less if you've ridden roller coasters, you've felt that before. You've felt it. In many roller coasters you probably felt it from the top of your head towards your spine, and in a car or airplane you've felt it across your chest like we were.

So you've felt, it, but it's always been instantaneous, a fraction of a second. It was just so impressive that that level of acceleration that is always some big, dramatic event in earthbound transportation and fades pretty quickly, that's what I was experiencing. It was just going on and

on and on and on like some giant had the back of my seat. It was just continuing to accelerate it out of the atmosphere.

We hit tail-off. The three-Gs phase was pretty well as expected. I just remember being more aware than I had realized, but again there's no way we'd actually really simulate this in the sims, and at that stage we were not sending crew members over to centrifuges to ride an actual three-G profile.

I knew technically what our flight path angle was, but I was feeling our flight path angle, because when we hit the three Gs, it's not directly transverse to your chest, but slightly up from your abdomen and up towards the back of your chest. So I felt myself lift into the shoulder straps, and I could feel my diaphragm lifting up.

I hadn't thought about the compression on my lungs and the extra sort of attention that would have to be paid to breathing normally until I actually felt the diaphragm come up. Then it all quickly made sense, and you adapt. "Oh, that's interesting. That's right. Okay, breathe, breathe."

So the engines cut off, I finally unglued my stare from the instrument panel, and again my eyes reverted to what would be a normal viewpoint in the simulator, which, from where I was sitting, was basically over Jon McBride's left shoulder towards Bob Crippen's right shoulder and the center console in the center windows of the Orbiter. That was at that moment that I for the very, very first time saw the Earth.

Of course, we're inverted. It's probably where I had returned my gaze after every ascent in the simulator. You see the Black Sea and a cartoon Earth, but it's the cartoon Earth, and you hardly notice it. You're in the checklist dealing with four malfunctions, so you don't really process the visual scene. I'm sure from a kinesthetic point of view I probably did exactly the

same movement I had always done in the simulator, but we'd never had a nominal ascent, and there hadn't ever actually been a real Earth out the window.

It was stunningly gorgeous, just this broad blue and white arc. We're up over the Atlantic just about coming to England. Just bright, vivid, you know, full color saturation, and it just literally pulled the words right out of me. I said, "Wow, look at that!"

Crippen, of course, seasoned veteran that he is, he's still on the checklists. He and Jon have got this kind of "not yet" look so his hands wave me to, "No, no, not yet. We've got some things to do yet."

I had a slightly sheepish moment. "I know we do, but oh, my god, look at this!" Two seconds to say, "Oh, wow, look at that," then we're back in the checklists. That was fine. It was that stunning a sight to me. It just literally yanked the words right out of me. It was just mesmerizing, but we did have things to do. We did have stuff to start getting in gear with pretty quickly, and that kicked back in very, very soon after that. It's a lot simpler evolution to get people out of seats and get into flight day one activities when we didn't have to strip pressure suits off and stow them.

The first order—pretty first order—of business other than configuring the Orbiter for orbit ops [operations], you shift the computer, the life support system, and open the radiator doors to make sure that you've got on-orbit cooling and thermal control. All of that is done, plus circularizing the orbit, within about an hour. In fact, when the engines cut off, if nothing has gone wrong by that point, you've got a fairly good sense of whether you're going to continue on with orbit ops. It's really just the payload bay doors at that point that might be any kind of issue.

That all went by pretty smoothly and quickly. Dave, Sally, and I kind of fanning out in our respective directions, to get the arm started, to get the refueling system in its initial state, get

the radar and other experiments in their initial state, get the cabin stowed and all the stuff that you need to start moving things around, cameras and checklists—everything.

I was surprised at how quickly it felt completely natural to be where we were. As careful and as cautious as we always are, to realize that by the end of day one, when it came to basic configuration things: cooling, lights, and cameras, we had worked that stuff so thoroughly and practiced it so well. I become kind of the czarina of stowage and logistics around the two decks. It was like being in your own living room and saying, "We need a little more light here. Turn on the overhead," or whatever. You just knew it that thoroughly.

So that was a neat sort of bookend against all those months of just learning as fast and as hard as you can, working as hard as you can, practicing as much as you can. And questioning, "Am I at the point I need to be at? Is this the proficiency curve I should be at for today, six months out or two months out, or a week out?" The trainers are saying, "yes." The commander is saying, "yes." The simulators are all indicating yes.

