ORAL HISTORY TRANSCRIPT

PETER J. ARMITAGE
INTERVIEWED BY KEVIN M. RUSNAK
HOUSTON, TEXAS – 20 AUGUST 2001

RUSNAK: Today is August 20, 2001. This oral history with Pete Armitage is being conducted in the offices of the Signal Corporation, in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Carol Butler and Kirk Freeman.

I'd like to thank you for taking out the time this morning to share your experiences with us.

ARMITAGE: It's my pleasure. Thank you.

RUSNAK: Well, we're certainly glad to have you here. As I said before, if we could start out by you telling us some about your personal background, growing up in England, and how you eventually ended up going to Canada and joining AVRO [Aircraft, Malton, Ontario, Canada], and how that led you into the space program.

ARMITAGE: I was born in the northern part of England and moved south when my father took work in the aircraft industry down there, to a place called Hamble, which was the cradle of aviation for England. In the little village of Hamble, which is a very picturesque village, there were three aircraft companies: Fairey Aviation, that made [most] of the… naval aircraft, for the British, similar aircraft to what Grumman [Aircraft Engineering Corp., Bethpage, Long Island, New York] did over here; Armstrong Whitworth, which was at the time—I'm talking about 1936—at the time was building the biggest airliner in the world, a

big four-engine airliner called the Ensign. [There was also an aircraft company called Folland Aviation.]

There was a major flying school there, so an airfield, grass field. It was an international flying school, training both RAF [Royal Air Force] and pilots for South Africa, Australia, and [the other British Commonwealth nations]…. A lot of the Luftwaffe pilots [were also trained there], as it turned out.

Just five hours away from where we lived was the Supermarine plant where the Spitfire was designed and built, and seven miles away was the big seaport of Southampton, with the *Queen Mary*, *Queen Elizabeth*, and all the big ships of the day. Just across the water from us was a place called Hythe, which was where the big Pan-American [Airlines] clippers came in.

So I was, as a young boy, kind of surrounded by all this stuff, and so, you know, it was inevitable, I guess, that steering current was going to steer me into aerospace or aircraft in some way or other. The village also, and still today, is the biggest yachting village in England. It's across from the Isle of White and Cowes, which is another big yachting place…. The folks from London come down in their fancy cars on the weekends to get to their boats, which are [moored] there at Hamble.

So here I was, surrounded by airplanes, surrounded by fancy cars, surrounded by fancy boats, and just a young kid, growing up. The war in England started in 1939, September 1939, and we lived in this village with three aircraft companies and a company building motor torpedo boats. And of course, that was, we assumed, going to be a pretty big target area.

We spent the first year of the war down in the air raid shelters every night. Of course, I was an eleven-year-old, so it was just exciting. My school was right adjacent to the airfield, and Spitfires coming in from the Battle of Britain every day. I mean, there was no way I was going to escape a career in aviation.

Also at Hamble was a fellow whose name was Don Julian Cierva, a Spanish guy, who had not gotten any funding in Spain to build his autogyro that he had invented, so he got it in England and set up a company right there in the village also. Later on, I would become a designer for Cierva. He died, actually, in a fixed-wing plane crash in '39, but his company went on from there. So there was all this environment that we were in.

As you think back—I've done this quite a bit—all of us somehow, whatever environment we're in becomes [affected by] what I call steering currents. How can you escape not actually continuing on into, in my case, aviation, and then an aerospace career? So that was my background.

I left school at age fourteen. It was what you would call an intermediate school, but we called it high school at the time. The leaving age in England was fourteen, from the general school, and then you could go on, of course, to technical schools, college or whatever.

I went straight into the local aircraft factory and was trained to be a draftsman, some time in the print shop first, but basically trained to be a drafting person. One of the first jobs I had, interestingly enough, the America Lend-Lease [Act], where America gave Britain all these airplanes, Airacobras P-57, I think, -47. I don't know, I forget. But anyway, DC-3s. And one of my first jobs as an early junior draftsman, was to take—and they were North American [Aviation, Inc.] drawings for some reason—but anyway, it was parts for the DC-3, which Britain had been given a lot of DC-3s, and American projection and British projection, drawing projection, was totally different. It's the same now, but it was totally different, so that we couldn't build parts because nobody could understand the drawings. So one of my early jobs was to take these North American—I remember the North American logo—for DC-3 parts and change them from American to British projections. So that was kind of interesting.

I worked at a company called Air Service Training, which was on the airfield at Hamble, when I was fourteen. [In] the British education system at the time, you could go on, just like here, to technical schools, colleges, etc., on a full-time basis, but Britain had, I think, an extremely good system. It was kind of like a co-op [cooperative education] program that you would call over here.

So we were employed five days a week, but allowed, with pay, to go to school one day a week, and, of course, evenings, and go through a program which was called the National Certificate Series. It took three years to get a national certificate, and that roughly is equivalent—well, I would say it's somewhere between a junior college degree here and a full degree, somewhere in between those. And then another two years to take a higher national certificate, which is somewhere between a bachelor's degree and a master's degree in terms of content.

It is very focused to whatever your trade is; in my case, engineering. The advantage being that you're getting practical experience at the same time as you're getting theoretical experience, which I think produces good engineers. But in my case, it gave me, I guess, a reason to want to be in operations, to want to be in a "hands-on field" of things, because my background was not all theory before I got a job; it was practical and theory together.

So I went through that. After graduating from the ordinary national program, I left this Air Service Training company, went to work for Cierva, the helicopter company. Cierva was the prominent helicopter company of the day. In fact, Sikorsky used Cierva patents for its rotor system in the early days. It was, as I say, a Spanish man that started the company. Cierva, at the time I joined them, as a design engineer now, was designing the biggest helicopter in the world at the time, a three-rotor job. [Cierva] was a very small company, about 100 people, from the guy who swept the hangar floor to the managing director. I was structural designer there, on the W-11 Air Horse, which, as I say, was a gigantic helicopter at the time.

I'm talking now of 1948, when I joined Cierva. At the time, the British had a conscription, a draft. They called up young men of eighteen, and you had to go serve in the military, one of the services, for eighteen months. If you were going to college, as I was, you could get deferred until you had finished your academic education. So I kept getting deferred until I was twenty-one, but they called me for my national service, as they called it, when I was twenty-one. Actually, they called me two weeks before my final exam, and so I had to scurry around and get another two weeks' deferment.

And of course I picked the RAF, Royal Air Force. I mean, that was obviously another steering current. When I arrived at the boot camp, it was June of 1950, to serve in the RAF for what was going to be eighteen months—actually, it turned out two years, because the Korean War started and they immediately tacked another six months on it, after I'd been there about a week. I was twenty-one. The boot camp basically took in like 1,000 recruits every week. It was just a massive place. And of course, they were all eighteen-year-old kids, which were, you know, like just young kids to me then, because I was twenty-one. [Laughter]

I had been there about three days, I guess. They had given us all our fatigues and stuff, and they told us about a program that they had just started in the Royal Air Force, because they were short of flight crews. It was just after the war. A lot of the wartime flight crew people had left, and they hadn't trained enough for peacetime. They would take people who had already an advanced degree of some kind, which was the few of us that had been deferred and were there at the boot camp. If we volunteered, they put us through the air crew selection tests and maybe that would be a trade. Well, I had no idea what trade I was going to be, probably a cook or a truck driver or something, so I obviously volunteered for that.

So I think it was a week, I'd been in the Air Force a week, they bundled us off to RAF Station Hornchurch, just east of London, put us through three days of aptitude tests, air crew tests, somewhat similar, as a matter of fact, on a much smaller scale, to what astronauts go

through. I mean, written tests, finger dexterity tests, psychological tests, a little medical stuff, things like that.

Then we were shipped back to the boot camp to await the results, came in a day later. I think 100 of us applied, that were qualified, and thirty got assigned to essentially become air crew, which I was lucky to be one. I was selected to be a flight engineer. They were short of flight engineers [in RAF Bomber Command].

Interestingly enough, I'd been at boot camp by then just like ten days, and now I'm air crew, you know, and they give you a little thing, flash, to put on your arm, and take away all of your boots and your fatigues, just leaving you with your best dress, and then issuing you with flight gear, right there, which I find amazing. But the flight gear was World War II flight gear, I mean long coveralls with fur collars, leather helmets, and goggles, like the Japanese pilots you see in the movies, and fur-lined boots up to here, which I would have died for when I was a young kid, motorcycling.

I got all this extra stuff now, and the worst part of that being you had another kit bag to carry around. Instead of one, you had two. [I was] shipped off immediately to RAF Station St. Athen in southern Wales, which was the main flight engineer training school. The idea was that since they had selected this bunch of people that, as I say, had advanced degrees, so they were kind of a little hopefully more mature than the average eighteen-year-old going in the service, at the time it took eighteen months to train a flight engineer, the idea was to train flight engineers in six months, out of this group, so it was a really fast-moving course, classroom and flying. There were twelve of us, just twelve of us. I've had reunions with them just three years ago.

Came out of that, assigned directly to an OCU, an Operational Conversion Unit, onto Lincoln bombers, which was the stretch version of the World War II Lancaster, main British bomber of the day, four Rolls-Royce engines.

With that, I was given a crew, or signed up with a crew, and if there's time, that's an interesting story, but I don't want to get into too much of this. Fast training on Lincolns as a crew, and we happened, luckily, again to get posted to the crack bomber squadron of the day, which was the 617 Squadron. I don't know if you know of 617 Squadron, but they made a movie called *The Dam Busters* and there's several books on 617 [and their missions in World War II].

So very soon after being in the Air Force, I found myself as a flight engineer on 617 Squadron, which made you feel pretty good, at twenty-one. I flew on 617 Squadron basically till I left the Air Force. I still only had to serve two years. I mean, they didn't ask you to go longer. But you get very attached to a crew. As well as being flight engineer, I was co-pilot, because in the wartime, they went to one pilot on bombers, because shortage of pilots and made the flight engineer the co-pilot as well, so he would fly the machine and flew right-hand seat in this big thing.

So that was the steering current, if I can use [those] words again, that made me want to be in operations. Again, my whole career basically was in operations, but just flying every day and being a member of a crew, doing bombing runs and all kinds of that—that was exciting. And being on a crack RAF squadron.

But at the end of the two years I had to make a decision, stay with my crew and, as I say, you get very close to crews, or leave the Air Force and get on with my design career, and that was an agonizing—we all face these agonizing decisions in life. That was mine at the time.

I decided to leave and go on with my design career. My crew got posted to Rhodesia to do aerial mapping, using Lancasters, actually, aerial mapping, which is kind of odd because I got into the space mapping business [later]. Unfortunately, all of them flew into a mountain a month later and got killed. They wouldn't have done that, of course, if I'd have been there. I'd have said, “There’s a mountain.” But that was unfortunate.

By this time, I was out and back in the village of Hamble. Joined one of the other aircraft companies called Folland Aviation, which was run by the chief designer of the English Electric Lightning and Canberra, which we see over here as the B-57. We were designing a very small fighter for NATO [North Atlantic Treaty Organization], called the Gnat—however you spell "gnat," things that buzz around.

I did some wing structural design. I'd just come out of the Air Force, wanted [me] to start my career. On the drawing board next to me was this fellow, a little older than I, married with a young child, and he had noticed in the paper that they were recruiting in Southampton, the local city, for AVRO Canada [A. V. Roe]. They were wanting flight test people… and engineering people, and would I go, and I said no, no way. I mean, I'd just come out of the Air Force. And he kept pestering me, and, "Okay, I'll come [to the interview] just for the experience."

So to cut that story very short, I, within about four weeks, found myself on the RMSS As*cania*, leaving Liverpool [England] for Halifax [Nova Scotia], and a job in flight testing at AVRO Canada, Toronto. Something I didn't plan. So I thought, "What the heck. Two years, let's do that."

I arrived in Canada in the first week of December 1952. It was Christmastime, and I remember not knowing a soul, walking through the streets of Toronto with all this Christmas music going on, and asking myself, "What the heck have I done?" [Laughter]

Toronto has fairly cool winter. Never met quite that much cold. But soon got involved in interesting programs. At the time, Canada was producing the CF-100, which was a top-line fighter for a number of air forces, actually, [Royal] Canadian [Air Force (RCAF)], certainly, but Germany had [also] used it. We also had the AVRO Jetliner, which was [one of] the first jetliners to be produced. Came on line, I think, just a month after the British Comet, but it was before the American jetliner [Boeing 707]. There was only one of them

and it wasn't [put into production], actually, because there was too much work in the fighter business.

I became a flight test engineer. One of the jobs that I did there—again, the steering current thing—was to test ejection seats, which, of course, used parachutes and drogue chutes. I did a live ejection—not me, a live ejection—but we used an ex-RAF squadron leader, but I was the principal test engineer flying in this jet liner alongside as he ejected, to prove that the system would work.

Did a lot of wind tunnel work up in Ottawa at that time because of the problems of getting out of the back seat of the CF-100 when you were traveling at velocities 350 [to] 400 knots. We lost a lot of people in the [Canadian] Air Force because when the CF-100 got into trouble, the pilot could get out [but not the rear seat navigator]. There's a single canopy that, when it blew off, the pilot could get out because he had the windshield in front of him. And the Martin-Baker ejection seat, you have to put your hands up and pull a blind down, which sends the ejection seat clear of the aircraft. But the poor guy, the navigator in the back, when he put his hands up above 350 [to] 400 knots, he couldn't pull them down again. And so the [Canadian] Air Force and the German Air Force lost a lot of people in accidents.

As it happened, the young flight [test] engineer that came to sit next to me lost his life on [his] very first flight. He was so excited about his first flight in a CF-100, and they got into trouble. Jan Zurakowski, who was the chief experimental test pilot, Jan held it as long as he could, but they found him [the flight test engineer] still in his seat with his hands up here, so he didn't get out. At the time I had not flown in a [CF]-100. I was just going through the medical requirements to do that, so that was kind of like my crew getting lost in Rhodesia.

I got lucky with my education. All the way through, I was lucky with my education. The English education through higher national [certificate] was kind of handed to you on a plate because the company paid for it, so it was very lucky. At AVRO, as a flight test engineer on the [CF]-100, they gave me a scholarship to go back to England. By this time I

was married and no children, but to go back to England and study at what was called the College of Aeronautics. It's called now the Cranfield Institute of [Technology]. It's basically the MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts] of England, if you like. It was the premier college of aeronautics of the day, and I was given a scholarship to go back and get a master's degree in aeronautics.

They shipped us to England on the *Queen Mary* out of New York, which was really interesting, because I spent all my young life watching the *Queen Mary* come back and forward every ten days, not thinking I would ever get [to travel] on it.

So we spent two years at College of Aeronautics, company-paid scholarship. I went out and bought a '38 Jaguar, because I had a little [money]—they called me "The Baron." The other students were, again, a little younger, but didn't have a Canadian salary. So we drove a silver Jaguar at the time. I wish I had it now.

Two years studying at College of Aeronautics. Again, I got lucky. They had two pilot training aircraft there, Auster Aglets, which were actually a direct copy of the Taylorcraft over here. I think they had some licensing agreement. But anyway, Auster Aglets. They ran a competition amongst the students. There were just thirty students, so there was a first year of thirty and a second year [of thirty], so it was really focused, again. They ran a competition, if anybody wanted to take a pilot's license, and I remember we had to write an essay as to why it was important that we learn how to fly. It was kind of interesting, because I had flown in the Air Force, but not officially as a pilot, a flight engineer, but co-pilot was my [part time job]. So I wrote the essay and got selected. I think there were about four of us, which is all the program would take. I was trained then as a pilot, and I think I soloed in about six hours, which was pretty fast for the day, but it was because of the experience I'd already had in the Air Force. So that was lucky.

Anyway, I graduated from there with what is a master's degree in aeronautics [MSCa]. By this time we had our first boy, born in England, Mark, the oldest one. We have

four boys. So my wife [June] and I were shipped back [to Canada]. It was the *Empress of Canada*, from Liverpool to Montreal, and rejoined AVRO. Of course, I'd never left AVRO. They were paying my way.

