

ORAL HISTORY TRANSCRIPT

ROBERT E. STEVENSON
INTERVIEWED BY CAROL BUTLER
SOLANA BEACH, CALIFORNIA – 5 MARCH 1999

BUTLER: Today is March 5, 1999. This oral history with Dr. Robert Stevenson is being conducted in Solana Beach, California, for the Johnson Space Center Oral History Project. Carol Butler is the interviewer, assisted by Rebecca Wright and Summer Chick Bergen.

Thank you for joining us today.

STEVENSON: I'm happy to join you today, wherever we're going to go.

BUTLER: Hopefully we can go a good distance. To start with, of course your career is quite expansive, so we'll focus in on the space-oriented aspects of it. So if we could begin with when you were working with the Air Force in the Photo and Radar Interpretation Section.

STEVENSON: Okay. Well, in 1951, I had just completed everything for a Ph.D. in oceanography, except a dissertation. I had passed the orals and the writtens and all that sort of stuff. The Korean War came along, or whatever they called the thing, and I was in the Air Force Reserves, so I was called back to active duty and sent back to Wright-Patterson Air Force Base [Ohio], where the new Air Research and Development Command had taken over this what used to be the Army's Air Material Command base, which was where they did all technology and research and stuff like that.

So I came aboard, and here I am, my basic capability was as an aerial navigator, but now that I had all this education, they decided I had to have another kind of position or position description. So I became an air research and development officer and, as such, they said, "Well, you're an oceanographer, you're a geologist. You go to the Aerial Photo Lab." I

went to the Aerial Photo Lab, not really knowing much about aerial photography except that I knew that they did such stuff, and when I got there, they assigned me to a project, a very highly classified project, in which they were doing photography of the North Arctic Slope of Alaska.

This is around Point Barrow, Alaska, and around what is now called Prudhoe Bay, but there wasn't any of that stuff there then. But there was a Navy petroleum reserve there, and they had a camp with guys living in Nissan huts, and they were going out and they were drilling for the Navy to see if there was indeed oil there. So we were to use that as our base, and we needed to take airplanes up there to do photography, and we needed a bunch of scientists to study the tundra of the North Arctic Slope, the plants and the soils and the water. You know, it was permafrost. The ground was frozen down about three feet down.

So I was given this job. The contract for the scientists was under Boston University, so they hired all the scientists and took them up there, but I was responsible for the whole group of people, including a couple of aircraft we were going to use for photography. We did all of the processing of our photos there at this little outpost in the middle of above the Arctic Circle. [Laughter]

BUTLER: Interesting place to work.

STEVENSON: So anyway, we got up there. We took an old World War II B-17 that had been converted as a photo test bed, so we could put eight cameras in that thing. We flew it off a little gravel runway. We took our own building up there. We air-transported a metal building, put it up. Part of the building was a photo lab. The other part was the living quarters. And we were there for four months, you know, because that's about the summertime in there. I've got pictures of us taken at midnight on the Fourth of July, you

know, and it's sunny and we're all standing out there in our skivvies. So that was my introduction to the photo lab.

When we got back from that, it worked pretty well. We had to go back a second year, but it worked pretty well. The whole point was that somebody in Air Force intelligence or somewhere in the Air Force had the brainy idea that if we ever had to invade the Soviet Union, that we might have to invade them from the Arctic Ocean. You know, they have funny guys up at that level. And so we needed to know what the terrain would be like, but we couldn't fly over the North Arctic Slope of the Soviet Union, because they didn't like that sort of stuff. So we would study our own North Arctic Slope, get enough information so that if we could take photographs from a distance, we'd know, "Ah, that's what kind of terrain it is, and if we're going to invade, here's the kind of vehicles we'll have to use." That was the idea.

Okay. So I get back to the lab after we're up there, back to Dayton, Ohio, and this thing had gone pretty well. While I was away, the guy who was the head of that section had been transferred, so I was immediately the head of that section.

We had a lot of other things going. Nighttime reconnaissance was a big thing in those days, had always been a big thing, and we didn't know how to do it, except we had this process where we'd drop flares, bright flares, every two seconds as an airplane would fly, and the camera would go on. This made a lot of noise, and if you were doing this over enemy territory, it told the enemy what you were doing, and you mostly got shot down.

Ford-Philco had a new organization that was in New York City, in which they were trying electronic methods of image processing. You could do visual from TV stuff, but they were thinking about thermal infrared. If you could look down on the Earth and you could get an image of the Earth and see the differences in temperatures, then you might be able to interpret—see, my section was about interpretation—interpret what was there. So we had this project going, and the first one they came up with, they flew right down the main drag of

New York City, whatever the street is that parallels the Central Park. Central Park, is that what it's called? Yes?

BUTLER: I think so.

STEVENSON: Anyway, and this was at nighttime, see, and it was just a scanner going like this. Well, of course, all the buildings were warm. The streets were even warmer because there were cars driving up and down them. Central Park was cold because it's just plants and stuff like that and people getting beat up, which I guess didn't make much heat. And so you could actually see every street in this first scan. It was unbelievable. And so, wow, that was big stuff. They did better and better, and, of course, that led to the scanners that we now have in space. All of the satellites that scan for weather, you know, which you see every night, they're pretty good stuff now, but even those are all based on that project. They all came out of that project.

Well, then also people were thinking, well, there's these guys out at White Sands [New Mexico] and they're firing rockets, some bunch of Germans out there sending rockets up in space. So, you know, maybe if we could get a rocket to do what we wanted it to do, we could put a camera aboard and it could be a reconnaissance rocket. We didn't know how we'd get the film back, but maybe we could make it a remote-control vehicle, remote-piloted vehicle, and go up like a rocket and then we could bring it back.

So everybody was saying we've got to play with film that will come from these high speeds. You know, a rocket goes faster than an airplane did. High-speed things at both low and high altitudes. So we had tests going on where the fastest airplanes we had were flying over Ohio landscape at fifty feet off the ground, with cameras going as fast as they could to see what they'd get with that. That would simulate, you see, a rocket going across the ground at about a mile, at whatever speed they were.

Then for high altitude, the Air Force had this experiment going on which was classified, called Operation Sky Hook. You may have heard of those days back in the fifties, the gracious calm days before the sixties. [Laughter] When people began to see UFOs, right? And, of course, 90 percent of the UFOs they saw were these round disk-like things that shined. They shined at nighttime and in the daytime. What they were, were these Sky Hook balloons that would take off, and they weren't very big, but when they got up there, the big round things, and they were up at 90, 95,000 feet, so that they'd glow in the dawn light for about an hour before the sun came up, and maybe an hour or so after the sun came down. It's dark down here, it's light up there, and there they were.

BUTLER: Oh, my.

STEVENSON: They were pure and simply doing studies on the chemicals and the air pressure and all that stuff at high altitude, thinking about high-altitude aircraft and stuff like that. But I thought, gee, you know, if we want photographs from rockets, and rockets can't carry very big camera, or at least the rockets we were thinking of in those days, nobody thought about satellites. I'd never heard of a satellite.

So I called these guys up in Minneapolis [Minnesota], where they were flying these balloons. General Mills had the contract. [Laughter] I don't know why.

BUTLER: That's interesting.

STEVENSON: Maybe they used snap, crackle, and pop things to make them go. I don't know.

So anyway, I called them up and I told them who I was and what I wanted, and I said, "Can you put a 35-millimeter camera aboard?"

They said, "Well, yeah, but it will have to have a very short focal length on it, because we wouldn't have a lot of space."

I said, "But it can go aboard, and you've got a little window in whatever wall you've got on that thing to look out?"

"Yeah, yeah, we can do that."

I said, "Okay, fine."

So I don't know, about three months later, this box came. It was all taped and had a top-secret classification on it, all sort of stuff, and it came to me. So we opened it up and it was exposed film but hadn't been processed. Now, in the photo lab at Wright Field, in the Aerial Photo Lab we had a photo laboratory where they processed film, because everybody was trying out new film. And we were flying cameras every day, so that we had to have a film process place where they could process everything just like we wanted.

And for whatever reason under the organizational structure, that laboratory was under my command, not that I did any commanding, because the master sergeant, who was in charge, had been in charge for years and he knew more than anybody else. But anyway, he talked to me. He was a nice guy anyway, so I didn't have to worry about him. His name was Master Sergeant Rudy Davalos. He's going to come up later, because when I appeared at the Johnson Space Center [Houston, Texas] Photo Lab, before I briefed the Gemini XII guys and I went into the photo lab, the first guy I saw was Rudy Davalos, and he looked at me and he says, "Captain Bob, what are you doing here?" And I said, "Rudy, what the hell you doing here?" [Laughter] Well, he'd retired and he'd gone to work.

But anyway, so we processed these film, and, boy, they were tiny, you know. I mean, a big airport on that was about yea big, and so we had to get better lenses than we'd been using for interpretation. I'd asked them to fly different rolls of film, and so one roll of film they flew was black and white infrared. I just wanted to see what that would look like, you know. And all these people were saying, well, infrared, black and white infrared, it's not

thermal infrared, it's infrared which is just above the wavelength that we can see. It's near infrared and it's just a little bit above the red that we can see. And everybody said, well, that cut through haze. Wrong. But anyway, that's what they said.

So we flew that stuff, and what we saw was, we'd pick out these air fields, and at the end of the runways on some air fields there was this little black streak maybe about a third of the length of the runway, but beyond the runway. And we couldn't figure out what that was, so we began to check out the airports. Remember, this is back in the early fifties and there were no jet commercial aircraft yet. The jet commercial aircraft, the Boeing 707 came in about 1955, I think, something like that. But what we did learn was that all those air fields and those runways that had that little black stuff stretching out were Air Force fields where they were flying F-80 jet fighters, and what that stuff was, was the soot that came out of a jet engine would settle on the vegetation, and the vegetation, under infrared, which normally on black and white would show a bright gray, if it was living vegetation, looked black. I said, oh, that's interesting, you know.

So what we did was put a little package together and send that information over to Korea. Of course, it was about this time that the MiGs were coming from on the other side of the Yalu River over to beat up our F-86s. So we said, "Look. You take your pictures from long range. You don't have to go over there. Be inside, take them from long range, as high an altitude as you can, take them with black and white infrared film, and you can tell which air bases have MiGs and which don't." Which they did.

Well, anyway, what we did, we set up a protocol on how to interpret these photographs that were such a hyperscale. They were scales of 1 to 2 million, rather than 1 to 18,000, which was usual. So when I got to Houston, to the photo lab there, and saw the first film there, that's just the scales that they were using. I mean, you know, the space photos coming from a Hasselblad [camera] that has 100-millimeter lens on it, then you're getting a scale of about 1 to 1 million.

So what I could see, of course, not in the ocean, because nobody was familiar with the ocean, but looking at features on land, none of it was unfamiliar to me. Everybody else was bleeding because they couldn't see streets and cars and stuff like that, and these guys in the spy satellite business say, "Why do you want to look at that stuff? We can show you a picture where you can see the license plate of an automobile sitting in the parking lot at NASA Houston." And the clear answer to that always is, "Great! I'd like to see that photograph," which you never get to see, of course.

BUTLER: Of course not.

STEVENSON: So anyway, what helped me when I was at Wright Air Development Center, first of all, were these new techniques. My whole role in being the head of that section was to develop new techniques in photo interpretation, which meant using new, different films. I began to use color film in the field for reconnaissance. They'd never done that because it was so expensive. They had to take the color film and send it back to Eastman-Kodak for processing. Well, we processed it out of the Coleville River that ran by Umiat, Alaska, you know, in the summer, with water that ran right into our tanks, and there's no problem. It was just the matter that people hadn't addressed the mechanism or the care that you had to go through in the field to do it. Soon as we set that up, then every reconnaissance unit in Korea began to process color film. Why? You can see a lot more from color film than you can from black and white.

