# ORAL HISTORY TRANSCRIPT

JOSEPH P. LOFTUS
INTERVIEWED BY DOYLE MCDONALD
JULY 1997

[This oral history with Joseph P. Loftus was conducted by Doyle McDonald for the Johnson Space Center Oral History Project.]

LOFTUS: How do you want to begin?

MCDONALD: I'd really like to start with people that might possibly be at risk for being older, might be missing before we can get to them, that had important parts of the program, maybe well known to you or well known inside the industry, but are not well known for historical purposes.

LOFTUS: There are a fair number of people in the area who have been with the program since the beginning. Bob [Robert F.] Thompson, who, in Mercury, ran the recovery division, later was the program manager for Skylab, and then was the program manager for shuttle, has sort of a unique perspective on having seen all these things go on.

Another fellow around who is up in the Woodlands teaching is Bob [Robert O.] Piland. Bob played a number of different roles throughout things. He was, at one time, the Apollo Program manager and [then] took on all the development of experiments for the lunar missions. He developed our Earth Resources Program and ran that rather effectively for a long time. He's teaching now. He has a lot of good perspectives. When he became the Apollo Program manager, he got us all out into what is now, or was the auditorium at Ellington [Field, Houston, Texas] before it was torn down, and sort of said, "I don't want to

hear about problems. In a program this size, if you can't find a problem, you are really incompetent." [Laughter] That gives you a little flavor on him.

There are a couple of people here. Brian Erb, who is the Canadian Space Agency representative over in the International Space Station office, was one of the fellows that we picked up when the Canadian Government decided to go out of the war-plane business. Canada at that time had in development an AVRO aircraft, the 105, which was *the* hottest airplane in the world, really a super bird. And the Canadian Government decided they couldn't compete with the U.S. and Europe, so they said, "Don't drive another rivet. Get cutting torches. Get rid of it."

So we and McDonnell and, at that time, North American went up to Canada and hired all those guys. [Laughter] Because we needed good engineers. So there was a large contingent of Brits and Canadians and what have you who worked in Mercury and on through Apollo that came about through that policy decision of the Canadian Government.

MCDONALD: Is that where John [D.] Hodge came from?

LOFTUS: Yes, amongst others. One of the people who had a lot of influence early in Mercury and on through Apollo was Bob [Robert G.] Chilton. Bob was a guidance navigation type and headed our Guidance and Navigation Division for many years…[and] he was also the one who, starting in Mercury and on through Apollo, established the interfaces that we used with the Draper Labs at MIT [Massachusetts Institute of Technology] for all of our work. So he has some fairly unique perspectives on things.

MCDONALD: Is he still in this area?

LOFTUS: Yes. Last time I saw Bob was when they had the big Russian exhibit up in Dallas. We were both up there looking at it.

Another fellow who's been with the program and has some fairly unique perspectives is Tom [Thomas U.] McElmurry. Tom lives over here in Nassau Bay. He just retired for the third time from teaching up at Texas A&M. Tom was an instructor at the Air Force Test Pilot School out at Edwards and came here originally with Deke [Donald K.] Slayton, but then he worked a lot of the issues in Skylab for Thompson before he retired from government, having previously retired from the Air Force. So he's had an interesting perspective on a lot of these things, both from outside and inside.

Max [Maxime A.] Faget is still in the area. He, of course, was very fundamental in a lot of our engineering choices [and] was the Director of engineering.

Another fellow in the area who had a lot of do with some of our early decisions in both Mercury and Apollo is Caldwell [C.] Johnson, who is also still in the area.

One of the people who has a perspective on the early years of the flight medicine thing is [A.] Duane Catterson, C-A-T-T-E-R-S-O-N. He's in the area, and he's at Kelsey-[Seabold]. Last time I talked to him he was running their clinic out at Intercontinental.

MCDONALD: He was in flight medicine all the time he was here.