Re-joined AVRO as a senior flight test engineer, just as the AVRO Arrow, that's the CF-105, was coming on line for flight tests. I was allocated the second and third aircraft as my charge aircraft for testing, if you like, and they were the systems test aircraft—brakes and hydraulic systems and fuel systems, rather than the aerodynamic systems, which was the first aircraft. And that was great for me, because I loved systems. Still do. I mean, it's the thing I like to work on.

Everything was wonderful, and there we are back at AVRO's and flight testing the CF-105, and then the big crash came. The [Canadian Prime Minister John] Diefenbaker government canceled the AVRO contract, you know the background of that, and threw about 15,000 people out of work. "Black Friday" we refer to it as.

RUSNAK: Do you remember what you thought at the time, how you heard?

ARMITAGE: Well, it was snowing, it was cold, and, yes, it was Friday. We had heard, of course, all the rumblings of Diefenbaker possibly making big changes, canceling contracts, and he wanted to buy the U.S. Bomarc [surface-to-air missile] as the main [defensive system] which the U.S. were very happy for him to do because it was obsolete. They were looking for other people to buy it.

It was Friday, and at eleven o'clock over the system, the communications system when the president of the company, Crawford [Gordon], saying that the funding had all been withdrawn and as of that minute, everybody in the plant should pack up their belongings and leave, and that was it. Of course, what he was doing, in retrospect, was trying to embarrass the Canadian government, because he was going to put 15,000 people out on the street in

Toronto. Of course, he wasn't going to win that battle… because they still had the CF-100 contract and other contracts.

So we were out. It was snowing, and we all got to our cars. Yes, I remember. [Laughter] At the time, of course, there was no other real aircraft work in Canada. There was another aircraft company called de Havillands, which was also a British company, close by in Toronto, but de Havillands were producing the small aircraft that you see for bush [flying and] for the float planes, and they use some in a small airline business, I believe.

There was no work there, so the only work, if you wanted to stay in aviation, was to go back to England, which, by this time I didn't really want to do, or to come to the States. Well, you couldn't come to the States because of the problems of security. It took over a year to get clearances to work on the [classified] projects, and so if you got a job [it would have to be] in a totally civilian aircraft place, [which] was totally divorced from military contracts. But even so, with 15,000 people on the streets in Toronto—well, a lot of them were engineers, obviously—it was taking something like twelve to eighteen months to just get the clearances to leave Canada and come to the U.S. So it was almost an impossible task.

So I personally, and of course, everybody else went through the trauma of "How do I pay my next car payment?" I got offered a job in flight testing in England, but there was no mention of paying my way back. The other thing that I pursued at that time was reenlisting in the Air Force, but in this time the Canadian Air Force. So I talked to them, and, again, I had to write an essay—it seems like that's the favorite thing to do—as to why I want to be in the Canadian [Air Force] and did that. They offered me a commission, actually, as an engineering officer in the Canadian Air Force.

So that was where I almost went when—I remember this day very well, too. It was a Saturday. I'd been out in the town, shopping or whatever. I got back home. It was 4:30, and there was a call from Jim [James A.] Chamberlin, and he said that there were some people from NASA there. It turned out to be Bob [Robert R.] Gilruth, Chuck [Charles W.]

Mathews, and the personnel guy, [W.] Kemble Johnson, were there at the plant at AVRO, which was like fifteen miles from where I lived, and they'd be there till five, and if I could get out there—you know, I'd been out and so they hadn't been able to get me. And if I could out there in—I drove that fifteen miles in record time.

The first thing they did was give me a Government Form 57 to fill in. Well, there wasn't time to do that, so I just wrote right across the middle of it—I drew this out of the personnel files many years later—right across the middle of it, said, "See résumé," because I had a résumé attached to it. Bang, that was it.

I was interviewed by Bob Gilruth, Chuck Mathews, and of course, it was Jim Chamberlin that had arranged all this. I had no clues what NASA did or was. I knew NACA because, as an aeronautical engineer, we used their aerofoil stuff and a lot of the background that NACA had produced. But I had no clues about NASA. The big drive was how do I pay my next car payment. [Laughter]

The next morning after that literally five-minute interview, because they had a plane back to Langley Field [Hampton, Virginia], it was Chamberlin that called me, and it was Sunday morning. He called about ten o'clock and he said, "You've got one hour to make up your mind whether you want to join NASA in Virginia." I was going to be a GS-12 aeronautical research engineer, and I had one hour to make up my mind.

Well, my wife didn't want to leave Canada and, of course, I—what is this stuff? [Laughter] But there were no other good offers. I mean, I could have gone in the Air Force, but I wasn't sure about that. And so I said, "Okay, we'll go."

From there, things moved very fast. As I say, it was taking well over a year to get all the paperwork together for engineers to even cross the border and go to work in the U.S., but somehow they pulled all the plugs, and within about four weeks we were driving our '57 Chevy over the Rainbow Bridge at Niagara Falls, heading for Langley Field, with my wife crying as we crossed [from Canada to the U.S.]. In the middle of the bridge, there's a British

flag and then there's a U.S. flag. And as we crossed, "Well, where is this place [called] Hampton?"

So we drove there, and went straight to Buckrow Beach, I remember. Scrappiest place I ever saw in my life. I thought, a beach, it's got to good, it's got to be like all these—the only thing I'd seen about America, when I was a kid, growing up, was when you [go to] the dentist's office or the doctor's office and they had a *National Geographic*. And I can remember thinking how wonderful it would be to live in Miami [Florida]. You know, a little kid growing up.

But anyway, Buckroe Beach, didn't care for that. Took a motel in Newport News and then got some housing just south of Langley Field. The NASA people were wonderful. The same day that I joined NASA—it was April 27 [1959]—and as we got to personnel on Langley Field that morning, the [original] seven astronauts were going through personnel at the same time, just their indoctrination. So that was kind of heady stuff. Because I, by this time, was trying to find out what this thing called NASA was. NASA was, of course, established in, I think it was November '58, and here I'm talking April '59, so NASA had changed from the old NACA [National Advisory Committee for Aeronautics] to NASA. Papers were full of this astronaut selection business.

Went into a branch that Jerry [Jerome B.] Hammack ran. Jerry Hammack was the branch chief. The branch was called Capsule Coordination Branch. It was a mishmash of about ten engineers. Milt [Milton L.] Windler was one of them, I remember. There was Walt [Walter J.] Kapryan, who later became the [launch] director at the Cape [Canaveral, Florida]…. Lou [Lewis R.] Fisher and Bill [William C.] Muhly, who did a lot of scheduling work. Bill Muhly became a great friend; unfortunately, not alive anymore.

Milton Windler was dropping pigs on couches, putting a pig on its back, dropping it to try and determine acceleration rates. They found out very quickly what any farmer would have told them if they'd have asked, was that if you put a pig on its back, it dies anyway,

because its system won't take that. They can't survive on their back. So they ended up with dead pigs, I guess. But not to do with space stuff. But he was doing couch work and Bill Muhly was doing schedules. Everybody seemed to be doing something different.

Well, I arrived in this office, still not knowing what NASA was all about, and I still have it today in my files, a little pamphlet which is the *Congressional Record* of Gilruth and the NASA top-level people briefing Congress on what the manned space flight program was to be. I still have that *Congressional Record*, because that was given to me when I got to—where they said, "Sit here and read that." I still have it. And finding out, I guess, what this Space Task Group is supposed to do.

We were hired, of course, out of [Canada], Langley had good solid aeronautical engineers, the best you could get, [Maxime A.] Faget and Bob [Robert F.] Thompson and all of those that we know the names of now. But they didn't have any real operations people or people that had interfaced very closely with big industry and big contracts, and so the thirty or so of us that were bundled down from Toronto were operations people. Of course, I was a flight test engineer on the AVRO Arrow, and arrived at NASA not knowing quite how they were going to use me, but was in Jerry Hammack's branch, and Chuck Mathews was the division chief. So Jerry Hammack had a branch, Chuck Mathews was the division chief, and Chris [Christopher C.] Kraft [Jr.] was Chuck Mathews' deputy division chief.

Chris was working to produce the early ideas for control centers and how flight controllers were going to work, and the charge was to get man into space, first ballistically and then into Earth orbit, with a program called Project Mercury. But anyway—and this is kind of an interesting story, I suppose—not knowing quite how they were going to use me, but being excited to be in the business, because every time you picked up a paper, you could see that you were in something big because it was in the paper every day.

Jerry Hammack, nice guy, friend today, but somewhat unusual as a manager. Take that off the record if you like. I'd been there a week. I'd just found out what NASA what

about to do. Things were beginning to click. "Pete," he said, "I want you to come to a meeting in the conference room at one o'clock." Little conference room, about the twice the size of this. Fine, you know. Didn't tell me what it was. No clues as to what the meeting was about, but it was a meeting and I was in a learn mode anyway.

So got in the meeting at one o'clock and there's Bob Thompson, Faget, a lot of his top engineering people, all sitting around the table and, of course, little old me, I sat in the corner somewhere and set my transmitter to receive, just to learn. Where's Jerry Hammack? He told me to be there. About ten minutes later, all these big guys chatting about what they were doing, and I'm sitting in the corner. Jerry comes in—this is a true story, because I often think about it—Jerry comes in and he said sorry he was late, etc., etc., and he had to rush to get to another meeting. It was his meeting.

The subject of the meeting, it turns out—I didn't know, but I found out right then—was parachute air-drop tests for the Mercury spacecraft. And he pointed in the corner and he said, "This is Pete Armitage," and his next words were, "He is the project manager [for] the [air drop tests]." Nobody had ever told me that. And then, even worse, he said, "Pete, why don't you tell them how you're going to run the program. I've got to go to another meeting." And he left.

You talk about soft-shoe dancing. Fortunately, I'd had parachute experience at AVRO, and also when I was in the Air Force, we used to drop big lifeboats, air rescue boats, from our bombers, to rescue people at sea. And of course I'd carried parachute [on] all [my flights], so I knew what these things were. Did the ejection-seat tests with AVRO. And all of a sudden, okay, so I'm the project engineer for the air-drop tests.

This is true of all engineering meetings and science meetings, because I get involved with those later. It's such a good group of people, that once you start getting [involved] and just saying anything, everybody joins in and after a while you've got the rumblings of a program coming along. There was Caldwell [C.] Johnson, and he's saying he was preparing

the drawings or they were manufacturing [boilerplate capsules]. There was Faget, who talked about the [engineer] thing[s]. There was Bob Thompson there, talked about he could get all the military support we needed, ships, aircraft, helicopters. I had put together lots of test programs, so it really wasn't as bad, but the story is interesting because I was kind of just thrown in, and so that's it.

I don't know whether Jerry ever did come back to that meeting, but as I say. So I found myself working in Chuck Mathews' division. Not working for Bob. Bob had a branch called the Recovery Branch, and we were the Capsule Coordination Branch.

So I started running air-drop programs. Bob got us all our support. We used C-130s, boilerplate spacecraft, which were developed, manufactured at NASA by [Jack A.] Kinzler and his Tech Services [Technical Services Division] people. And Caldwell Johnson, of course, was always there, because he was mainly the designer of the boilerplate systems.

The idea was to drop from C-130s, into water, boilerplate Mercury spacecraft, determine the stability characteristics on the parachute, determine how they entered the water, and then from there, the stability on the water, and then fly aircraft on the location aids—the UHF [ultra-high frquency], HF [high frequency] location aids, dye markers, shark repellents. I mean, just test the landing part of the Mercury operation.

First test we did was an air-drop in the Atlantic just off of Norfolk [Virginia]. Bob Thompson was out on a destroyer that day. Another story which Bob, I'm sure, remembers. So I'm in this branch, Bob's got his Recovery Branch, he's out in a destroyer, and I'm the project test engineer on the air drop, and I'm supposed to drop it at ten o'clock, out in the Atlantic, right close to Bob's destroyer. When we loaded [the boilerplate] into the C-130, we found the battery was flat, on the system, and we couldn't fly, we couldn't drop, because that's the sequencing system for all the parachutes.

Dragged it out again and worked like mad all through lunch, Caldwell Johnson and everybody, to get new batteries. Then we had to retest the whole system. We finally got the

drop off about two or three in the afternoon. The destroyer, of course, was out on station, waiting for this, but we got it off and it was successful.

The next morning I went into Bob's office, and he was mad. He was mad that we'd missed our target time. I'd only been there a little while. But Bob is and still is today, a very imposing character. He's a Navy guy, you know, and good voice and a commanding sort of an air. I tore into him, too. I said, "You guys have no idea what it takes to get an operation up." Here were are, thinking, worked our behinds off and here we are, we got the drop off. "All you're doing is sitting on a destroyer. What's your problem?" [Laughter] So this was my introduction to Bob. Interesting.

About a week later, they decided to disband Jerry's branch and move some of us around. Some went into engineering, Max Faget's. Chuck Mathews called me up in his office and said, "I'd like you to go work in the Recovery Branch with Bob Thompson."

I remember very clearly, I said, "I won't go. I'm here. I don't want to work [with Bob]." Because we'd just had this argument.

Chuck was a nice guy and he said, "Look, just try it. It'll work out." You know, he'd obviously already talked to Bob. "If it won't work, we'll find some [where] else."

So I went to work for Bob and, of course, just loved working for Bob, probably the best guy to work for that you could ever have, because smart, commanding. My criteria for a—I hate the word "boss," but a manager—my criteria is somebody that assigns you your responsibility, leaves you to do it as long as you keep them informed, and is always there with knowledge that you can go to if you get into any problems or need advice, and Bob was really good at that. He would give you the job, leave you alone, be there if you needed him, keep him informed. A great, great guy to work for.

And of course, I continued on doing air drops. We did several air drops off of Wallops Island [Virginia], all from C-130s. Did one at the Cape to show the Air Force people at the Cape what a Mercury air drop was going to be like. Because, of course,

launching at the Cape, the early abort situation, the capsule would have come down in the water just off the Cape, so it was an exercise for that.

At the time, the real program was moving along, and Bob's Recovery Division was split into two parts, basically. There's the operations people, these are the people that went out on the land and recovery operation, and then there was the test people. I initially had a test group of a few people, and then became a test section head when the branch had two sections. Eventually, when we got to Houston, that became the Operational, Evaluation and Test Branch.

But anyway, continued looking at Mercury to prove all the operational systems, the landing systems and all, and dye markers, locations systems, all of that stuff. Exciting job, because every time you did something, the news media were there, and you could read what you did in the paper the next day. Also a dangerous job in terms of careers, because if you slipped up, it also would be in the paper the next day. And that is the nature, and why I guess I loved operational work.

It's kind of what you might term hip-shooting stuff. You have a charge, you have to go out and do it. You can't hang around forever, analyzing every little detail. You have to go get the drop off or whatever it is, test off, or whatever you're doing. So you do the best you can with whatever your past experience is, and you put the test plan together and you go out and do it. If it doesn't work out, you might get your head lopped off. And that was what we were doing. We were dropping things all over the place.

Thinking back, NASA could not do that program today, because there are so many safety and quality and all this other stuff now, all necessary now, that wasn't there then, and you would never get it off. For instance, we used to go down to Jack Kinzler's division, sketch on the back of an envelope what we thought we needed. Can you build that? Yes, it'd be there in the morning. Now, of course, you'd have to go through big design reviews and all

kinds of things, all necessary because of the complication of the program. But at the time we were moving very fast, and that made it exciting.

One of the first programs was the monkey called Ham, that was launched out of the Cape, and Bob was out on that destroyer also. I was back doing test work…. At that time they had put the landing bag on the spacecraft. The reason for the landing bag was the rare occurrence of Mercury actually landing on land. This could happen with an early abort at the Cape if the winds were right and it blew it back on to the Cape, or it could happen actually in orbit in a contingency case where it might land in Africa or somewhere.

Of course, Mercury was such a small spacecraft, there wasn't room to put [internal] attenuation systems to [reduce] the G forces on the astronaut. There wasn't room to put those inside the spacecraft itself. He had a molded couch, like Milton was doing with his pigs, but they were molded to each individual. So the idea, of course, was to spread the accelerations of impact and reentry across his body in a completely uniform way, and so they were molded couches.