So anyway, those were all the—you know, I enjoyed that very much. I would have enjoyed staying in the Air Force and doing that for the rest of my life, but that didn't happen. So, you know, I just figured, well, that was nice stuff to do and I'll never have to do it again, and all of a sudden I walk into the—well.

BUTLER: Little did you know.

STEVENSON: So then how did I get involved? Well, I was teaching graduate oceanography, marine meteorology, and stuff like that, and while I was there, the National Science Foundation decided that the one thing that the high schools in the United States needed more than anything else was a book on earth sciences, textbook. And so they got a hundred guys together, all kinds of earth sciences, and they took us up to Boulder, Colorado, and asked us to write a textbook.

Well, interestingly, out of the hundred guys, thirty of them left in two weeks because they couldn't write down to the level—we had a writer from the *Chicago Sun* newspaper there to tell us how to write down to the public. These guys just said they—you know, the guy who was the astronomer said, "You know, we have to have a whole chapter on the integration equations for the planets."

We said, "Well, you can't have any differential calculus or integral calculus, because these kids in high school won't have had it yet."

"Oh, well, I can't write without that." So he left. A lot of others did, too.

Then we did it the second year, and then after the second year they took it to some high schools during the wintertime, four or five of them, as a test book, and it worked pretty well, but it still needed more—

JEANI STEVENSON: Pizazz.

STEVENSON: No, no, it had enough pizazz. It needed less scientific details and more pictures. So anyway, I had been to Russia to a meeting, an oceanographic meeting, and I came back, and I went up there for two weeks just to edit the three chapters that I had written: oceanography and plate tectonics. Two chapters on that. So I'm standing in this office, these

offices they had for us at Boulder, and in walks this guy, and he says, "You're an oceanographer?"

I said, "Yeah."

And he says, "I'm Dr. Paul [D.] Lowman." L-O-W-M-A-N.

I said, "How do you do, sir?" I had to say "sir" because he was younger than me.

And he says, "I'm from Goddard Space [Flight] Center [Greenbelt, Maryland], and I'm a geologist. I'm in charge of the Earth Resource Program for the Gemini space flights."

I said, "Oh, that's interesting." I'd been kind of interested in that.

So he brings out this picture and he lays it down, and he says, "What can you tell me about that?" Well, so that was the picture. That's the picture Ed [Edward H.] White [II] took. Ed White took it because they were going over the Keys, and Gordo [L. Gordon] Cooper [Jr.] had a fish camp down there that he used to love to go catch bonefish or whatever the hell he caught down there, and he says, "I'm going to take a picture of Gordo's fish camp."

But what he got was a picture of most of the western end of the Florida Keys and part of the Straits and parts of the Florida Bay behind it, in the sun's reflection pattern. So that all of the little squiggles—you know, you look out there and you can see the sun's kind of reflecting on the water out there, and you can see a lot of little squiggles, a lot of little waves, and you can see shadows from the waves, different texture one side of the waves than the other. And all of those show up in the sun glitter pattern. So I said, "Oh, well, that's interesting. Here's a whole bunch of internal waves that are coming in from the west, apparently from the Atlantic Ocean. Here's a ship's wake. Here's a bunch of eddies along the Keys going in like that."

And he says, "What's all this golden stuff that looks like worms here?"

I said, "Oh, the water's so shallow there, that's the sun shining off the sand bars in the Florida Bay."

And he looked at that and he said, "My God." He said, "You know, you've told me more in five minutes than the Naval Oceanographic Office has been able to tell me in six months."

BUTLER: Wow.

STEVENSON: And he says, "How would you like to look at some more of these pictures?"

I said, "Great! How do I do that?"

At the time I was working for the Fish and Wildlife Service. I was a deputy director of their laboratory, Bureau of Commercial Fishery Lab, in Galveston [Texas], and head of their oceanographic program. And he says, "Well, you know, just go up to the Manned Space Center [Houston, Texas]," which was up in that cow pasture, which it was. [Laughter] They still didn't have a big paved road. It was still a narrow two-lane road going into the Space Center there.

So I said, "Okay, I'll do that." So one day I drove up there. In those days, you know, there weren't all the buildings that are there now. You drove in the front gate and there was a visitors' parking lot right in front of Building 1, and there weren't a lot of other buildings around. So you walked into the lobby of Building 1, to the desk, which you know is over on the right-hand side as you walk in. There weren't opening and closing doors then. And you go in and say, "I need a pass because I want to go back to the photo lab."

Then I write down "Bureau of Commercial Fisheries," and the first time I did it, the girl said, "Oh, are you here to take care of the ducks?" See, because in those days, all those ponds had ducks in them. They're no longer there now because the ducks liked it so much there and they got so much food, that they wouldn't go away. The water would get bad and they got sick, so they had to finally flush the ducks out of there. But anyway, they were there for a long time.

So I walked back. Where is the photo lab? It's back there. So I walked back and I went up the stairs, walked down the hall. It said "Photo Lab," and I turned and walked in. As I say, the first guy I saw was Rudy Davalos. "What the hell are you doing here?"

"What are you doing here?"

And then he introduced me to Dick [Richard W.] Underwood, who became a good friend of mine. He had been a Navy photographer from naval aircraft for many years.

I said, "Well, I'm here, Paul Lowman told me to come and look at some Gemini photos."

He said, "Okay." So he said, "Come in this room here." And here's a light table. And here's how you put the spools on the roll, and there's a light table, and there's a little magnifying glass, and there are all the photos right there in rolls."

So I thought, wow. So I figured, well, I'd better be very cautious about how many I ask for, so I spent about four hours there, going through those rolls. By this time they were up through Gemini XI. And so every now and then I'd see one I really liked, and it was usually one with a sun glitter or one that was some great—I love coral islands, so some great coral islands, other than the Bahamas. Too many of those.

So when I got all through, I said, "Gee, thank you very much. Here's the list of the ones I'd like."

So about three days later, down in Galveston, twenty miles away, three boxes come, are delivered to my office, and I open them and there are the entire bunch of photos in canisters from the Gemini space flight, with a note saying, "Hey, Bob, it's too difficult to cut them out. Just take the whole damn rolls."

So, now, see, one thing you have to think about this is that those were different times. I mean, you couldn't do that today. In the first place, you couldn't walk into the Johnson Space Center without somebody at the Center already having approved you coming in, and if

you have a car, you have to show your insurance and all that sort of stuff, you know. But those were different days.

So then I got a phone call from Paul Lowman. He said, "Well, what have you seen?"

I said, "Man, I've got about a hundred pictures here that are unbelievable. They're showing me details of the ocean that I would never have known. Is there any chance of my briefing those guys on Gemini XII and ask them to do some things specifically for me?"

And he says, "Well, I've got thirty minutes. I'll give you five."

So I went in. Neither of the guys were famous then. They were very busy, Jim [James A.] Lovell [Jr.] and Buzz [Edwin E.] Aldrin [Jr.]. Buzz was very kind of hyper because he had to do an EVA [Extravehicular Activity] on that flight, and they had to do a rendezvous, and they didn't have a lot of time for us guys who weren't telling them all about engineering. So I got up and I showed them three pictures. I told them I was from the laboratory in Galveston, and they said, "Oh, aren't you the guys who are studying shrimp?" I said, "Yes." Shrimp fishery. So from ever after, when I'd meet those guys, they never knew my name. It was just, "Hi! How are the shrimp these days?" "Yes, sir, Dr. Aldrin," Major Aldrin, whatever he was, Colonel.

So that's what I did. In five minutes I just said, "Look. Whenever you have the time, whenever you have the opportunity, I don't care, I don't know any specific place, because you've got all these other duties to do, and your time may run over, whenever you have the opportunity, look in the sun's reflection pattern, and if you see anything in the pattern that's just not flat, anything in there, take pictures." So they did. Buzz Aldrin did, and we got some great stuff from that. I mean, we got stuff we'd never seen before.

And that was it. I didn't have any more opportunity. Well, when they did get back, I did get a chance to talk with them for about ten minutes and thank them, and I showed them three pictures that they'd taken, and I explained to them in ten minutes what they meant to us in oceanography.

BUTLER: Now that Gemini was over, you didn't have any more opportunities there.

STEVENSON: No.

BUTLER: But when did you realize that you'd be able to continue working?

STEVENSON: Gemini. So Gemini ended in—that was 1966. Gemini XII was November '66. I remember they went up on a rendezvous and they got up to 300 miles, if you remember that. They took this picture—I still use it—where they're over Africa and they're looking east, looking right down the axis of the Gulf of Aden, and here's the Red Sea coming up here, coming down straight like this. There's the Gulf of Aden, there's the Red Sea, there's the entire Arabian Peninsula, you know, and you're 300 miles up. It was so clear and it didn't give you any detail, but, man, I'll tell you, it's a picture that I use it a lot to show people this is what it's like up there, you know. That's the Earth up there.

But anyway, I was pretty eager, you know, to do something with Apollo, with the Earth orbital Apollo flights, 7 and 9. First of all, they had an unmanned Apollo. I forget what number it was. Apollo 1? Something like that. They sent up an Apollo spacecraft and they had a camera, an inertial camera. The capsule was pointed with its pointed nose downward. I guess when they went into zero G and the capsule went like this, then the camera started and it just ran, just until it ran out of film.

So we had an orbit and a half of vertical photos and they were taken quickly enough so they were stereo pairs. They overlapped, you see. So we had stereo photos all across the Atlantic after the launch, into Africa, and then when they hit a little bit in Africa, then it got dark. Then they begin to come out over on the other side of the Pacific, and then they ran

them all the way across the U.S., and then they ran out of film just after they'd passed the coast of Georgia, going into the Atlantic Ocean.

Well, those are fascinating, fascinating. We saw internal waves off Africa, where we knew there were internal waves in the ocean, but not the faintest idea you could ever see them from space. I mean, they're under water and they just make little things in the water. I don't see any coming in out there today, but sometimes you can see them coming in, because it will be calm. The peak tops of the waves will ruffle the water a little bit and you see them in lines. But here they were, they were going into the coast of Africa. It was an interesting—well, not only interesting to see them, but it was the location in the history of oceanography where the first internal waves had been measured from a research vessel by the Germans in 1938 on their meteor ship. They'd been doing—why the hell they were off Africa, I don't know, the west coast of Africa, northwest Africa. But it was—I forget his name, but anyway, they were out measuring all these internal waves.

They wrote this little paper. I remember it was very interesting in that nobody believed them. [Laughter] And it wasn't until World War II and people in the U.S. Navy began to encounter internal waves that they believed them. But anyway, so they had those internal waves there.

Then over the Atlantic Ocean there were lots of cumulus clouds, and [they] began to see that they were organized in kind of circular patterns, some of them, and they were all stereo pairs, so you could literally measure the height of them. Then there was a bunch of cloud systems over the eastern part of the U.S., all linear clouds. The wind must have been blowing like mad. And then they came across the Georgia coast and there's all those islands, you know, and embayments and stuff like that. Again, they were in stereo, not that those islands or embayments give you much stereo, but I mean, we'd never seen them like that before.

So I said, "Boy. My God, you know, if we can just get these guys on Apollo 7 to really address particular places." Well, for Apollo 7 and Apollo 9, the program was run by a branch at the Manned Space Center. I think they called it the Earth Resource Branch then. And all the guys were over in old barracks buildings at Ellington Field, and the head of it was a guy named John Dornsbach [phonetic], and he was a—what kind of nice name can I call him? He was an arrogant—an arrogant jerk, I guess. He was a Ph.D. in, I think, geography or something like that, and he was in charge of this thing. Therefore, these two space flights were going to look at things that were of great significance, and he would determine which features were of great significance.

There were a lot of guys. There were guys who were desert people, who wanted to look at deserts, you know. At that time there were lots of people who were—we'd call them environmentalists today, but they were concerned with land areas and urban growth. Urban growth, yes, that's the big thing. But when it came to the ocean, John Dornsbach, he didn't know the ocean from third base, and he said, "What can you see in the ocean?"

