NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

FRED PEARCE
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is November 12th, 2003. This oral history interview is being conducted with Fred Pearce in Houston, Texas, for the NASA Johnson Space Center Oral History Project. Interviewer is Rebecca Wright, assisted by Jennifer Ross-Nazzal.

Thank you for coming in this morning, and I'd like to start today by asking you how you began working for [National Advisory Committee for Aeronautics (NACA) Langley Aeronautical Laboratory, Hampton, Virginia] in 1956.

PEARCE: First, when I got out of high school, I got an offer to work there as an under-aircraft model maker, but that was in 1941. Anyway, I didn't take that job. In [19]'56, I was working at Bell Labs [Laboratories], and I thought it was politically best to move. I was offered, at Bell Labs, to go to the New Jersey location and work part-time towards a master's degree, but I knew there were political problems. They never hired anybody that way. So I got several other offers.

And the day of my leaving, at dinner I got the phone call. I was thinking I was going to go to New Jersey to Bell Labs and start graduate work. It was the guy that was going to hire me there, and he was very defensive. Anyway, he was turning me off.

So I was interested at National Advisory [Committee for Aeronautics], NACA, and so I took that offer at NACA.

WRIGHT: What were your duties going to be at NACA?

PEARCE: Initially, I [worked on] the anti-ICBM [Intercontinental Ballistic Missile] study, sort of the feasibility, not as to accuracy, but it's the feasibility from time and energy to intercept an ICBM.

Shortly after that, the Space Task Group [STG] came about, and this was all at the Pilotless Aircraft Research Division, which is where the nucleus started, and I chose to go there, and I went to work in guidance and control there.

WRIGHT: How did you make the transition to the Space Task Group? Did they approach you, or was this something you were interested in?

PEARCE: There were only maybe twenty people about that time, and people expressed an interest. Then [the Space Task Group] chose who they wanted to talk with, and I was one of those. I went to work for [Robert G.] Bob Chilton in guidance and control-type stuff.

WRIGHT: What did you know about the nation's goal of sending an American in space at the time that you transferred over to the STG?

PEARCE: As soon as the Russians put one up, they had all these lectures on space, and I felt it was more interesting to move on to the space project rather than to continue working at the Pilotless Aircraft Research Division. [The Space Task Group] moved across the campus to some very ancient buildings in a giant bullpen-type configuration.

WRIGHT: Could you share with us what it was like during those first few days of discussion?

PEARCE: There was a lot of enthusiasm, and the organization was rather loose, so everybody talked up and down to everyone. Since I knew everyone anyway, and I was also a model airplane enthusiast and [Maxime A.] Faget was also one, and we had flown together. So most of the people then knew everyone.

Then they started to expand slightly. The Canadian group came down. When the Canadian aircraft thing folded [A. V. Roe Canada Ltd. (AVRO) Aircraft, Malton, Ontario, Canada], they brought down about twenty-five people. I presume you've interviewed about that part.

WRIGHT: Some, yes.

PEARCE: When the [CF-105] Arrow there, fighter aircraft, was cancelled, then they chose, supposedly, the most promising group, and it came down with James [A.] Chamberlin, and they did well.

WRIGHT: What did the Flight Control Section start working on, and how did you develop your plan of what needed to be done for your part of the STG?

PEARCE: They investigated a lot of wild ideas, and Faget always like to have a large solid rocket booster and so on. Then it began to focus down, and Faget's group configured the Mercury capsule. I believe several of them, including [William E.] Bill Stoney, [Jr.], got patents on that

shape, and so we converged on that configuration. Initially, it didn't have any window, except a porthole on one side, and that was felt—you know the sardine passenger, that was felt [demeaning to the astronaut]. I think it was much better that they installed a window in the Mercury capsule, a very funny window. Then they had so many panes in the window for safety that there were optical problems, and the astronaut had to be trained to do navigation by the stars through the window.

Then the guidance and control problem came up, and we had to do simulations of that where we had to orient to the Earth with a scanner which bisected the signal from the Earth to give you the vertical, and that took a bit of study. Then just the logistics of the Mercury Project and monitoring all of the contractual work where you would go out occasionally to McDonnell [Aircraft Corporation] and may be on duty for thirty-six hours for verifying every step for the testing of the Mercury capsule. I would generally go out with an astronaut or two, and there [were] a lot of funny stories there.

WRIGHT: … When you were working with Mr. Chilton, were you part of the Flight Dynamics Evaluation Team that actually came up with the specs for the Mercury capsule?

PEARCE: Yes.

WRIGHT: Would you share with us how that team worked and how you were able to come up with those specific requirements for McDonnell Aircraft?

PEARCE: There was no structure, somewhat. Just everybody started in and wrote and criticized everyone else, and it evolved from that. McDonnell was a worthy contractor, so things went fairly smoothly after the contract was awarded.