You just think, "Well, I guess so." For me to be able to close that loop sort of in an internal psychological sense, even that first day on orbit, was an important confirming piece. That was like my own individual verification measure of that level of effort and performance works like this in orbit, and so that was a pretty neat to start to the first couple of days. "I actually know where I am."

When the Earth popped into the frame in the window, there were two thoughts that went through my mind. The first one was the one that I blurted out before I could clamp my jaw shut. The second one right on the heels—but I did get my jaw closed fast enough to not say this out loud—was, "Oh, this is way too much fun to be sick over."

Because the other uncertainty, and Dave and I had talked about this some—a little bit with Jon, but I remember talking it over more with Dave—50 percent of the folks, roughly, have some nauseous reaction in the first couple of days. "I wonder which side I'll be on, and I wonder what I ought to do to try to push myself to the not-sick side? I wonder what my best therapy will be if I end up on the feeling ill-disposed side?"

That thought went through my head. Literally 8.7 minutes after liftoff I thought, "This is way too much fun to get sick over," and it really never crossed my mind again. I thought, "Oh, I'm fine. I know exactly where I am. This is going to be really good." [Laughs] So that was pretty cool.

ROSS-NAZZAL: How exciting. I would probably have the same reaction immediately, "Wow!"

SULLIVAN: Yes. Get sick over this? You're crazy. Why would you get sick over this?

I think the other thing that probably was operating there was my ship experience. I can remember times at sea in pretty rough sea conditions up off places like Greenland and Iceland, and there were plenty of folks lashed to their bunks or green at their workstations. My reaction then was, "This is so cool. How can you be sick over this? It's amazingly cool. You see what we're doing here?"

They [imitates sound], "I don't want to see what we're doing. This is disgusting."

So that was day one. That was a pretty lickety-split day. Get up, configure things, get the arm unstowed, deploy the satellite. Satellite deployment became a bit sporty, with the stuck solar array and some gymnastics on the arm, some of which, again, we made good use of still

having LOS [Loss of Signal] periods to do some things that probably would have taken three days to get cleared from mission control. But they worked.

We were fated to have interesting times with deployable appendages that day. Between Sally's stuck solar array and my bouncing radar antenna, it was an amusing day when it came to deployments. It was crazy.

ROSS-NAZZAL: According to Henry [S.F.] Cooper, that antenna actually gave you guys a lot of trouble during that entire mission.

SULLIVAN: No, it didn't, actually. It had that one burst of stored-energy oscillation at the beginning. In retrospect, it's a little surprising that the ground, or for that matter we, didn't wrap our heads in thinking-ahead mode a little better. When it came time to fold the antenna up, and the first time we were going to do that was for our spacewalk, in retrospect any number of folks on the ground or in orbit might have scratched their head and said, "Well, duh. If you had to squish it down some and put some stored energy into it to get it latched down, what makes you think that the motors are going to latch all the way down?"

There were two motors on each end. We were meant to only drive one motor at a time. When we went to fold it up the first time, it really didn't want to latch all the way down, and that's when Sally drove the arm over and just put the little bit of pressure on it to drive it down.

The other improvisation there that we ended up in a discussion with the ground about, around EVA day, was how do you get it to close all the way down. At one point they wanted to fire the pyrotechnic devices. That was for the final latch-down. Firing the pyrotechnic devices would add a spring force to closing it down. That's irreversible, so it's probably not a good thing

to do. We went through a little onboard discussion while the ground was discussing the problem, and it was Crip who said, "Does anything bad happen if they use two motors?"

Simple. Does it overtorque the shaft? In my mind, I'm sitting there thinking through the schematic to make sure I answer correctly, and he says, "Just tell them to try two motors." So we voiced down, "Why don't we just do dual-motor time?" It's an option to use on everything else on the Orbiter. You've got single-motor or dual-motor capability on the ET [External Tank] doors, on the payload bay doors, on all sorts of things. It's a natural recognition to try that on this antenna; Crip beat me to it.

ROSS-NAZZAL: There were a bunch of malfunctions on this flight. Did any of them have any negative effect on the mission itself?

SULLIVAN: No. I guess you would classify the sticky solar array on ERBS as a malfunction as well as the bouncing antenna and the compressibility issue on the antenna, I suppose.

The one that really had some impact scientifically and operationally was the plain old short in one of the gimbal motors on Ku-band antenna. That was a critical link in getting the high-resolution, high-fidelity radar data down to the ground. I'd actually have to go back and look at who was technically assigned as in-flight maintenance on the flight, because Sally, Dave, and I all liked it so much, I think we actually had three IFM-ers on the flight.

