ORAL HISTORY TRANSCRIPT

RODNEY G. ROSE
INTERVIEWED BY KEVIN M. RUSNAK
WIMBERLEY, TEXAS – 8 NOVEMBER 1999

RUSNAK: Today is November 8, 1999. This interview with Rod Rose is being conducted for the Johnson Space Center Oral History Project. The interview is being conducted at his home in Wimberley, Texas. I'm Kevin Rusnak. I'm being assisted today by Carol Butler and Sandra Johnson.

I'd like to thank you for agreeing to do this interview with us today.

ROSE: You're welcome.

RUSNAK: And if we could start, just tell us a little bit about your background, and particularly your interest in aviation, going into college, or engineering.

ROSE: Okay. Well, aviation-wise, I guess I have to start very early, back in the 1930s. I was born in Huntingdon, which was the county town of Huntingdonshire. It's since been swallowed up by Cambridgeshire, but in those days, it was there. Ours was a poor family, and I got a scholarship to the local grammar school, Huntington Grammar School, which was also the original school that Oliver Cromwell went to. Of course, he went a few years before I did. Samuel Pepys also hung around Huntingdon quite a lot. So it's an old school of history.

Whilst there—in fact, before I went to the grammar school, I was very interested in airplanes. We used to have what we called a sherbet fountain from the little confectionery store. It was one with a licorice stick in it, a hollow tube, and sherbet, and you could suck it up, and as a bonus they gave a little tiny balsa airplane, where you just glided it. That was my first introduction to flight and aerodynamics. And then also, being an industrious type, I carved an airspeed Ambassador model, about that big, out of kindle wood, and painted it all up.

When I went to the grammar school, it was the beginning of the war, beginning for us in England, which was 1939, and then I was involved in what at that time was called the Air Defence Cadet Corps, and used to do dumb things like stand in slip trenches guarding the local airfield and all that stuff, and then the Air Training Corps.

Let's see. We went from there. Well, I also got involved with flying model airplanes, building competition model airplanes and flying them, gliders and things. There were three of us school friends together who flew [model] airplanes and, funnily enough, all three went into the aircraft business. They both went to DeHavilland and I went to Avro [A.V. Roe and Company, Ltd.] at Manchester, and I went there because I wrote to Short Brothers first and they turned me down, so then I wrote to Avro and got a job there.

I went as what they call an engineering apprentice, or gentleman apprentice, they called it, as opposed to a trade apprentice. A gentleman apprentice, you got paid a very small amount, less than the amount of my lodgings, I might add, and you went through every department in the whole company. I started off in the machine shop and went through there, marking out, tool room, jig and tools, subassemblies, assemblies, hydraulics, you name it, through the whole process of building an airplane, and then out to Woodford, which was the test airfield, and got involved in flight controls and engines and all that stuff, getting that flying. Then came back and did six months in the drawing office and then the research department, stress office, and then aerodynamics. Aerodynamics was my final sort of love, I guess.

Whilst I was at Avro, we had a further education program and I started off at technical school, then jumped from there, got a scholarship to Manchester College [of Technology] and graduated from there with a BS equivalent in mechanical and aeronautical engineering, and that was a scholarship. After that, I finished my apprenticeship and got two scholarship offers. One was from Huntingdonshire County and the other was from Manchester, it was an Armament scholarship to go to Manchester College [of Technology] for further higher degree. Being sold on airplanes, I went to Cranfield College of Aeronautics at that time. It's since been granted university status and it's [now the] University of Cranfield outside Bedford.

When I went, we were the fourth year, I think, to go through it. It was basically a three-year course crammed into two, so we did eighteen-hour days sort of thing, you know. Fed you well, but worked you hard. There we studied the whole nine yards of aviation, aeronautics, and so on. We did test flying. We also learned to fly both power flight, gliders, did wind tunnel work, especially in the second year.

We had to do two theses. The first one I did, the written one, was on the low-speed characteristics of delta wings, which was used quite extensively. In fact, I've got a copy here somewhere. One of the things it had—one of my tutors was the originator of the carpet plot. I don't know, probably in today's age of computers, people don't even know what a carpet plot is, but it was a way of plotting five variables on one sheet of paper in two dimensions, and the intercepts would all line up vertically, and therefore you could interpolate very nicely. And you could have carpets that curled under and did all sorts of weird things. So I used those extensively in the thesis, and that probably helped with my tutor. Then the experimental one was the low-speed characteristics of swept wings, and we did a significant amount of wind tunnel work on that.

After I graduated from Cranfield, I went to join Vickers-Armstrong Supermarine. That's Supermarine of the Spitfire fame, who at that time were [outside] Winchester. They used to be down at Southampton, but got bombed out during the war, and this was 1951 when I went there.

At Supermarine, I was in charge of all the performance, the engine performance, the loads on external stores, stuff like that, and also, for my sins, I got involved in designing their wind tunnel for them, because they were going to build a wind tunnel, and did that.

I worked on the Swift, of course, the Attacker, the Swift, the 525, which didn't go too far, and the N-113, which eventually became the Scimitar, and that was the first twin-engine jet that the Royal Navy had used. In doing that, I was very heavily involved in several leading-edge things. One was supersonic blow over the flaps, to get more lift. The other was, we were working on angled decks for aircraft carriers, and Supermarine, when we did a catapult launch, we didn't launch them horizontal, we cocked the airplane up about twelve degrees and launched it off that way.