WRIGHT: You mentioned visiting with them—

PEARCE: So we invited them to propose to us a configuration, and that congealed it, but we knew what we wanted, and so it was pretty straightforward. They came back with what we expected them to propose.

WRIGHT: After Mercury, or during that time, the transition began or the talk began of opening up the Manned Spacecraft Center [MSC] in Houston [Texas]. Can you tell us how that affected you and your family and your working and moving here?

PEARCE: Well, it tore the family structure up. Really, the reason for coming to Houston was somewhat nebulous. My wife was a psychiatrist and directing the Child Guidance Center at Virginia Beach, [Virginia] and so it was very disruptive to come here. Also, when we get here, the number of people coming onboard was just astronomical compared to the initial group. And many people didn't come, and wandered off into other areas of NASA.

WRIGHT: How did that affect your working group to have an influx of new people?

PEARCE: Well, [initially] the new people that came in were very few in each [area], and they were all the really select group from the AVRO Program. So the only political problem was James Chamberlin, the head of the AVRO thing, and he was a remarkably bright fellow. He kind of husbanded all the information to himself, if he could, and he didn't like to tell anybody else anything. But he was a very worthy in the lead, so it was not too bad.

WRIGHT: What were your first impressions of the new home that you and your family would have here in the Houston area?

PEARCE: Well, my wife was somewhat distressed because she came from directing a psychiatric center, so she entered the training program for a specialty in child guidance at Baylor [College of Medicine, Houston, Texas], so that she rapidly became involved in that, but it was disruptive to have moved to a small frog in a big pond, is the way she put it.

WRIGHT: Did you live nearby the Space Center?

PEARCE: Initially, we were all somewhat around the Gulfgate area, and so we rented a house not far from there. Then in about a year there was an area which used to be largely Jewish got block-busted, and they dumped the homes for nothing, like a 3,500-square-foot prime piece of property might sell for [forty] grand, where the legitimate price might be for three times that. So we bought there when it was still convenient to work, but then, of course, I had to commute. After they started to build out here, with the commute, it was easy for her, but long, you know, forty minutes for me.

WRIGHT: How did your work schedule change? Were your days now longer when the group moved to Houston?

PEARCE: You would get, perhaps, if things got pressured, you might work very extensive hours. Just depended on how the pressure was and what the situation was. If you went out to McDonnell, you might be on duty thirty-six hours in a row. But the hours were whatever—whatever was needed was done.

WRIGHT: What was the main focus of your work once you arrived in Houston? What were you and your group attempting to accomplish?

PEARCE: We started the various challenges to handle the Mercury capsule and attitude control of the Mercury capsule, the guidance of Mercury capsule, and that occupied us. And we had to, of course, support each mission. For example, you had to husband the fuel for attitude control because you had to have enough left [for re-entry]. When the space vehicle had to come back, it had to damp any oscillations. If you didn't damp the oscillations, it might start spinning and just pulverize the astronaut.

One of our astronauts was wasting the fuel doing frivolous things. I tried my best to stop him. We stopped him in time from using it too much, but he didn't seem to be paying much attention to, "Stop using the attitude control. Stop it, stop it, stop it." I don't know whether he got reprimanded. I presume he got reprimanded later for that.

WRIGHT: As you were working on Mercury, were you also beginning to work on some of the—

PEARCE: Well, the Gemini was off to the side, and it was just scaled up of the same technology. Then the Apollo thing started to arise, and just monitoring what was going on was the main activity since they are about a hundred times more in the contractor side of the house than in the NASA side of the house.

WRIGHT: You mentioned that you had worked with McDonnell Aircraft. Were there other contractors—

PEARCE: I didn't work with them. NASA people went out to McDonnell to monitor each checkout of every vehicle.

WRIGHT: Were there other companies or institutions—

PEARCE: There were lots of subcontractors to McDonnell, yes.

WRIGHT: But were you also involved in going out to do oversight and monitoring their work?

PEARCE: For example, MIT [Massachusetts Institute of Technology Instrumentation Lab, Cambridge, Massachusetts] was doing a navigational instrument, and we were involved in that effort, where you take shots on stars in case—if in an emergency you had to manually bring the vehicle back in the proper form and so on. They had these backup modes of navigation, whereas

really the thing could do everything automatically if so it needed to be done. The astronauts didn't want the last maneuvers [to be done] automatically. They wanted to actually guide the thing.

WRIGHT: How did that difference of procedure get agreed upon?

PEARCE: That's how the window got in there. Until they could see out, what could they do? The porthole in the side window couldn't do much, so at great expense to reconfigure the vehicle to incorporate this strange window—I think it had about five panes of glass in it; quartz, really. Of course, glass is very fragile, and you worry about damage in orbit and so on. So there was a lot of activity on the astronauts doing their thing as [back-up] if none of the automatic things work[ed].

WRIGHT: At what point did you start working on or with, for the Apollo Program? Was it a natural transition of the work that you were doing with Mercury and Gemini?