So on day one, basically, or early day two, we had to get into a pretty complex area on the starboard side of the middeck. You have to take out a whole stack of lockers and then take off cover panels to get back to the electronics boxes that operate the Ku-band antenna and several processors in the gimbal motors. Pick the connector that has the one pin that drives that

motor, pull the pin out, and then remake the connector so that everything on the whole system works fine except for this one circuit that you've disabled.

It's the size of one of today's direct broadcast system dishes. It's not perfectly the right size, but on the order of magnitude, it's that size. It should be able to gimbal, like if you flip your wrist like you're waving your hand up and down, and pivot like you're rotating around your elbow, and it was the pivot, I think. Those were the gimbal motors that we had to get rid of, the wrist gimbal motors, in a sense.

Now we have this frozen wrist; it was stuck at the position when we pulled the pin. Anytime we wanted to position or beam data from the antenna to the TDRS satellite and down to the ground, we had to maneuver the whole Orbiter. That put havoc into the radar guys' plans. It made them much more dependent on the optical recorder, because it did not have to have line of sight to a satellite. It made us really highly dependent on the digital data recorder, processing through tapes on board to capture that digital data and hand carry it to the ground basically. From a real mission impact consequence, I would say that's the one that would rise to the top as a mission impact malfunction.

Then at the end of the flight, of course, while Dave and I were outside, Jon, Sally, and Crip went down and tore back into all of that electronics cabinetry. I got the job of going across the starboard side of the Orbiter, once the antenna deployment boom was swung back in along the sill. Then I had to grab the rim of the antenna, gently, because it's just a pretty flimsy carbon-fiber dish, and rotate it—it's like locking the knuckles of your first two fingers together—toward this sort of knife-type of a lock that could be driven home and secure the antenna for coming back in.

For that, Sally was waiting down below for basically a voice relay saying, "Okay, it's in position. Drive it."

Then she waited for me to visually confirm, "It's there. You're done," because we wanted that positive proof.

Ironically that same malfunction happened again on a much, much later Hubble deployment flight. Another Kathryn got to do the same task on the spacewalk, Kathy [Kathryn C.] Thornton. There's some little odd paragraph of space history that the first two American women to do the spacewalks both spelled their first name the same way, and both of them had to do the same antenna repair before it was all done.

ROSS-NAZZAL: What are the odds? Let's talk about the EVA next time, but one of the things that I hadn't asked you about was Henry Cooper, who was actually shadowing the crew while he was working on his book [*Before Lift-Off: the Making of a Space Shuttle Crew*]. What did you think of that, and what did you think of the outcome?

SULLIVAN: I'll just speak for myself. I was less than thrilled to be shadowed. This was one of the biggest, most important evolutions I was getting to be a part of in my professional life, maybe in my life. It's intense. It's focused; it's under lots of spotlight, scrutiny, and glare. It's technically challenging, professionally demanding, and personally demanding. If it had been left to me, I would have preferred not having to process and give voice about that experience for a publication that's going to describe me while I'm being formed.

Other people might have invited that; I would have preferred to just be able to focus on what I was trying to do, what I was trying to learn, and how it was transforming me and get done

with it. Nothing against Henry; Henry's just Henry. But the proposition wasn't what I would have preferred for a first flight. So that was the most general point.

Then, because he's writing a book, he's looking for a story line, and there's lots of story lines in any team of people that you might encounter. We all know that when we're in them. Again, to have someone coming in and say, "I'm going to spend"—however many weeks it was—"with you, and of the sixty-four, seventy-four, a hundred and ninety-four dynamics I see amongst you, I'm going to pick three. Can't ever do any more than three or four with an audience, so I'm going pick three. I'm going to make them the backbone of an entire story, and I'm going to hang everything else I saw around those three things."

That makes for good reading and good literature. It also leads to distortions and inaccuracies, and when those distortions and inaccuracies are about things you care deeply about, whether they're your own performance, your personality, your family, events you're involved in, those can be something between aggravating and really annoying, or just uncomfortable.

Not my call. Now it's another part of what we're going to do, so we're going to do it. I thought Henry was a pretty intriguing and amusing guy. My brain was in pretty tight focus mode, so I didn't have a lot of brain cells to be processing, "Who is this guy and what book is he writing?" I'm trying to write three checklists and do a spaceflight.

He seemed like an interesting guy. Physically he's a very interesting guy, and it was always interesting and amusing watching his reactions, and amusing—nonplussing, and bewildering sometimes—what questions he would come up with, looking at all this from such a very different point of view.