That really wasn't enough protection for the G forces of a land landing, a hard land landing with just the heat shield attached. So out of the engineering area, and I think Rod [Rodney G.] Rose had a big hand in this, but I always thought it was Caldwell Johnson that did most of the design, was this bag, this four-foot bag that, after reentry, on the parachute, the heat shield would drop and then you've got this bag here. Of course, we had to look at the bag from a standpoint of how is it going to affect us in the water. Obviously, it's going to fill up with water and now the spacecraft's going to weigh a whole lot more. We were going to pull it out by helicopters and, of course, cranes from Navy ships. That was my job, to come up with all the systems and techniques for recovering.

But anyway, they flew Ham with a bag. Of course, it was found out there that the bag tore away and it was just barely hanging, because the wave action, the two dynamic situations of the heat shield and capsule doing this just tore the bag away.

And then the other thing they found out very quickly was there was a good sea state running when they picked Ham up on the destroyer. And as I say, Bob was out on that destroyer. Picking things up at sea is very difficult, especially two things that are totally different, because the destroyer is rolling and pitching and doing it with its inertia, at a much different frequency to the spacecraft, which is rolling and pitching. You've got to pick the two things up together and they're both doing different things. And when you pick it up, it becomes essentially a wrecker's ball, and it bangs into the side of the ship. Poor Ham got more Gs on him from the recovery than the whole space flight.

So I can remember very well Bob coming in the office the next morning, back from that Ham mission. Was it MR-2 [Mercury-Redstone 2], I believe? I forget. I think it was MR-2. And saying, "We've got to do something. We can't pick spacecraft up this way in those kind of seas." I remember getting some ideas and working through the lunch hour and coming up with a system that we called the hold-off ring, which was a system that went out from the side of the ship with a ring, and then we would pull the spacecraft, by crane, into the ring, and once it was into the ring then it became part of the ship instead of a wrecker's ball. That idea, essentially… a lunchtime idea and a few sketches again, we had [it] engineered [by] Faget's people, and it was basically the same system we used all the way through to Apollo, is the hold-off system for bringing the spacecraft in.

But again, the time of the day was, find a solution fast, make a quick sketch, get it done, get it tested. We tested on a lot of spacecraft pickups at sea with the so-called hold-off device.

There were other things, like the Mercury spacecraft had a telescope in HF antenna for recovery purposes that went out twenty-two feet. It started out, aluminum of about an inch or so [in diameter], and ended up just a thin antenna at the top. But when we flew in with a helicopter, it was so high up that you couldn't get close enough because you might hit

the rotor blades. And of course, the helicopter guy had to come in with what amounts to a shepherd's crook, and hook onto the spacecraft and then get the big hook in and pull it all out.

So I think it was Bob at the time said, you know, maybe the—oh, no, what really happened was Milt Windler and I started thinking about that problem, and we got some money out of petty cash… and we went down to the hardware store in Hampton and we bought two things. We bought a tree pronged pruner. They're saws that they—okay, on the end of a pole. And we bought just a pole tree pruner, the little thing that lops off limbs. I still have it. It's at home. I use it still.

We did a few tests to see if we could cut through [the antenna]. Well, of course, the dynamics were terrible, because the helicopter was doing this and the spacecraft, [was] waving around. So it was really difficult. So Bob said one day, "Why don't you go up to the naval ordnance place at Dahlgren, Virginia," just north of Hampton. Quite a bit north of Hampton.

It was, I remember, snowing. By this time I had a [Chevrolet] Corvair, a little thing with a rear engine. Took off one day on my own, talked to the people, to see if they could put an explosive charge in this tree pruner, so that once you got onto it, instead of having to pull a rope, which took too much time, that you'd press a button and the antenna would [be cut off]. They took that project and what they produced was a great thing, and then we tested that and it worked fine. The helicopter would first fly in to the antenna, put this thing, press a button, lopped off the antenna, and then they could go in and pick it up.

Interesting story there. We had sent this to the New River Marine Base down in… North Carolina. But anyway, the big Marine base where all the helicopter support came from. Sent it down there and they had played around with it. They had put a Mercury boilerplate out with the antenna. Not in the water initially, but just on the land, flown in, cut the antenna off, picked it up.

We were using HR-2S twin-engine helicopters, big helicopters, single-blade, twin-engine. You could reach out of a front of it—in fact, we designed and built a catamaran that was nothing more than a structure with rails that stuck right out of the front of the [helicopter], with a little basket on it, something like you see guys going up telephone poles with. And here you've got this big helicopter behind you.

So we had produced this, and they had done some tests. I went down to witness a test of this new system we designed, and we got down there. They said, "Would you like to do it?" and I said "Fine." So here I am, strapped on the end of this flimsy-looking thing with this gigantic helicopter behind me, and they gave me the electronic tree-pruning device in my hands, and they flew around the field and flew into the boilerplate spacecraft with the antenna.

As soon as I touched the thing to the antenna, my hands went up like that. There's a big static shock. I looked behind and there's all these Marines laughing their heads off. Of course, you needed big gloves. They were just having fun, you know. But just terrible. [Laughter] But they got a big charge out of it. But anyway, you know, that was the fun of the day.

But back to the landing bag for a minute. We did some work in the wave tank at Langley. There was a long tank there; it was originally designed for testing seaplane hulls. You create a wave, like a children's wave pool, and it would go down this thing. So we could tether a spacecraft at the end of it and get it bobbing and weaving in a tank.

We tested the bag there because were interested mostly in—the stability of the Mercury spacecraft when it was in the water was such that it could easily be blown over on its side. In fact, the astronaut egress, if he didn't come out of the main hatch, the real egress was supposed to go up a tunnel where the parachute was packed, and then out of the top, and then he was going to be picked up by helicopter and then the helicopter, or another helicopter, would go in and pick up [the capsule].

That was the technique, and we'd practiced this technique in the river behind Langley many times. It was a fairly smooth river. But we found on some air drops, early air drops, that the capsule, in [certain] wind and wave condition[s], would actually not turn entirely upside down, but with the cone, where the astronaut was supposed to egress, under water, and the heat shield sticking up.

We did one test—again, a story of Bob Thompson—we did one test, which I was the test engineer, and I know there were press out that day, and we were operating from a small fishing vessel, fishing ship, a crabbing ship, but small, that belonged to the father of one of the engineers that we worked with, as a matter of fact, in Hampton. [We] dropped it and the [capsule] tipped over. I remember Bob was there out on the ship with me. I was the test engineer. Bob was, of course, my boss. He looked at me and said, "What do you think? Is it going to sink?" We didn't know. It was tipped over. And I didn't know either. He said, "We ought to get a line on it fast."

I said, "We sure should."

This is typical Bob. He said, "Do you want me to swim a line out?" [Laughter]

I said, "Sure." I mean, he's asking me, because I'm the test engineer. Again, typical Bob, because he recognizes who he's put in charge. And Bob stripped off, swam out there, put a line on it.

[Later] we found out it wasn't sinking; it was just turned over. Air was trapped and it wasn't sinking. But we didn't know. That's a typical Bob Thompson, just dive in and go. Good swimmer.

RUSNAK: He didn't tell us that story.

ARMITAGE: There was no way I could—well, you know, you can't remember all stories. Then we, of course, got to worry because this thing could tip on its side. So that was one of

the reasons we were doing the tests in the wave basin at Langley. And we did some more air-drop tests.

I had a five-dollar bet at that time with McDonnell [Aircraft Corp.] in St. Louis [Missouri], who had done some water tests of their own, in tanks, and did not believe that it would tip over, and they wouldn't believe our results. They first said that our boilerplates must be wrong in terms of how the CG [center of gravity] was in relation to the center of buoyancy. Just briefly, on a ship or anything that floats, the CG of the vehicle, ship, whatever, has to be below what is called the center of buoyancy. If the CG is above the center of buoyancy, the ship will tip over.

What we had on Mercury was something where the margin between the center of buoyancy and the CG was so close that it would tip over in some conditions and not others. McDonnell would not believe that. But I had a five-dollar bet with our resident engineer at McDonnell, and finally they got to believe it. I got my five bucks. I wish I'd kept that. Should have framed it.

McDonnell did some reengineering and lowered the CG of the spacecraft. Just needed a tad to get it to be more statically stable in the water, and we didn't have any more problem with it turning over, so that was important.

The next thing, of course, was to be running tests to see if an H-34 helicopter, which the Marines mostly used off the carriers, could pick up this weight. The spacecraft was 2,000 pounds or something, but then you had this water [in the landing bag]. Of course, we had water trapped in a bag. We had holes in the bag, that as they pulled it out, water would run out. Of course, the most significant thing was *Liberty Bell* with [Virgil I. “Gus”] Grissom. When they were trying to get him out, the hatch blew, for whatever reason, and the whole spacecraft started filling with water, and the H-34 could not handle that load, so that's why that was dropped, and Gus was plucked out of the water, fortunately.

But anyway, we had to run a bunch of tests of that. The principal reason for the bag, again, was land landing, to attenuate velocity on that. So I ran two helicopter drops on the field at Langley, to actually drop, parachute Mercury capsule onto the land, and test out the bag system for an actual land landing. To my knowledge, only two drops were made like that, and they were made the same day. Dropped them from an HR-2S, a bigger helicopter, one that had the catamaran out the front, as a matter of fact.

I remember that so vividly, because Gilruth and all the top brass of the Space Task Group [including] Faget, came out to watch the drop. The wind of the day—I mean, you just get what you get, when I did my calculations as to where the release point was from the helicopter, it was right over the Langley NCO [non-commissioned officers] quarters. If the parachute had not opened, that would have been the end of my career, I'm sure. But then you've got all these people out there, and they don't have time [to wait for a wind change].

This is the hip-shooting nature of operations that I loved so much. You make a decision. You say, "Go," in that case. Or you say, "Don't go," and then everybody has to go home. You say, "Go," and we dropped it over there. Fortunately, everything [went] good. Then the first land landings with the bag were done at Langley Field….

We measured things like attenuation velocities, and, of course, the spacecraft dynamic, when it hit the ground. That was the final test, I guess. They were approaching John [H.] Glenn's [Jr.] flight at that time. As you well know, if you go into the John Glenn history, on that reentry they were very worried that the bag had pre-deployed just after reentry, and kept the retro [rocket] pack on for that reason, because it kind of closed up and held the heat shield in place. It turns out that wasn't the case, so he reentered with the retro pack on. But that worked out.

That was kind of the nature of the tests. The test programs were great, because, like I say, the next day you could read what you did in the paper. But if you screwed up, that was the end of your career. That was the excitement of operations.

From then, I stayed in the Landing Recovery Division and I finally got to be the deputy of the Landing Recovery Division. Actually, my old friend Jerry Hammack was brought back in when Bob Thompson moved [to manage] the [Apollo Applications] Program, which turned into being the Skylab program. So he moved off, and they brought Jerry Hammack back. Gilruth was still director at this time. Now Jerry was the division chief for landing and recovery.

I had a big branch at the time. It was probably the biggest branch in NASA because I had about seventy-five people. Well, one of the things we found out earlier was that you could not let the contractor come up with recovery equipment, and the reason was that his people were not trained as operational people. They were not out there in the ocean. They didn't see the dynamics involved. They had to just visualize this stuff.

So the systems that the contractor, McDonnell, came up with were bulky, big, expensive, would have needed major modifications to the ships. So our solution was quite simple. We'd do that work ourselves. We'd do our own design work. So my branch had design people, and they were the same people, on a mission, that went out on the ship or in an aircraft or in a helicopter, so that they lived through the real thing and they came back and designed systems that would work.

Of course, we always had to be mindful of not affecting the military's main mission too much. You can't go and modify a ship, a destroyer, because one day it's assigned to NASA, or one week or whatever period, the next it's on ASW [anti-submarine warfare] duty, looking for mines or submarines or whatever. I mean, it's doing its Navy job. So you can't just go in and change the ship. So we had to be very mindful of that.

One of the things—divulge just a little bit—that I came across, just personally, in my early career, was, you get things done better if you work directly hand-to-hand, eyeball-to-eyeball, with the people who are actually responsible for getting the test ready or that kind of thing.

Back at AVRO, I used to go down and sit on the airplane wing. I was a senior flight test engineer, but the guy, the shop foreman and the electricians and everybody that were scurrying around to put all these black boxes in or things we needed for the test, which was to be two days hence or something, most of the flight test engineers didn't tell them what they were doing, why they were doing what they were doing. You know, you would make written test requirements. "Here's the configuration. I want it tested on this day," and send that to the foreman, and go away.

It occurred to me that that was the wrong thing to do, and I only mention it because it was something I carried on for the rest of my career. So I'd go down, talk to the guys doing the job, say, "Here's why we're doing this. Here's what this black box does. Here's why I need it," and ask them the question, "Do you think, is it possible to get it installed in two days?"

The difference between sending a directive through the foreman, saying you want it in two days, and going down there and asking the guy who has the job to do, "Is it possible you can do this? Seems like a lot of work." You know, talking to him. Very soon you find out they'll pull everything out of the woodwork to get it for you because you have asked them or you have brought them into the decision-making process.

This is taught in schools today, but it wasn't, at least to my knowledge, when I was there. And that was something that occurred to me is you always should do. You bring the people—and it was just like, you know, when we went to Kinzler's people in the Tech Service. "Can you make something like this?" You're drawing them into the problem, and they say, "Of course we can." That was very important.

The reason I got sidetracked there was, [we] used to go aboard Navy ships and I used to tell our engineers, "Please do this." You don't go aboard a Navy ship, a destroyer captain who's proud of his ship and his group, he's assigned to NASA, these young guys come aboard from NASA, a lot younger than him and a lot less under the ears than him, or above

the ears, and you don't go there demanding you want to move this torpedo tube and you want to clear the deck here and you want to put this NASA-designed crane here. You don't go aboard saying that. What you do is, you go aboard saying, "Boy, this is going to be difficult." You go aboard saying, "The best place would be where that torpedo tube is, but obviously, we don't want to do that. We could try it here."

You get him involved in the problem, and it works every time. Lo and behold, "Of course I can move that torpedo tube." He is now in the process of decision-making, because you've told him what the problem is, you've told him it's going to be difficult, and you've told him that you don't think he can do—never tell a Navy man you don't think he can do something. It's a good technique. You don't think he can move that torpedo tube because it'll mess up his ship too much, and all of a sudden he's busting his butt to get you what you want.

In modern college days they call that management psychology, I think. We did a lot of that, and we found it out the hard way. Or perhaps it's the easy way. And so we did a lot of that, especially working with the military. I remember, one day a U.S. major coming into NASA, into my office, and he sat down. He had this puzzled look on his face. He'd been there a day and he'd talked to a lot of our people. We're all young engineers. I guess I was one of the older ones. I guess I was thirty when I joined NASA.

And he said, tell me, "Are there no older people here?" [Laughter] I'll always remember that. Because in the military, especially when you get up to major, colonel, admiral, you were pretty much older people. And here they are being assigned to deal with all these young, wet-under-the-ear—but again, that was the wonderful part of working with NASA in those early days, was the fact that there was no big safety, reliability—I'm not saying it's not necessary, but we had a charge to get the job done, and we delegated right down to the lowest guy that would accept the responsibility, and let him get on with it, and worked together as a team.

NASA has, and did have, a lot of people with big egos. I tend to tell myself at least that that's a bad thing, that the idea of working as a team is what it's all about, and that's why I appreciated it personally so much, that everybody worked together as a team. There should have been no grandstanding. "I did this. This was my idea," etc., etc. Sometimes it was your idea, but basically it was the team spirit that was so genuinely good.

That deteriorates with all government, or all entities, not just government. If you look at management psychology and stuff like that, as companies or engineering groups or whatever, get bigger and bigger, then they get more bureaucratic and more committees and more meetings, and after a while, you're not doing things anywhere near as efficiently as you did. But in the Mercury program, early programs, tremendously efficient. You couldn't do them like that today.

Anyway, going off into NASA. I had done all this parachute work. I got involved in some of the operational work that the science people were doing, even though the science people were not connected to us. By this time I'm a branch chief or the deputy chief of the Landing and Recovery Division. They were doing high-altitude balloon work, for science purposes, and I got involved in some of that to help them out with the logistics and operations associated with that, so I got a little experience there, and we helped them with that program.