PEARCE: Once they had to decide on the means how to do the mission and the least extravagant way to get there was to go into orbit around the Moon and then descend to the Moon in a small vehicle and then come back and rendezvous again in orbit. That used much less fuel.

You had to [study] landing on the Moon, which is surprisingly different from what you might think. The surface of the Moon is dust, so that if you're trying to land and the sun is behind you, which you would think that would be the least glare and so on, you couldn't even see the surface because it's as if the surface of the Moon were covered with an egg crate painted

bright white, and all the light that bounces off the egg crate bounces right back in your face, and [ruined visibility]. So you had to land with the sun in your face, but since the sky is black and you didn't look at the sun anyway, that's the way we had to simulate that.

We didn't have any decent [visual simulation]. … If you take like a big model and have a TV camera fly over it and so on, and play it back on a TV screen, it's like looking at a TV screen. It's not real. It's not like looking out a window.

About that time, the Farand Optical Company came. They had a device to project a TV. They thought maps or something, to project them as if they were out there in front of you, like looking out a window, and this was called virtual image projection. At the time, G.E. [General Electric Company] was starting to generate digitally any kind of scene you could describe in the computer. It had limited memory, so these things were somewhat simplified, but they could simulate the surface of the Moon and craters, and the Sun direction so the shadows would be correct.

I thought of combining the digital image generation with the virtual image projector, and I sold that program and managed it. Some of the optics were up to five feet in diameter. It cost a couple million dollars at that time. We started to use that as a [study] device [when] I was head of the Guidance and Control Simulation Branch. Then after we did the studies of how to do the job that way, then later on the variations on that system were used for actual training. But the original system, in which, I guess, we did the first [virtual reality. The term is now in the language.]

Later on, this stuff was used for many things. It's the standard now for sophisticated simulations. For example, a giant oil tanker is difficult to pilot, and they might generate the scene for him coming into port with such a system.

WRIGHT: How was your idea first received when—

PEARCE: I made mockups of what would happen, and I made the pitch, and I sold it. So they stuck me with being the manager. So, somehow or another, I got to be considered an optical person, and it was really a hobby. Optical questions seemed to come to me, were brought to me.

WRIGHT: Could you share a few more details of how your idea and once you sold the idea, how it became a reality? How long did it take?

PEARCE: We were very concerned to have a decent way to study the landing and the rendezvous back with the mother vehicle, and we were desperate to do a proper job with that. This is the thing that solved the [visual] problem. Hence, at least I seemed to have no resistance selling it, although it was very expensive for the time.

WRIGHT: Was G.E. the manufacturer that helped you create the product?

PEARCE: G.E. was showing us they could generate digital scenes, and Farand was showing us how they could make it appear to be a window looking out at reality. So I brought the two together, and I wrote the request for proposals, and they went out. Of course, I knew that [G.E. and Farand were the only group] worthy of doing the job.

WRIGHT: How long did it take to implement the product and get it to the standard that you wanted to have?

PEARCE: I'm having to make a wild guess. Less than a year. Of course, everything was very pressed at the time.

WRIGHT: How was the new product received by those who were beginning to use it?

PEARCE: It worked great. Everybody was happy. They're still using it. I don't know whether they're still doing it or not, but the lunar surface texture when they had not too much computer capacity, they made my initials, FTP, as the background pattern like a rug. I don't think they still have that. I haven't been there back to look.

WRIGHT: Was that a surprise for you or did it—

PEARCE: Well, kind of, but I was the branch head, see, so they catered to the boss, I guess.

WRIGHT: As it became more enhanced—

PEARCE: Eventually it looks just as good as you would see—you see occasionally scenes of an airplane on TV, which are generated with a computer. As the memory gets greater and greater and greater, you can keep adding detail until you get enough that you can saturate what the eye

expects to see, and then it looks real. But at the time, they were somewhat simplified because we didn't have as much memory.

WRIGHT: Do you recall the first times that the astronauts began using it for simulation? Were you there when—

PEARCE: Well, I presume they went back and sold their bosses that we had to have their training simulators do the same thing, so they took what we did and made trainers of the same technique.

WRIGHT: That's pretty interesting. How long were you in this area of development and enriching and enhancing the virtual system?

PEARCE: Until about [19]'66, and at that time they were opening up an office to interface with the scientific community for soliciting experiments and developing the hardware to satisfy the various scientists. I joined that group under [Robert O.] Bob Piland, where we interfaced with the various scientists. There were, of course, many wild schemes and many worthy ones and then a lot of politics.