And so after I showed him some few things, and John [L.] Kaltenbach was working with me at the time, he finally agreed that, yes, there were areas of the ocean that could logically be looked at, but that he couldn't see any point in doing any open ocean because, you know, the only important part of the ocean was near shore, where people lived.

So, well, anyway, and furthermore, he would not let anybody brief the astronauts other than himself, because, you know, "I know how to do it and they have too many other things to do, and we can't waste their time with people who are not—" all that sort of stuff.

So anyway, the bottom line is that we did have an experiment, an oceanographic experiment, on Apollo 7 and we primarily wanted to look at the Gulf of Mexico, since John Dornsbach would agree that that was a—

BUTLER: Worthwhile target?

STEVENSON: —important target. Now, at the time, you know, we still didn't know a lot about how to see turbulence in the ocean. I mean, we really didn't learn that. We learned that a bit on Skylab, but we really didn't learn it until the Shuttle came along. But we thought, well, maybe we can track ocean currents by putting dye in the water. A lot of people had done this from ships, and I'd done it myself. Like when you're tracing fresh water or plumes coming out of sewer pipes or something, you could put some dye in it and it would come up, and you could track the stuff. I'd even done that from airplanes, you know, because you could easily see the dye patterns.

So we thought, if we had enough dye to make a big long path in the ocean, then they ought to be able to photograph that thing from Apollo 7. So we had a big research vessel, called *Geronimo*, after an Indian. Why the hell they named it after an Indian, I have no idea. It later was given to Taiwan and became the *Chu-Eh Lien* [phonetic], but anyway, we had it as *Geronimo*. It was a big ship, big old Navy tug, and we in the commercial fisheries went in together with NASA to do a joint program, and with the Navy.

The Navy provided us with the dye, and we had fifty fifty-gallon drums. Fifty fifty-gallon drums on the stern of that ship, full of powdered rhodamine dye. Rhodamine dye, when you put it in the ocean, it turns to a beautiful vermilion color, but, man, if you drop a teaspoonful of it on the deck of a ship, which is wet, it just doesn't come off. Guys would walk through it, and the whole damn ship gets vermilion and it shines in the dark, and all that stuff.

STEVENSON: So we, very careful, we had two guys aboard the ship who knew all about dye. We sent the ship down to the Yucatan Strait between Yucatan and Cuba, and they were going to dump all fifty fifty-gallons of this dye into the ocean the day before Apollo 7 was to orbit over, because that would give the dye time to spread out in the Florida current up into the

Gulf of Mexico, and either turn off past the Keys or we thought was going to go up in a loop current and then go off.

So everybody went off. Apollo went, the ship went. And about three days before that experiment was to take place, and about two days before the Apollo launch, the ship had already gone. It takes a week to get down there. A big storm was seen in the Caribbean [Sea] and it got bigger and bigger, and eventually it became Hurricane Betsy.

BUTLER: Oh, no.

STEVENSON: Which was a big hurricane which came right through the Yucatan Straits and right straight north and, bang, right against the coast of Louisiana. Our ship would have been right in the middle of the Florida Straits when it came through, but fortunately the guys in the ship had brains enough to understand "Let's go home," and they went home. So that experiment was wiped out.

BUTLER: Quite unfortunate. Were you able to repeat that?

STEVENSON: But, you see, it was interesting in this way, and that is, it was the first attempt to coordinate a seagoing oceanographic experiment with an orbiting space flight. After that, we did a lot of them, but, I mean, or quite a few, but that was the first one.

Well, we had all this dye, so we thought, well, got all these T-38s up at Ellington. Why don't we fly some photography at 60,000 or 50,000 feet with a T-38. We had that RV-60 up there for a while, and it flies high altitude. And see what the dye looks like up there. Well, turns out that when we put over a whole fifty-gallon can of dye, the red gets absorbed in the lower atmosphere, so when you're up at 40,000 feet, what you're looking at is a green

streak in the water, which is hard to tell from a lot of other green streaks in the water, you know, if you're near shore. So we decided it was a bad plan, and we never tried it again.

We did get some good photos, although Apollo 7 was— [Laughter] Well, I guess I can—you can cut it out if you want to. But anyway, the commander of Apollo 7 was Wally [Walter M.] Schirra [Jr.]. He was and still is, I guess, an irascible soul. I mean, "We're going to do it this way, and that's the way we're going to do it, and don't tell me how to take a picture because I know how to take a picture, because I was up before and I took pictures."

In those days, Dick Underwood prepared all the cameras and all the film, and he trained all the astronauts. On the back of every film cassette they put in was a little—pasted on there was the lens stop and the lens speed, F stop and the lens speed, and then they had five different scenes: water, sunglint water, desert, you know, so forth and so on. Actually, the photographs from [Apollo] 7 was not all that great, because Schirra said, "I know how to do it." And he used a light meter. He had his light meter, said, "That's better than what you guys tell me." Anyway, don't tell him I said that. Well, you can tell him I said that. I've already told him that a long time ago. But anyway, I don't know him that well.

So then along came [Apollo] 9. Now, 9, a very, very busy flight. They got the lunar lander [Lunar Module, LM], they're going to try to undock the lunar lander, and they're going to orbit the lunar lander while they're orbiting over the Earth, and then they're going to try to redock with the lunar lander, and if they can't do that, then we've got more problems than we thought about in going to the Moon. So that was a very, very busy mission. The astronauts, however, were very eager to do Earth observation. I forget who the commander was on that.

BUTLER: Jim [James A.] McDivitt, I believe.

STEVENSON: Was he the commander? Was Donn [F.] Eisele on that one?

BUTLER: Don Eisele was in Apollo 7 with Walter Schirra.

STEVENSON: Okay. Well, anyway. Oh, I know, [R. Walter] Cunningham was aboard, right? On [Apollo] 9.

BUTLER: Cunningham was on [Apollo] 7 also.

STEVENSON: He was on 7.

BUTLER: Nine, I think, was McDivitt, [Russell L. "Rusty"] Schweikart, and [David R.] Scott. I know Rusty Schweikart was on it.

STEVENSON: Rusty Schweikart. That's right. You're right. Well, anyway, those guys were much more amiable. As a matter of fact, we lashed together, had lashed together by a camera company, I forget the name of it, they took four Hasselblad cameras and they lashed them together, and they bore-sighted them so that they were all going to look at the same thing. Then we could put four different films in that camera. It had a bracket on one of the windows, and you got it in the bracket and then you just punched the button and you let it go, so you got four different films looking at the same area. That was pretty good. In order to do that, though, the spacecraft had to be pointed straight down.

I can remember their coming up toward the coast of California and, again, our great friend John Dornsbach, in mission control, telling how to do, "Okay, they're ready to take photos."

So the commander, whoever it was, McDivitt, calls down and he says, "We're all ready to shoot this four-barrel camera here."

So they said, "Okay, go ahead."

He says, "Aren't we supposed to be pointing towards the Earth?"

Then Dornsbach had not gone through his time line until the mission control guy, Capcom [Capsule Communicator], to say, "Make sure that they turn it over," in whatever they call that position.

So anyway, but we got some awfully good film from that. One thing we got from it, it was in March of [19]'68, right? March '69, I think. Right?

BUTLER: Yes, I think it was early '69.

STEVENSON: Yes, because then [Apollo] 10 went and undocked and floated around, and that's when Gene [Eugene A.] Cernan and Tom [Thomas P.] Stafford were in the lunar module and they hit the wrong switch, and Gene Cernan said, "Son of a bitch. What did we do?" But anyway.

BUTLER: That's right.

STEVENSON: So, yes, this was March of '69. They got a whole mess of great photographs of the Texas coast. What they showed, it showed the plumes of sediment being blown offshore in March from the lagoons, and they're all being blown at an angle like this, and then there are plumes farther out that were very dim, but they were at an angle coming in like that, almost looked like a herring bone. So I went back to the meteorology, and turns out that while they came over, there was a very strong norther, dry norther had come through Houston, and there were strong winds blowing offshore and blowing this stuff out like that. It was blowing out and meeting this stuff that had been blown from the southerly winds a few days before. All right. I said, "Wow, that's pretty interesting."

All those little shrimpies that are in the bays along the Texas coast in March, they're babies. They're not ready to go out and get big. So if they're being blown strongly out in those plumes, then there's not going to be much of a shrimp crop this year. So I proposed this to the Gulf Coast Shrimping Association, that maybe the manner in which they could determine the crop that they could expect during the shrimping season, which began later in the summer and goes through the fall, when the juvenile shrimp begin to go offshore and then spawn, and that's when they catch them, would be by knowing what the winds were doing. Because normally winds, you know, along that coast and in Houston blow from the south, but when the northers come through, then it blows from the north. But usually it's from the south.

So in the late fall, when the shrimp are way offshore, they spawn and all the little shrimp larvae get born, and they're little tiny things. They've got a little wiggly tail, but that wiggly tail won't do them any good unless they're in a jug of water, because they can't go against the current. So they get brought into the bays by the wind, by the wind blowing them in from the southeast. All embayments along Louisiana and Texas get all the shrimp in, and the greatest embayment area is from like Galveston on down to Brownsville [Texas].

Now, if when these things are going to be coming in, which is going to be—see they go out there and they grow up and they spawn in the late winter and the springtime, springtime they should be coming in. If there's a strong wind in the springtime blowing offshore, then they ain't going to make it in, and so the shrimp crop's not going to be as big as it normally would be. That was my theory. Now, the biologists didn't like that because they said, "Oh, well, you're just an oceanographer, and that's wind, and our shrimp don't mind the wind." I said, "Well, I don't—"

So what I did, I went back for twenty years and I got all the wind data for the whole Gulf Coast, daily wind data, and I plotted, and I found out that if we had northers coming through, if the northers quit coming through in February, everything was fine. If the northers

continued to come through in March, then shrimp crop was going to diminish, and if they kept coming through into April, if we got any into April, then the shrimp crop was going to be a wipeout. But, no, nobody wanted to believe that, you know. Biology—ah, forget it.

But there was a guy in Galveston, I don't know whether he's still there, by the name of John Mehos, and he owned and operated the Liberty Shrimp and Oyster Company. It may be gone now, I don't know. He was a retired FBI [Federal Bureau of Investigation] guy, and I knew him pretty well. I showed him this thing, and he says, "Well, that sounds logical to me."

See, the big deal in those days—it's not like this anymore, because, you know, they've kind of killed their shrimp industry by their treaties with Mexico, but if they knew the shrimp crop was going to be big in the northwestern Gulf, the brown shrimp and the white shrimp over in Louisiana, if they knew that was going to be big, then all of their onshore frozen factories and everything would get set up and they'd get all the shrimp boats in there, as many as they could, and then they'd just go at it, and they'd bring shrimp boats in from the Gulf of Campeche and from Mexico and wherever, wherever the companies had them.

But if the crop was going to be less than average, then they'd get their shrimp boats and take them down to the Gulf of Campeche, down to Venezuela, down to look at the pink shrimp in Florida, off the coast of Mexico, when we could still shrimp there legally. And their frozen houses would begin to take in frozen vegetables to freeze and stuff like that. So it was really a big deal for these shrimpers and the companies that they own to know, yes or no, are we going to have a lot of shrimp or not.

So anyway, John Mehos says, "I'll try it." So the next year, you know, I looked at all the stuff and I said, "Okay, John, it's going to be a big shrimp year this year." He said, "Okay. Fine." And I think that's the year I actually left then. [Laughter] I went to work for the Office of Naval Research. But it was a big shrimp year. John Mehos made out like a bandit.

Then after that, they all—I'd just written it up on a little copy. We didn't have Xerox. Did we have Xerox in those days?

JEANI STEVENSON: I think so.

STEVENSON: Sixties. Okay. Am I telling you stories you don't want to hear?

BUTLER: No, you're doing great.