The reason we did that was because flying, getting catapulted off a deck, you want to minimize the amount of wind you need down on the deck, and ideally you should be able to launch an airplane on a dead calm day with the aircraft carrier stationary. That's the ultimate objective, and so by rotating the aircraft twelve degrees and shooting it off that way, you saved about fifteen to twenty feet of height, because the pilot didn't have to rotate the airplane after he got off the deck. He was already rotated, and therefore he could just go straight up. So that saved us about ten knots down the deck, which is quite appreciable.

We did have a funny thing on that there, because [at] the RAE Bedford drome we were checking all this catapult stuff out with Mike Lithgow, who was the chief test pilot, and we were going through different loadings, and we were doing a low loading one and shot him off, and the airplane staggered around like a drunken sailor, you know. Made one quick circuit and came down. Went over to him and I said, "What's wrong, Mike?" "Well," he said, "I nearly redded out." I said, "Uh-oh."

So I started hastily doing some calculations and realized that the airplane was tilted at twelve degrees, the seat was tilted another eleven degrees inside the cockpit, and so when you do your triangulation of forces, he was getting a lot of positive G to the head, which is, you can't stand much of that. And so we hastily put some limits on that.

The other interesting thing at Supermarine, the Swift was—at that time we had slots in the leading edge and fences and all that stuff, and we were going for the world speed record. To do that, we took the plane down to Libya, because for a given Mach number, the maximum velocity in miles an hour you get is when you get the highest temperature, so we had to get the right conditions. You had to do a flight so many kilometers this way and back again in one flight and they mean the two.

On this particular morning, I'd spend about a week on the telephone with them because, working up, they'd give me the temperatures and I'd work out what the velocity would be, because you had to beat the existing velocity by, I think it was 10 percent, something like that. So this one morning, conditions were just right, Mike flew it, and we set the record, and I was busy filling out the forms. That was the day that, of course, the record was shattered out at Edwards [Air Force Base, California], when they went about mach one and a half or two or something. I mean, it was way faster than the Swift would do.

Following the N-113, I looked after the deck trials on HMS *Ark Royal* with that, and we had an interesting thing on that, because the N-113 was almost a delta wing, but not quite, and I'd spent a lot of time with Mike Lithgow telling him, you know, that as you come in, if you're too high, don't just check on the stick, because normally you'd check on the stick to drop a little. I said, "Don't do that, because with a delta wing, you'll drop too far."

So Mike's coming in, you know, and it got the light and everything and it's a bit high, and he checks and drops like a stone. The hook—it's got a huge hook on the back of the airplane—that caught on the round-down of the carrier. The carrier deck was covered with tarmac, but it's steel plates underneath, and the round-down is about a foot radius, and then there's about a two-foot steel I-beam that holds up the back end of the flight deck. Mike's hook got on the round-down and plowed the tarmac up all the way to the front wire.

So at the formal dinner that night, the captain said, "Mr. Rose, I would appreciate it if you'd tell Mr. Lithgow not to plow my bloody deck up next time." [Laughter] So I said, "Yes sir, I'll do that." So that was that.

Then we were working on the Supermarine 545, which never flew. It was an aerodynamicist's dream and a structural engineer's nightmare, because it was multi-cranked. We had steep sweep inboard, and then less sweep, less sweep, less sweep, and the wings were twisted as well, aerodynamic twist. The idea was that we could fly at about just under 1.2 mach number, with subsonic flow over the wing.

The other thing, by the way, on the N-113, I forgot, that comes in, it was the first airplane that I'm aware of that had true area-rule waisting. Now, a lot of people, of course, at Langley, I wasn't very popular, because they said, "Well, the engineer discovered that at Langley," and I'd say, "Well, not quite, because I worked with Dr. [Dietrich] Kuchemann, who was one of the German scientist engineers, who was one of the wartime reparations to Britain, and he was at RAE and he'd worked out a theory for the nonviscous flow to correct. Then I took that, worked with him, and did the viscous flow application, and that's how the waistline of the N-113 was shaped. And it supposedly saved you quite a bit of speed on that, or got you a lot of speed. So that was the other thing.

Anyway, the 545 never saw the light of day, and finally, we had some old friends of mine from Avro were in Southampton, and one called me up and said, "Hey, we're looking for people to come out to AVRO Canada. Are you interested?" So I said, "Well, yes, I might be," you know, being young and all that stuff. I had a young family at the time. The net result was, we emigrated to Canada and settled over there and got involved with the Arrow. That's how I was still doing airplanes.

The Arrow was a great airplane, by the way, because not only was it delta wing, which, of course, was my thing, but it had a fly-by-wire control system, which I don't think anybody else had flown up to then. We had a unique system on the intake and the engine through to the back end, because instead of having a variable inlet, a variable ramp, that a lot of people had, we had a fixed ramp, but then we had a boundary layer bleed on that, of course, but then we had a tap-off, a bleed, off the fifth stage of the compressor, and we would computer-match the flow and the bypass, so that the shockwave was always on the lip of the intake for maximum intake efficiency at all mach numbers. Then the flow was also matched at the back end and ejected, and that reduced the base drag at the back end, and it made a very, very efficient system.