LOFTUS: One of the people who's got an interesting perspective is Jim McBarron. Jim has been in the suit business from the beginning, and Jim is still here and active in suits and EVA, and he's got sort of an interesting approach because he's also worked closely with Ingmar Skuog and Guy Severin, who are the guys who do European and Russian suits.

MCDONALD: There still a suit business here?

LOFTUS: Yes. Another fellow in the area who's retired but active in many ways is Reginald Machel. Reg worked Gemini, the original EVAs, crew interfaces and what have you, and then moved on to Skylab to do the same kind of things, and he retired early in the Shuttle Program.

One of the names I had put down was Gene Shoemaker, because Gene had worked with us in terms of teaching astronauts how to look out the window and recognize interesting geological phenomena, but Gene was killed last week in an automobile accident in Australia.

Richard [S.] Johnston is around. He lives over in Green Tee [Pearland]. He was one of the guys who we picked up from the Navy early in the program, and he ran our crew and Thermal Systems Division for its first fifteen years or so, and then he went on into a number of special assignments, like putting together a quarantine facilities when we brought stuff back from the moon and what have you. So he's had some interesting perspectives on the program.

Staffing was a problem early in the program, and one of the interesting things that happened is, the Air Force said to NASA, "Here's a roster of 6,000 ROTC graduates this year, and any of them you hire, we'll waive their service requirements." So we picked up about 600 fresh-outs, courtesy of the Air Force. Then there are others like myself who were on active duty who were detailed to NASA.

MCDONALD: When did you come [to NASA]?

LOFTUS: Well, I was on the original Mercury Selection Testing Group, and it turned out that a couple of the people, Charlie [Charles J.] Donlan, in particular, who was the deputy director of Space Task Group, and I had gotten to know each other working on the X-15. So he asked if I could come with NASA, and I didn't want to move my family at the time. We were at

Wright Field. So I cut a deal where I was still at Wright Field, but I'd go work wherever they wanted me. So I didn't transfer until the Space Task Group moved down here in '62. …I was one of the first people to arrive in Houston because I came direct from Wright Field in Dayton.

At that time, our facilities here were what's now the post office at Gulf Gate, and we were renting space all over the southeast part of town. So I've been with it since the beginning. I flew with guys like Slayton and [Virgil I. "Gus"] Grissom and Ed [Edward H.] White [II] at Wright Field.

MCDONALD: What do you see as the difference between those programs, the Wright Field programs and going into the Space Task Group? Obviously programs have evolved gradually. What do you see as the key differences between those programs and these programs today?

LOFTUS: You're saying Mercury versus shuttle?

MCDONALD: Just the evolution as it went along.

LOFTUS: Well, novelty. Here we were, a bunch of guys, most of us out of the airplane business, who were trying to understand about the space business, and so one of the things that we would do is, in the evenings, we'd have seminars where one of us would teach the rest of us about some subject on which he was expert. I had done a lot of work in the Air Force in terms of various optical illusions and optical phenomena in high-altitude flight. One of the reasons it's hard to see things is that you get what's called "empty field myopia." If there's nothing to see five miles out, your focus comes back inside the canopy, so you don't see things that are out there, even though you could see them if somehow or other you could

focus out there. You see this phenomenon in regular experience where you can look through the window, or if the window is dirty, you can look at the window [and not see what is beyond it, similarly]…with a screen door, things of that variety.

So I used to explain all of these various phenomena, and that was of some significance. …When it came time to go to Apollo, one of the significant things about the moon is that it's a retro-reflective surface. That means that if…a line from the point you're looking at to the sun is above you, it's like driving into the fog with high beams on; you don't see anything. That's why we had such a steep approach and why we had to land [further] to the west if we delayed a day, because the approach path had to be above the line to the sun at the landing site or you wouldn't be able to see anything.

Other guys would teach what are cryogens, what are hypergols? So everybody learned orbital mechanics and learned all of these kinds of different things. It was exciting in the sense that you were learning so many different things and people were enthusiastic about sharing their knowledge. So it was a pick-up team, and we were all young. There were no old men in the space business. [Laughter] At the time we landed on the moon, the average age was thirty-four.