STEVENSON: Anyway, the point is that that particular—that flight of Apollo 9, by chance, got us photographs which led to a concept and, later on, a forecasting technique that not only worked along the Texas Gulf Coast, we later applied it to the shrimp fishery in Venezuela, in the Gulf of Guinea off Africa, to the shrimp fishery along the Gulf of Kutch coast in northwest India, and to the Gulf of Carpentaria in Australia. They all had the same kind of wind/lagoonal situations, and it worked in all cases.

BUTLER: That really shows the value of—

STEVENSON: We never would have done it if we didn't have the space stuff. Well, that made everybody happy. Didn't make the biologists happy, but made all the space guys happy.

All right. Now where are we?

BUTLER: As Apollo was moving on in the sixties, NASA began hiring scientist astronauts.

STEVENSON: Oh, yes, that's true.

BUTLER: Were you involved at all with—

STEVENSON: Not with the hiring of them, but they had a lot of them, you know. They had guys like Bob [Robert A.] Parker and Karl [G.] Henize and Ed [Edward G.] Gibson. I can't remember who they all were, but they had a lot of them. I knew them all. Of course, after Apollo, you know, people weren't really—you know, the astronauts really didn't know what was going to happen, you know, but even knowing that Skylab was going to come and Apollo-Soyuz [Test Project, ASTP] was going to come, there were still a lot of guys who were there and didn't know what was going to happen.

So by that time I was out at Scripps [Institution of Oceanography], working for the Office of Naval Research, and so I used to, about once every two months, I'd get a call from somebody, [Robert L.] Crippen or Bob [Robert F.] Overmyer or somebody, say, "We want to come out to Scripps. We're tired here. Will you teach us something?"

"Yes. Okay. Come out." So there would be six or seven come out and spend three or four days. Of course, the scientists around Scripps loved to talk to them, and the director of Scripps at the time was a big fan. So we'd have a big Mexican dinner, and then we'd have maybe a couple of hours of lecture a day, in hopes that eventually they'd get to fly.

Then, of course, I guess it was in about May of [19]'73, I got a call, again from John Kaltenbach, and he says, "We are going to have a full-blown Earth observation program on Skylab 4. See, Skylab already had a big Earth resource program. They had radar altimeters aboard. They had scanning microwave radiometers, scatterometers for wind. They had cameras, all kinds of cameras. But those were very organized, highly organized by specialists, and they were not designed to be, in effect, Earth observations where you didn't know precisely what you wanted at precisely a given second in time. So John Kaltenbach and...[Dick Wilmarth] and Bill [William B.] Lenoir convinced them that an Earth

observation program with handheld cameras, and using the other cameras, too, would be beneficial.

Actually, the astronauts asked for it. You know, they're going to be up there for eighty-four days, and even the middle crew was up for, what, about a month or so, they got to the point where they didn't have anything to do, and they were looking out the window. "How come we don't know that stuff?"

So, anyway, then they got together a bunch of people. There must have been about fifteen or so people. They were desert types and tropical types and grasslands. I don't know who all they had. I know they had two or three desert people, and then for oceanography they had a guy named George Maul, who was from NOAA, and me. So he and I put together about a fifteen-hour course for Gerry [Gerald P.] Carr and Bill [William R.] Pogue and Ed Gibson, and they liked it. I mean, you know, Bill Pogue being an Air Force colonel, he said, "I don't know anything about the ocean."

I said, "When we get through with you, you'll know everything there is to know." [Laughter] He turned out to be—you know, they all turned out to be good.

Then before they launched, we had a closed-circuit briefing with them when they were down in Houston. They said, "We still have questions." So from Building 4 up in the main conference room—no, we were in mission control, and they were down at the Cape, and we had a closed-circuit TV communication, real time. I remember Harrison [H. "Jack"] Schmitt was there, geologist, an "I've been to the Moon" man. "I know all about this stuff."

I'd be talking with—I remember one time Gerry Carr was saying, "Now, Bob, over this area you think we're going to see something there if the sunlight's just right, and we're going to be looking into the sun." And old Jack Schmitt says, "No, no, no. You never want to look into the sun. You want the sun behind your back."

And I turned to him and I said, "Jack, shut up. You don't know what you're talking about." [Laughter] He didn't. But anyway, I mean.

So those guys were very receptive, and when you look at this one particular—this first tape [refers to a video tape], which is narrated by Bill Conrad—doesn't ring any bells, huh? Come on. Well, probably before your time. There was a TV show for years about this detective, and he was a big fat detective. Right?

WRIGHT: *Cannon.*

STEVENSON: *Cannon. Cannon.* And we made this picture at the Navy Photo Lab in Anacostia. ONR [Office of Naval Research] made it. I wrote it out and we got the pictures all together and then they got stuff from NASA. He was a good friend of the guy who was directing it, and he says, "I'll get Bill Conrad to do the narration."

I said, "Gee, that's great," you know.

He came in. He didn't want to read anything. "Don't you want to read through the script?" "No, I do it better if I just read it." And you listen to it. I mean, the guy was great. Yes. Big and fat but very good.

So anyway, on that you will see—you can easily tell, especially when Gerry Carr decides to give a lecture on oceanography in space, in which he's drawn his own charts, you know. "Here's the great wind drift current down here, and here's the Falkland Current coming up like this, and here's the Brazil Current coming down like this," and by this time they'd seen the currents. The Brazil Current is blue and this is chartreuse color, you know. I mean, it's spectacular. Of course, it was a lot of stuff we talked about, but nobody had ever seen this stuff. Nobody! And there he is. I mean, he's up there giving a lecture, with his beard on. He hadn't shaved. None of them shaved.

So when you see that, you'll see that Skylab was really a very—we did a lot of good stuff from Skylab. There was a report, a very thick report, written. I forget what it was called. "Investigating the Earth from Skylab" or "Earth Observations from Skylab." They

had everything in there. They had desert and all that stuff, but the oceanography part was really good. We saw stuff I never thought we'd ever see.

BUTLER: Sounds like you trained those astronauts pretty well.

STEVENSON: They were good. They were good guys, you know. They're still good friends of mine.

BERGEN: [Did they find what you thought they might?].

STEVENSON: Yes. We found these things [refers to a picture]. See, these are big eddies in the—who signed that? Somebody signed that.

BUTLER: Looks like Bill Pogue and Gerry Carr.

STEVENSON: And Ed Gibson. Imagine that. Anyway, we found these eddies. You can see them right in there. This is the current in the Caribbean Sea. It comes up. Up in here is Cuba and up here is Yucatan and it's coming right up through that toward the Gulf of Mexico. And right on that side of the current we saw these features, and we thought, well, those have got to be called eddies. They're peeling off. So we asked them to look for them, and they found them. We got a P-3 airplane over there, a Navy P-3, dropping expendable bathythermographs to get the temperature, and, sure enough, there's [unclear] eddies. People kind of thought maybe there might be eddies coming off on the boundaries of currents, but nobody had ever seen one or measured one, you know, and if they were eddies coming off on the boundary of ocean currents routinely, then to the Navy this was very important, because it meant an acoustic problem that they had never addressed.

It just happened that right at that time, was during the days when the Russians were transiting Yankee submarines across the Pacific [Ocean] and they had them off the West Coast of the United States, patrolling. Of course, we were patrolling them, too. But the Yankees would come across at about forty—no, no, about thirty-five degrees north, and then they'd hit maybe 100 miles off the West Coast. Then they'd travel down the coast, sitting here and there, then go back.

Well, it was about the time when the highly classified underwater surveillance system of the United States—God knows how many billions it cost to put it down there at the bottom—was beginning every now and then to lose one of these Yankee submarines when it was transiting. A guy would come along, and all of a sudden he's gone. When they'd pick him up, he'd be over here, so he clearly had come this way, but where was he? What had he been doing?

So when we found these eddies from Skylab and we ran the Navy P-3 down there, and, sure enough, they were eddies, then, you know, we went to the admiral of the Pacific Fleet and we said, "We think we know what they are. We think this is what's going on." And he brought in his oceanographer and he looked at it, and we had some other data that we thought satisfied it. But anyway, he sent, again, P-3 airplanes up there with temperature probes to check it out, and, sure enough, that's exactly what they're doing. The Russians knew about them. I don't know how they knew about them, but they did. And sometimes they'd get into these eddies and they'd just stay there. Yes. "Let's sit around here, Ivan. Make those guys sweat a little bit."

So anyway, that we learned while Skylab was still up there. We saw a lot of other stuff. Gerry Carr said one day, "You know, we just came over all these fjords down on the west coast of Chile, way down at the bottom, you know. Usually it's all cloud-covered, but this morning it was kind of sunny there. Are we going to see anything there?"

I said, "Yes. Are you going to come over there later today?"

He says, "Yes, we're going to come over, but the sun's going to be down lower because it's later in the day in our orbit."

I said, "That's great. When you look into the sun glitter, with the sun low, I'll bet you see waves, big waves and surges going up into those fjords." Everybody's always suspected that. And, sure enough, they got some great pictures showing that. So that was a great advantage.

We didn't talk to them in real time. They'd send down messages every day, and they'd be typed by some girls in Houston, were typing it all night long, probably all day long, too. Then I'd get a copy of what they sent down weekly, but if it was something hot like that, then they'd call me up. John Kaltenbach would call me up and say, "Hey, they say so and so. What do you want to tell them?" And then that would get back, and so Cap Com would tell them. So that was great stuff. Now, later on with the Shuttle astronauts, we could do that, could talk to them, you know.

Well, then Apollo-Soyuz came along, and because it was an international program for the first time in history—what's happening, Summer?

JEANI STEVENSON: Do you want to talk about the WOCE project?

STEVENSON: No. When you see one of the movies, you'll learn about the WOCE. Well, that's Apollo-Soyuz. I haven't got to that.

JEANI STEVENSON: I thought it was Skylab.

BUTLER: No, that was Apollo-Soyuz.

JEANI STEVENSON: Okay. I've got pictures of that.

WRIGHT: Can we take a break and change tape?

STEVENSON: Whatever you wish. [Brief interruption]

STEVENSON: But then what I was really getting at, so then knowing what audio you have, and knowing that you can then insert photographs.

JEANI STEVENSON: This is the book he did that they put together. I don't know if you ever got back to the book.

BUTLER: Great.

JEANI STEVENSON: And he did integrate some space photos in it.

STEVENSON: That's the book we were writing, finishing up—

JEANI STEVENSON: Textbook.

STEVENSON: —in Colorado.

JEANI STEVENSON: He did a lot on plate tectonics, and there's some pictures in here in plate tectonics. It's not really great, but—

STEVENSON: Well, that's because it was plate tectonics.

JEANI STEVENSON: Right. It's not great for the ocean, but it's great for plate tectonics.

STEVENSON: This turned out to be—this is a teacher's edition, so it has all the answers in front. It turned out to be—that textbook hit the market in 1967. No. '66 and '67 was our last test. Then that was published by Houghlin-Mifflin, hit the market in '68. We revised it in '70 and '74, in '78, and '80. They finally watered it down to six guys. [Laughter] Those six guys could write juvenile or high school-level stuff.

Yes, see, there's the photo I was telling you about from Gemini XII. See, those guys were way up there. It's a poor reproduction, but you can look all the way down the Gulf of Oman, there's the Red Sea, there's the Arabian Sea, there's Somalia. Actually, the photo comes all the way down there, but anyway.

BUTLER: Great.

STEVENSON: But I think it finally became politically incorrect in some way so they don't publish it anymore. I don't know how or why.

Okay. Apollo-Soyuz was an international program, and so somebody—see, all of the Earth observations done on Gemini and Apollo and Skylab were all done through the aegis of the Manned Space Center, which eventually became the Johnson Space Center, and because the science people at headquarters said that photography is not scientific, because it's just photos and you can't measure anything with them, and so they refused to put money into it. So it was all done somehow in the budget down in Houston.

When Apollo-Soyuz came along, you know, there wasn't really much you can do from an Apollo, other than dock and shake hands and take a shot of vodka, and that was about it. The windows were small and all that sort of stuff, and you weren't going to get out on the Moon and put stuff.