Of course, we were involved in some pretty advanced thermodynamics, in terms of refrigeration. I mean, we could refrigerate a pretty big building with the refrigeration system we had on it. We were using real-time telemetry. I'm bringing all this stuff up because it has a bearing when I get to NASA, because things weren't quite the same there. We were also using a hybrid analog/digital simulator for the crew to train on. So there were some, at the time, state-of-the-art or cutting-edge stuff that was going on there.

Of course, we got our experience of fly-by-wire, because Jan [Janus] Zurakowski, who was the pilot, chief test pilot there, super guy, I mean, in the air, he was cool as a block of ice. On the ground, boy, he'd get all agitated. I mean, discussions with him were really—he'd emote if it didn't go right. But in the air, he was calm.

One day he was taking off and the system failed. The flight control system failed. Jan just came on the voice loop and said, "Had a failure in system A, switching over to manual," and just took over manually and carried on with the takeoff. So he was a cool customer.

So that was AVRO, and that went on fine until February 20, 1959, the day of infamy for Canadians. I wasn't a Canadian, but we thought we were going to be. And that's when [Prime Minister John G.] Diefenbaker announced in the House, in the morning, that the contract had been canceled. Now, we didn't know that. The management came on the PA system in the morning and said, "There's an announcement been made about the future of the Arrow, and we'll tell you all about it later today."

So in the afternoon they came on again and said, "Well, the Arrow contract's been canceled, and we have no option but to terminate everybody." So everybody was effectively fired, and that was pretty tough.

Then they came round to me and said, well, among other supervisors, said, "Well, we want you to come back Monday through Wednesday, because we want you to supervise your people and make sure they don't take anything that belongs to the company or anything about the Arrow." And that was probably the worst three days I spent. Especially I had one young engineer who had only just arrived a few days before. He was still with his family and a young baby, being put up in a hotel in Toronto, and there he was, fired. So it was tough.

All the Orenda people were put out of work as well, which I never could understand because the Orenda [Iroquois] was a super engine. Unlike a lot of paper engines, this one had actually flown, it had demonstrated its capability, and it was scrapped. It was a great shame. And I think the same with that about the Arrow, too.

Anyway, on Saturday the 21st, I got a call from Frank Brame, who was the chief engineer's assistant, I guess he was. Frank had been at Cranfield, too, later than I had, and he said, "Well, you're not fired. We've got a small group that we want to study supersonic transatlantic airliners." So there was, I know, John [D.] Hodge and Tec [Tecwyn] Roberts and myself were three of the folks who were kept on. And, of course, we didn't know how long we'd be kept on or what.

I guess it was sometime in March, Bob [Robert] Lindley called everybody together, and all the people who'd been fired and everything came and we had a big meeting in the cafeteria. He said, "Well, I've got something you might be interested in. There's something called manned space flight in the States, and they've made some inquiries as to whether any of you would go down and join them." Of course, nobody really knew much about space, especially manned space flight. We were airplane people. Then I discovered later that there weren't many people who knew much about manned space flight anyway.

So anyway, AVRO, we had about 500/550 people in the technical office at AVRO, and AVRO picked roughly about 200 people that they thought NASA might be interested in. NASA looked at that and winnowed it down, and I think they interviewed somewhere about 100, and of the 100, roughly, they interviewed, probably about four dozen got offers, of which 25 accepted.

I was one of the 25, but I must admit, rather reluctantly, because at first I turned it down and then Jim Chamberlin, who was the chief technical person at AVRO, he was going down to NASA, and I'd been working directly for Jim. Although I was looking after performance, Jim had a habit of coming to me on a Monday morning and saying, "Well, I'm interested in so and so, and I'd like you to look at it and have a report on my desk by Friday." And then Monday morning he'd come back and say, "Well, that was what I thought it would be," or, "How about looking further into so and so." I did that for probably the last six months of the two years I was at AVRO.

So Jim took me aside and spent about two hours twisting my arm and talking to me like a Dutch uncle, and finally persuaded me that that was the place to go. So on the 21st of April, we crossed the border at Niagara Falls and drove down to Buckroe Beach, Virginia, to a miserable—better not say that—but a motel that was not of the finest.

Owen [E.] Maynard had his family there as well, and we decided early on that that was really not the place for us or the family, so we all moved to the Chamberlin Hotel, no relation to Jim Chamberlin, but it was "the hotel" on the James River estuary and all that stuff. I think we nearly got thrown out of there because we had two boys, Steve and Chris, and Owen had three girls and one boy, and they were all hell on wheels, because they monopolized the elevators, and they'd go up and down in those things all day. [Laughter] Drove the hotel staff crazy. Anyway, that was our introduction to getting to the States.

At the time, about half the group were Canadians, either born Canadians or converted Canadians, and the other half were English and one Welshman. Got to remember Tec, who was a Welshman. So we settled in. The average—see, the thing is that the average experience of that group was probably about twelve to thirteen years in the business. I had had fourteen years in the business, including the apprenticeship, and that was a pretty solid chunk of experience, especially with the things we'd been working on, like the real-time telemetry, the digital/analog simulations and so on. It was a whole lot of stuff that I discovered.

When I got there, I got appointed as the [systems] engineer for Little Joe. So the first thing I discovered was that Langley, that's the IRD, the Instrumentation Research Division, at Langley, was still using 16-millimeter and 8-millimeter cameras to photograph the instrument panel and of course, if you get a lot of vibration, that's pretty tough to read instruments. We said, "Where's the telemetry?" "Well, we don't have that on this. This is a low-cost thing." So we said, "Okay." So that was one problem.