I read the book months, months, months later after the flight, and on one level thought it was a good read. On another level, I guess I kind of didn't like seeing something of the story

line that he chose. You've got a revered commander, fair-haired golden boy, superb performer, one of the best experts the office has got, and three rookies who are trying to do everything professionally, superbly technically, competently; survive the flight, succeed at their tasks; deliver what they promised for the agency and the country; and, because they're all kind of wired this way, meet his standards.

I flew my rookie flight with one of the best spacecraft pilots that ever walked the Earth. That's my measuring bar. To have somebody spectating on the side and alternately critiquing the horse race or writing the gossip sheet about, "Well, now what's this relationship or what's that relationship, and who's where." Not real comfortable.

So I read the book when it came out. I remember thinking, I do think the dynamics he chose to highlight as his story line, they're plausible. They were there. The experienced commander, a super-experienced commander; a celebrated and renowned mission specialist, his close working compadre from flight number one; these sort of eager, striving rookies trying to claw their way into things; and then these other two guys who come aboard, and that dynamic. That was probably close to about right.

Interestingly, I've met Henry again in New York through some other friends in literary circles, about twenty-two years after the flight. Around 2006 I had dinner with a couple friends and Henry in New York, and we had a very different and interesting second discussion about the crew and the book, all of what we had sensed and made of it now twenty-two years later.

ROSS-NAZZAL: It's an interesting book.

SULLIVAN: Yes, what was your take on it?

ROSS-NAZZAL: I thought that the information he provided about training crews was particularly interesting.

SULLIVAN: I remember the second time I read it realizing more. If you were just reading that, and if I stepped back from being one of the guinea pigs involved in the writing of it, it's a vignette; it's only a vignette. It was interesting in showing some of the crew and training team group dynamics, and then look at the little individual characterizations like you do to give a little more depth to either of those. I think the first time I read it, I probably read it almost only absorbing and critiquing what he wrote of our crew as a crew, almost unaware of the training crew side.

ROSS-NAZZAL: We use it a lot when we do interviews to try to get an idea of what some of the trainers were doing at that point. So I enjoyed it from that point. But some of the perspectives about the crew, I was sort of curious about myself, because I wondered, "Is that indeed the case, or is this his individual take on the crew members themselves."

SULLIVAN: I think at some level, at least certainly to me—we work for the country. We are in a public program; we were able to do things as part of a public purpose—so I get that, and the story should be told. We should find ways like this to give all the other folks who support the program through tax funding and voting, a chance to appreciate or critique what's going on. So I accept that. That's completely valid.

But where was I going with this? I got lost.

ROSS-NAZZAL: It must have presented some challenges, though, for the crew. Was anyone ever guarded around Henry?

SULLIVAN: Actually, that's where I was going to go with it. The validity and worthiness of a book project is fine, but being what it is, certainly in the moment when he's doing interviews, you know, my main concern was we've got a flight to go do, and we need to be ready. Competent, ready, and coherent, a unified crew.

I never sat down one-on-one with Crip, Sally, or Dave or something and in any detailed fashion coordinated, "So how are we treating Henry if he asks about this?" It was never that overt or conscious, but I think we all had a tacit sense of our net preferences about how much individual detail, how much family detail, what is the domain that we implicitly and collectively think is a fair domain to share broadly and openly. You know where your own boundaries are. Where do you sense your crewmates' boundaries are? So not planned, not really calculated, but I suspect that was present.

We were being written about as a crew and as individuals coming together as a crew. Henry wasn't probing hard for that, but if he'd ever interviewed me on a bad day where I was either feeling disappointed in something I had done or angry at some interaction with a trainer or a crew, I wouldn't have gone on chapter and verse about that. Those things happen. It's a moment. It's going to pass. You're going to restore whatever balance was needed and get back into gear. I wouldn't have shared it out of skepticism that it would be made into an Everest that wouldn't portray accurately the real dynamics of coming together as a crew.

You get dustups. You get screwups. You get miscommunications. You laugh them off or you talk them out or you do whatever your crew finds its way to do. You make them small, and you put them behind you, and you get on with it. That's what you've got to do.

It was a lot more fun to read twenty-two years later. [Laughs]

ROSS-NAZZAL: I'm sure.

SULLIVAN: I knew I had two more successful flights under my belt, and I really knew how to do spaceflights, and all those things had sort of settled themselves out a bit.

ROSS-NAZZAL: Well, thank you again for your time today.

SULLIVAN: You're welcome. Thanks.

[End of interview]