Again, the steering currents. I got a call from John [D.] Hodge. By this time the first Apollo lunar landing stuff was coming on. Of course, we had to put together the Lunar Receiving Laboratory, a [facility] to handle the lunar materials, [in] a really pristine way so that they wouldn't get back-contaminated with [the] Earth [environment] and then not be very much good for scientific purposes.

But that butted up completely loggerheads with what the U.S. Health Services wanted. They were concerned only with, if we brought these lunar materials back into the Earth, that they might contain pathogens that could contaminate the Earth and cause all kinds

of problems on Earth. Whereas the scientists wanted them to come back, and the scientists were only worried about their precious samples getting contaminated by the Earth organisms. So, completely diverse viewpoints. A lot of head-butting there.

The Lunar Receiving Facility was designed to try and get over that problem in some way. Anyway, the first call I got was a call from John Hodge, who had been assigned as a manager to do the Lunar Receiving Lab, LRL… readiness inspection. Readiness inspections at NASA are big things. You've got a manager and he has a lot of teams and he gets information and briefings, and the final outcome of all that is, yes, it's ready, or no, it's not ready until you do this. [The LRL was a] big facility. Sixteen million-dollar facility.

John Hodge asked me if I would be the—I guess they call it the executive secretary of such committees. What that really means is that he's the guy that does all the work. And I said yes. Of course, I was in Landing and Recovery, so that was the first thing we did. We had all kinds of… meetings. We ended up saying, okay, the facility is operationally ready, and of course, the program was moving along to Armstrong's first mission.

So I had had that sort of background in the LRL there, and [then] back to Landing and Recovery, my job. I've missed a bit out on the lunar landing training vehicle, but I need to get to that. So anyway, I'd done this LRL thing.

Get another call, this time from Kraft, saying the lunar landing training vehicle, LLTV, has run into problems. That was run out of Deke [Donald K.] Slayton's operation, the Flight Crew Ops [Operations] people. We were Flight Ops, he was Flight Crew [Ops]. They ran that program. It was a contract they had with Bell [Aerospace], and they had a group of NASA people running it.

But as you know, there were three lunar landing training vehicles. They looked a lot like that tripod there. They took off with a jet engine, and then no aerodynamic surfaces, had to control their attitude with peroxide, little jet motors, and then land at 1/6 G to try and train the astronaut to land on the Moon.

Of course, as you know from the history, that program ran into trouble. We just heard about it in Landing and Recovery. I mean, we weren't involved, it wasn't our problem. Joe [Joseph S.] Algranti, the chief test pilot here, had to eject, so that took care of one of the three vehicles. And then [Neil A.] Armstrong had to eject. It might have been in the opposite sequence; I forget. And that left one vehicle.

I got this call. You remember these things, the big things like that. Sitting in my office in Landing and Recovery, not knowing much about this, of course, heard that it happened. It was Scottie [Iva L. Scott], Gilruth's secretary. Well, when Scottie called, you always kind of jumped. She was head of the "petticoat mafia." She was the head secretary. When Scottie called, all the other secretaries stood up, not literally, but the boss's secretary, the director's secretary. And Gilruth was such a nice, nice man, and a very, very good engineer.

But anyway, Scottie called. It was about a quarter to five, and she said, "Peter, Dr." —secretaries liked to call everybody by their honorary title— "Dr. Gilruth needs you in his office right now."

"Okay. What does he need?"

"Just get over here." Don't know what he needs.

So you go, and we were in Building 30, walk across the campus, up to the ninth floor [of Building 1]. Walk into Scottie's office first. "Dr. Gilruth is waiting for you." This was typical Scottie. Everybody would think of her that way, I should think. Obviously she did a good job, just protecting her boss.

Then you walk into Gilruth's office, of course, which I'd been in before, but not that often. Such a nice guy. "Peter, sit down. Great you could come." You know, totally different to his secretary. [Laughter]

And you sat down at his round conference table and he passes the time of day, and he makes you feel very comfortable. He's just a great man. He said, "You were a flight test

engineer in Canada." Well, he knew darn well I was, because he hired me from flight testing.

I said, "Yes, I remember that."

He said, "We've got problems with the LLTV. We've lost two vehicles. We've got one left. We've got an astronaut, Armstrong, to train and we've got big problems." What he had done is basically lost confidence in the team because the group somehow had not solved the problem.

Previous to that, I had been on this thing that Kraft had assigned me, to look into the ground operations of it, and I had written a report on that and they had done a lot of the things we said. But they were basically running into a wind-shear problem as they got up to the 2,000-foot altitude where the descent started. Wind shears, at certain days, would actually put so much pressure on the vehicle that they would run out of steering fluids, or steering control, and that was the reason they ejected.

"There's one vehicle left and there's a lunar mission coming up and," he said, "I want you to take over the [program to get the vehicle ready to train the first lunar crew]."

RUSNAK: If we can interrupt for a second and change out the tape. I'm sorry.

Before we stopped, you were talking about the LLTVs had crashed and Bob Gilruth had put you on the project.

ARMITAGE: Yes. So I went to Gilruth's office at Scottie's summons. He reminded me I'd been a flight test engineer and said he wanted me to take over the program. Just one vehicle left. Armstrong had to be—I think the mission was like to be—it wasn't a couple of months from that first mission, so it was in that time frame. I remember protesting a bit. "I haven't done flight test for a long time."

When Bob Gilruth made up his mind he wanted you, that's time to shut up. I could get back to another story on that, as a matter of fact.

So he said, "I want you to go talk to Deke." Deke was the director of Flight Crew Operations and LLTV came under him. Of course, Deke was waiting for me. He knew I was coming. Deke, by the way, was my favorite astronaut. Great guy. "Okay, Deke, I'm here."

Well, I take over the LLTV program, because they've got to get through the problem that they've got, find out what it is, modify it, get it ready, get Armstrong trained. Well, you see, that's not an easy thing, because now they're pulling this guy out of Landing and Recovery and they're going to put him in this pile of people that think they're doing a good job, even though they lost two vehicles. You're kind of a scab, is what you are.

But it all worked out. Put together a flight test plan and said, okay, we're going to go through a step-by-step test program, testing it at several points within an envelope of flight tests, and we're not going to move to the next point in the envelope until—and we're going to make some modifications.

Langley had done some work in a wind tunnel. Basically, to make it all very simple, what the problem was, when they got it off to altitude, on some days the wind shear was so strong at 1,000 feet, 2,000 feet, off the ground—their tests were done at Ellington [Field, Houston, Texas]—that, as I say, they ran out of steering command and had to eject. So part of the problem was getting to know what the wind shears were before you did the test. That was part of the problem.

The other part of the problem was opening a window on the thing. The thing was a glassed-in thing like a glass house, legs like that and jet engine down the middle, and there was so much flat plate kind of edge to the thing that when they got in this wind shear—so that kind of solution came out of some of the Langley wind tunnel tests. Basically all we did was open the windows and let the wind go through. I'm really being simplistic.

And then you run through all this program of—I remember having to—came up with a test program, had to brief Gilruth and George [M.] Low, of course, he was, by this time, the Apollo manager and, of course, leading up to the first flight. And George Low was there, and, again, all the [top Center people], Thompson, Faget, in Gilruth's office. Much more imposing place than that office that I got the baptismal when I was in Jerry's [Branch].

So I'm up there, giving the standard NASA briefing, collar, tie, viewgraphs, you know, the fancy stuff, not the back-of-the-envelope stuff anymore. That's gone. Got through my briefing, here's what I'm going to do. Here's the envelope we're going to fly. We're going to stop at every point before we go to the next one.

I can remember what George Low said. He said, "Okay, Pete. What happens if you do that point and you run into trouble? What are you going to do now?"

And I said, "I'm going to tell Deke what's happened, first thing, because I'm reporting to Deke, and I'm going to ask Deke to call this meeting with you, George Low, in it, and I'm going to ask you, what do I do now?" I mean, that's what I said.

And he said, "That's the answer I want to hear." [Laughter]

It's interesting, because especially in NASA more than any place, [are some] managers, when asked a question that they didn't quite know what the answer was, would try and ad lib an answer, because they didn't want to look [lacking] in front of their [bosses]—you know, the wrong thing to do. Absolutely the wrong thing. You could say, "Hell, I don't know. I don't know what I'd do then. We'll get together and we'll decide." That always works.

Chris Kraft was a good guy to work for in that way, because he and [Sigurd A.] Sjoberg, when he was director, Sjoberg was deputy director, Sjoberg was Chris' hatchet man, I think. But anyway, in those big meetings, where we were given—it doesn't matter what it was, budget meeting, those two guys would probe and probe and probe. This is the NASA way. They'd probe and probe. It's a good way, actually. Probe until they get you to the

point where you don't know anymore. There's always a point that you can probe somebody to, that he now no longer knows the answer.

At that point, if you try and ad lib and invent answers in the spur of the moment, you're dead. Now, I would never do that. I'd say, "Hell, I don't know. We'll study it." And everybody then is very happy. So that's something you learn. Or some people never learn that, actually. Some people never learn that. Shouldn't get into personalities, I guess, in this thing.

One of the reasons I don't read these "spacey" books, as I said, is they also stereotyped, "Here's what we did." The real story is in the people and why they behaved the way they behaved. Nobody's ever written a book like that yet—the real people, the mistakes they made. You read these books, nobody ever made a mistake. But anyway, that's kind of interesting.

Anyway, back to the LLTV. I had to go up to Headquarters, I had to brief the Administrator. That's always an experience. I used to hate going up to Washington. All the guys had to go up to Washington and brief the Administrator. There's a pack of people up there that have all the money and the titles that says they're in charge. Like the Administrator for Manned Space Flight, or whatever. So you have to go through that hoop, and it's certainly a hoop. I used to hate that, because Washington is such a frustrating place.

But getting away from all that. So I had to go up there, and when you go up there at a big briefing, like, you know, they've had a big problem and now you've got a test plan to cure it. It's gone through the people here and everybody's happy. Gilruth's happy. You go up there. Now you get all these underlings, the guys that are between the Administrator or the guy in charge of manned space flight. You've got to go through them, because they have to have their two cents [worth], so that's a frustration up there.

Did that, though. Got through. I think it was Noel [W.] Hinners. He was the Director of the Manned Space Flight program at the time. I think it was Noel Hinners. But

when you get there, it's usually okay. So they approved and we went on and did the tests, did the program, got Armstrong trained on the LLTV. Got a few Letters of Commendation. NASA's good at handing out medals and keeping the troops happy.

But the thing that I did get out of that, and it was Gilruth and Kraft that gave it me, and I'm sure it came out of that and some of the other things, they gave me the scholarship to Stanford [University, Stanford, California]. That's the most coveted, I guess, of the [scholarship] that NASA gave out, because it's one year at Stanford Business School, and you become what is called an Alfred P. Sloan Executive Fellow. It sounds so grand, doesn't it? [Laughter]

So I got one of those, and the whole family—I mean, I had four boys, [all] young. The oldest boy was like twelve, and the youngest was like one, I think, might be eighteen months. But anyway, the whole family, we went out to Stanford. Had student housing, a three-bedroom furnished apartment on campus. Beautiful experience. My older kids—the younger two don't remember it—but the older kids, that was wonderful. My oldest boy took tennis lessons with a Stanford pro, because he was a ball boy and they gave him free lessons. They went to all the Stanford games. It was just a really nice, nice experience.

Again, there were thirty of us, oddly, in the class like it was when I went to Cranfield, in England, and they were all managers, middle-level people from all over the world. There were several foreign people. But in the U.S., you know, people from GM [General Motors]. That's where Alfred P. Sloan came from. He was the CEO [Chief Executive Officer] of GM in the ‘30s, made a lot of money and became a philanthropist, I guess. He set up a Sloan School at MIT and one at Stanford, and the Stanford one was great, because California is great.

So we spent a year there. It was just wonderful. The people that were on the course—I mean, one guy, Frank Shrontz, a student on the course with me—of course, we were all in our forties by then—became the CEO of Boeing later, and still we communicate.

He retired just two years ago. Still we communicate. But I mean, they were great people that were coming up in the industry, and it was a super, super year. We toured all the major places in the States, got into Congress, talked with senators. Got to New York City, talked with the CEOs of all the big [corporations]—it was a hands-on, visit-industry program, learn all you can about executive management techniques.

Interesting thing is, [as] wonderful [as] it was, but it's over, you're back, you're back in… my same slot in Landing and Recovery. So what do you do with all this information? Another little story. Going to get in trouble with this stuff. Not really. I don't care, you see. I'm past caring. Went to see Kraft, who by now was [Center] director. Gilruth had retired. I said, "Okay, Coach, what do you want me to do now?" That's what I actually said. Now he's in this fancy office.

Probably shouldn't say this, but you can cut it out if you think it's not right. He said, "Why don't you go talk to Tony [Anthony J.] Calio." Tony Calio at the time was the Director of Space Sciences. Not Space and Life Sciences; Space Sciences. Dr. Chuck [Charles A.] Berry was the Director of Life Sciences Directorate. What Chris said to me—he'll probably deny this, but he actually said it—he said, "Go talk to Chuck and go talk to Tony. Both of them need help, but neither of them will admit it." [Laughter]

And so I did. I went to talk to Tony, and I thought, "Well, this is closer to what I want to do." There was Earth Resources, interesting stuff, viewing from space Earth-type scenes, and all the technology involved with that. There was the balloon program that I'd previously done some work on. High-altitude physics science program. There was the LRL, which I knew very well because I'd been on the Readiness Committee. I mean, all that stuff that, again, steering currents, back to that theme. I already knew a bit about all that stuff.

So I became an assistant director, I guess it was, on Tony's staff. It was more than that. It was a real line job, but they called them assistant directors at the time. He didn't have a deputy anyway. It was just me and him.

At the time, the LRL had run into tremendous problems. They had done Apollo 11, they had done, of course, 12. Thirteen, of course, was the one that…[ran into problems and did not land on the moon]. And the next mission was 14. They had gone through the initial quarantine missions that the LRL had to cater to the [National] Health people in this country. I had mentioned earlier, for instance, that the scientists wanted pristine materials not contaminated by the Earth. The national health people, or whatever they call them, wanted not to have the Moon contaminate the Earth. Totally different things. [The first three Apollo landing missions 11, 12, and 14 were run under the strict National Health Service requirements for back contamination].

And so on the first three missions, at the insistence of the health people, the cabinets that the lunar material was put in had to have a negative pressure, a very slight negative pressure. The cabinets were all stainless steel. And gloves—you've probably seen pictures of them, and the operator is standing there, and the only thing that the lunar materials touch are stainless steel aluminum foil, basically, and Teflon, and the gloves are Teflon, I think. Well, now the gloves are neoprene, but they don't touch it with the gloves.

But the national health people wanted to make sure that bugs wouldn't come out from the Moon rocks, so they insisted on having a negative pressure in the cabinets, such that if there was a leak, the leak would not be out, but it would be drawing the stuff in. Well, of course, the science group were livid about that, because that would contaminate their precious sample, you see, with Earth [contaminants].

And incidentally, the worst Earth contaminations are leads from automobile emissions and things like that, and if you get lead in the lunar sample, you'd just as well throw it away. It's no good scientifically anymore. But the first three missions had to go through that.

But when I got to be the manager of the lab on Apollo 14—and I was there [for] 14 [and] 15, I guess—by that time [of Apollo 15] we had proven to the health people that the

lunar materials did not contain any pathogens of any kind, because they couldn't. I mean, the scientists knew this. They were sitting there on the Moon, with like 250 degrees Fahrenheit on the high side, and 250 minus on the low side, and no pathogens that we knew of could exist under those extreme conditions.

Rather odd, because the criteria for designing the Lunar Receiving Lab was to keep the lunar materials from contaminating the Earth. That was the main criteria. Scientists didn't like that. And the only Earth pathogen that the health people knew about, which was the most—not the worst from a health standpoint, but the one that was most easily spread, and guess what it is? It's the common cold. And the incubation period is three weeks. You can spread a cold to somebody in that incubation period. The only one they knew about. The fact that a common cold pathogen could not exist under the lunar temperature extremes, that they didn't even consider, the scientists [did know that]. The reason, the whole reason the astronauts were quarantined for three weeks was because that was the period of a common cold. [Laughter] All that's documented someplace else, I'm sure.