But anyway, I got involved in Little Joe. We were launching [that] from Wallops Island in Virginia, and Jack [John C.] Palmer was the basic—well, Bob [Robert L.] Krieger headed up Wallops Island, but Jack Palmer basically headed up the whole thing on a day-to-day basis, and he was the range safety manager, if you will, at Wallops and so he and I used to do what we called eyeball range safety work. In other words, when the vehicle was launched, we'd stand outside and watch it go up, because [were doing] an abort to check the abort system, and Jack would say, "Do you think it's about time?" I'd say, "No, give it a few more seconds." And he'd say, "Okay, we'll do it now," and hit the abort button.

Well, that was when we were actually flying it, but the first one [LJ-A (August 21, 1959)], we had the thing on the pad like you can see over there, and we were going through the count. In those days, we were pretty dumb, because we did about thirty-five hours straight, preparing the vehicle and going through the count, and that's not the best thing to do, we discovered.

About one o'clock in the morning, there was a slight change in the resistance of the explosive bolts on the marman band that held the capsule [on] the booster. So we get all the drawings out. In those days, they didn't have schematics, they used wiring diagrams, and the darn things were about thirty feet long. And there we were on hands and knees in the blockhouse, following wires along this thing, and finally, in our considered opinion, everybody decided, well, it was a tenth of an ohm difference from what it had been when they measured it prior to installation, [but] that'll be alright.

So the decision was made to go ahead, and we started off and we got to about forty minutes or so before the launch time, and in those days, of course, this was the biggest thing Wallops had launched. Prior to that, they were fairly small things, Scout rockets and things like that, and they didn't clear the pad until way, way late in the count.

So we still had people in the vicinity of the pad, and I was in the tracking room station there, and heard a rumble, ran to the door, and the capsule had gone and had left the booster on the pad. And as my first sort of, as a pseudo flight director—my first launch—that was pretty embarrassing. You're not supposed to do that.

What happened, the—well, before I get to what actually happened, we had about eight engineers or ten engineers there, and I got eight or ten different versions of what happened. Fortunately, I'd been working with the T-33 people, and Gene Edmunds from the Photographic Division, and we'd worked up what I call an ascent rendezvous technique. With that, we'd rendezvous the T-33 with the count, such that at the moment of liftoff, the T-33 would come in on a dive to speed up and bank around away from the pad and spiral upwards, with Gene photographing with a movie camera from inside the back seat, and get an air-to-air shot of the thing coming up, which was just as well, because I got eight different versions, or ten, whatever the number of engineers were, I got that many wildly different reports of what happened. Then, fortunately, Gene got his film, and he did get good film, and we could see what happened.

It turned out that there was a back-door circuit. The Little Joe, Langley had designed it with what they call a three-wire circuit with a common ground, and a common ground, we realized afterward, is not a good thing to have, because you think you've got two independent systems, but if you're not careful, there's a leak capability, and that's what happened. So when they were charging the batteries, about forty minutes before launch, the battery level got to such that it overcame the resistance in the back-door circuit, fired the explosive bolts, fired the escape motor, off went the capsule.

Well, it did the right thing, it went up like a beach abort, dumped the tower and the escape motor after it had burned out, popped out the drogue chute, and it just had one amp surefire squib to fire to let the main chute out, and it wouldn't do it. Didn't have enough gas, so it came down on the drogue chute. I think we spent probably about two weeks picking up pieces off the sea floor, along with fifty million other pieces, because Wallops had been doing an awful lot of stuff off the beach. So that was that. So that's when we did some major revisions and we cleared the pad an hour before launch and we had schematics instead of wiring diagrams and a whole host of changes, so it was a good learning lesson.

Wallops at that time was an island, by the way. It really was. Now they've got a causeway built across there. It's a piece of cake to get over. You drive over now. But in those days, it was an island and you went over by boat, and I remember they had a contract with one of the fishing guys. They had a boat run us in.

We came back from the island one time, and the thing started taking on water, and we got as far as the—just coming into the dock at Chincoteague, we're all sitting on the engine housing, with our feet on the gunwale, because the water was all sloshing around inside. It finally, as we scrambled off, it sank at the dock. I said, "Oh, well, there goes that one."

[On one of the Little Joes (#3)] we had our first animated flight, and that was with Sam, which really wasn't a male, it was a female, but it was a rhesus monkey that the School of Aviation Medicine [SAM] folks at San Antonio [Texas] had instrumented and trained. Sam had her own little capsule, and she was trained that as soon as it lifted or they turned things on, and soon to lift off, she had to punch a button when a red light showed, and then if she did, a green light would show and she'd get a banana pellet. And the idea was to keep her operating to see what happened.

Well, you have to realize that Little Joe goes off at just over, about seven and a half G, which is a fair lick going up, and then when the escape motor goes off and pulls the capsule off, the animal gets a total negative to positive G, a total G of nearly twenty G. At that time Sam suffered what they call nystagmus, which is involuntary rolling of the eyeballs, in whichever direction, and in spite of the shots of electricity to her foot, she refused to work until the drogue chute came out and then she started hitting the button again.