MCDONALD: In the agency?

LOFTUS: No, in this organization, [the Johnson Space Center, then called the Manned Spacecraft Center].

MCDONALD: That certainly changed.

LOFTUS: Yes.

MCDONALD: Do you think that that's necessary? Has it become so big and so complex that you can't learn fast enough to be [unclear]?

LOFTUS: No. I think that nowadays we can hire youngsters who learned in school what we had to learn on the fly, and they're very bright and they're very good, but we've got a very different problem. I'm not sure, for example, that Rocketdyne could have built the SSME [Space Shuttle Main Engines] had they not built the J-2 and the F-1. You had to have come up that learning curve.

I don't think people realize how much better we do things [today]. We fly eight shuttle flights a year and handle the *Mir* Program and the space station development with less people than it took us to do two Apollo flights a year. Now, a lot of that is just taking advantage of the state of the art in data processing and what have you. We do thermal analyses on the shuttle which are far more complex than those we did on Apollo, and it would take us a year to do a mission on Apollo. They'll do a much more complex shuttle mission in a matter of a few days, but they've got big UNIX workstations and silicon graphics, what have you, to do it all, computational power and visual graphics engineering. So there's a tremendous increase in productivity that has gone on. And the shuttle is just a marvelous piece of equipment. It's probably the most complex thing we've ever built.

MCDONALD: How do you see the X-33 and X-38 and local fly-back booster, those kind of things? [Telephone interruption]

Do you really think so?

LOFTUS: Well, I guess I don't have a real clear picture of where you guys want to get to.

MCDONALD: Well, what we're trying to do is get the names of the people, and then there's a second piece of that, which is we're looking for topics which we can cover. You were covering several of those when you were discussing how the training was different, computing power. I think both of those are very useful for us because they're not as flashy as SSMEs and F-1s, but approaching the program from the angle that the learning curve is what enabled us to build the SSME will be very useful to us when we're talking to rocket designers, engine designers.

LOFTUS: Well, to continue, then, along that line, software was a big issue for us in Mercury and Gemini and Apollo, because machine capability was limited so we were essentially doing everything in machine language, and that not only was difficult to do, but it made change control very, very difficult as well.

So, out of that, Jack Garman [phonetic] and I started an effort to develop a higher-order language suitable for use in things, and it got labeled "the Houston aerospace language," which was obviously a takeoff on HAL, and HAL, obviously, is IBM minus one. [Laughter] But that's the higher-order language with which we did the shuttle software, and we probably could not have developed a quad redundant asynchronous software suite for the shuttle had we not had a higher order compiler like that. So that was an exceptionally successful effort.

We did some pretty spectacular things in the world of software at the time. For example, the question was, how are you going to do the simulator for Apollo, and how is it going to be animated if you couldn't get a flight computer and you couldn't get the flight software and what have you? So a fellow by the name of Jim Rainey [phonetic] developed an emulation of the MIT [Massachusetts Institue of Technology] software, and we were on the air before they were.

I can remember long sessions with Dick [Richard E.] Battin, [J.] Hal Lanning, and the MIT guys about whether that was the right way to go, and we said, "We've got no choice. We've got to have something to train with," and it was an extremely successful effort. Much of what we built for the Apollo mission simulators is the core of what we use for some of the shuttle mission simulators. We bought the optic system that provides a lot of the out-of-the-window views, and it was a good enough system that you could actually do star sightings navigation fixes, just like you would on the way to the moon. So that was a big activity.