But anyway, the first thing I did [for Apollo 15] was change everything around in the LRL, so now we were meeting the science requirements of having a positive pressure rather than a negative pressure. I'm talking about a very, very small difference. Positive pressure from 14.7 that we're all in now. You know, it might be 14.72, but it is positive, so that if there's a leak now, the leak is out, not pulling in stuff in. Scientists are getting happy now.

[For the Apollo 14 lunar samples] we closed down some lines that were totally overdone, vacuum lines and things, vacuum cabinets, because at one point they thought that they would have to work on the space material under the same vacuum conditions of space, and that is just a gigantic piece of equipment on the Earth, to have the vacuum of space. It's practically impossible, but we had such a thing. It was called a SNAP line, and I don't know what SNAP stands for anymore. You'll have to look it up. SNAP. "Atmospheric Pressure" may be the last one.

But anyway, I closed those down. I remember writing a letter and sending it to Kraft, who was the [Center] director, and saying, "I'm going to close this down, close that down. I'm going to lay off this part of the contract." Kraft was great, because when he got those things, you wouldn't get a letter back from him, and mostly you wouldn't get a call back from him. But he would write across the top—I still have the letter—"This sounds great, Pete. CCK." That was it. Or, "Do it," or "Go for it." But that was good, because that's the kind of communication you want.

Apollo [15] was totally different. [Now for the first time we could meet the scientists' requirements for the lunar samples]. The scientist people were getting happier, now their material was handled the proper way. We went through a period to help meet the science communities' requirements, where we were going to take 10 percent of the lunar material and house it someplace else, at Brooks Air Force Base [San Antonio, Texas], still is, in big bunkers and containers at Brooks, and that is because the concern of losing this precious sample. You can't replace it, unless you go back to the Moon, of course.

And the sample [that are allocated for analysis], of course, are very, very, very small. Portions of all of these samples are sent out to scientists across the world, and they do their studies on it. And once it's sent out, then it's totally a different—it's not put back with the [pristine] stuff if it comes back, and it's all accounted for. But if it comes back, it's then allocated somewhere else. It's a pretty interesting job.

But I made a lot of changes when I became the manager. One big change, the one I had to insist on. There was a NASA curator, and his name was Michael [B.] Duke, good guy, a scientist. He was really the main interface with the external scientists, who were the ones that could be gotten unhappy very quickly. Michael Duke worked in another division. He worked in the Lunar Planetary Science Division, as branch chief, I think. But he was the curator. Then there was the LRL, which had a manager, which, at that time, was me. But I insisted, with Tony Calio, that… Michael Duke should work in the LRL, to report to me,

because you can't have somebody handling the samples in another group. That's just plain management sense, organizational management sense.

So we did that, and Mike and I worked together really nicely. Then I recruited a fellow by the name of Gus [Weldon B.] McCown that I [had] worked with back in the Landing and Recovery. He was one of my great engineers back in Landing and Recovery when we were doing air drops and all the retrieval stuff. Gus was hired out of Convair, I think, and he was a very good—unfortunately, not alive—very good operational engineer. Worked with my group at Landing and Recovery for a long time, and ran all the ship tests that we did when we had the LCU [Landing Craft – Utility]. We never got into that, but he was the one that ran that part of our program for us. Just a wonderful engineer, operations engineer.

By the time I was in the LRL and we'd got everything working again, I was ready to go back to Tony's staff, do some other stuff with Earth Resources in Skylab, principally, and recruited Gus to take over the LRL position, and he did a great job till the LRL finished [at the end of the Apollo missions]. So I went back as assistant director to Tony. At one time my title was Assistant Director for Earth Sciences, I think, or Earth Resources, or something like that. And so I had to oversee the—we had a division called the Earth Resources Division.

But the main interface was now again with Bob Thompson and some of his people, who was, by this time, you know, he was managing the Skylab program. Of course, we had all the Earth Resources experiments on the Skylab program. Again, it was a balancing of engineering and operational needs against scientific needs. NASA didn't always do a great job of that, but there was always a reason it didn't work out as well. To make it fairly simple, I guess Skylab is a good example, but it happened on Apollo and the other [programs]. When the external science community get involved, their interest is getting the data back, material or data, and then being funded to do the research work they need to do. If you think

about it in simplistic terms, the only reason we're in space in the first place is to get engineering and scientific data. I mean, that's why we're there.

The kind of conversations we had, I guess one with Chris, he may not remember, but Chris' approach, and it's a good approach, was, for instance, if you build a building with a big laboratory, and you put inside that laboratory all of the very best latest instruments and equipment that you possibly can buy, but you don't have a reason to do it, you don't have any scientists to use it, you don't have anything like that, his answer was, "They will come." And it's a good answer.

You see, that's been used on the Space Station. Put a space station in orbit, somebody will figure out how to use it. But that's too simplistic. You can't actually do that, of course. But in actual fact, it's right. If you have a laboratory with all these fine instruments, the scientists want to get in there, and when they get in there, they'll start doing good things, because that's what scientists do; difference between engineers and scientists. Engineers can build the building, put the instruments in, but the scientists are going to make it happen. That's what Space Station is all about.

The trend of thought I was trying to get, going back again to Skylab, so you put all this money into—and it was EREP [Earth Resources Experiments Package], it was the Earth-viewing equipment, millions and millions of dollars of equipment to be carried off into space, to look at the Earth through all the electronic, magnetic spectrums, and all this great, great equipment is there.

Now, it wasn't exactly, "We'll put it there and see who wants to use it." There were scientists worldwide that submitted a proposal to use that equipment in a certain way, and money was allocated in the budget to feed that science research that would happen when you got all this great data back. That is fine. What really happens, though, you have a chunk of money, you know, so many million dollars. The hardware is going to cost the most of it, always does, about, rough numbers, 80 percent. Twenty percent of it is initially usually put

aside to feed the scientists' programs, contracts, so that they can get something out of the data that has been brought back. It all makes sense.

What happens in real life, the hardware end of the program runs into funding problems, and where do they get the money from? The 20 percent scientist part gets smaller and smaller and smaller, and now you've got [unhappy] scientists. But it happens all the time, because that's where they get the money from. The whole reason for the program in the first place is to do science, but the pot of money to actually do the science is getting smaller and smaller.

Well, what it boils down to is, it was just a basic reoccurring battle to try and safeguard the science money from this big elephant that sucked up all the hardware money. Everybody did what they could with it. In a lot of ways, that sort of became a part of the job I did, trying to keep the scientists happy and money involved. But anyway, I did some Earth Resources work, and that's where we ran into that problem first, the fact that there wasn't enough money to do the science, with the data that had come back.

Then we went on to Space Station stuff. My job was to kind of overview a lot of the work that we were doing in payloads and payload development in the actual Space Station modules themselves, which were going to go.

Then along came the day we all remember, which was the Challenger accident. By this time, the two directorates had been put together, first under Dick [Richard S.] Johnston, and I was Assistant Director for Space and Life Sciences, but we had a bunch of assistant directors. We had one for the life sciences and one for earth sciences. So my job by this time had become largely sort of internal, what they might say in the Navy, an exec officer who looks at the internal runnings of the ship. A lot of budget stuff. Not as interesting as some of the operations work, but you have to do what you have to do.

I'm going to tell you a story in a little bit that you also might not want to put on the—so this is going on and they put the two directorates together. The half-life of directors for

Space and Life Sciences was really—well, I mean, they would come in, stay six months, go out. Dick Johnson retired. I think they brought Joe [Joseph V.] Piland in there. Not Joe. Bob [Robert O.] Piland in. His brother. Joe was in maintenance.

Bob was a wonderful guy. Actually, in my opinion, the best director Space and Life Sciences [ever] had, because Bob was an engineer and you could understand him. He was a damn good manager, and he delegated. I remember the day he came in, he got us all together, the managers of space and life sciences, and he said, simply, "Okay, what do I need to know to manage this place?" That's a wonderful approach. Rather than come in and say, "Okay, I'm going to change this, change that." "What do I need to know?" You tell him everything that's going on, he puts it all down, and he said, "Okay, Pete, you do this and this, and you're responsible for that bit." You know, other guy, "You're responsible—." You farm out the work and then you manage it. You oversee, manage it. Trust the people, have constant staff meetings so you're getting the information flowback. And he was the very best guy at doing that, so I was totally happy working with Bob Piland.

But we had some strange ones. After Bob—well, I think there were a couple of interim acting ones—but after Bob, Joe [Joseph P.] Kerwin, an astronaut who had been out in—a medical guy, obviously. I'd worked with him, as a matter of fact, in the lunar lab because he was on the original Readiness Committee, so I knew Joe pretty well. But he'd been out in Australia for two years as a NASA rep [representative] to Australia, after his Skylab mission. It was one of those perks, I guess, sit out and count kangaroos or something. He'd say, "Good day, mate," which he was pretty good at.

But he had been looking for a job. You know, what are we going to do? He's coming back. Wow, he's got a Ph.D. We'll make him director. This is great NASA thinking. Can I say this? He was a lousy manager. He was a very nice guy, but he was so unorganized, and so we ran into that problem. Things were getting pretty frustrating, especially for me. You

had to still do all this internal stuff, but, you know, you'd keep getting these short half-life managers.

Well, then the *Challenger* happened. Joe is the manager at the time. Joe had the TV in his—you know, the top manager's got the TV and they were all sucked into all the tests that were going on in the Cape and everything. All previous managers had told their staff, you know, "Come on in." Joe used to shut his door and just look at it himself.

So actually, I wasn't looking at that mission, and some of our guys—John [C.] Stonesifer, who was in the office, were down in George [W. S.] Abbey's office looking [at his TV], because George used to open his office to everybody. And I remember Stonesifer coming back into my office, and saying, "There's been a bad accident at the Cape," and of course, by then we take over TVs and find out what's going on.

Joe got appointed to go down to the Cape and sort of run the medical investigation part of that. At that time I was frustrated, frankly, with the job. It wasn't the operations job I started with. It was all budgets, and there was this [frequent] turnover of [directors] and so I decided it was time to retire from NASA. And one decision I made was, I don't want to work for a NASA contractor, either. Because a lot of people that left NASA went off to work for Lockheed or Boeing or North American or Rockwell, and they were doing exactly the same job, except now they had to cross the road and try and get money out of NASA, like you guys do. You're doing good. I didn't want to do that.

I had an old friend. His name was David Rush, and he had an electronic company and it was in Fort Lauderdale, nice place. But David Rush, how he'd gotten started in the business, he had a camera repair company in New York City, a dirty little place down by the docks in New York City. But David Rush was a tinkerer and he came up with a radio beacon, all on his own. Guess he'd worked with the Coast Guard up there and he knew some of their problems of trying to locate people at sea.

At the time—getting back to Mercury now—at the time, McDonnell Douglas had put in a beacon called the SARAH beacon. SARAH stands, if I can get it right—Search and Rescue and Homing. Now, I knew of the SARAH beacon because when I was flying in the RAF we had SARAH beacons. We had them in the aircraft, the bigger ones, that went out with the big life rafts. We had them on our life vests. Of course, we all thought, dumb as we were, that if we downed ourselves in the North Sea, all we've got to do is switch on this beacon and, zap, everybody would come out and find us and pluck us out of the water. Just great, dumb, and happy. Okay?

So back at Langley now, going back in time, Milt Windler, actually, out of my section at Langley, was testing SARAH beacons, putting spacecraft out, antennas, flying airplanes with receivers on to the beacon, and lo and behold, we found out the SARAH beacon was totally useless. If this is a spacecraft, it had lobes that go out maybe 100 miles like this, and then nothing, and then a little lobe maybe going out, too, and then nothing. I mean, it wasn't symmetrical, so you could miss the [location]—so when I was in the Air Force, it was a good job I didn't know about that, because we used to go out in some terrible weather over the North Sea.

But anyway, so the SARAH beacon was not very good, and McDonnell designated the SARAH beacon to go in the Mercury kits.

Into my office one day walks this guy called David Rush. Never met him before. Little camera repair company in New York, but he had in his hand a beacon. Little box about this big, with a little antenna like that, as a matter of fact. And he said, "If I give you this—" Contractors never give NASA anything. You know that. "If I give you this, no cost, no development cost, and you test it, in other words, you get to put it out on a boilerplate [and fly ranging runs on it]. If it's good, consider my beacon as maybe one that [could be used in Mercury]." It was great. It was the best beacon. It had a perfectly symmetrical antenna that went out 100 miles any direction we flew on it. The ACR beacon.

And so ACR moved from being a camera repair company to ACR Electronic Company. We're still back at Langley. I'm really moving backwards. I don't know how you're going to handle that. We're back at Langley, and Dave and I got to be pretty close, and also he did with some of our other engineers, like Milton Windler, who was testing beacons. And Dave [at that time] offered me the job in New York City as VP of his company. It was a small company, no big deal. Thirty people. And this was while we were back at Langley.

And what I said to him—you know, you remember these things. I had four kids. Actually, only three kids at that time. But I said, "Dave, if you ever move your company to Florida or California, give me a call." I had no plans to move, and we went on and did all these things we talked about.

Well, as it turns out, we saw David Rush several times through the early days, and then I lost sort of contact with him, as I got into the space sciences business. I probably wouldn't see him two, three years on end. I had heard that he'd moved his company to Ft. Lauderdale [Florida], though, however.

Back now to where I was. When the Challenger accident happened, and I was really not very happy in the last couple of years at NASA because it was all budgets, in-and-out directors, and it wasn't as nice as it was. I was ready to retire, and I didn't want to work for local contractors. Out of the blue, actually—I didn't call Dave Rush. I hadn't heard from him. He had heard—there was a great ABC news commentator. Jules—

RUSNAK: Bergman.

ARMITAGE: Bergman. Jules Bergman. Jules, at the time, had brain cancer, as a matter of fact. I have the letter at home. And he somehow picked it up that I was retiring, however those things happen. Maybe it [was reported] in some NASA paper, I don't know. But Jules

wrote a letter to Dave Rush. They were very friendly. They both worked down in New York in the early days. They're both Jewish. But David moved his company to Ft. Lauderdale. By now it was like a big company, well, three or four hundred people, and then he had another company as well down there. Two other companies down there.

And so Dave had heard that I was retiring, so he called me and he said, "I'm going to send you an airplane ticket to come down and talk." So, gosh, great. Ft. Lauderdale. Dave and I have dinner, and he offers me the position as senior vice president of the company, which was really nice. I'm supposed to take over all the engineering and all the production lines.

By this time, ACR has got contracts with all of the U.S. military for all of their beacons. Still has. ACR beacons are carried on every military aircraft. He [also] has most of the [survival] stuff going on in the yachting world. He's into… satellite location stuff. Just neat stuff going on down there.

So I moved to Ft. Lauderdale. Didn't sell the house here. The company gave me a four-bedroom, furnished apartment, a car, and it was nice. And I'm not working for a NASA contractor now. It's far enough away.

But you know, what I ran into…. The world you really knew was the kind of NASA world, and I got into a totally different world. Now we're down in Ft. Lauderdale. Good job, car, whatever. And a great guy to work with, David Rush. But a strange group of people. They were all—do we have any Jewish people in this room?

RUSNAK: No.

ARMITAGE: I'm safe. People that moved down to that area of Florida—this has nothing to do with what we should be talking about—come from New York City, New Jersey. They've lived all their life up there, scraping enough to get to retire. They lived in a dog-eat-dog kind

of world. I mean, it's a vicious place, New York City. And then they retire down in Florida—Ft. Lauderdale, Miami—lots and lots. They live on their black cloud. It's weird. I never met this before, but I met it when I hit that company. There were devious people, people that would keep information back. Oh, it was awful. I was naive enough to think I could change it all, and that was naive.