Professor Thomas Gold of Cornell [University, Ithaca, New York], he wanted to do a close-up surface study of the nature of the surface on a very small scale like four inches square. He had a controversial idea that the Moon was covered with dust like twenty feet deep; if you land, you just sink into the [dust]. We called it the Gold Dust Hypothesis. Now, I don't know whether you know it or not, but back then, there was a famous detergent called Gold Dust. No longer. …

Gold was a very controversial person, very argumentative, always conflicted with [Eugene M.] Gene Shoemaker. They had debates. At the same time, [Gold] was on the President's Scientific Advisory [Committee], and he was lobbying against manned flight, yet he had an experiment on manned flight. He went to a lot of Nobel Prize laureates to get them to be co-investigators with him on the project to do a stereo picture of the surface, and they all turned him down. They stuck me as being his co-investigator, which, politically, I guess, put me in bad light forever.

Anyway, it was a very successful experiment, his enemies congratulated him, and it was flown on a few flights. It did a lot of work, but much less than if he hadn't been on the bad side of the astronauts. They didn't give it as much time as they could have given.

WRIGHT: Did you have other challenges beginning to work with the scientific community, whereas prior—

PEARCE: No, I didn't have any problem. [I found it easy] to communicate with them.

WRIGHT: Are there other examples of experiments and projects that you were able to make happen?

PEARCE: Well, Gene Shoemaker, he wanted to have a mapping camera of the lunar surface. I worked that interface, and we started that project. But it got corrupted further downstream of being too elaborate, and the contractor never did successfully complete it. When the funds came

in, it was given to a different organization, and they didn't discipline the scientist enough to make him come down to reality. It was too much to put in a small box.

Gene Shoemaker. You, of course, know of Shoemaker.

WRIGHT: Yes, sir.

PEARCE: He was killed in an automobile wreck in Australia a couple years back. Shoemaker was well liked, but he and Gold were real enemies and debated. The debates were always an entertainment.

WRIGHT: Did you happen to get to witness some of those?

PEARCE: I saw the debates since I was having to work with them. I was the contact with both scientists [for their lunar cameras].

WRIGHT: That must, on occasion, have challenging aspects. Were there many scientists that wanted to put projects with the missions, but maybe didn't have enough room?

PEARCE: There was a very limited amount of cargo space, and they confined the area for Gold's thing to a certain size, which was enough to do the job. But then Shoemaker's was confined very much, and it couldn't—it was just too small to do as much as he wanted to do. Perhaps it could have been done, but the contractor never delivered the successful hardware. [Many worthy experiments could not be accommodated.]

WRIGHT: Could you explain the process of how a scientist, once their project was accepted, that it would be flown on a mission and how you were involved?

PEARCE: At [NASA] Headquarters [panels] debate[d] on whether someone's experiment is blessed or not. But as soon as it's blessed, we wrote up requirements for proposals for the hardware needed to accomplish the experiment as desired. It was a very short time to do some of them. Some of them were sole-sourced and some of them were competed. The competitions—well, for example, Shoemaker's handheld mapping camera, there might have been a half a dozen contractors bid it. Some of the proposals were ridiculous. The one that won it was not up to finishing the job [for a complicated camera in a confined space]. It was a very small company that won, not one of the larger ones. It was composed mostly of Hungarian Jewish refugees.

WRIGHT: In this new job, did you find there was a great deal of interest in the scientific community in being a part of the new space program?

PEARCE: Everybody was gung-ho, and money was no problem.

WRIGHT: How were you involved with the Lunar Receiving Laboratory?

PEARCE: I was not involved with that. We were worried about there being something toxic, some mysterious virus or what have you, so they were very uptight about handling any of the return samples, yet they overlooked the fact the film cassettes we brought back had lunar dust all

over them, and we cleaned those and we had all the waste. It looks like coal dust. Lunar soil looks like coal dust, that dark. If it had been something hazardous, we would have certainly spread it around. But they were real uptight about [something being] dangerous.

A lot of things were dangerous. The reaction controls for attitude control, the chemical was very poisonous. By the time if you smelled it, it was too late, you were going to be dead. The same thing was used on the Shuttle. The attitude controls for the Shuttle are very toxic.

WRIGHT: The work that you did prior to Apollo 11, of course, led up to the success of the lunar landing. Could you share with us where you were when the *Eagle* landed?

PEARCE: When the *Eagle* landed, at the time I was doing the interface for the science for other experiments, and the celebration was not so much the landing as the return. That was the real celebration.

WRIGHT: Were you here in Houston?

PEARCE: For the first mission, the control center had the VIP [Very Important People] lounge where the scientists were supposed to be. [Since I was a co-investigator with T. Gold, I was there.] There must have been about fifteen or twenty of us. Wernher von Braun [was] there. Later on, people want[ed] to get in there, and they crowded everybody out unless you had a political clout to get in the control center. The overview is like a balcony looking down at the control center.

Then the first mission when the astronauts landed, everybody was jumping up around and waving flags and things.

WRIGHT: After the success of this first landing, was there an increase of requests from scientists to become more a part?

PEARCE: See, we didn't see all those proposals coming in. Headquarters only sent us back the worthiest of them. We had lots of nutcase calls, and we had to field those, a lot of crazy stuff.