So headquarters agreed, "Well, okay, we'll do an Earth observation thing." But they refused to put any cameras aboard other than the standard Hasselblads, handheld. They weren't going to let us get fancy. But they did put up money, so there was a project which was a NASA headquarters project, and they hired a guy named Frukkel Baas, who was a desert guy and who at the time was working at the Smithsonian. I think he's in—well, where is he now? I think he's at Harvard or MIT [Massachusetts Institute of Technology], somewhere up there now. He was the leader.

What?

JEANI STEVENSON: I know where those pictures are.

STEVENSON: You know where those pictures are.

JEANI STEVENSON: Do you want me to get them?

STEVENSON: Well, if you want. Sure. It won't take you long. So Farouk al Bas, he mainly was going to look at the deserts, because he's from Egypt. So he got a lot of desert. A lot of desert. My God, there must have been about ten desert people on that thing. And there were two oceanographers. Well, the oceanographers were imposed upon him by the Johnson Space Center, and that was George Maul and me. And they had some geologists, you know, and some—I still didn't think we called them environmentalists, but people who were worried about the environment.

But it was pretty good, because, you know, it was kind of exciting, you know. Wow! You're going to get to lecture to Deke [Donald K.] Slayton. Because, you know, I'd never met Deke Slayton, but he was always down in that corner office, you know. Turned out he's

a really nice guy, you know. [Laughter] After the first day, you know, "I don't know anything about that, Stevenson."

I says, "Slayton, before I'm finished with you, you're going to know so much about it."

He just looked at me and he says, "Okay."

Tom Stafford, you know, he was the commanding officer and he was going to listen to everything. I'd known Vance [D.] Brand for some time. I forget how I knew him. But anyway.

So it was really—we had about eighteen hours, you know, assigned hours for those guys, and that was over a year's period of time. Then you know, of course, how it happens. You'll come in to give them—and I demanded that they be in two-hour segments, because if you go an hour and then the guy's going to suddenly get up and leave, you're right in the middle of somewhere. So we had two-hour segments, and they were once a month.

Then it was not unusual, as it turns out, about halfway through, for me, anyway, to meet Deke Slayton afterwards, because he'd be with John [W.] Young and a guy that I didn't know for a long time, whose name turned out to be George [W. S.] Abbey. But Vance had a—I think Vance was either in the state of—I think he was in the state of getting unmarried about that time, so he was not a night owl. So at the Outpost it would usually be Deke. John was not a night owl either, because he either just had or was just about ready to marry Susie, and once that happened, then John's extracurricular activities were very much diminished. [Laughter]

But anyway, the point is that you saw these guys. You either saw them in the cafeteria, maybe you saw them in somebody else's office. They'd have a question. At the time, by that time the Navy decided that man in space was a great thing, and they had assigned a lieutenant commander oceanographer in the Navy to the Johnson Space Center, so he had an office in Building 4. The first guy was a young guy named Ty Aldinger, and he

was there for a while. No, I'm sorry. I guess that wasn't until Shuttle. Ty was when the Shuttle came along.

But nonetheless, George Abbey was a graduate of the [U.S.] Naval Academy, although he went in the Air Force. Damn near everybody who was anybody in the Astronaut Office in those days was Navy, as you all know. I mean, it became kind of a laughing thing, other than Joe Engle and—who else was there? Joe [H.] Engle and—I can't think of anybody else in the early days.

BUTLER: In the early days of Shuttle?

STEVENSON: Well, even before Shuttle. There were a lot of Navy guys there. But anyway, Shuttle was even worse. I mean, everybody was Navy for a while. But those guys turned out to be good. I mean, they began to get interested, they began to take stuff home with them, they began to take charts with them. They began to go over their CAP and see where they could really benefit. Then by this time Paul Scully-Power was back in Australia, so he got the Australian Navy interested, so he was going to do the Tasman Sea.

I'd been in England and I'd been talking to some RAF [Royal Air Force] guys. Their antisubmarine warfare airplane were these four-engine jet Nimrod planes, great big planes, fast. I mentioned something about this and they said, "Well, why don't we fly some flights for you." So I said, "Fine." So we had the Royal Air Force flying for us.

Then I got a call from this guy that I knew in the New Zealand defense establishment, an oceanographer, and he says, "I understand that the Australians are going to put a boat out for this space flight."

I said, "Yes, they are."

He says, "Well, why can't we do something?"

I said, "What would you like to do?"

He says, "We'll put a ship out and we'll fly airplanes."

And I said, "Okay. Fine."

By this time the admiral of the Office of Naval Research had gotten so excited, he put out an order to the whole fleet that this flight was going to go on, that ONR had a big experiment on it to look at the ocean, and here's where it was going to be, and he wanted all fleet units who might have ships or aircraft in given areas in which we were interested to respond. So that's how we got two aircraft carriers and a research vessel and two aircraft and a submarine that we never saw. He said he was going to be there. Now, whether he was or not, I don't know. So then we had all this stuff going.

So the three guys on Apollo became very excited about this. They didn't do anything up until the time they got rid of the Russians, the Soviets. I mean, they were geared to docking with that thing after Tom Stafford had rocked the— [Laughter] Those people are still yelling about that. He said, "I didn't break it. What's your problem?"

And after they left, they had about five days or six days with nothing to do. Nothing. So they came back with some very good stuff, and the photographs, Tom Stafford was the observer for this area in the Gulf of Cadiz...[west of] Spain, which we called the Huelva Front, after the name of—it kind of pointed north and it pointed toward the town of Huelva, so we called it the Huelva Front. He saw it. The aircraft got it, the ship got it. They also got the eddy inside the Strait of Gibraltar. The ship got that. The satellite data all showed it.

The NATO [North Atlantic Treaty Organization] lab in La Spezia, Italy, got so excited about the fact that there was an oceanfront out there that they didn't know about and they didn't really believe it, that they sent a major expedition of two research vessels out there the next year to look at the Huelva Front, and, sure enough, it was not only a temperature front, it was a salinity front. See, all our submarines went into Rota, Spain, which was on that coast, and then they began to speak up and they said, "Well, no wonder. That's where we're losing our sound, right there at that front."

So it turned out to be—in Navy circles it turned out to be spectacular. It was about that time that the Oceanographer of the Navy then began to think, "Well, maybe there's something here that I should really pay attention to." So it was probably right after Apollo—no, let's see. It was probably right after Dick [Richard H.] Truly's flight on STS-8, where he saw all the spiral eddies and we reported that to the Oceanographer of the Navy. That's when he decided that space oceanography is a very serious thing, and the Shuttle is a very important thing, and that's when the lieutenant commander came down;...Ty Aldinger. Then Don Mautner was there during the *Challenger* [STS 51-L] explosion. Then Sue Runco came in to replace him. Then she retired, because she was still active in the Navy, but Mario [Runco, Jr.] was going to stay there as an astronaut, and she didn't want to go away and leave Mario all by himself, because how could he possibly take care of himself. So she retired from the Navy and stayed there.

But I'd say from 1980, the Navy began to get pretty interested following Skylab and Apollo-Soyuz. Then after STS-1, see, remember back in the eighties, in 1980, the Navy had a whole mess of carriers over there in the Arabian Sea, because there was the Tehran [Iran] hostage crisis, so we had carriers over there. Three carriers all the time over there, ready to go to war in the event something happened. When John Young flew down that leg and saw this eddy that I was pretty sure was there, and was there, then we were able to pass it on to the ships, then the Navy started, really picked up.

But Apollo-Soyuz was a very key interesting key, in that we hardly knew what was going to come out of it, but what did come out of it—and it's the same—it's like, you know, probably through 61-A or something like that, I guess, when Jim [James F.] Buchli photographed the ship wakes, I'd always start out by debriefing of those guys by saying, "Well, let me first of all tell you what you guys found that we didn't know about before." [Laughter] And Jim Buchli finally spoke up and he says, "Bob, is there ever going to be a

space flight when you don't find something that you didn't know about before?" And I said, "I don't know. There hasn't been one yet."

BUTLER: Well, that's good. It shows how useful it all is.

STEVENSON: [Addressing Jeannie] So, now, do you have any good photos?

JEANI STEVENSON: Why don't you turn your film off for a second. [Tape recorder turned off.]

STEVENSON: ... [pointing to photograph] move back and forth like that, and we figured that the Russian Soviet submarine was sitting there, and they couldn't hear him through that acoustic boundary. But the problem was, since our ships didn't have a satellite receiver and they couldn't see the infrared stuff, how were we going to tell them how to find it? And so El [Ellison S.] Onizuka came on down here on this orbit and he shot this picture, and you can see that line in the water right like that, and you can see several lines. As a matter of fact, you look closely, you can see some ships crossing that line. One of the ships crossing was the USS *Enterprise* carrier that Don Mautner was on at the time, so he got good data, and we were able to say, "Look. I think we can see this from an airplane if we just tell these airplane guys what to look for."

So we drew up a little technique for airplane guys to see fronts in the water, and we briefed them down here before they went out, briefed all the airplane jockeys, mostly the guys who flew the twin-engine aircraft, who were the ASW aircraft, on how to find these things, how to look for them, and then once they saw them, then to keep on them to see, make sure they knew where they went, and if there were double boundaries to it. And they got pretty good at it.

So they're over there one time and the guy says, "You know, why don't we have those airplanes go out and see if they can find that damn submarine, like Bob Stevenson said. It's right behind there." So they went out there and they found where those were, and the ships went over there and they started pinging around. I told them, "Just drive over there and start your sonars going, because submarines don't like to hear sonars." And they did. About the third time around, why, sure enough, the Soviet submarine, two of them, came up to the surface and followed them out. I guess they thought, "Gee, there must be a party. Let's go." [Laughter] So, you know, this is a very famous photograph in the Navy, therefore.

BUTLER: Absolutely. I can see why.

STEVENSON: Yes. See, there's a ship's wake right there. That's the *Enterprise* going across right there. There's another ship's wake. See, this is all the oil tankers come out of the Persian Gulf down here and then they turn and they head on down around Africa that way, you see, or turn this way and go up the Suez Canal. So that's a great photo. The El Onizuka did a good job with that. He said, "I didn't see any of those ships." I said, "Yes, but you saw that other stuff."

BUTLER: Saw the other stuff, and that was enough to—

STEVENSON: I said, "That's enough." What else do we have?

JEANI STEVENSON: This is [a] Skylab [photograph].

STEVENSON: Skylab.

JEANI STEVENSON: And this is Huelva Front [another photograph].

STEVENSON: But that's only the infrared stuff.

JEANI STEVENSON: Yes. And this is [an] STS-2 [photograph].

STEVENSON: There's a great shot. Not much ocean in this stuff. This, however, is pretty interesting. You see this is the southern Arabian Peninsula, very mountainous. This is the Arabian Sea down in here, and you're going north up that way, and there's this huge valley. I mean, there's some great novels written about this valley. But anyway, you see right in that part it's kind of—there's all the sand, but there's something else right in there. That's something else right in there, is the remnants of the great city that was the home city of the Queen of Sheba. And everybody's heard of the Queen of Sheba. I don't know what she did, but she was big stuff back in those days. [Laughter] I love this photo. I mean, it's the best photo ever taken, even though it's way back. Where is—yes, it's a Gemini photo, I think, isn't it? '65. Yes, a Gemini photo. But it's the best photo ever taken of that area, I mean, because you can see the—and, you know, that's when guys like Farouk al Bas and all those guys get excited. They sent an expedition in there. They said, "There's something there," and by golly, there is. They found it.

BUTLER: So they hadn't even known.

STEVENSON: Well, they knew it was there. I mean, you know, historically they knew it was there, but, "There's a picture of it. Let's go find it."

BUTLER: That's great.

STEVENSON: All right. Where are we? Well, okay. So now we're ready to go to Shuttle, and that may be time to take a break and come back.

BUTLER: Sure.

STEVENSON: When I'm in Houston next time or whatever.