Cut the story real short. Seven months later, I told Dave I'm going back to [Houston]—we hadn't sold the house, fortunately. Going back to [Texas] and so we came back here. Got a job as a vice president for science and engineering with Presearch [Inc.]. Presearch is, I guess, still a sort of a Washington beltway-based company. The owner was a guy named Len [Leonard P.] Gollobin. He put a contingent of people here, trying to get NASA contracts into space sciences. In fact, they were bidding on the contract for Shuttle payload development. And I had been hired there, and NASA contracts always, at least in those days, hired people from NASA when they retired that they felt could help them get the contract again. That's the world.

[At NASA] I had been, whatever we called it, the source board chairman of the contract, a big contract. Went to GE initially. Took about eighteen months for the source board to work, I remember. I'd been chairman of that for the payload development contract, the initial one. This company was trying to bid on that so they offered me this job. I came back. I was wanting to get back anyway. That didn't work out. They didn't have the people to do that kind of work….

So I retired. Actually, this is the third time I've retired. I used to say to myself, "I'm going to get this retirement right one day." I retired after a year with Presearch, and Presearch kind of closed down the operation [in Houston], after I retired and went back to Washington. When I got a call—actually, it came in to my wife, June, first. Call from Deke. Hadn't heard from Deke in a long time. He had heard I retired again and he said, "Why don't you come and talk."

Deke by now was running Space Services [Incorporated (SSI)]. David Hannah was the main guy, an entrepreneur, money guy that had wanted to get into the commercial booster business. And Deke, of course, had joined him back in, I think it was '83, on the Conestoga [rocket] launch that was done out of the [Matagorda]Texas area just south of here. And he had heard that I was retiring again. And so I went and talked and he said, "Come and consult."

Well, I consulted for a week—for a month, actually. But Deke was, as I say, my favorite guy, definitely favorite astronaut. He was the kind of guy—he didn't say, but he was very quiet. Didn't say very much. Very polite. But didn't have the ego that some of them had. He had nominated me as a title that he had had, which was manager of the Conestoga rocket development program, and we had contracts with Eagle Engineering, which was a bunch of ex-NASA people, and they were using up money like mad. Our funding people were the Houston Power and Light. Actually, Houston Industries. [They] were using like a million or two of seed money to feed us, and they did that with a lot of small companies.

So I did that, and then I found myself on proposals as the Conestoga manager and I said, well, I can't be a consultant if I'm a Conestoga manager. Deke said, "Okay. Well, we need to hire you then." So I came out of retirement again and became the vice president for programs for Space [Services, Inc.]. I had a wonderful, wonderful job and group of people, just a small group of people, using contractors mostly.

We produced a ballistic up-and-down booster called the Starfire, which we had a contract with the University of Alabama [Tuscaloosa, Alabama] to fly like a 1,000-pound payload into zero G. And we flew missions out of White Sands [New Mexico]. It was a great job. I recruited my old friend Gus McCown to be the operations manager, who I'd recruited several times before, and remembered something that Chris Kraft always used to say when we were trying to pick a contractor. The NASA rules for picking contractors is all very formal. They have to respond to an RFP [request for proposal], they have to meet all

the criteria, they have to say who their key people will be and what their background is. You have to do that, because those were the government rules. But Chris' attitude—and I'll never forget this—was when you briefed him, when I was running things like contract reviews or source boards, do you know the guys who are going to run the program? …Not what [the proposal] says about him, but do you know him personally? Do you think he can do the job?

That's not legal to pick contractors like that, but you know, that is the best criteria. If I know you're the best historian in town and I know that, it doesn't matter what they say about all these others. You're the guy I want. Somehow you make that happen in this contract. You have to tread lightly. But I also remember Chris saying, "Do you know him? Is he a good guy? Is he the guy you would want?" He'll probably deny that because it's not legal…. Won't put anybody in jail.

But anyway, so I'm now with Deke in a lot of that, and we're flying things. It's NASA-related, so we have to get some support out of NASA. At White Sands, we had to use their launch site, we had to use some of their tracking equipment. But we're dealing with the Navy because the Navy ran part of the site out there. We're dealing with the Army that had the overall base. We're dealing with Eagle [Engineering] and we're dealing with all kinds of other contractors, a Swedish company [SARB] that was providing our avionics, a Canadian company that was providing an upper stage. Thiokol was providing the lower stage. Great job, because you're dealing with all these [companies]. Here's a bunch of like ten or twelve of us, dealing with all of these big companies, but we got the money and it's our program.

That's wonderful because it took me all the way back to my days even in the Air Force when you're kind of a flight crew. It's a bunch of small, tight-knit people flying an airplane, or in flight test at AVRO, just a small group, with a lot of autonomy from the rest of the company. Or the original Landing and Recovery group. A lot of autonomy because we're doing just our little thing.

So here we are, and that was a neat, neat job and we did a lot of work. But the bottom line of all that is, commercial space flight really can't happen without big government funding. Funding's got to come. The Congress decided, back in the late ‘80s, that NASA should get out of the small rocket business, that they should turn all that over to contractors. Wallops Island, NASA Wallops, does the small [sounding] rocket business and had always done the small rocket business. And even though Congress said they've got to get out of it, they never got out of it, and they would fight you if you tried to get them out of it.

But here were we in there, so when we wanted NASA support, it was hard, the hardest support, when I was in space services, to get. Everybody was really cooperative in all Army, Navy, whatever you wanted. Hardest people to deal with were NASA. That's terrible, but that's the way it was. And what it is, it's a turf war thing, people protecting what they've done in the past. It's not something you can't understand. I'm sure we all protect our turf sometimes. But that was a problem, but it was a workable problem and we did some good stuff.

Then Houston Power and Light or Houston Industries pulled the plug on us. They had a lot of bad investments in cable companies and nuclear power, and so they pulled the plug and we had to close down the Space Services. Too bad because it was just really taking off. The remnants of it and the design of Conestoga and the other stuff was taken over by a company called EER, a minority-owned company up on the beltway of Washington [DC]. Deke went back and forward. I'd elected to retire again. How many times? Four times.

Deke went up, and we helped him a little bit after. I did some kind of unpaid stuff because I was interested in just helping him transition. Of course, Deke got his brain cancer and, unfortunately, left us.

I came out of retirement once more to take a small—not a small job, but actually, I was, what did they call me, senior vice president of John Zacarro's company, a small electronic management [information] company here in the area. Thirty, forty people.

They're still going. I did that for a while and then I really got retirement right. And you know what? I love this job. It's the best job I've ever had.

So now I'm back to where I started. I'm back [working restoring classic] cars that I love. I spend a lot of time on the Internet with a group called the Royal Wings, which is a group of ex-RAF people that are spread all over the world, with all kinds of neat stories to tell about their time in the Air Force, the RAF. I have a good friend that I got through the Internet who was a Squadron Leader in the Battle of Britain, so he's eighty. He wasn't a squadron leader then, but he was in the Battle of Britain. Ex-RAF…. In New Orleans [Louisiana]. I'm going down there, as a matter of fact, next week to give him an old computer I have and teach him how to use the computer, because he uses WebTV. I have friends all over the place.

I've gotten into digital photography and I'm kind of a computer photography guru. I enjoy that and spend a lot of time doing that. Write articles for the Rolls-Royce Club, member of the Rolls-Royce Club. I love this job. And I have not joined any NASA alumnis, I have not read any NASA space books, and I'm sorry, but, you know, and that's why I was a little reluctant to come, but if you wanted to hear my story, that's it. Because I like to get on with something new.

The cars that I dreamed about owning when I was a little kid in Hamble, the London people that came down in Rolls-Royce and Bentleys, parked in a local pub so they could get on their yacht and go sailing for weekend. I, as a young kid, used to drool. Now I've got a PMC [“proper motor car”].

So I don't know. Where do you want to go from here?

RUSNAK: Well, if you didn't mind, I'd like to go back and ask you some questions to go over kind of the range of things. One of the big ones, I guess, is we didn't really talk much about Gemini. I don't know if you had much involvement there that you wanted to recount for us.

ARMITAGE: Okay. The involvement in Gemini was basically the same as Mercury. It was another spacecraft, with two guys, of course. We were Landing and Recovery Division. Bob was still running the division and I was the branch chief, so we basically did the same things for Gemini, initially, that we did for Mercury. We didn't do any drop work that I remember, but we did a lot of pickup work and helicopter techniques to pick the crews out of it, and cranes and hold off arms to put on the ships so that we could prevent it becoming the wreckage ball that we talked about on Mercury, and all the beacons, runs, location beacons. We basically did all that stuff again, because we were supporting the Gemini missions. I went out on a few myself. Picked the good ones, like Spain.

But the big thing, I guess, that comes to mind is paraglider. Now, the paraglider, great idea. We'd landed Mercury in the water, and because it had not a great capability as it reentered to get to a specific point in the water, there was great dispersions. I seem to remember, and it's a bit hazy, but I seem to remember that the landing dispersion on Mercury was like a 150 miles wide and 1,000 miles downrange. I mean, if anything was slightly off in the hypersonic reentry, you could land anywhere in that footpath. Out in the Atlantic, or any ocean, it's a big chunk of [area]—now you know why we needed good beacons. But you know, they did a pretty good job on that.

The Mercury came in what we called the barbecue mode. I don't know if you've heard the term. But it was rotated so that the lifting function, which was real small, about a quarter of a—I don't know, how do they term that—lift vector function—was really small, anyway. But you see, if you came in without rotating, with a left vector, it would just pull you off. Going so fast, it doesn't need very much lift to pull you off. So somebody came up with a barbecue mode, where you keep the spacecraft rotating. It's quite slow, but it cancels itself out, so they're trying to keep on the course. But still the dispersions were big.

On Mercury—I've still got some of the old charts at home, because I mostly flew on the aircraft because that was cushy. Got a box lunch. We didn't have that on the destroyer. We'd stay there for three days and drink coffee. So there were ships, literally, from the Cape to Africa. There were like two destroyers and an aircraft carrier, where you hoped it would land, more destroyers, all to take care of what happened if. And that was very expensive, of course, to do that, cutting back a bit as you got more confidence.

So Gemini comes along, getting back to Gemini, and this big impetus to land land, because now you know where it's going to be. You don't need a ship and don't even need a beacon probably. Still got the contingency cases, so you do need something. So into Gemini was designed this thing called the paraglider, but that wasn't the only thing. You had to have landing skids. These were skids, [two] of them, that came out of the bottom. And it's a small vehicle. You know, Gemini's only from here to that wall and, I don't know, what, eight-foot diameter or something like that. Two guys in there. And you've got this landing stuff [to stow in the vehicle].

Just diverting just a little bit. The worst thing on a airplane, I mean an ordinary passenger airplane, is the landing gear. It's only used two times: takeoff and landing. Or it stands on it when it's doing nothing, not earning any money. It's just dead weight when it's flying, and it's heavy dead weight. The Shuttle was supposed to have a couple of jet engines so it could go around again. I mean, a terrible dead weight to take to space, so got rid of that early in the program. Bob [Thompson] obviously talked about that.

But anyway, back to Gemini. So it had these great cumbersome skids that came out, with pads, so that it could skid along the ground when it landed, and the paraglider. Now, you know what the paraglider is. It's a triangular device, totally flexible. It was designed by a fellow named [Francis M.] Rogallo, who was a Langley research engineer, brilliant guy. Designed initially, I think, as a sport-type thing, so you could jump off a cliff. It had three booms. Center boom [and two side booms], and then it was just like a parachute. But the

booms were solid on those, and you'd kind of strap it on, run with it, and jump off a cliff, and then you steer it by moving side to side. Still do that today.

So it's called a Rogallo Wing. Rogallo was a great friend, I guess, of Bob Gilruth. In Gemini it was thought that the paraglider would be a great land landing mechanism for solving the fact that we wanted to get away from water landing. But to put it in Gemini, of course, is a total different kettle of fish than jumping off a cliff. Now you can't have solid booms, because they won't fit. It all has to be packed away, and, of course, Rockwell had the job to do the paraglider part of it, although the spacecraft came out of McDonnell. But it was Rockwell [and the Northrop] Radioplane [Division] that had the paraglider part of the job, as I recall, and Rod Rose was the program office manager on the paraglider. I was in Landing and Recovery.

It occurred to us in Landing and Recovery, this thing won't work. And the reason is—well, let me say, when it's packed away in the spacecraft, it was fine. No problems. When it was out and flying—incidentally, they put inflatable booms because they had to pack it away so the booms had to inflate with an air pressure so they became solid booms and then the wing between them, and so that had to have pressure systems and all sorts of [systems]. When it was out and flying, it was fine, too. I mean, you could steer the thing around and all that. And we ran some, I think they were quarter-scale drops, dropping them from helicopters, with a paraglider.

In fact, we put a TV system in and we could actually sit at a TV in a room. The Army base just northeast of Houston—what's it called? But we could sit in the room, and like radio control, and fly a quarter-scale of Gemini. We did a number of these, land-landing them. So we were doing those kind of things, trying to at least stay with the program.

But it always nagged on us that it wouldn't work. You could not get the paraglider from the packed position to the flying position while the spacecraft was coming in at great

velocity. Contractors never give up, of course, until the money runs out. The contractors, of course, kept going and going, and Rod Rose was running that part of the contract work.

So I remember, in the Landing and Recovery Division we wrote a memo to say that we had these great reservations about the paraglider. There was two things, the fact that I've just mentioned, that dynamically it was going to be a bear to get it through this transition stage; that was one thing. The other thing was this thing called orthostatic hypertension, that every astronaut feels when he gets into space. It's not so bad a problem now because they've got room to exercise and things in space. In Mercury it was a problem. We had to hold a guy up almost, the astronaut, when he got out because it's, as you know, similar to bed rest. If an old person stays in bed for a long time, you get pretty wobbly when you stand up because the blood pools to your lower extremities. In fact, bed rest [tests were] done—I don't know whether they still do it—probably not now, but a lot of programs were done to find out the problems associated with people in zero gravity. We had bed rest studies here, and Ames [Research Center, Moffett Field, California] had them.

But anyway, that was the other problem that occurred to us, at least, with Gemini. These two astronauts had been in space. Now they're dangling on a paraglider, if it did get out. You're thrusting them vertically, so they're now sitting heads up, and now you're asking them to be pilots, to fly an airplane, when they can't even stand up, when they're now under the Earth gravity. If they pass out, how are they going to fly an airplane?

I remember bringing that up at a meeting where Chuck Berry and all his medical people were [there]. Well, of course, all of Gemini [management] was here. And he almost threw me out because he accused me of being a "pseudo-physician." The audacity of this LRD [Landing and Recovery Division] engineer coming to say that they couldn't fly it. But you see, what happened in those days, it's a turf war again. I was getting into his business by saying this. Not really getting into his business; just saying it was not going to work.

So we wrote this long memo. I remember Wayne Koons had a lot to do with the memo. I had a lot to do, and Bob, I'm sure, had a lot [of input to it]. I was presenting it in this big meeting. It was in the Lanes-Wells Building downtown where Gilruth had his offices, and we were in the Houston Petroleum Center, I think, or something like that. I presented this memo and a briefing as to why we thought paraglider had some problems. You just don't go in and say it won't work. You just say, "Here are some concerns." Because you don't want to [sound negative] and the main reason for the memo was, let's at least develop a backup system, a parachute, in case it doesn't work.

We were still doing tests. We were dropping quarter-scale—you know, we hadn't given up on the program. Well, we kept hitting heads with Rod Rose, of course, who was defending his contract. It got to be rather comical, because [on] the air drops that North American were doing, they did run into this deployment problem, so they ran a lot of air drops with it pre-inflated. I mean, that's dumb. They're just dropping it when it's already out. That wasn't going to get by the problem.

So anyway, at this meeting—Bob Gilruth, as I said earlier, was such a nice, nice guy. But I gave this pitch. I'll never forget this day, either. I'm essentially now saying the paraglider has all these problems, it's not going to work. I say "me." I mean it was a collective memo. I'm a member of the group, but I'm giving the briefing. Gilruth looked at me and he said—I remember him pointing his finger at me. He said, "Pete." He called me Peter, actually. "Peter, I want the paraglider in Gemini because I want the paraglider in Gemini."

You know, when somebody says that to you in this meeting, it's time to go to receive. It's just time to shut up. [Laughter] So we shut up. I mean, it wasn't meant in any hard sense. It was just, "I want it, and we want to get away from water landing and this was how we're going to do it." And of course, the spacecraft was already designed by then, skids in the paraglider.