WRIGHT: So you got those here, as well as at Headquarters.

PEARCE: … I remember one crazy call. This is somewhat risqué. This woman with a funny accent kept calling in to the astronauts. They had somebody fielding the calls, and I knew one of the guys fielding the calls. This woman calls in, and she strongly objected to the use of monkeys for those Mercury flights, especially female ones because their reproductive systems were accommodating [to] thrust so it would be an invalid subject.

The guy that was listening to the call recognized the voice of this woman, and she used a lot of obscenities, and she was raving and raving and raving. He recognized the voice as the wife of a professor at University of Florida [Gainesville, Florida]. During a lull in our conversation, he chimed in and said, "How is so-and-so?" Not her husband, the boyfriend. She shrieked and dropped the phone, and they never heard from her again.

WRIGHT: I guess there were very few dull moments during those time periods.

PEARCE: Yes. We had a great deal of nutcase people come in. One of the real big shots at Brown & Root, he's very elderly, he thought he'd discovered the secret of the cosmos. He took pictures of constellations and stars and [other things as well as bacteria]. He blew them up to the grain of the film showed, and said, "That is the secret of the cosmos, of everything. We can see the grain here."

His daughter, very embarrassed, brought him in, and we, another guy and I, had to sit with this guy. … No matter how much you explained to him, he wouldn't listen.

Then we had a guy that called in, and he had discovered perpetual motion, had something to do with revving up and spinning faster and faster and faster. I kept trying to explain it to him, why it was nonsensical. After a while, I guess he felt cornered. He got very angry and insulting and accused me of all sorts of stuff. I don't know. That's the last we heard of him. But it was that sort of stuff going on.

We had women writing to the astronauts to be their girlfriends. Some Austrian countess, duchess—was it countess? I saw [her] letter to [John H.] Glenn [, Jr.].

WRIGHT: Amazing. What a time.

When we all learned that the Apollo years were going to be shortened and the last flight, Apollo 17, had such an emphasis on science, how were you involved in preparing for those last science flights?

PEARCE: … [Not much changed except a geologist was selected for the crew.] The scientists, even this morning, they were talking about how important it was to have [had] the geologist—

[we] only had one—bring back the samples with some province of where they picked them up and so on, because you couldn't have done that automatically without a man being present. And they were bemoaning the fact there were some interns that stole a safe full of lunar samples. Do you remember that? I think one of them got twenty years recently. When they did that, they dumped all the data. They stole the safe, took the samples, and dumped all of the records, which was a tremendously damaging thing to lose all the records off of the samples in the safe.

WRIGHT: When did your role begin to change again from working with the scientific community?

PEARCE: Then we switched over to looking at the value to the Earth, Earth resource value, how can you help agriculture or forestry or any facet involving pollution or what have you, and by looking at the Earth with various cameras and [multi]spectral scanners, and correlating that data with ground truth, and there were great numbers of scientists involved in that program.

One of the program's thing was to—if you take pictures, the same picture, with a whole bank of cameras, each in a different color, you can manipulate those colors, adding and subtracting and multiplying them just like a computer—it's an optical analog computer—and derive certain information like the health of a crop, or the disease of a forest, or pollution. That was a big program at this center.

But then politically [they] decided to abandon the Earth Resource Program [at MSC]. They sent that program to the [NASA] Ames [Research Center, Moffett Field, California] Lab, and that's the last anybody heard of it. But [there had been] a big program here, and [we] had lots of instruments that [were flown: multi]spectral scanners, mapping cameras and all that, and

that was a major program. The mapping camera [had] film twice as big [as] the size of your open notebook there. The camera weighed about 600 pounds. That was a very interesting project.

Then [taking] the same scene in six different spectral regions, multispectrally, that project looked very worthy, but they brought in this guy from the scientific community who was promoting scanners rather than cameras. He felt, to further his scanner project, he had to kill the camera projects, which was nonsense. … [The camera program helped develop, calibrate, and design the scanner systems.]

WRIGHT: What was your role in all of this area that you're describing?

PEARCE: I was heading the camera group. But then all of that was terminated when the whole thing was sent to the Ames Lab.

We had not only space instruments, but lots of aircraft flights shooting crops at various stages of the growth, correlating that with the ground to see what nuances of color you could see from space for what those nuances meant on the ground. That's a major program.

Professor Robert Colwell was a major factor in that. He was a professor of geology at [University of California] Berkeley [California]. In World War II, he was head of Naval Intelligence Pacific, and he was a very conservative person, excellent speaker. The campus at Berkeley is very rabid, well, [ultra liberal]. Anyway, they were always trying to harass him. He [won every] debate with them, but there was always harassment with Professor Colwell, and he was not even working in politics. …

WRIGHT: Were you involved in the methods of technology that helped prepare the instruments to go to space when you were part of the Earth Resources as well?