BUTLER: That would work.

STEVENSON: Whatever you guys say. I mean, you know. Summer's run out of tape.

WRIGHT: Oh, no, they haven't run out of tape. I just had that much left on that tape.

BUTLER: So it's that one tape. We do have more, so it's completely up to you. We can either go a little longer today, although it's getting—

JEANI STEVENSON: Did you show her all the pictures that you talked about so far?

STEVENSON: No, I don't have them all.

BERGEN: Show us the pictures up through Apollo-Soyuz and then we can save all the Shuttle stuff for later, do that all at one time.

STEVENSON: Do the Shuttle stuff all at one time. All right. Let's, therefore, do— [Tape recorder turned off.]

WRIGHT: Did you finish it [referring to the book *Dragonfly*]?

STEVENSON: I've read it three times.

WRIGHT: Really?

STEVENSON: Yes, because you read it through first to pick out the juicy stuff, and then you realize that some of the stuff in there ain't really—if you know the guys—that you know really isn't true, so then you think, if those aren't true, then let me go back and read it again. So I just last week—some person in a magazine had written a review of it and sent me a copy of it because she knew that I had very strong feeling.

My strong feelings are that to criticize the Americans that went up there and say that they weren't prepared is not correct. I mean, the guys who went up there, they may not have been prepared for what they were going to be doing, but, you know, like Norm [Norman E.] Thagard and John [E.] Blaha were up there to do experiments and the guys on the ground didn't even know how the hell to tell them what to do. And here's John Blaha, who's what, an Air Force colonel, a Shuttle commander, and he's doing these medical experiments, so he's supposed to be using syringes. "Okay. Where's the syringe?" "Well, we don't know. You'll have to go find it." Well, I mean, you can't blame him for that.

I've known those guys, other than...[Jerry M.] Linenger, I didn't know that well, and I don't know Mike [C. Michael] Foale well, but all the rest of them I know very well. I mean, they're friends. I can walk in and "Hi. How are you? What's happening? How are your hemorrhoids today?" You know, not quite, but I mean—not with Shannon [W. Lucid]. Well, yes, I could with her. She'd say, "Oh, mine are okay."

So I had to go through it again, and there's some stuff in there that—so I wrote a long probably politically incorrect discourse on—I think he got some marvelous stuff, you know. I talked to Jim [James S.] Voss. It was probably accurate but I didn't like the implications. I didn't like the tenor of what he was saying. Basically what he was saying was that the Russians knew what they were doing, were very brave and tough, and the Americans didn't know what they were doing and they were weak anyway. That's dead wrong.

I mean, if Mike Foale hadn't been there, they'd all been dead. And if Jerry Linenger hadn't been there and gotten the oxygen mask, they might all have been dead, too. Even though those guys were handling it, you know, he eventually had to come around, get a mask on, and get the other—you know. Don't tell me he wasn't working for them.

BUTLER: Even down there at the Space Center, it's been quite talked about, that book. Similar reactions.

STEVENSON: Of course, I know George Abbey very well. [Tape recorder turned off.]

... what they call it. I lectured to them. I gave them a course. Like the new ASCANs [Astronaut Candidates], they're going up to [International] Space Station and they won't be seeing much ocean. So I only get two hours with them, but then, you know, it depends. It used to be, when I was there frequently, before the accident, I was there every month. Each crew would get briefed as many times as the commander wanted the crew to get briefed, minimum of twice, many times it was five or six times. And there was no cutoff date. Now there's a cutoff date. Ninety days before launch, they don't want any more briefings because they're in training, they're in their sim [simulation], and they just can't have any more. But then it wasn't like that.

It was up through [STS] 51-L [*Challenger*], I gave them a briefing in crew quarters at the Cape the day before they launched. "You guys know all this stuff, but I don't want you to

forget this and this." And some of them would be, if they were Spacehabs or Spacelabs, then it would be the two pilots were going to do all the work, they're going to be in the cockpit, and if they're going to run a twenty-four-hour-day flight, then there's going to be one pilot there for twelve hours and one pilot there for twelve hours, but there's always going to be somebody with him, so that somebody with him, four guys, therefore, those guys had to be briefed just like the pilots did.

If it was a medical habitation, forget it. Those people were going to be down there taking blood and all that sort of stuff, and they never came up. Sometimes they did. But like [Margaret] Rhea Seddon said, in all of the space flights, four, I think, four or five—four. Well, whatever, it was four or five. On her last one, she says, "You know—" I usually sat in the office when I was down there where she is, and she said, "You know, I've never looked outside. I hear you talk about all this stuff, and I just never looked outside."

When she came in the class of '78, you know, thirty-five of them, I trained those people for two weeks, a solid two weeks of lectures, eight hours every other day. I'd start in, you know, and as soon as the lights would go out, one person would go to sleep, invariably. Fortunately, Rhea doesn't snore very much. Every now and then, Rick [Frederick H.] Hauck would be sitting next to her. "Rhea, this is a good one. You'd better look at this." "Oh, yeah!" But she never looked out.

So I said, "Well, why don't you just take—it isn't going to take long. It would take you two minutes to come out of the lab and look out."

And she said, "Well, what will I want to see?"

And I said, "Well, looking at your orbit, you've got a good pass and it's a good time of the year, so why don't you come out and look down at Murfreesboro [Tennessee]," which is her home town.

She says, "Can I see it?"

I said, "Sure, you can see it. You'll see Nashville and you'll be able to tell where Murfreesboro is." So she did. It's the only time she's ever looked out.

BUTLER: Amazing.

STEVENSON: Just so dedicated. Whereas, on the other hand, you get people like Ellen [S.] Baker, you know, they're very dedicated, too, and Shannon Lucid and all of the medical people who were going to be down in the lab. [unclear] very dedicated. Everyone else will at one time or another float on up and say, "Well—" Like on the flight Shannon was on with John [M.] Fabian. I think they had a day or so to go, and she was up on the flight deck, and she said, "Do you know, John, we have not taken any pictures for Bob. We'd better start doing it." So for the whole day they were up there taking, wherever they could. So, you know, it depends on the crew, but they're all—the younger kids I don't know very well, so many of them.

WRIGHT: Did you have one outstanding student that you felt really took your enthusiasm up into space, was able to capture what you were looking for?

STEVENSON: A lot of them did. I think my greatest triumph was [C.] Gordon Fullerton. Gordon Fullerton's a test pilot, you know, came very early on. Came in with Joe Engle. He was going to fly with Jack [R.] Lousma. Is that right? Yes. Jack Lousma was very eager for Earth observations, and Gordon Fullerton was not. He said, "I can't see anything. I don't know why I have to sit through all this stuff." Those were the days when two-men crew, they'd be out at Edwards [Air Force Base, California] a lot practicing landings, and they'd fly back through Miramar [Naval Base, California]. I'd go out and meet them in a car and bring them to Scripps [Oceanographic Institute], and we'd have a couple of hours of lecture. I'd

take them out for a Mexican dinner and then we'd drive them back to Miramar, you know. That happened a lot. Sally [K.] Ride was here damn near more than she was anyplace else, you know, for a while.

But anyway, Gordo just was resisting. God, he was resisting. So he went up and they got some good pictures, pretty good pictures. When he got back, we did a debriefing, and I said, "Well, Jack, this is a damn good picture you took here. You can see here," and suddenly Gordo said, "I took that." "Oh, well, Gordo, that was a good picture, you know. Let me show you." And he was kind of perking up a bit.

So then Gordo gets his space flight, [STS] 51-F. He's the commander. And 51-F had, without question, the best photography we'd had up to that time from any space flight.

BUTLER: That's great.

STEVENSON: And the resolution was good, there was no fuzzy shots or anything. The color was good. So when he got back, I asked him, "How the hell did you do this, Gordon?" He said, "Well, you know, I wedged myself in, my shoulder wedged into the window." Of course, his feet are up there somewhere. So he ended up to be a good photographer.

Jim Buchli was great. El Onizuka was good. Dick [Richard H.] Truly took pictures, but it was Dick Truly who, when he came back from STS-2, he says, "I don't know why you're telling me all this stuff. Why don't you go fly? Because I can't remember all this stuff." And that's kind of what started it. He went to George Abbey and then George decided that Paul Scully-Power and I were going to fly.

It was in [19]'82, late '82, George and I, we were all out at the Outpost one night. I never drank a lot of beer, but I'd sit there. George turned to me and he says, "I don't think you should have any more beer."

I said, "What do you mean? I've only had two."

He says, "Well, if you're going to go fly next year, you've got to get into shape."

I said, "Oh, am I going to go fly next year?"

He says, "Yeah."

I said, "Oh. Well, who am I going to fly with?"

He says, "Well, I think we're going to send you up with Sally."

I said, "What do you think Sally will think about that?"

He said, "Well, why don't you go ask her?" [Laughter]

I thought, "Oh, boy." So I knew Sally pretty well. I caught her in the hall a day or so later, and I says, "Sally, George said something about they might put another person on STS-7."

She looked at me and she says, "I knew George was up to something. I knew you guys were going to get into this. I suppose it's going to be you."

I said, "Well, that's what he's thinking about."

She says, "Well, I don't have any hang-up with that." I think Sally would have liked it, because, you know, man, she hated the publicity. Oh, did she hate it. And here would be somebody who would take a lot of that load off her back.

So I was going to fly with Sally. Paul was going to fly with Dick Truly on 8, and then we were both going to fly together on 41-G. But then people...were getting space sick and headquarters kept saying, "We've got to really get a handle on this," so they decided to put Norm Thagard on 7 and Bill [William E.] Thornton on 8. Then all of the congressmen and the Saudi princes and the senators got involved, so things kind of went down the tubes from there.

Okay. What are we going to do now?

BUTLER: If you would talk about these [referring to photographs], we can probably prop them up here against—

STEVENSON: Is that okay for you [and the videocamera], Summer? Okay. Now, this is a photograph taken from Apollo 9, AS-9, and it's of the Texas Gulf Coast. Here's Galveston and Clear Lake right up in here. Then we come down the Gulf Coast towards Corpus Christi, which is right down in there. Then Padre Island and the Rio Grande River and so forth. This was part of the specific area in which we briefed the crew, or which, in this particular crew, I didn't get to brief them, but this was an area in which they were briefed and which we wanted photographs and wanted multiple photographs. So this was actually on one of the early orbits, and they took this photograph because the coast was very clear, to make sure that they were going to get all of the coast in the photograph that we wanted to look at.

It was later on in the flight, this was the flight that had the four-barrel Hasselblad that looked straight down and had four different film in it. It had color, had color infrared, had black and white, and black and white infrared. They were looking straight down. So when they came across a day later, I think, in an orbit which came right down like this, right across the coast at Matagordo Bay [Texas], and they were looking straight down, those very features, these plumes of water that you see being blown offshore here, those very features were very visible with the cameras looking straight down in all those different film types. They were great in color, but they were great in color infrared, too. Then black and white infrared didn't do anything.

So this particular photograph was taken kind of as a first panoramic shot to make sure they got something, and then the later shots turned out very well. This is the one and the other photos from that mission was what gave us the clue towards making a little forecasting technique for the shrimp crop, Texas shrimp crop, and then we expanded that to other shrimp crops.

Okay. Now let's go to Skylab. I talked about, in Skylab, that these guys had seen the Falkland current. When you listen to the videotape of Gerry Carr giving this lecture, he's

going to say that the Falkland current has plankton blooming in it, and those plankton give it an almost chartreuse-green color. Well, it's hard to catch that color in a camera. What he saw visually was a chartreuse-green. First he said it was yellow, but he said, no, it's chartreuse. But when you get it in a camera, the camera just can't cope with those kind of colors, so it turned out to be this very light blue.

So this photograph is about 90-by-90 square miles of ocean, so that particular plume of plankton right there is stretching out for ninety miles. When they visually looked out of the window, they could see that thing. There were other plumes that were outside of this picture. They could see them stretching along for 1,500 miles, which was the clue that anybody needed to know that that was not an oil spill. [Laughter] I mean, not that much oil in the world. They'd already figured that one out.