I think it was six weeks later that I heard through the grapevine that North American or Radioplane, under McDonnell's direction, were working on a backup parachute. [Laughter] And so the paraglider disappeared. It was a good idea that was a very bad idea. I mean, like I say, it flies well when it's out, but it didn't do well at all between.

So Gemini was now to be water-landed. But now, of course, the big penalty—not the money they'd spent on the paraglider program, which was, I'd say, in retrospect, a fiasco, but the spacecraft had all this structure in it to [house] these [landing] skids. Well, they weren't going to use them. So there was a lot of design space wasted there and stuff. But the one thing we got out of it, which was different to Mercury, was during the landing we could now suspend the Gemini on a—better be careful I don't [gestures using coffee mug as a model]—the Gemini, rather than Mercury, came down flat onto the heat shield, because there's a horizontal component as wind travels you along, so it's not exactly. But anyway, flat. The landing bag, in that case.

We were able to organize so the Gemini—again, I say "we." We didn't. It was the parachute design people over at McDAC [McDonnell Aircraft Corp.]. So the Gemini came down and landed on a corner like that. It had a heatshield like Mercury. But you see, it's a lot better to attenuate velocities if you land it like that than it is like that [demonstrates with mug].

So that was good, and we were back in the water landing business, with ships all over the ocean. But Gemini had a much higher lift vector capability than Mercury, so the accuracy of landing was better, and we were able to cut back on the number of ships and aircraft and all that kind of thing. If it had done a contingency landing, it might not have been so good, but they were able to design couches that had a little bit of absorption capability. Of course, it wasn't until they got to the Apollo program that they had fully-attenuated couches, because you know the three couches in Apollo have these big struts and

when you land they stroke, like a suspension on a car or the undercarriage of an airplane, things that couldn't be built into Mercury or Gemini.

So we were back, basically, landing on water, with ships, the aircraft, etc. So that's what I did in Gemini. It was a pity the paraglider wouldn't work. It would have been nice, but it just wouldn't work. I mean, there's no way about it. We never got into the orthostatic hypertension system because they didn't have to fly it like an airplane in the end anyway. Then, of course, we got into the lunar program.

RUSNAK: Did the issue of the orthostatic hypertension come up again with Space Shuttle since they're up for a few weeks at a time?

ARMITAGE: It's always there, yes. If you put a person in zero gravity, you do get this blood-pooling. When you suddenly put them back in a 1-G environment, it's going to be like picking an old person out of bed that's been there for a month and sit them upright. They're going to get dizzy and light-headed. A Russian astronaut—well, everybody. We're all the same.

Of course, it's so much better in—it was in Skylab when we first started, but in Space Station, Shuttle, they've got lots of space now. They can exercise. There's exercise machines, so they can stop the blood pooling. Just sitting there, letting their blood pool. They can put G forces on themselves by using the odometers. So the medical advances in keeping a man or woman in space for a longer period of time without any great detrimental effects from blood-pooling or orthostatic hypertension is a whole lot better now.

And then there's been a whole lot of work done in medications to stop that, and space motion sickness and all of that, which were a problem in the beginning. Nobody ever likes to talk about astronauts barfing, but they do.

So that's what we did in space and life sciences, a lot of that work. So Apollo was the first spacecraft that basically had enough room to move around. They'd get out of their couches. Of course, on the lunar missions, they go into the LM [lunar module] and through the air lock, so they were able to acclimatize themselves a little better to space, and so it's gotten less and less of a problem. Of course, now with Shuttle, they can sit on the runway after they land until they get their bearings. Just don't get out and go through all their checks or whatever they do. But it's always there in some degree.

RUSNAK: One of the comments you made just a few minutes ago reminded me of another question. You talked earlier about when you were working on the LRL, this kind of engineering and science, how those two groups worked together a little bit, which made me wonder how you as an engineer in operations worked with the engineers from Engineering and Development [Directorate], those guys under Max Faget who, you said at the beginning they kind of split off. So how was that between the design folks and those of you who were actually having to operate these systems?

ARMITAGE: In the Lunar Receiving Lab?

RUSNAK: No, no. I just mean over the whole span of your career, I guess.

ARMITAGE: Oh, okay. The whole span of the career. All the design stuff, all the thoughts and things come out of engineering, true engineering. Max Faget is a brilliant engineer. They called him the Father of Space Flight sometimes, I believe. But good, good people. And people like Caldwell [C.] Johnson who was a real, to me, a designer's designer. I mean, he just could dream up ways of doing it.

It's not something you learn at school, incidentally. To be a really good designer, you have to have a lot of practical [experience and] you have to have concepts in your head. It's like a good architect or anything, I suppose. So, yes, there was a lot of cooperation at that sort of level, but then again, in Landing and Recovery, we were kind of a little company of our own. See, in doing test work, our main relationship was with the DoD [Department of Defense], with getting airplanes and ships and helicopters. We were meeting the requirements of the engineering people, to the degree that they needed [test information], although a lot of the requirements we were meeting were our own requirements. Does the radio beacon work? Can we locate the spacecraft? Can we pick it up after landing? What happens to it dynamically? Those kind of things we were solving for our own problems.

One of the problems—this might be of interest… When we got to Apollo, it was a water landing also, but now it's a much bigger vehicle. It's thirteen-foot diameter at the heatshield, either thirteen or fourteen, I forget which. But now, it's floating on the water like this, and it's got very little draft. So in effect, it's a sailboat. It's a very good sailboat. There's like this much of it in the water and there's a lot of it up there. And if you get a wind, as you always do on the ocean, over 10, 15, 20-knot wind, this thing is really moving, and it's moving similar to a sailboat, maybe as much as a quarter of the wind speed. So you might roll along at 3 or 4 or 5 knots after it's landed. And now you've got to fly in with a helicopter. We used to put a collar around it. But you've got to catch the thing first. It's moving along the water at a high clip.

The technique that was used was one of these things that was used on Mercury that basically had the bag to slow it down, but the technique that was used was to go in with a C-130 over the landing area. Now, what I'm talking about is techniques for contingency purposes, if we landed in the Pacific or another part of the Atlantic where the helicopters weren't there. With a helicopter, you can kind of chase it down and drop the guys right on top of it, the [Air Rescue Services] guys that put the collar around. You can chase it around,

so this scurrying along the water wasn't too much of a problem there. But it was a big problem if you landed someplace else.

The technique ourselves and the Air Force had came up with—the Air Force was the air rescue service. They flew C-130s, and these were UDT-type people. They were air rescue people, but they'd jump with parachutes into the water and swim for miles. Real tough guys and great guys to work with. Gung-ho. They'd do anything, you know. So the technique was to come in a C-130, try and determine the winds, and they could do that from their nav equipment, see the spacecraft moving along, and try and put the guys down [in the right position]. They put two guys down, I think it was. Try to put the guys down in front of it so that they could swim to it before it passed them up. Because if it passed them up, they would never catch it. There's no way. You can only swim at about one mile an hour, or even less. But this thing's moving along at five.

So that presented big problems, because a lot of the tests that were done, you know, the guys actually landed in the water slightly behind it, and then it was too late. It was gone. So we sat around one day in the office and said, "How do we solve that problem?"

Incidentally, the air rescue people had to take with them this great big bag, about this long, this by this, which contained the collar to put around, the flotation collar. Then they had to take another big bag that had all kinds of survival and medical gear and stuff if they needed it. So, those two big bags. They also had to parachute in. So the first thing they had to do is not only catch the spacecraft, but get these bags that have been parachuted in separately and meet somewhere in the ocean, in the same place. Not an easy thing to do.

So at the time we were dealing with a guy called Robert Fulton. He's the [great-] grandson of the real Robert Fulton, who invented, over here, the steam engine. Steam ship, I suppose. The steam engine was English. That was Robert Stevenson…. So Robert Fulton was an entrepreneur like his great-grandfather was, and he developed a lot of what they call long-line techniques. He had a technique where you fly an airplane with a fork on the front

of it into a line that's held up by a balloon. There's a weight on the other end—a man or a package. Fly it like that, and then you snatch it somehow and pull it behind you and then reel in the guy. He had a contract with the Air Force to do that.

Then there was another company called American Engineering, up on the East Coast, that developed runway things for stopping airplanes that were coming in too fast. It's the same basic principle as used on a carrier, where you stretch a line, the plane comes in with a hook, and then the line has shock-absorbing and it slows the plane down really fast. It's the same technique. We refer to them generally as long-line techniques. Well, Fulton was an expert, and Fulton used to come down and visit us. In fact, he used to fly his own private P-51 and land at Spaceland Field, a really interesting guy.

One of the things he had developed in the early days, working with the Navy, was a way of picking up UDT, underwater demolition people, off an enemy coastline after they'd been ashore and done their thing. What they had to do then is swim out and be picked up, and it's usually a motor torpedo boat that comes along and picks them up, [but] because the motor torpedo boat has to stop. When it stops, it's a really good target for the onshore [enemy]. So he had solved that problem with a long-line technique. I was always intrigued with long-line techniques. But I have to give the basic spawning of the idea—I'm going to get back to Apollo—came from our talks with Robert Fulton.

What he had done in that case, the UDT pickup off an enemy shoreline at high speed, was he was—and this was his story, because it's interesting, if ever this gets chronicled properly. He was with his family somewhere in Florida at the beach, on vacation, and the problem he knew about. It was in his head. There was an old wrecked wooden rowing boat on the beach, had been there a long time, and the transom had been broken out of it, so it was just a hull with nothing [at] the back. And he came up with this idea, which was really neat, from that, just seeing that. He was a really interesting guy.

So how he solved the problem was, he got UDT guys, done their demolition work, they're swimming out, motor torpedo boats coming along. You have two of these boats with no transom in the back. Little boats, aluminum, in that case. They're floating right down [in the water] because they've got no transom. They're totally in the water, but not they're not sinking because they've got flotation, and they're light, and they're connected together with a long line like this. Motor torpedo comes along and hits that line in the middle. Before it does that, the UDT guys have got themselves inside these little boats, with no transom. So they're down in the water, they're not targets anymore. The motor torpedo boat's coming along at 20 knots or whatever it's doing, hits the line. The two little boats without the transoms with the guys in come right behind it. They reel them in. They don't stop; they keep going.

"Line dynamics" is the proper term for that. It's using a long nylon line to do something with, in terms of [retrieval]. And so his system for picking up things from the ground, they did it with men. Unfortunately, lost a guy doing this, but is to put up a balloon, a man sits in a harness on the ground. A C-130 comes along with this fork thing on the nose. The balloon goes overhead, hits the balloon, connects to [a grabbing device between the forks]—I have a model of this at home which they gave me. Connects to the front of the fork, then the line starts pulling the guy off the ground.

Well, the aircraft is doing about 150 knots. It's pretty slow, slow for an airplane, not slow for the guy on the ground.

RUSNAK: I've got to interrupt you again. I'm almost out of tape.

ARMITAGE: So they pulled in these UDT types that way. And so if you string a long line out—it's usually a nylon line—you can hit it at high speed. If you had a piece of string I could demonstrate, but never mind. See, if you hit a line there and you've got something on

the end, or if there's something on this end, you hit that line up here, when you're going at high speed this way, if you do the math or just do it on a drawing, even though you're going at 150 knots, by the time this point gets to this point there, this point has hardly moved.

And so the liftoff of the guy, as he's being pulled behind the airplane, is quite slow. He just comes "shshshshs" like that. Because at some point he's going to get to be going 150 miles an hour. But I mean, it's not like a jerk. Okay? It's quite slow, and there's a lot of elasticity in the line. Line techniques are really interesting. And of course they're used on carriers and they're used on other things.

So anyway, I told you this story about the UDT because I always thought that was a neat story that Fulton used to tell us, and he developed this technique for airplanes, and he used to bring his own P-51 in here. He obviously had a bit of money, although he's an entrepreneur. He owned a B-17, a World War B-17. That's a bear of a thing to keep up. But he had done all this line technique with the B-17, and he used to hire an airline pilot or pilots to fly it for him.

So this B-17 was equipped, and what happened was, you have an airplane from the nose and that you would have a stainless steel cable to the wingtips, and this was to protect the propellers if they hit the line outside the fork, if they hit here. Of course, they want it to slide off the wing, not get tangled up [in the propeller]. That would be bad. So that was put on Air Force C-130s, air rescue 130s, that idea. But he had this B-17 and he did all the personal test work.

And then there's another good story you ought to look into sometime. There was an ice floe in the Arctic. There was a Russian Arctic station, weather station, and the Russians had people on this big ice floe for years. And of course, the U.S. were always interested in what the heck they were doing down there. Then the ice started breaking up one year. There was enough intelligence to know what was being done there, at least, but the Russians pulled the guys off the ice, took them off before it broke up. So there's this station that had been

there for years, on the ice, and the Russians had now abandoned it because the ice had started breaking up.

So the U.S. Air Force parachuted, I think it was three guys, down there, onto the ice floe—pretty gutsy thing to do—to gather data, find out what the Russians had been doing all these years. The ice is still breaking up. [The ice break up is] a slow process, but it's getting less and less. The weather got bad, worse, and they now could not get the three guys off the ice. Normally you would land a small aircraft with skis. I think that's how they got them in there in the first place.

But anyway, they couldn't do that anymore, and they called Robert Fulton. Robert Fulton had his B-17 with this pickup thing. So they parachuted down the balloons and the pickup harnesses, and he hired an airline pilot and he took his B-17, and he had the movies of this. It was total white-out, could not see which was up or down. It was total white on the ground, total white. It takes a lot of navigating to do that. You don't know which way is up. He, with his airline pilots and his B-17, pulled the three guys off the ice, with the line technique. He had movies of that. It was really something.

Sorry to divert. Apollo is moving along the water, and half the time, the air rescue people don't get in front of it so they can't get to it. Half the time when they're getting in front of it and can get to it [and they also have to] get these bags to it…. And so we sat around the office one day, and of course, I was always interested in Fulton and his stuff, especially the lines. I guess by nature I'm a tinkerer of things. That's a disease also. So I thought, here's what we could do, and we worked this amongst the group. We fly a [C-]130 in. The spacecraft's down there moving along with the wind. Don't put the guys down there first; put the equipment down there first. See, they were doing it the other way around, guys, then dropping equipment. Then the guys had to swim to the equipment and get it. Don't put the guys down there. Put the equipment down first.

And the way you put the equipment down, on the inside of a C-130, you know, they open the ramps at the back and they push things out. That's how we did the air drops for Mercury. And there's a rail system, because you can do drops with static lines attached to the rail, and it pulls the chute out and everything. In fact, you can even time the rail. You can time a drop. Just to drop big packages on the ground, actually, they fly real low and pull a great big package out and it just bangs down on the ground. It has lots of attenuation devices.

All that was available to us, so what I said was, okay, we'll take the big flotation collar and then this emergency equipment, which is always big equipment. We tie them together with a nylon line, which is all bunched up, and we'll put them up on this rack in the aircraft. The line between them is a nylon line about 150, 200 feet long, or more. I forget what we actually used. And so now here's this spacecraft going along the water. They know which way the wind's going. They fly up in front of it this way. The do a drop, a timed drop. The first package goes out on a chute. As it goes out, it pulls this line in front of the spacecraft. Then the next thing goes out, and the spacecraft is going to intersect the line at some point. The swimmers are not in the water yet. No problem with that. See, we can do that.

Another problem is, how do I get the spacecraft to grab the line? Because otherwise it'll just go over it and go on. So [we] designed a little grappling hook. You know what a grappling hook is. They use them in the Navy on boats. But I'm talking about a little one. It was about this long and it had three spikes, you know, like this, and a shaft. Of course, if you drag that through the water, when it hits a line, it's going to grab the line. So what I needed to do was get a grappling hook in the spacecraft. Boy, was that ever a problem, because now you had to go through the big CCBs [Configuration Control Boards]. George Low was running the program at the time, and you had to convince him that you wanted this ten ounces of grappling hook and the line, and that when they landed, the astronauts were to push

it through a little—there was a little opening for something or other they could take and push it out.