There's quite a tale with that one because the flight was nearly canceled. We had a limited capability of oxygen for her, and we were near the end of the window, and I remember the captain of the destroyer flotilla downrange, we were fortunately listening in on his frequency to the messages back to the admiral at Norfolk, and he was saying, "Well, we've got [fifty]-foot seas and thirty-knot winds," and we said, "I think that's the other way around," but anyway, it was pretty rough. It was pretty rough.

One of the School of Aviation Medicine doctors, a veterinarian, as well as an M.D., he was on the destroyer, and this was the first time he had ever been to sea, and it really was rough. They had special stuff to inject the monkey with in case it was seasick. Well, when it landed, we nearly lost a sailor, because it was over eight-foot seas, and it was pretty hard getting the capsule grappled and back on board. But when they did, the monkey was fine. You know, just gave it a real banana and it was very, very happy. Unfortunately, the poor SAM doc was very sick, and apparently they had to give him some of the injection that was bound for the monkey because he was so sick. Well, they'd psyched him out beforehand, because the captain said, "Oh, you've never been on a destroyer? Oh, boy, you're going to be sick." So he was. Anyway, that was that one.

We went through some more Little Joes… We seemed to launch them monthly, the fourth of the month. Like, Little Joe 1 was the fourth of [October]. Then we launched [on the] fourth of [November, December, and January 21, 1960]… [One of them] was the first time we decided, or the powers-that-be decided, we could open it up to the media. So we had all the usual big guns from the networks there and we briefed them. I gave them a briefing, and I said, "Well, this is not quite like what you're used to at the Cape, guys. This thing goes off pretty fast, you know."

One of them didn't follow that, because I was in the control center there with the radar and everything, and my guys told me afterwards, when it went off, this guy who, when I briefed them, he said, "Yes, no sweat. We'll follow that," well, he still had his camera zoomed in on the pad, and the vehicle was up here and he was saying, "Where did it go? Where did it go?" Six G makes a difference, because, you know, he'd been used to things that—I say, stagger off—but, you know, 1.1 or less G, they take off pretty sedately from the Cape. And so that was that one. Anyway, that was Little Joe [for me. There were three more flights after] I got moved over to the Mercury Program Office and got volunteered to take the first Mercury capsule being built by McDonnell. That was quite an experience for everybody, them as well as us, because this was the first capsule, manned capsule that they'd built, that probably anybody had built, and so there was a learning curve for everybody.

They had three shifts working, and I was the lone capsule engineer trying to keep an eye on what three shifts were doing, so it meant some long days and long nights. That went on, then I got sick and had [another] kidney stone, and that got me back from that.

But then I got put in as problem engineer on MR-2 [Mercury-Redstone 2], which was this capsule, and we had Ham on board, the chimpanzee. It was launched on the Redstone and did the flight all right, came down, but about an hour or so after it impacted with the water, while they still going in to recover [it], the capsule tilted over and started sinking. Fortunately, the Marine helicopter crew were able to get a shepherd's hook on it and haul it up. It turned out that the heat shield had gone.

Now, the thing is—let me show you this, what we did in Mercury, because this comes in on the [John H.] Glenn [Jr.] flight, too. See, this was Ham in the water, and as you can see, there's just a torn bag and no heat shield and the thing's lying on its side, and, unfortunately, water was coming in through a couple of valves on the top. That's what we thought. Afterwards, we discovered it was a bit more serious than that, because when we got back and we looked at the—there's a fiberglass heat shield that's fitted on the bottom of the capsule and then the bag goes down from that. I don't know whether you can see it on here, but there were some holes cut into the fiberglass and it went right through the bulkhead. So not only did we have some valves leaking, but we had water coming in through the bulkhead.

So, being the problem engineer, I got the job of putting a team together. Langley had another capsule. We took that over to the water tank at Langley, the wave tank. It's 200 feet long or so and cold as all get-out in the winter. We set up the wave state, because we knew what wave state we had to—it had been measured and all. We set that up, and, sure enough, within a few minutes of when it failed in the actual flight, it failed in the tank.

What happened was, McDonnell had, on the side of the capsule, the bag would come from the capsule down to the heat shield and they had some stainless steel straps about an inch and a half wide and about, oh, probably, fourteen gauge, very thin stainless steel strap. What had happened, the jerking load of the heat shield, with the wave action on it, had snatched on those things and fatigued them, and they failed. And once they failed, of course, the bag tore and the heat shield disappeared, and then the CG [center of gravity] was wrong.

So we got looking at that, and said, "Well, the straps obviously don't work, so what's the next best thing?" Well, a stainless steel aircraft control cable. Good stuff. We've used that for twenty, thirty years, you know, it's good stuff. So we had the guys in Jack [A.] Kinzler's shop set up a—they made a test setup for us, and what we did was continuously bend, at different frequencies, different diameters of stainless steel cable, over different radii, all in salt water, at the right temperature, and we'd run those twenty-four hours a day, seven days a week. We eventually came up with the minimum radius and the minimum diameter of cable that would do the job.

Now, the problem was that we still had snatch loads in the cables. Now, a cable will only take so much snatch load. So, thinking about this one night, I said, "Well, you know, there's the old triangle of forces. We'd better triangulate these." So what I did was came up with putting—this is just a little seven-pound spring, and you attach it to the middle of each of the cables, and when you get a snatch load this way, it's totally ameliorated by this little spring, because what you're doing is putting a large load this way, but you're taking it all out on a little spring this way, and by the triangle of forces, all you needed was a seven-pound spring.