So this was, first of all, it took me and other oceanographers who I called upon, because I didn't know—I said, "Plankton in the Falkland current?" I never heard of it, you know. I'd call up these guys who ought to know about this. Finally, about a month later I got a call from a guy back at Booth Bay, Maine, Laboratory, and he says, "I've dredged up an old reference from 1938, when a German ship did a lot of criss-crossing of the Falkland current, and they collected plankton." Far as we knew, it was the only publication that talked about plankton in any sort of magnitude in the Falkland current. Now, of course, there were dozens of them after that space flight, you know, especially from—we have a couple of good friends down in Argentina, Cynthia and Geraldo.

But, nonetheless, this was a first. And the fact that you could track an ocean current for that far, 1,500 miles—and, you see, another thing that doesn't show here, but these plankton blooms, of course, they just go with the current. Gerry Carr's first thing says there's great big eddies coming off from this thing. So in the video you'll see some of these eddies. But that's again, you see, it was on this flight that we determined that there were eddies up in the Caribbean, Caribbean Sea, and then we got them down here. So, you know, gee whiz, it

may be every current's got them, you know. So, you know, it was a really big breakthrough, although the physical oceanographers say, "Well, I knew that all along." I said, "Yeah, where's your equation, men?"

STEVENSON: Okay. So then this is actually a picture from Skylab 3, and I'd seen this picture, and I said, you know, it's a piece of the ocean. It's, again, a 90-by-90 square-mile piece of the ocean in the western Caribbean Sea, and right up here is Cuba and over here on this side over there is the coast of Yucatan. Down way over here is Nicaragua, and this is the open Caribbean Sea here. So there's a current. There's a strong current which is flowing up like this, going into the Yucatan Strait.

So I'd seen these things along—here's the current, and these are along the edge of the current, and I said, "Hey, you know, those have got to be eddies peeling off that current." And they're about, you know, fifteen to thirty miles in diameter. I said, "Gee, that looks pretty good."

So that's when we sent the message up to the crew and said, "When you come on this pass, you're coming right down the axis of this current. Could you look out?" I couldn't talk to them. This had to go through the Cap Com. The Cap Com couldn't really talk to them, so what we did was—and they were sending this stuff up by teletype, you know. So what we did was, we teletyped a picture with Xs and Ys, and we made these clouds dark and round and all this sort of thing on the teletype thing. [Laughter] Didn't have anything else, you know.

BUTLER: Imaginative approach.

STEVENSON: So anyway, that came up. So Gerry Carr later said they kind of sat around wondering what in the hell that was, but then they said, "Well, Bob Stevenson said these are

eddies," blah, blah, blah, and they said, "Okay. We'll take a look, you know." Well, they took a look. So then in real time they were talking to Capcom, and they said, "Yeah, we're just about at the end of the com pass, communication pass, but we're right over the Caribbean current. Yes, we can see the things that the oceanographer was talking about, and we're taking some pictures." And that was in real time, see. Hell, the reporters went crazy over there in Building 2, you know. They came running around, and they're calling me up on the phone. "Oh, God, am I supposed to—" You know. But it worked out, you know.

We then had a pass in January, toward the end of their mission, when they'd be going down, or we got the P-3 down there, and turned out to be correct. Correctamundo. It's strange, you know. I think that probably of all the new advances in a natural science that I know of in this half century, they've probably been greater in oceanography than anything else. Don't count the computer bit, but, I mean, in actually knowing what's going on. But well over half of that has been serendipity, which goes along with it, anyway. You know, it's finding something that's unexpected. What is it, anyway? It's a surprise. It's something you hadn't planned on.

This is sure a lousy picture. Can you see that, Summer? Can you see that dark line right up there?

BERGEN: Yes.

STEVENSON: Oh, you can? Oh, okay. Well, this is a photograph that was taken from Skylab and was with one of their big cameras. They had this camera that was a 5-by-5-inch film format. Man, that's a big camera, you know, and it had an 18-inch focal length lens. I thought we were going to see the whites of their eyes with that thing. So they were just—actually they were on a pass and they were going to come across Spain. This is the Gulf of Cadiz in Spain. This is Strait of Gibraltar. Here's Morocco down in here. This is Spain over

on this side, and Madrid is up in this neck of the woods somewhere. I only said it once today, Jeani, "neck of the woods."

They were making this pass, and they were going to shoot overlapping frames as they went across Spain, across France and the French Alps. They were going right across the Alps, as a matter of fact, almost. And so they turned this thing on. So I'm looking at this and I say, "Hey, wait a minute. What's that thing right there? Why is that line in the water?" And actually there's a stereo pair of this. If you look at the stereo pair, you can see that that line is actually some internal waves, and the waves come up to that line and they stop, come up from this side and they stop. That's the town of Huelva right up in there.

So I said, "If internal waves are flowing up in the open ocean, deep water, and they're stopping, that means they're flowing up a mass of water that's getting colder and shallower until they get to the surface and they stop and they can't be internal waves anymore." So Paul Scully-Power and I said, "Well, that must be a front, and if that's a front, then it's got acoustic implications," and so we chose that as being a site for Apollo-Soyuz, because we knew that we could get a U.S. Navy research vessel to come in here. We could get aircraft to come in here, and we had the carrier *Kennedy* over in here, and we had the *Roosevelt* going out that way. We just figured we were going to get a lot of data to support that.

Man, I was listening to those guys coming over there, and Tom Stafford was saying, "I don't see that thing. I'm looking for it, but I don't see it." And I thought, "Oh." Then all of a sudden he says, "There the son of a bitch is! There you are." Click, click, click, click. But that's not on the tape, on the video that you have [referring to video he loaned to project for reference].

BUTLER: Sure.

STEVENSON: NASA didn't think that would be quite appropriate. So, anyway, so that's, I guess, about it. I can show you another nice picture which was not from any of those. This is a picture in the Red Sea. The Red Sea is a very interesting place. Doesn't look red from space. The reason it's called the Red Sea is, it's very full of biological activity, mainly plankton, microscopic animals and plants, mainly microscopic plants. When they bloom, as you probably have heard, in the ocean, in any great numbers, billions per square or per cubic inch, they turn the water red. And if they're a particular kind, like the kind that grows off the west coast of Florida, they get in the air with the wind, and they get in people's noses and they're toxic. Not toxic, but they're very irritating. So during the times along the coast of Florida when there's a red tide, as they call it, a lot of people get ill. They have respiratory trouble and they have sinus trouble, and it's not very nice.

But anyway, in the Red Sea they're a different species, so they—I don't think they make the Arabians sick, or the Ethiopians or whoever else is there. But one thing they do is that they coat the surface of the sea with biological oils. Biological oils are different than petroleum oils, in that they are monomolecular. In other words, they're one molecule thick, whereas petroleum products, even when it comes out of the ground, it's a very complex carbohydrate or biocarbon—

BERGEN: Hydrocarbon.

STEVENSON: Hydrocarbon. And they're not one molecule thick, so they don't form these very smooth slicks. When you see a smooth slick over a sea surface, you know it's biological. It's when it's patchy and lumpy or stuff, that it's from petroleum.

So anyway, the Red Sea, as long as the wind doesn't blow, has this real smooth surface, and in the sun's reflection it's spectacular, because any little motion of the water you can see. And, man, you see more things. But the one thing you can also see is that if the

water kind of converges—a lot of parts of the ocean, there will just be motions on the surface of the water, maybe the wind blowing it, and a piece will come together. And if there's any of these biological films there, then they'll clump together and they'll make kind of a thicker layer, and it's what back in the old days the sailors called flotsam and jetsam on the sea surface.

So this is in the Red Sea, and you see there's been a lot of stuff come together here, and that's a lot of plankton junk being brought together, making thicker stuff. If the sun were reflecting off that, it would be a very bright reflection that is like a mirror, whereas since it's really not reflecting much at all, you just see the white color. As ships go through here, they very often talk about this stuff that they go through. Well, what do you see here? There's a ship right there, and look at that beautiful ship's wake. That's a stern wake going right back through the water. There's another ship up there. See, when it went through this bits of flotsam in here, it got bright, you see. Then there it is going back.

So you say, wait a minute. How come there's no bow wake? Well, there is a bow wake, but from this particular angle and with the sun reflecting the way it is, and because of the biological oils, you're seeing primarily the stern wake of the ship. And it even looks as if it's making a shadow here and it's sticking up in the air, doesn't it.

BUTLER: Yes, it does.

STEVENSON: Which it really isn't. So, you know, those kind of things, I mean, you see the strangest ship wakes. The Navy at first got all excited about that, saying, "Oh, my God, why is that ship wake sticking up? It must be a submarine." It's the Prince of Saudi Arabia out there driving his motorboat or something. But anyway, that's just the kind of thing that you can see. The astronauts love to look for ships, and some of them, their eyes are—I don't know whether their eyes are more acute or what, but there are a lot of them that will swear

they've seen ships at the point of those wakes. John Young claims that he can tell whether the wake is a carrier or a middle-sized ship. I said, "How about a small ship?" No, he can't tell that. [Laughter]

BUTLER: That's great.

STEVENSON: Another thing, too, I'll just throw this out and then we'll quit. This is my last comment. Back in—let's see. George Abbey became the head of flight operations in the late seventies, and I didn't know George Abbey then. I had heard he was a very stern and quiet guy, but he was very particular, you know. So it was probably about in [19]'79 that I'd been given a chat with those astronaut candidates, and Steve Hawley said, "Well, we're going out to dinner tonight. Want to come with us?"

I said, "Sure. Who's going?"

He said, "Sally [Ride]," and I don't know who all else it was, about four or five of them. And he says, "And probably pick up Mr. Abbey."

I thought, "Oh, boy."

So it was a strange night. We went to the one place, went in, and George said something to Steve. He and Steve are very close, for whatever reason. So Steve says, "No, we're not going to go here." So we went out and we finally ended up with some restaurant way out in the boonies down near Alvin [Texas]. It was a good restaurant, but, I mean, you know, I never would have known it was there. And we had a good meal. I think it was Italian.

I was sitting over on this side of the table and George was over on the other side, and I think he made Sally sit at the head. I know Rick Hauck was down at one end. Maybe eight of us there. So I didn't know whether to talk to George or what, you know. So finally he says, "Well, you've been giving them some oceanography today?"

I said, "Yes, that's right."

He said, "Do you think they're learning anything?"

And I said, "Well, yes, sir, I think they are."

He said, "I think you're going to have a hell of a time teaching oceanography to Hawley here. He's just a damn astronomer, you know."

So then I began to know, okay, you know, at least I'm not going to get stomped in the floor. So then I began to chat with him a bit. So when the dessert came and some of them got up and went to the bathroom before we had dessert or coffee, he came around and sat next to me, says, "You know, I don't know how valuable looking at the ocean or the Earth is going to be to any scientist." He said, "I expect it's going to be very valuable to you and to Scully-Power, who I hear is coming here."

I said, "How did you hear that?"

He says, "Well, because Rick Hauck told me you were going to have a buddy. Where the hell is he coming from? Is he Australian?" [Laughter]

I said, "Yeah."

But anyway, he said, "The most important thing is that these people who fly, they've been under a tremendous effort to train properly. Flying in space in a Space Shuttle is not necessarily"—he didn't say "tense." He said, "Is an occupation that requires complete attention to duty at all times." And he says, "So all of them needs some recreation. They need something to do to relax." And he said, "There isn't any question they're going to be looking out the window, and I want them to look out the window. It's the most relaxing thing you can do in space, is to look out the window and look at the Earth, but, by God, I want them to know what the hell they're looking at. So that's what your job is."

"Yes, sir, Mr. Abbey."

And, you know, it made a lot of sense to me then. From that time on, I've never had any problem with George Abbey. I mean, he's been—now I can say anything I want to him, and he ain't gonna beat me, you know. He says a lot of things he wants to me, too, you know.