So now the spacecraft's moving along, but it's trailing this grappling hook on the end of a little line. So now we go with a C-130. We did all the tests before I went to George Low, to make sure it would work. So we go over with a C-130, we drop the first package, the spacecraft's coming along here. The next package, there's a nylon line between them. The spacecraft goes over the line, but the grappling hook grabs the line. Now what happens, it pulls the two packages in line behind it, and now you've got, all of a sudden, about 200 feet of target. The spacecraft is virtually stopped dead now because the two things at the end of the line we dropped have still got parachutes attached, and they become big [sea anchors]. The whole thing is stopped. Now you go in and drop the guys. They've got this gigantic target. It don't matter where they hit. It's stopped, and they've got all these lines and they pull them.

But we ran all the tests out in the Gulf, just off of Galveston. Worked like a charm. The hardest thing was to get the [Program] Office people to put his 10-ounce [grappling hook in the spacecraft] but George Low did see the benefit. [We] never used it operationally, because it was only if we ran into a contingency [landing in some remote area]. As I say, [in the main landing area] the helicopters could chase it down. All of Apollos fortunately landed not far off the [aircraft] carrier. Pretty good. So we didn't get into the Pacific situation like we did on one Gemini mission, landing in the Pacific.

But this was the technique, and it all came out of the talks with Fulton and using line techniques. You know, it's always been tremendously interesting, to me at least. But again, it's the group where it was real-time innovation, and that's what made the job so interesting.

RUSNAK: You've certainly done quite a variety of interesting things while you were there, and this is just one example, I think, of the sorts of unusual experiences you've brought to the space program.

ARMITAGE: It was exciting. I should tell you the story that I said I wasn't going to tell you. We can be off, if you'd like. I don't care. I told you about how frustrating it got when I really got up into the rotating directors of Space and Life Science, and I was dealing in budget stuff. A long way from what I've just been talking about, so you can see that's not as interesting a job for a tinkerer to be in.

When I finally left NASA, which was just after the *Challenger* mission, I mean, I decided this is a good time to do something else. Dave Rush and his beacon stuff, I'd pulled out of it. And when you check out of NASA, it's like checking out of a military base. You have to go around to different places and have them sign a chit for you. So you have to go to the library, so you don't have any library [books not returned]—you have to go to personnel, you have to go to the security place. So you go around with this thing. That's what you do on your last day. Then you're all signed out and then you're retired.

So I'm going around, and I've been to security and I've been to the library, and they've all signed my chits. Oh, payroll. That's another one. They sign your chit. And I get to personnel. I still like this story. I guess they had their own "historian." I use the word with a lot of quote, because they put in front of me, and I guess they did to everybody, a piece of paper that had a box, literally about that square, a white box on it. And it said, "Describe your time with NASA," in a space this big. We've already taken four hours. And you know what, what do you say? I'm leading to what I wrote. What I wrote was—I was at NASA twenty-eight years, I think, twenty-eight. No, twenty-seven, excuse me. I wrote, "Twenty-five years of pure joy and two years of frustration." That's exactly what I wrote, and the paper's in [the NASA system] someplace.

And then I got home and I thought, "You know what? They'll never know which the two years of frustration was." [Laughter] Then I thought, "Well, that's kind of [too bad]." But the last two years were really frustrating. I had Joe Kerwin and he was hard to [work for]; he was uncommunicative. It was budget stuff. It was frustrating. It wasn't anything like the beginning. I was glad to get out of there. I've heard of these NASA guys that really worry about retirement. I loved the idea. And I was going to Ft. Lauderdale, what the heck. But anyway, yes, twenty-five years of pure joy and two years of frustration. You can print that if you like. I don't care. One advantage of getting old—I'm seventy-two—one advantage of getting old and retired is you don't care what you say. [Laughter]

RUSNAK: Well, as long as you're okay with it, we are, too.

ARMITAGE: I'm perfectly okay. Because, serious now, I would really, really like to see somebody—I don't know how it would happen—write a book to say how it really was. The personalities—there were fights, there were egos. There still are. People that didn't agree with each other, people that didn't get along with each other. There was shenanigans going on as to how they [worked together]. I mean, if somebody could write that story, I would even buy the book.

But all this stuff, "Everything went beautiful, and Joe did this and Bill did that," that's not real. But it's history, so I don't mean to be too flippant about it.

RUSNAK: We certainly get a sense of people's personalities from talking to those people themselves, but also from the people who work with them.

ARMITAGE: That's, I guess, what struck me as good about this project, that it's people talking now and not writing. When you write, it's quite a bit different. When you talk, you can see through all the baloney. I hope you're seeing through mine.

RUSNAK: We often have to remind people that when they look at their transcript that that's how you talk and not how you write.

ARMITAGE: Yes, I suppose, you know, you've done this for a while now. I suppose you get some pretty serious guys, don't you, that just talk about [it] in a [formal kind of way]. If you were talking to Gene [Eugene F.] Kranz, for instance. I love Gene. He's a brilliant guy, but "General Patton" we used to call him. He had these silver guns on his—are we off?

RUSNAK: No, we're still on. I did want to, however, give Kirk and Carol a chance to ask any questions if they did, because I didn't have anymore. Kirk?

FREEMAN: There is one question, sir. During the recovery process of the Mercury capsule, there was a debate between the resin shield for the heat shield—

ARMITAGE: Beryllium?

FREEMAN: Yes. And I was sort of curious if you were involved in that and what came of it.

ARMITAGE: Not involved in it in the engineering sense. I knew what was happening and we had to be concerned about it, because the beryllium shield, obviously, was going to be quite a bit heavier than the phenolic [resin] shield. But you know, it was Max Faget and his people that came up with the ablation approach. That is, you could burn off—I think the

temperature on the outside of the heat shield was something like 3,000 degrees Fahrenheit at the hottest point, and the heat shield is like this thick. And then you go in another less than a foot, and there's the astronaut's back. That's the problem. And so you've got to ablate all that heat off or protect him from that heat, because you don't want much more than 80, 90 ninety degrees at his back. So you've got this amount of space, on Mercury at least, to get rid of all that. That's quite a problem.

It was not known, as I understand it, it was not known that the ablation approach would work. That's where you actually ablate or burn off material and it goes off in energy, and then energy then carries off the heat. It was not known whether that would really function or work, and so I believe—you've got to ask others about this, because I just know about it because I followed it at the time. I believe the beryllium shield was kind of a backup. If it didn't work, then we have to have a material that will totally absorb the heat, rather than ablate it off. But Max is an authority on that, and his heat-shield people. What's her name, Dottie [Dorothy B.] Lee. Have you talked to Dot Lee?

RUSNAK: We did.

ARMITAGE: Brilliant thermal lady. Did most of the thermal stuff. She could talk for hours on that. I can't. In fact, I've told you all I know.

RUSNAK: Carol?

BUTLER: I had two questions for you. The first question was, you mentioned early on that you got involved with the parachute work at NASA because Jerry Hammack called you into the meeting and said, “Here he is. He's doing it,” and kind of jumped you into it. How did

you then, after that fact, prepare yourself for that job? What were some of the steps that you took to be able to learn the systems and the people?

ARMITAGE: Yes, that's good. Again, I go back to these steering mechanisms, and what you do when you're thrust into a situation like that is you draw heavily on your background. If there's nothing there to draw on, you're in deep, serious trouble. But you see, what I did there was, okay, so I did [ejection seat] tests on the CF-100. I had dropped from bombers large lifeboats into the North Sea in really bad weather. I knew what parachutes were and how they were pulled out, and drogue chutes. I mean, I had a background.

At the time that the background was embedding itself in whatever mess I have up there [(my head)], you don't assimilate that at some point in the future it's going to be useful. But when you get thrust in a situation like that, if you have something to draw on, as I did in that particular case, then it sort of comes together. So I'm really actually interested, just personally, in this, what I call steering currents. The fact that as you go through life, like my early life around airplanes all the time, and cars and such, but as you go through life, you keep drawing on something from way back here, and when all that comes together it kind of steers your career in some way. That would be my answer to that.

BUTLER: Thank you. The other question I had was, you talked about after you were laid off from AVRO, that you came down here and you talked about the interview process at NASA, but you said your wife didn't want to leave. But yet not only did you go to Virginia, but then you came down to Texas and you've ended up staying here.

ARMITAGE: Do you want my wife to come down? [Laughter]

BUTLER: I'm just wondering about the—

ARMITAGE: In her real heart, she still wishes she was in England. She doesn't like the Texas heat. I put up with it because, you know, you can handle it, but she doesn't like the heat. People are fine, and no problem. Well, we've been here longer than we lived in England. But yes, if she had her way, she'd be in some country village in England, living in a thatched cottage and looking at a picture of the Queen every day, drinking English tea. You know, it's a good question because the woman in a relationship, where the man is doing, every day, really interesting things, and the woman is looking after kids, not you, because you're doing really interesting things. But the woman is at home, looking after, in our case, four screaming boys, which is like having ten screaming boys. But it doesn't have the things going on that a man does. I mean, I could go to NASA and get absorbed in all this stuff we've talked about. It's a lot tougher on them. And of course, you've been into the question, I guess, of astronaut wives worrying about when they're in space and this kind of thing.

You have to balance, and I think I tried to do this, at least, especially in the early days, I mean, there was opportunities—and I shouldn't call them opportunities—sometimes when you had to be someplace else. You know, down at the Cape, Bermuda. That's a nice place to be. I went to Libya, I went to Norway. I did do some of this stuff. There were some guys that just did that, did it all the time. But I tried to balance the travel that I did with your responsibilities as a family member, and it's not easy to do. I think probably the group that had the worse time doing that were the astronaut group, because they were away long times, not only when they were in space, but just training at the Cape. And I have to feel for those families.

I was in a fortunate position with enough people working for me or with me that liked to go out on a ship for a month. When I went, I took the box lunch and the airplane trip. It's nice to be able to choose.

BUTLER: I'm sure your family appreciated that.

ARMITAGE: Well, I don't know. Let's hope so.

BUTLER: Thank you. That's all the questions I had.

RUSNAK: I did want to give you the chance to make any final remarks or anything else maybe we haven't covered, or just anything you'd like to close with before we finish for the afternoon.

ARMITAGE: I looked through these [notes] for the first time last night. When I gave talks at NASA, I would never rehearse. It's not my style. You've got to be familiar a little bit with the subject and then you just talk. It's hard getting up, but once you start, it's okay.

RUSNAK: The questions are always certainly meant really to refresh your memory.

ARMITAGE: One thing we didn't discuss—I've got it right here. I've got an American Engineering folder and I had made a note that says “Airstream” here. You had a question, how did Landing and Recovery address the concerns of back contamination from the moon, biological isolation garments [BIGs], quarantine trailer. You want to hear about it?

RUSNAK: Sure.

ARMITAGE: I think we discussed about the health authorities worrying about these lunar pathogens that were going to come crawling out like the science movies show, and growing

bigger and bigger and bigger till they can't get out of the door, and now you're in the house with them. That's the kind of image.

So of course, there's part of that whole requirement in the LRL to keep them in quarantine for three weeks. They had to be in quarantine from the minute they landed. So the first things, after the collar got put around Apollo, that we've gone into the techniques for doing that. And the hatch was opened, the first things that the air rescue swimmers handed the astronauts was this isolation garment, which is nothing more than like a guy going into a nuclear spill or something. You know, he gets in his bag, and of course, they would give it to him [and move away], in case they got some of these bad stuff.

And then they were getting these biological garments, and then they would be brought into the helicopter, so that they didn't contaminate anybody around them on the helicopter. When they got back on the carrier, now what do you do with them? You've got to get them into isolation on the carrier. So there was a lot of work went on with, I think—not McDonnell—Rockwell. And of course, again, the old contractor thing is, you give a contractor a thought, he can always come up with an idea that'll cost you millions of dollars. They had these big ideas for quarantine facilities on the ship.

We were sitting around the LRD one day, and I don't know who it was that came up with the idea, but it most likely was me, and I don't say that [for any other reason that] I've always been interested in trailers. I had a motor home and I lived in a trailer when I was at college. I've always been interested in trailers. They're little live-in environments, is what they are. Tight living environments. I lived in a trailer two years when I was at Cranfield in College of Aeronautics, on the [college trailer] site. Twenty-two foot long. Got breakfast in bed every day because June couldn't get by me, because the bed was between the kitchen, so I got breakfast in bed.

So I thought, an Airstream trailer. It's a beautiful trailer. Why not put an Airstream trailer on the carrier, and did a few calculations. An Airstream trailer will fit inside a C-130.

So now you don't have the problem—see, the only problem was, you're going to lift this big facility off the ship, put it on [a flatbed truck], and then somehow get that [back to the LRL]. How are you going to get the astronauts and the samples back to the Lunar Receiving Lab? So the idea was to do it all mobile. So you have an Airstream trailer on the carrier. They've got on their biological suits. You bring them back by helicopter. They get out and they get immediately into this Airstream trailer, the door is shut, and now they stay in there on the ship until the ship gets back to shore.

When it gets back to shore, the whole trailer, with the astronauts inside, is lifted off, put on flat bed, moved to the nearest airport, put in the back of a C-130, flown to Ellington, docked up, brought here on a flat bed, and docked up to the LRL. We had a docking system on the LRL. It's just like when you get in an airliner, a flexible thing that came out and went right to the door of the Airstream trailer.

So they actually never get out. Well, that made the [National] Health people happy, of course. It didn't make the contractor happy because he wasn't going to get all this money now. [We are] just going to spend—what's an Airstream trailer cost? Fifteen thousand.

And there was another reason for Airstream trailers, before the flight crews went to the lunar missions, they had to be in quarantine here for about three weeks, I think. So you could sort out if they got colds or caught their kids' measles or whatever before they went off into space. They had to live somewhere then, so that's a good reason, too, to have a contained [environment] and so we talked about this, and sold the idea, I think, to Gilruth. He said, "Yeah, that's a good idea." He was a good guy. He'd accept all these innovative-type things. Not that that was very innovative. It was a contained package that has a kitchen and beds and I've lived in them.

So I called the president of Airstream. There is a story here. I had a little tough time getting to the president of Airstream. I said, "Look, why don't you think about this, because this will be the best publicity that Airstream will ever get. They have big ad campaigns for

Airstream trailers." It's an expensive deal. "This will be the best publicity. The astronauts will be in it on the ship when they get back [from the Moon], and all the way back to [Houston]." And of course he saw the beauty of all that. What I was trying to do was get a better deal, which we did. Got a good deal, got a good contract with him.

More than the deal of cost was the fact that we needed it in a hurry because the idea came up fairly late, and the mission was coming up. So to get an Airstream, or we actually needed, I think, three of them, to get Airstream trailers configured exactly the way we wanted it, with the proper seals and docking mechanisms, it was going to take a little time.

And so they had to pull the stops out, too, and I was promising—I forget what his name was now—I was promising him, without paying for it, he was going to get all this publicity because on the back of an Airstream—are you familiar with an Airstream trailer? It's an aluminum thing that's quite nicely shaped at the ends, and at the ends it has, in blue—it's all aluminum—it has "Airstream." I have a friend with an Airstream trailer. Two friends, as a matter of fact. And of course, all the cameras in the world are going to be focusing on these flight crew members at the window, and up above they're going to see "Airstream." I'm telling this guy, "Help us out, because you're going to get all this free publicity." And they did help us out.

You know what happened? They put that Airstream on the carrier, they brought Armstrong and his crew onto it, and someone on the [ship]—I don't know who it was, but it was obviously a NASA guy, or maybe it was a PAO [Public Affairs Officer], I don't know, he looked at that and he said, "Hey, we can't advertise Airstream," and he put a piece of paper over it. It was blanked out with a welcome sign or something. So all my talk with the president of Airstream [went out the window]. It really didn't matter, because you can look at an Airstream trailer without the "Airstream" and you can tell it's [an Airstream] so it really didn't matter.

RUSNAK: Well, I think that's probably a good story to end with, unless something else just comes to mind.

ARMITAGE: When's lunch? No, I'm happy to do it.

RUSNAK: I'd like to thank you for taking the few hours out today to talk with us.

ARMITAGE: You're welcome.

[End of interview]