So that was the system that we came up with, with the bag outside, of course. It was a sort of a—I don't know whether it was a nylon bag. It was rubberized, coating with rubber, and had holes down the bottom to get the right impact characteristics. And then we had drop capsules. We dropped those in Back Bay, off Langley, successfully. And then did two drops at sea, off Cape Hatteras. They both worked successfully, so at that point, Walt [Walter C.] Williams, who was head of operations at that time, said, "That's it."

We only had—well, let's see. I think it was a matter of just two months or so before [Alan B.] Shepard's [Jr.] flight, and we had to get this working, otherwise Shepard couldn't fly. We finished it about two weeks to ten days before he flew. Of course, they'd already fitted this into his capsule, but we had to prove that it worked. So that was that one.

RUSNAK: All right. Well, if we could pause for a moment, to change the tape.

ROSE: The Mercury landing, the other thing I didn't mention, was the honeycomb that we put on the bulkhead, so that if the heat shield were to come up and hit it, the honeycomb would absorb the blow and therefore you wouldn't get a hole in the bulkhead. Now, landing, Pete [Peter J.] Armitage and I, who was another ex-Cranfield, but somewhat later than me, landing, an ocean landing, people tend to think the ocean's a benign thing to land on because it's water.

As a matter of fact, water is harder than land, when you get right down to it. I know people have a hard time believing that, but it turned out the worst thing you could have was a perfectly calm sea. You get the maximum G from that. What you really needed was a nice little chop, and then the capsule would come in—of course, we hung at an angle, so it hit on a corner—and the waves would act as a shock absorber. By breaking down the wave structure, you could absorb a lot of the energy coming in.

Pete and I did a paper on that to the [AIAA – American Institute of Aeronautics and Astronautics] and all those people. I remember, I wasn't involved in it, but I was told that at the time when the medical people were doing drop tests, they used a pig, and they had it in the Mercury capsule and the pigs kept dying. So they got this old farmer, I guess from North Carolina, and he took one look at it and said, "Well, of course the pigs are dying. You've got them on their back. Pigs die when they get on their back." So they said, "Okay." You still put the crew on their back.

And the thing with that, of course, is that if you can put a G load on rapidly enough and get it off again rapidly enough, if you can beat the inertia of the intestines and all the innards in a human body, then a human can withstand a pretty high G. It's only if it goes on too long. Now we're talking milliseconds, you know, twenty, but if you can get it on and off in twenty, thirty milliseconds, it's not so bad. But if you go it a bit longer than that, then everything starts moving, then you've got a problem. So that's why we were working with that, also, an angle.

So, taking Mercury through McDonnell and then the MR-2, I worked on some more Mercury, but then I got moved over to Gemini. With Gemini, this was really Jim Chamberlin's brainchild. Mercury, bless its heart, you know, looking back, it's horribly crude by today's standards. In those days, people thought it was sort of leading-edge technology, but it was not an operations man's capsule. For example, to get at the batteries, you had to take half the units out of the capsule, because they're buried under the floor. So Jim said, "Well, what we really need is an operations man's capsule."

Jim had a house just the other side of Mariner's Museum in Hidenwood from me, and I remember Jim [James T.] Rose, among others, and myself, used to spend some Sunday mornings in Jim Chamberlin's basement, scheming out stuff for Gemini, and that's really where we came up with the clamshells opening up and all the systems and everything were on the doors and inside the clamshells.

Then the other thing was that they decided water landing was really for pelicans or something, and what we really needed was a land landing. So Dr. [Robert R.] Gilruth called me in and said, "Rod, I'd like you to take a look at developing a Rogallo wing. We're going to call it a paraglider system for Gemini." So that's how I got involved in that.

I was doing that and all the escape stuff for Gemini, the ejection seats and so on. The ejection seats, that was the first time we put ejection seats on, because Mercury didn't have them. They had the escape tower. Gemini did not have any escape tower, it had ejection seats, sat on top of a Titan, and the problem there was that, you had to get the crew through a fireball, so we developed, or had developed by Du Pont people, special fire suits that were fire—not fireproof, but they would allow them to go through the number of seconds we had to, and we checked it with dummies, flying over trenches full of lit gasoline and all that stuff, just to check it out. One of the benefits of that, of course, was ultimately, it got into use for fire departments' suits that they use.

One of the problems with the ejection seat is that if the vehicle is tilting on the pad and the wind's blowing a certain way, that's the worst combination, because if you're tilting too much, one guy, or both of them, are probably going to hit the ground before the chute comes out, so that's a pretty critical timing thing of keeping the escape fast enough with the chute opening and so forth, that it doesn't open in the fireball, but it opens immediately afterwards, so you can get the velocity down before they land. So that's what we were doing on that.

The paraglider, we spent two years on that. The big problem with the paraglider, it [had] inflatable booms, for a start, and it was deployed, as you can see on the picture up there, like a parachute, then you'd inflate the booms and then you became a delta wing. Now, a delta wing on cables is a very flexible system, and so it was a whole new field of aerodynamics.

Meanwhile, McDonnell [Aircraft Corp.] was dashing on building the Gemini capsule, and here we were trying to do a research program as to how to get a flying wing flying, among other things. Two major problems. Number one, the landing characteristics. Now, being an old delta wing guy, I was pretty familiar with it, and I told people, I said, "Look, the ground effect on a delta wing is a lot different to a regular airplane." Normally, on a regular airplane—well, on any airplane—as you come in to land, you've got what we call a Delta H, a height increment, where you've got to start your easing back on the stick to flair. With a Delta wing, that Delta H is much smaller than on a regular airplane, because the onset of the ground effects on it is that much steeper.