PEARCE: I was part of the program of selecting the contractors and managing the contracts for those instruments. Just managing those programs and then dealing with the data that came back and testing and this and that, that saturated all of the effort.

WRIGHT: Was the Earth Resources a new division that you helped establish?

PEARCE: It was a [new] division. I didn't help establish it. Bob Piland was the first person, and I was just one of his supervisors. And later on, the emphasis changed. They decided to have [the program at] the Manned Spacecraft Center [be a scientist managed organization rather than] an engineering organization [interfacing with the outside scientific community. They had] the scientists come in and supervise and become the lead of that program at the Manned Spacecraft Center. They weren't engineers and they weren't the top scientists, but they decided they were going to be the bosses, and [they] subordinated the engineering, and then a lot of projects were misdirected. Maybe that's why it was transferred to Ames Lab.

WRIGHT: Did many projects not reach fruition as well?

PEARCE: Well, the multispectral project. We developed the cameras, I think a couple [million] bucks apiece, but then the instrument to put the images back together would be, in effect, an optical computer, something maybe the size of this room. That program was cancelled by the

guy who wanted to promote scanners rather than cameras, which was really naïve, because it was a complementary program.

WRIGHT: After the work that you were helping with, with the Apollo Program, and those days started to end, of course, talk was beginning about Shuttle. Could you share with us what you were doing and what your roles were during the time between as the Apollo ended and before the Shuttle began? Were you involved with ASTP [Apollo-Soyuz Test Project] or with the Skylab?

PEARCE: Back then I became involved with the astronauts' utilization of cameras and the cameras that went into the Shuttle Program. First, they wanted a documentary movie with the fisheye lens of the Earth, and we had to put this gigantic camera in an enclosure with a window—the window was a hemisphere—and take pictures of the mission and the Earth with it. That was not a very successful program. Everything worked, but the people that proposed it and in charge were aesthetically deficient. And the movie they made, you cringed when you saw it.

Then the IMAX Program got involved, and they're very sophisticated. That's a gigantic camera. In fact, to make an IMAX movie, you have to have very husky cameramen, because the camera weighs eighty pounds. Anyway, we made an enclosure for that and made some superb documentaries of the Shuttle Program both from the ground and in the vehicle and of the Earth with the camera aimed at the Earth. That effort was very successful, the IMAX Program. You've seen that. That was the first thing IMAX did that got [major] public attention. It was a Toronto [Canada] firm.

WRIGHT: Were you involved in helping to establish the training procedures for the astronauts and even the ground crews?

PEARCE: When it came to using the cameras, yes, and it was hard to get some of them to focus cameras properly. There were all sorts of problems. The cameras were limited. The spacecraft has about a third of an atmosphere of pressure inside, and as you reduce the pressure or density of the gas around a camera lens, the camera lens is relatively stronger, so it focuses the picture in front of the film, so you've got to move the lens closer to the film to compensate for the cabin pressure, which was a problem. Then the window degrades the image dramatically, and you had to cope with that. Then you have to trade off the film speed and resolution versus the shutter speed and all of those things, and that's a full-time job having interface with the astronauts and the astronaut trainers to keep that program rolling and calibrate all of the equipment. They used, of course, many different kinds of cameras, and all of them had those problems with the image quality.

Also, [at the Johnson Space Center] they didn't want to ever give out any of the original film, so they made a master from the original film. Then they made the prints they distributed to the scientists from that. So that was the third generation, and every time you copy, you degrade the information. I don't know how to cope with that and preserve the originals.

WRIGHT: Were you familiar with the IMAX camera before it—

PEARCE: Our first acquaintance with it was when they proposed to do [a] film [documenting] the Shuttle Program. The premiere was done at the Smithsonian [Institution] in Washington [D.C.], and it was a great success. Have you ever been there to see the IMAX?

WRIGHT: Oh yes.

PEARCE: Have you ever seen [their next movie about the space program]?

WRIGHT: Yes, they're very stunning.

PEARCE: The "Girl Friday" of the head of IMAX was an Indian, American Indian, and very sharp. … [She was great at getting things done.] She got caught sneaking under the [JSC] fence, just trying to get some logistics done supporting the [movie], and they raised hell with her about it. Of course, she got away with it because she wasn't doing anything wrong.

WRIGHT: What type of differences did you encounter of preparing any types of these types of payloads for the Shuttle as you did when you were the Apollo era? Were you able to use the same processes and procedures?

PEARCE: You worry about the stress of going into orbit. The forces and vibrations are heavy. You would be surprised. That great big rocket on Apollo vibrates in all these modes, including the pogo mode [end to] end, and these forces are enough to tear things apart. You had to take all the equipment and design it to cope with that, and then you had to put it in machines to vibrate

that to see if it would withstand what you designed it to meet. That was just the environment challenge. The temperature problem, the pressurization problem, the window problem, and the operational problem of the astronauts, all those things you had to constantly deal with them and fight. As long as they were using the equipment, you were just saturated performing that task and then analyzing what they got back and how they did this and should have done that, and how to use it. …

WRIGHT: Did you encounter then the same type of aspects when you were preparing things for the Shuttle that you had to do all the testing for the environment and pressure?