One of the things that's been sort of a learning experience for us is that when we started out in Mercury, there was no formal interface between the manned space flight program and science, but we were curious about some things, so we did some experiments, and, of course, the science community sort of said we shouldn't have a bunch of amateur engineers deciding what is and what is not proper science to do in flight. So we began to get into the whole protocol of establishing science groups and peer review and what have you to sort of get good science, if you will. That was sort of a pretty secondary activity through Mercury and Gemini, because those were primarily, (A), in Mercury, can man survive and function in flight, and then in Gemini the question is, can you do the kind of complex maneuvering that's required to do rendezvous. Because we were debating whether or not we should go Earth orbit rendezvous or lunar orbit rendezvous, and it was the success in Gemini that helped us decide to go lunar orbit rendezvous.

That was sort of a gut-wrenching decision, because John [C.] Houbolt at Langley [Research Center] had made that proposal, and we became the advocates for that here, and, of course, the guys who were advocates for Earth orbit rendezvous and space stations were at Marshall [Space Flight Center]. I can remember the day that we sort of had the final round of discussions, and after all-day presentations by JSC [Johnson Space Center] and by the Marshall guys on the pros and cons of the approaches, Wernher [von Braun] said, "We are

going to go lunar orbit rendezvous. It's the only way to get there in time." That was sort of a classy act on his part.

MCDONALD: [Unclear] were talking to some people who suggested we talk to Eberhard Rees, and we found that he evidently is not [unclear] support that, and they suggested we talk to Ernst Stulinger instead. Do you have any other people that it would be useful to talk to about the [unclear]?

LOFTUS: Herman Koelle is at the Technical University of Berlin. He will be at the IAF [International Astronautical Federation] in Turin in October. Herman was part of that group. He retired and subsequently was accused of having run prison labor activities at Peenemunde, but he has a lot of insight as to sort of the mentality of that group that came [from Germany].

Another guy you could talk to who has a fair amount of insight into a lot of that is Henry [O.] Pohl, P-O-H-L. Henry was here, ran our Power and Propulsion Division, but he actually started out at Marshall in the Redstone Arsenal before Marshall was created, as the Army enlisted man.

Another guy who's got a lot of insight into some of those things is [Joseph G.] Guy Thibodaux, who lives over here in Nassau Bay. [Telephone interruption]

A fellow you could talk to about some of the Marshall perspectives is a fellow named Dan Germany [phonetic]. Dan is now with Allied Signal as part of the USA [United Space Alliance] team, but he originally came here as a Marshall resident office guy, having been at Huntsville.

MCDONALD: [Unclear]?

LOFTUS: Yes, and then eventually he [Germany] retired here as the orbiter project manager.

MCDONALD: One of the areas we're particularly interested in finding people is the science research side. Most folks we've seen today has been on engineering activities and all this on engineering marvels, and less on the scientific investigation. A lot of that, I know, [unclear]. Who would you suggest that we talk to, [unclear]? [unclear].

LOFTUS: Well, let's see [for Apollo]. Mike Duke is retired, but he's still here. He's over at the Planetary Institute. Mike was the original custodian, Lunar Curatorial Facility, a Caltech geologist with a lot of insight into that. [Bob Piland would be appropriate.]

One of our big science activities, a trade-off between science and operations, was site selection. A fellow by the name of Jack [John R] Sevier, who's also over at the Institute, was sort of the executive secretary of the Site Selection Panel, because that was a trade-off between places that were geologically interesting and operationally hazardous and how did you balance those considerations.

I was involved fairly extensively, because I headed up the design team that did the redesign of the command [and] service module…[and] the lunar module for the later missions, where we extended the stay time to seventy-two hours and built a lunar rover and more elaborate packages of experiments and what have you, [and] put a lot of other instruments in the open bay in the service module. I had run the team that did all that design.

Obviously, one of the people you'd want to talk to is Harrison [H. "Jack"] Schmitt. He's living out in Albuquerque [New Mexico], consulting. Joe [Joseph P.] Allen is here in the area. It would be worthwhile to talk to him.

It was a very macho pilot-oriented kind of culture that developed in the astronaut corps, because these guys were all out of either Pax [Patuxent] River or Edwards as test pilots. So when we first selected the group of scientist-astronauts, they were known as the XS-Eleven. [Laughter] They had a diverse set of experiences. They were all good scientists.