That was one of the problems that apparently happened. I'd left the paraglider program by that time, but when they did the full-scale drop out at Edwards, the pilot of the T-33 was supposed to say the word "flair," and, unfortunately, took a rather long time to say it, and so by the time the guy started to flair, he'd almost got out of the Delta H, and he had a pretty high vertical velocity, and got hurt.

Net result, anyway, was that the paraglider was scrapped as far as Gemini was concerned, and they went back to a chute. The other thing we did for the paraglider, by the way, was, it had a triangular landing system, which was the stable one, but instead of wheels or skids, we found that wire brushes, metal wire brushes, gave you the best stability characteristics and drag on your landing with it. So this was Rockwell that had that contract. So that was the paraglider, and did that one.

RUSNAK: Did you have any involvement with the parasail that was sort of an alternative to the paraglider?

ROSE: No. I knew it was going on. Gosh, there was a little bit of competition, but they were checking that out at Fort Hood [Texas], as a matter of fact, and some of the guys from Landing and Recovery Division would say, "Well, that's the way to go." I said, "Well, that's fine, but my marching orders are to make the paraglider work," so that's what we tried to do.

The one interesting thing that came up with the paraglider, and I haven't heard it mentioned at all since, but Rockwell came out with what they call microballoons, which are teeny little plastic balls, and very, very tiny, and if you put them in a boom and suck a vacuum on it, it'll rigidize, and it'll be stronger than steel. I mean, you could jump up—I've jumped up and down on one.

I've often thought that, gee, you know, that would be a great thing, like, for the Space Station. One of the things you're always worried about is a leak. You know, if you get a minute little thing hit the thing, gets through the shielding that they've got, and you get a tiny leak, if you had these microballoons in a little sachet and you let one go, it'd find the leak. Believe me, it'd find the leak because of the outflow. And once it hit the hole, it'd rigidize, because it's a vacuum on the outside, pressure on the inside, it'd rigidize and seal it. I don't think anybody's taken it up, which is a shame. That would have been one of the positive things that could have come out of the paraglider research.

Gemini, I was involved with other stuff on that, like the payloads and so on, and especially the radioactive payloads. DoD [Department of Defense] had a radiometer on board one, and I remember the Mexican Government was not going to let us operate the Guaymas station if the DOO8 experiment was on because it was a radioactive experiment. Well, you know, it was radioactive, but not in the normal sense of the word. It was to measure radioactivity, and it had a certain isotope in it, and that was all.

So I started getting involved in that, and I forget exactly when it happened, but there was a big debate going on. This was as we were getting into Apollo days. When I first was there, I was under Max [Maxime A.] Faget in the Engineering Division, then I got moved over to the program office, Mercury and then Gemini.

Then from Gemini I was moved over to the operations, and at first I worked for John Hodge. This was before we had the center built in Houston. Then was hauled over to work for Walt Williams, and Walt was "Mr. Operations" in those days. One of the first things I had to do for Walt, he had a report from the Bellcom people at headquarters, which said we needed thirteen ships on the tracking site for Mercury. He said, "Well, take a look at this, because I don't think we need that many." So, okay, I went away and looked at it, came back. I said, "Well, I figure we need about seven, Walt." He said, "Good, we'll go with that." I think we finished up with five to seven, something like that.

Then shortly after that, Chris [Christopher C.] Kraft took me on board as his technical assistant, and that started a long—I forget how long I worked for him, about [six or seven] years, I guess. When we moved down to the Center, Chris had the corner office and I had the one next door. As far as a varied career, that was a very fortuitous thing, because Chris had a habit of sticking his head in the door. Like one time, he stuck it in and said, "We've got a big argument going on between the medical doctors and the space physicists about radiation. I wonder if you'd take a look at it." And so I said, "Okay."

So I thought, well, the best thing to do is to get everybody around the table and see if we can sort this out, so I started up what was called the Radiation Constraints Panel, and we had medical doctors there, the space physicists, the crew, flight ops people. What we did was, we'd go into the whole environment, and the big thing, of course, was the maximum allowable dose for the crew. Not that I'm a physicist or anything like that, but I got quite acquainted with radiation through third parties, but I'm more of—what do you call it? Not an integrator, but a person who allows things, you know, steers them in the right direction, gets them developed, as opposed to doing the actual work themselves. And that's what happened with the Radiation Constraints Panel.

We finished up working with the National Academy of Sciences' Radiobiological Subcommittee, and they would never come up with a dose. They came up with what they called a reference risk, and then we'd play the risk-versus-gain game and say, well, we're going to the moon, we'll risk a lot more than Joe Blow working every day in a shop somewhere with low-level radiation. And that's where the reference risk was set up as—excuse me, ladies—but for white males, because that was all the crew we had at that time, for white males between the age of twenty-five and fifty, and forty-nine, I think it was, at that time. We would allow double the incidence of leukemia and that was how we came up with our maximum career dose of 400 rem…to depth [5 cm].

So what we did on that, we worked through this, and, by the way, Radiation Constraints Panels are still going on today, for each Shuttle flight, so when I think of what have I left as a legacy to the space program, I guess one is the Radiation Constraints Panel, and the other, we'll get into later, is the Flight Operations Panel, because we did a similar thing there.