PEARCE: Well, just as much as you did for the Apollo. You had the terrible vibrations and forces of getting into orbit. You had to cope with the pressure and temperature problems in orbit, and then just the astronauts' activity supporting it to get a maximum return. There's a whole staff of people training the astronauts, and some astronauts were real good, some were not so good.

WRIGHT: You had so many more going on the Shuttle than you did with the Apollo, so that must have added a little bit more—

PEARCE: [It was very important to communicate with the astronauts and to recognize their insights.] …

WRIGHT: You were with the Space Program for thirty-seven years, and you saw quite many changes, including—I'm going to ask you about some changes that you saw in your first virtual reality concepts that you put together and then, of course, what they're using now for the Shuttle in how to do training. Could you share that with us?

PEARCE: I haven't seen the current equipment, but I'm sure they've got some of the old—see, it's expensive to do the virtual reality properly, and they've probably got some lesser systems. But I'm sure they've got some of the real ones around. I've got to go over to Building 16 and look and see if that stuff's still there.

WRIGHT: What other areas did you have some specific involvement in during those first days that you were here, that you feel are still having an impact on today's space program?

PEARCE: Oh, everything's melted together, but I presume that training with valid virtual realities is significant, I'm sure. The more valid it is, the more virtuous the reality, the more likely they're to benefit from the training, and the astronaut training is a big activity.

WRIGHT: Also during the tenure at NASA that you had, there were so many high points, but there were some tragic times, too, including the loss of Apollo 1 crew and of *Challenger*. Can you tell us how that affected your work?

PEARCE: Everybody was very unhappy about [the two accidents], and when you know how some of those things happened, you wonder how some people could have been so stupid. For

example, the test where the Apollo capsule burned all the guys inside [during] training. They pressurized the vehicle with eighteen pounds per square inch of pure oxygen. You know, there's only about three pounds per square inch of pure oxygen in air. Well, if you take [a] piece of [cotton], you put it in an atmosphere of eighteen pounds of pure oxygen, it will [behave like] gun cotton. It truly is gun cotton. … And everything's just explosive. It was a very naïve and stupid thing to pressurize that [test] with pure oxygen. Then the door, there was no way to get it open. I mean, it was engineered [with] no emergency [opening] procedure. …

The [STS] 51-L, those solid rocket boosters, were segmented. There were three segments. Now, the competing contractor proposed to cast it in one great cylinder, hollow cylinder, and to do that on site. But they awarded the contract to the company that would make it in three segments. … They got very stupid about the gasketry between the various segments. It was very naïve, and they had warnings that they were in trouble [and did nothing]. … Three segments would have worked if they'd done it right.

The [propellant is a] hollow cylinder of solid rocket fuel. … There's a gap, maybe an eighth of an inch gap between the [cylinders]. Now, that's full of air so when the rocket fires, it compresses the air in that gap so the gasket is not seeing burning rocket fuel [initially]; it's seeing compressed air, [very, very] hot [air], and that's what damaged the seal. They had warning that they were having damage, but they didn't react to do something about it.

… Imagine having a gasket that becomes hard at, say, thirty-five or forty degrees when that part of the solid rocket booster might be down to twenty, it's facing the hydrogen tank, oxygen tank, and it's a cold morning. The gasket was like a hard a piece of plastic. That was very naïve.

… [The telescopic cameras observing] had to be compensated for temperature. The compensating mechanism wasn't any good [below] about forty degrees, and it was down to [about] thirty, so the cameras were all out of focus, so [so the pictures were not sharp]. …

I was the liaison between the Cape [Canaveral, Florida] and the [Johnson Space] Center for the 51-L photography, so that's not secondhand information.

WRIGHT: What were some of the changes that were made in your area after 51-L through before return to flight?

PEARCE: They [redesigned the gasket system]. That's about all I can think of they did. They insulated one of the struts that held the oxygen-hydrogen tank, so that the falling ice being shed off a tank wouldn't damage the strut so much.

WRIGHT: Did these setbacks or any other incidents in your time with NASA ever make you stop to think that maybe you wanted to change your career?

PEARCE: No.

WRIGHT: In [19]'93, what prompted you to retire from NASA?

PEARCE: I was sixty-nine years old. I was older than [almost] everybody. Also, I had been diagnosed with cutaneous lymphoma, and I was going to have to undergo whole-body radiation plus a year of chemotherapy. I didn't know, but you can't do anything under those conditions.

You hold on to the walls for a year after [treatment]. … After ten years, they told me I was cured [and said almost no one is ever cured]. But the penalties, your tear glands, your salivary glands, your sense of smell, [your sense of taste] are all very badly damaged, lots of other things.