Some of them developed into pretty good pilots. Joe certainly is one in that category. Others had difficulty with the flying. But there's one perspective that you can get from that group.

MCDONALD: Life sciences-type people.

LOFTUS: We didn't do a whole lot of life sciences until we got into the [Skylab and] shuttle era. Largely because flights were short, we didn't have a lot of opportunity to do that. So mostly what we were doing through Apollo was essentially geology.

We have, each spring here, a Lunar and Planetary Science Conference. It runs for about four days, and it is the largest gathering of people in planetary science that ever happens. We've been doing that since the first one twenty-seven years ago. Practically all of the people who had a role in that activity attend that conference, because it's a very large exchange. I'd have to sit down and dig out a few names, but the guy who could probably rattle them all off is Mike Duke, [Jim] Head…[at] Brown University, is still active.

Shoemaker was the most active, but unfortunately he's passed away. The reason I think Gene would have been particularly interesting to talk to is that we started using him as a science source in Mercury, in terms of briefing the crew as to how to recognize various geological kind of phenomena from orbit and what have you. So he's the only one I know who was alive at the time who had that kind of continuity through the program. Most of the others came in during the Apollo era.

The reason we didn't do much life sciences is that you couldn't do wet chemistry or that kind of laboratory activity until you got to Skylab. So Skylab was really where we started significant life science. We had done very small things with frog eggs and that kind of thing earlier, but Skylab was the first time we had a real laboratory. So while the primary instrument for Skylab was a solar telescope, because we had the large crew quarters and because we had eighty-day kind of cycles and what have you, we did a fair amount of life

science. There are some fairly good reports on--so the best way to deal with that would be simply to go start combing through the list of authors.

Gerry [Gerald R.] Taylor is retired, living up in Colorado, but Judy Robinson here has him on a consulting role. He'd certainly be worth talking to.

Howard Schneider is retired. He's living out in Arizona, but he comes in periodically because we have him on contract as a consultant.

Jerry [L.] Homick, who is the deputy of our Medical Sciences Division, was one of the major investigators on Skylab and had been one of the major investigators in our earliest terrestrial programs to try and understand the space adaptation syndrome. We have this phenomena that about a third of our people accommodate pretty readily to weightlessness, about a third get nauseous and malaise, and a third get violently ill. [Laughter] Jerry worked in that area. He's very good.

Millard [F.] Reschke, who's in his organization, is another one who worked in that area.

There was sort of a human factors task and work performance group. Joe Kubis is dead, Ed McLaughlin [phonetic] is dead, and I don't know where any of the others—there were six authors on that. I don't know whether any of the others are still around or active.

Owen [K.] Garriott was a scientist-astronaut, and he is now, I believe, with Teledyne Brown in Huntsville, and would be a worthwhile guy to talk to. John Rummel, who is our acting director, was one of the physiologists who was an investigator on Skylab. Joe [Joseph P.] Kerwin, who is now the president of Wylie life sciences here, was also a scientist-astronaut. He was a test pilot physician in the Navy who came with us and did his thing as an astronaut, and then he was the director of life sciences for a number of years. Then he left ten years ago, or eleven years ago, and went to Lockheed, and Krug hired him away from Lockheed last year. [Krug was acquired by Wylie in October 1997.]

Arnold Nicogosian, who is now the associate administrator for life science and microgravity, was a primary flight surgeon on Skylab. [John Rummel, Deputy Director SISD was a Skylab P.I.] Larry Dietlein [phonetic], who is the assistant director here, was a guy from the Public Health Service who was detailed to us. He retired there and came to work directly for NASA, but Larry has run, practically from the beginning, our Institutional Review Board. Following World War II and the Nuremberg Convention, international and national law requires that you have an Institutional Review Board who reviews any activity which involves human subjects, to be sure that it is ethical and has scientific merit and all of those kinds of things. Larry has been running our Institutional Review Board since time immemorial. So that would get you some of the life sciences stuff.