But that was really, as I told Paul when I called him the next day, I said, "Look. Let me tell you what George—" He'd never met George. I said, "Let me tell you what George says." And he said, "Well, that makes sense." He said, "That makes a lot of sense, but that doesn't mean that we're not going to get good information." I said, "I know. It means we're going to get better information, because now, number one, we know that this is something they're going to do anyway. They want to know what they're looking at, and if they want to know, then we're going to get better information than if they don't know." So, anyway, that's really, in my opinion, how the Shuttle Earth observations really came about, was because George felt so strongly that his astronauts needed relaxation, they needed some way to unwind from a hard day docking or something like that, or letting a satellite out. They were going to look out anyway, so, by God, they might as well look out and know what they're looking at.

BUTLER: Absolutely.

WRIGHT: Before you close, will you share with us, if you had had a chance to go up, what would be the one picture that you would have really liked to have taken?

STEVENSON: Well, I would have liked to taken a picture of me aboard the Shuttle. I don't know, you know.

WRIGHT: Or would you have looked for the unexpected?

STEVENSON: Yes, I don't think I would have wanted to be pre—see, when Paul went up [STS 411G], they kept saying—I was supposed to go up, but I couldn't go. So when Paul went up, then they wanted to have a manifesto for him, you know, he should be doing this and this and this. And so, you know, he and I sat down and said, "Okay. What do we think we know and what don't we know, and what would we like to know about something?"

And the big thing was spiral eddies. We'd seen them here and there, and we didn't really know what caused them, but if they were indeed—see, Dick Truly had seen them for 1,500 miles, in a swath 1,500 miles wide, clear across the Indian Ocean and on the other side and going to the other side of New Zealand. So he saw them for more than 6,000 miles. We said, you know, if they really exist like that, then they are very important features of the ocean. They're just not little sporty things.

So for Paul, therefore, the thing was spiral eddies, and then also he was going to see Gibraltar, and we wanted to make damn sure that we understood that there were these big solitary waves coming through Gibraltar. So he had that thing to look for. But, you know, he saw a lot of things that we didn't expect, and so I think that's what I think I would—he had the luxury that the astronauts do not have and did not have, is that his job was to sit at the window and look out.

BUTLER: What a job.

STEVENSON: And he was very conscientious about it. He would sit at the window during the forty-five minutes of daylight, and as soon as it got dark, he went down below and he talked into his tape recorder. He talked into it while he was watching, but then he'd go back and he'd reiterate and try to consolidate what he'd seen, and he also wrote notes. Then it would be daylight again and he'd go up topside. It would only be at a time when the two pilots had to be at the controls and were doing something like launching a satellite or some damn—well,

let's see. What happened during his flight? Oh, that was the flight when they had the synthetic aperture radar, so he could be up there nearly all the time.

Now, the thing was that [Robert L.] Crippen, who was the commander on that, flew a—it was a sleeping mission. That is, that meant that everybody had to go to sleep at the same time, and so there couldn't be any photographs taken while they were asleep, because even though there's not a lot of noise up there, you know, there's just kind of the little rush of air moving around. So if there's no chit-chat going on, it's quiet. And when you crank one of those Hasselblads, it goes "ca-glonk," you know, and wakes everybody up. So he didn't want that, so there couldn't be any pictures taken during sleeping time.

Paul and Kathy [Kathryn D.] Sullivan, several occasions, and Dave [C.] Leestma, too, were up looking during that time, because there was some place they wanted to look at, and they saw things that they couldn't photograph. So I think the thing I would want to do, I would want to—I probably would have been glued to that window. As Paul said, he said, "You know, you saw subtleties that you never see in the photographs," and those are the things that—plus the fact that things go by pretty fast, you know. You're doing five miles a second over the ground, so when you're looking in the sun's reflection and something comes into the sun's reflection, like the edge of an eddy, if you're not ready to watch it, it's gone. So you really need to be paying attention.

Other than the picture of me sitting on the head—have you ever seen that little thing? It's got a hole about that big around, and if you are not centered precisely over that hole, then it ain't going to work.

BUTLER: That's not going to be pretty.

STEVENSON: And I don't know whether they still have the training. When I was going to fly, I had to have my potty training. Mary [L.] Cleave was the potty trainer in those days, and

they had this potty over in—I forget what building it was. They had a television camera right down below so that when you sat down on this thing, you looked at the screen up here to see if you were properly centered.

BUTLER: That's a picture you've never seen of yourself before, I guess. [Laughter]

STEVENSON: That's correct. Absolutely correct. [Laughter] So, anyway.

No, I just thought I'd have a ball, that's all. The crew that I finally was assigned to was a reflight of STS-9. STS-9 that John Young and Brewster Shaw commanded was the first Spacelab, if you remember. It was the first high-inclination flight. But it got delayed so much that the Earth observation, or the Earth resource part of it, which was all European, really couldn't be done because they flew it in December and it was dark over Europe in December.

So the European Space Agency had always asked for another flight, so they finally got one. They were going to do one in August of [19]'86, and Vance Brand was going to command it, and Dave [David S.] Griggs was going to be the pilot, and Bob [Robert L.] Stewart, the colonel, eventually general now retired, was going to be aboard. Bob Stewart, Bob [Robert A. R.] Parker, and Claude Nicollier, all guys that I knew very well, and me. And the Europeans had all these big fancy cameras that were going to go aboard. When they heard I was going to go, they decided to put another camera aboard for the oceanographer, and then they were going to double the film load. It was going to be a 57-degree orbit and launched at a time when would be daylight over much of the Earth that we hadn't seen in daylight before, but in particular over Europe. If it were daylight over Europe, that meant we're daylight over the western Pacific and the coral atolls and everything. It was an eight-day mission. Perfect. Then that schoolteacher went up and blew the things up and it was a sad day.

BUTLER: Very sad.

STEVENSON: I didn't know her and I didn't know the guy, because in those days I didn't brief the payload specialists, but all the others I knew. I was very close to all of them.

BUTLER: Very unfortunate. Very unfortunate.

STEVENSON: Yes. You know, the funny thing was—not funny, but I'd been down to brief them and they kept delaying it. I forget why they were delaying it. They delayed it twice.

JEANI STEVENSON: The cold.

STEVENSON: Yes. And I was down there. Yes, there were a lot of headquarters people down there. Finally, I had already briefed them, and then I went into crew quarters to brief them on Saturday, and Mike [Michael J.] Smith came out and he said, "Bob, you know, we've just got another delay." They were supposed to go the next day. He says, "I don't know when we're going to go, but we're recalculating all of our crew activity plans because of new orbits and daylight and all this sort of stuff." And he says, "We know what you want us to do, and you know what we're going to do, so would it be okay if we just get this second briefing?"

I said, "That's fine with me." And I said, "When are you going to go now?"

"Well, we're scheduled for Monday."

I said, "I'm not going to stay around for that. To hell with it," because I had five crews to brief the next week. So I said, "I'm going. Have a good flight."

And Judy [Judith A. Resnik] stuck her head out and said, "What did you say?"

I said, "Have a good flight!"

So then I drove, went back, and watched. It was Super Bowl weekend. I got back to Houston at noon on Sunday, got in my apartment over at the Camino Village. They used to rent apartments by the week, you know, and I was over there. Watched the Super Bowl game, went in preparing for my first briefing, and Steve [Steven R.] Nagel came by and he says, "Hey, they're going to launch."

I said, "You're kidding me," because I had been watching NASA Select all morning, you know, in my apartment, and the icicles were hanging from the tower. When I got over there, I had heard from Lucy Lytwynsky that Mike Smith had called his wife, who was down at Cocoa Beach, and said, "Don't get everybody up. We're not going to go today, so just relax."

So I thought, well, okay, they're not going to go, you know. Steve Nagel says, "Well, they're going to go."

I said, "What do you mean, they're going to go?"

He said, "They're going to launch."

I said, "You're kidding me."

He says, "No, I'm not."

So we walk down. In old Building 4, on the third floor there was an astronaut library over in the far corner. So we went in there. There was one TV set in there, and there were a bunch of the secretaries in there, and everybody else was over in the big room. The damn thing blew. I remember I said, "Oh, well—" I saw something come through, and I said, "Oh, well, Scobe will bring it through. He'll turn it around and come back." And Steve [Steven R.] Nagel just got up and walked out. He knew what it was. I didn't.

Then what came through the other side was one of the solids that had poked through and was going off like that. Sad day.

BUTLER: Very sad day.

STEVENSON: So that wiped me out.

WRIGHT: Hopefully that will be the last time that any of us have to endure that, and we'll all have good memories of all the work that you've put into working with the astronauts.

STEVENSON: I have good memories, you know. I flew in World War II and I lost people, friends then, you know. But, you know, the thing was, I don't think it was necessary. I don't think anybody thinks it was necessary. I mean, when you're flying in combat, that's different. People are shooting at you and you're shooting at them. I mean, that's kind of the name of the game. But in this case, if somebody wanted them to go and—

BUTLER: Hopefully we have learned from that and can move forward.

STEVENSON: It's like Jeannie [Stevenson] and I were down at the STS-88 launch last December. We'd stayed up all night and been to a couple of the crews' families parties. We got our hotel late, so our hotel was in Daytona Beach, you know. [Laughter] So we got back in time to get out there, to be driven out to the VIP stand.

JEANI STEVENSON: It was a night launch.

STEVENSON: They were to go off about four in the morning.

JEANI STEVENSON: Three-something.

STEVENSON: Three-fifty-nine or something like that.

JEANI STEVENSON: And when you start out at eleven o'clock driving from Daytona, you know, and we were up for a four o'clock launch.

BUTLER: Wow.

WRIGHT: But it must have been beautiful to watch the beginning of a whole new era.

STEVENSON: Didn't see it, because at nineteen seconds, the countdown stopped because they heard a warning bell ringing in the cockpit, and they still had a minute and twenty seconds to go before the window would close. So they called the crew, "What's going on?"

The crew said, "I don't know what's going on."

"Do you have anything bad?"

"No, we don't have anything bad." But they had to, therefore, run through all of the systems. They had a minute to run through the systems in order to catch—you know, for them to catch back at minus-nineteen to make the launch. Well, I mean, are you kidding me? I mean, you don't know what's happened, you know. And I'm sitting there saying, "They're not going to launch on that. They don't know—" I mean, it would be just like [STS] 51-L launching, thinking—then they heard somebody, one of the women controllers who was at some station, say, "Oh, well, tell them to launch anyway."

Then launch control says, "Okay, we're going to pick up the count."

And they picked it up and they missed the window, so they had to stop it. But, you know, we went in to the breakfast they had for us, with 2,000 other people, and we were talking to a bunch of the astronauts sitting there, and they said, "God." I mean, it's the last thing you want to do is to launch when you've got a warning and you can't find out what it is."

BUTLER: Absolutely. Luckily, they didn't launch.

STEVENSON: Whatever it was, was easily fixed, and they launched the next day. Pardon?

JEANI STEVENSON: Perfectly.

STEVENSON: Perfectly.

JEANI STEVENSON: That was a perfect flight.

STEVENSON: And the next day we were up in Savannah, Georgia, because my old bomb group was holding a reunion and I hadn't seen those guys in 500 years, so I'd better see them.

BUTLER: That's always nice to be able to get back together with old comrades.

STEVENSON: Only knew one guy.

BUTLER: Really.

STEVENSON: Yes. Fifty years. But it's strange, you know, he was my waist gunner.

BUTLER: What do you know.

STEVENSON: Well, I knew he was going to be there, but I hadn't seen him since he was a little kid and I was a little kid. He came walking across the room and I knew him.

BUTLER: Right away?

STEVENSON: Yes.

BUTLER: That's great.

STEVENSON: Well, that's enough stories.

BUTLER: Thank you for spending all this time with us and showing us pictures.

STEVENSON: Sorry for keeping you so late.

BUTLER: Not a problem.

[End of Interview]