WRIGHT: You mentioned a couple times in our conversation today that you referred to this morning, so you still have a chance to meet with some of your colleagues.

PEARCE: Every month, some of the very senior types meet at a restaurant [for breakfast]. Carl Watkins [coordinates these meetings]. … Typically, maybe thirty-some people will show. …

WRIGHT: The success of the space program for the United States, of course, results from all of the work of individuals like yourself and your other colleagues. Are there other people that, as you were working at NASA, made an impact on your life or maybe served as a mentor or someone that you remember as being very instrumental in helping you?

PEARCE: Oh, I knew a lot of instrumental people, but I don't look upon them as—I mean, everybody was self-teaching themselves. You had to become good at aerodynamics, electronics, optics, physics, all of that stuff. [We became self taught] rocket scientist[s]. The term is now in the language.

WRIGHT: Mr. Pearce, what do you consider to be the most challenging aspect of your career with working with NASA? What was the most challenging time for you?

PEARCE: Well, the worst time was when they decided to bring [some] scientists into NASA and have them supervise the [experiment] engineering rather than have NASA have the engineers go to the [scientific community] and give them everything they could possibly hope to get, rather than [have] the scientist dictating what he thinks he ought to get. Generally speaking, we gave them everything they could possibly squeeze [on to the spacecraft]. …

WRIGHT: On the other end of that, what do you consider, with everything that you've done and so much that you've done, is there an area or two areas or however many areas that you consider to be the most significant accomplishment that you've made?

PEARCE: Doing the first virtual reality, I guess that's the most significant thing. I guess that was it. That was the first real virtual reality, and that was in [19]'62, '63.

WRIGHT: We've talked quite a bit about many of the roles that you've done, but are there aspects or areas that we haven't covered this morning that you would like for us to know or maybe some moments or remembrances of your time with NASA that we haven't covered yet that you'd like to spend some time?

PEARCE: Right at the moment, nothing comes to mind other than the fact, it is very regrettable that they abandoned the Earth Resource Program at this center and pushed it into limbo. That was unfortunate, because a lot of that was a lot more worthy than much of the stuff that's now being [done].

WRIGHT: I was going to ask Jennifer if you have any questions.

ROSS-NAZZAL: I thought of one question. You mentioned that you interfaced with the scientists on experiments for the Apollo Program, and I'm curious, we have read a lot of books that talked about the tensions between scientists and engineers in the Manned Spacecraft Center. What were your perceptions of that during the sixties?

PEARCE: Well, perhaps on my programs they always listened to me, so I somehow had the knack in that I could interface with them, and they always bought my side, my argument. A lot of other people that should have straightened something out didn't. But it was very important to interface with scientists or astronauts. You've got to be able to interface on their level, and if you can't, the information doesn't go back and forth. They've got to believe you.

ROSS-NAZZAL: I also had another question about your Earth Resources Program. Can you give us a timeline of when that began and when that program ended?

PEARCE: I would say it began to be significant like in [19]'68, '69, maybe, and I'm trying to think of the date when they moved it to Ames. Oh, middle seventies. It was a big thing here. We had three or four airplanes flying out of Ellington [Air Force Base, Houston, Texas], and a whole batch of things going, and they just vanished.

ROSS-NAZZAL: You mentioned you worked with contractors. Did you work at all with any other federal agencies, like the Department of Agriculture or NOAA [National Oceanic and Atmospheric Administration]?

PEARCE: Well, no, they weren't putting [many] experiments onboard. Of course, NOAA, we had weather problems and we always interfaced with them and all that governs the thing, when you do the mission. [When informed about solar flares, we] put the astronauts in the heaviest shielded part of the Space Station, otherwise, they're liable to be injured by the solar flare.

But in general, [it was not] the government agencies. It was the academic community that was feeding the experiments into the programs, and we were getting some of the best stuff that way. …

WRIGHT: Before we end, I was going to ask if you had any involvement at all with all the different phases of the Space Station development that NASA has.

PEARCE: Well, the Space Station was—I did interface significantly. It was a parallel program and the Shuttle was saturating us just keeping current with what we were doing there, and so I never really interfaced with the Space Station, other than some slight early inputs about the windows. To do an appropriate window, which is very, very important, not just from the tourist standpoint of the astronauts, but the instruments have to go see through the windows. First, it has to be safe, and to be optically perfect, it's extremely extravagant, unbelievably expensive. A window. A window might [cost] several million dollars to do this, to have perfect quartz, things like that.

WRIGHT: Is there anything else you would like to add today?

PEARCE: Well, right at the moment, I don't think of it. Later, I'll probably think of something, and you'll say, "Why didn't we ask him about such-and such?"

WRIGHT: Well, that seems to happen, and so we'll have that opportunity maybe to add as we review your transcript. But we thank you for coming in today.

PEARCE: You're welcome.

[End of interview]