A good person to talk to about some of the microgravity stuff would be Bonnie Dunbar. That was her training. That's how she got her doctorate, was working on microgravity phenomena. And then there are a couple of guys over in our Medical Sciences Division: Dennis Morrison and Neil [R.] Pellis have done interesting work in that area.

MCDONALD: I know that you know these guys and I don't. What about the institutional side of the house, you know, just working, putting this place together and developing the physical plant and the systems?

LOFTUS: Bob Piland's brother Joe, his older brother. I don't know where Joe is, but our personnel people would be able to help you.

MCDONALD: Well, we're talking to Bob Piland.

LOFTUS: Essentially, when we moved down here, we were scattered all over southeast Houston in various office buildings. Some of us were in what is now Oshman's warehouse at

the corner of I-45 and OST. The office complex just to the south of that was occupied. The Lane Wells Building and buildings all over. If you know where there's a K-Mart and a shopping center on the west side of the freeway and the bayou, Simms Bayou there, that whole complex of apartments on the south side of Simms Bayou was all occupied by what is now MOD. We took up every habitable building at Ellington, and we had a pretty liberal definition of "habitable," because some of them didn't have wall-to-wall floors. [Laughter]

In effect, the [U.S. Army] Corps of Engineers built this place for us, but we had a lot of voice in how to lay out the campus, design the buildings, and see to it that there were enough conference rooms and all these kinds of things. So we didn't get a conventional government campus. And I think the guys who did it did a superb job. It's held up pretty well.

MCDONALD: It must be thirty some-odd years old and its in shape.

LOFTUS: Yes. Unfortunately we're not putting as much into maintenance as we should.

MCDONALD: If we get all these guys interviewed in the next year and a half, I'll be happy. You know you're on our list—you know that, don't you—to be interviewed? That wasn't the purpose of this meeting, but I do have a couple of questions. What is that on there, that rocket?

LOFTUS: That was one of a number of configurations we looked at for building a heavy lift vehicle out of shuttle derived hardware.

MCDONALD: This is shuttle derived hardware—these aren't F-1s. These are SSMEs [Space Shuttle Main Engines]?

LOFTUS: J-2s. They were just cartoons, if you will.

MCDONALD: [Unclear]?

LOFTUS: It was a fairly serious study, but just not exactly the—

MCDONALD: I'm always interested in talking about shuttle replacements. I think Jay Honeycutt puts it well. He says the Shuttle's the DC-3 of the human space flight. It'll be flying forever and ever, basically, until somebody wants something orders of magnitude better.

LOFTUS: Well, the rocket equation is extraordinarily straightforward, and you really, really have to change materials technology if you're going to do anything significantly different. I don't think there's anything wrong in trying to design a single stage to orbit, but God didn't mean launch vehicles to be single stage.

MCDONALD: The physics don't help to support it. What do you think about a fly-back booster? I was just wondering, because you've been around so long.

LOFTUS: Well, fly-back boosters are difficult for the same reason single stage to orbit is difficult. Basically, until we can really get to advanced materials, engineered materials, basically things like polyumate and carbon kinds of composites, you can't really do much. There are two essential problems, and that is, you want to go with hydrogen and oxygen for specific impulse, but metals become brittle in continued exposure to hydrogen [and mechanically stressed by thermal chancges]. So you've got a real problem.

One of the problems with hydrogen and oxygen is when you imbed the tankage inside the airfoil, you've now got the problem of having to build all your electrical harnesses and everything to stand the condensation environment that that cold tank creates. That means your wire harness now begins to look like an underseas cable. So it goes up in weight and complexity and all of these kinds of things. So the key to anything like that is going to have to lie in truly advanced materials, and while we've made a lot of progress in the last twenty years, it's not obvious to me that we're there.

MCDONALD: Thank you very much for your time.

[End of Interview]