On the radiation—going to the moon, the big concern, really, was if there was a solar particle event. Not a solar flare, because you can have a solar flare with not many particles or the particles can be going the other way, because you have to realize the sun's rotating. It's not rotating at its poles, but it is at the equator. And as a sun spot comes around from east to west, as we call it, if it's on the west side, then it's not a big problem, because the particles will go off in a [spiral] and disappear into space, but if you have one come up on the east limb, then that's going to put particles in the Earth-Moon part of space, so that's the one you're worried about.

We worked with NOAA [National Oceanographic and Atmospheric Administration], by the way, the space environment lab at Boulder. NOAA ran the SPAN, Solar Particle Alert Network, that set up telescopes and things worldwide, which, you know, NASA funded and everything. The guys came up with a program where you could plot the onset of particle event, the intensity of it, and they could forecast, it turned out, fortuitously, that the maximum event took longer to build up to a peak than the short ones, the low-level ones, so you could plot it for about eight or nine hours, and that would give you a good idea if it was going to peak and go down, or if it was going to really peak. If it was really going to peak, you had a total of twenty-four hours, so you had about twelve hours to decide what to do.

And what we were going to do with Apollo, of course, because if the crew were on the moon in the suit, doing an EVA, there's virtually no protection at all. If they got in the lunar module, there was next to nothing either. So the technique that we used was to have the crew, if an event like this were to come about, we'd have twelve hours or so for them to get back into the lunar module, get things set up, get a rendezvous set up, take off, rendezvous with the CSM, the command and service module, and then put the command and service module, with the hatch and the windows down, because the Apollo had a thick side and a thin side, and the thick side was away from the windows, because that's how we came into Earth reentry. And with that, you then stay in lunar orbit.

The lowest radiation dose is not to come back to Earth as quick as possible, but was actually to stay in lunar orbit. If you stayed in lunar orbit, the Moon acted as a partial shield and cut the total dose down to about a third of the free-space dose. Well, a certain celebrated author, named James Michener, was doing research for his book on space, and he came to the Center and talked to us, and I talked to him about the radiation, explained to him what our techniques were. Unfortunately, he took, I guess it's writer's liberty or something, and had the crew die from a radiation dose, which was unfortunate. Made it dramatic, but misled a lot of people on what the dangers were with Apollo. So that was one thing.

The other thing early on, shortly after I started working with Chris, we wanted to organize the flight operations activities, and so I cooked up something. I called it—it was a mission operations plan, and it involved everybody. Everybody that had anything to do with the mission, with the vehicle, the mission, the network, anything, were all involved, and it was really a tool to help the mission planners, the old MPAD [Mission Planning and Analysis Division], in their work, because the Program Office would come up with a set of requirements, and then we had to come up with a mission to meet them.

So I set it up that we had all these different people from the program office, the crew, Max Faget's people, the contractors, Goddard [Space Flight Center, Greenbelt, Maryland], you name it, KSC [Kennedy Space Center, Florida], everybody was involved. Typically, we'd have probably six or seven dozen people at the meeting, and others on voice loops, and what we'd do is iterate the requirements, and the MPAD people would come in with a rough cut at a profile, you know, of what their first cut was, and then we'd iterate it, and get everybody's inputs and so on.

I remember that at the first mission operations plan meeting we had, the medical people were very reluctant to come because they thought it was a waste of time. So we got them to come, and, lo and behold, they found there were all sorts of things going on that they ought to be interested in that affected what they were going to do. And from then on, they were pretty good attenders.

The same in those early days with the crew. The crews attended because they said, well, this is the best place to find out what's going on with their mission, because all the latest stuff on a mission, what we were going to do and so on, was all carried out in the mission operations plan. Later on, we changed it to flight operations plan because in the earlier days, we also covered all the network communications and everything, and then in later years we moved off that and just did basically the flight plan. We did those all through Apollo, every program. In fact, they still go on today with Shuttle.

For the Apollo Program, we also started a lunar surface operations plan, and this, again, was because I felt that just the flight borne part of the program was one thing. That was pretty complicated. But the lunar surface operations were tremendously important and very complicated, and we needed to make sure that everybody was on board playing from the same sheet of paper, that we maximized the time the crew were on the moon, and went to the right place, did the right things, and so on, and all the procedures.

Now, getting involved in that, we soon came to realize that, hey, there's a heck of a lot the crew have got to learn about lunar surface operations, so when we were planning the G mission, which turned out to be Apollo 11, we said, "Look it. This is too big a chunk to bite off, from an operations point of view, in one go," having a crew learn all about flying to the moon and also all the lunar surface stuff. So that's really where Mission F, Apollo 10, was born.

I wrote a long letter for Chris to sign, where we sent it up to headquarters and put all the whys and wherefores down, you know, why we wanted to do it, because basically it was so that the whole of the flight to the Moon and from the LM [lunar module] down to 50,000 feet was SOP, standard operating procedures. And then the only new thing, really new, the 11 people had, was from there down to the Moon and on the Moon.

So finally, after an awful lot of debate, etc., etc., and Chris was really the one who was pushing this hard, because he signed off on it right away, he said, "Hey, that's great. We need to do that."

So finally we had an Apollo 10. Well, it was fortunate we did. I have a great deal of admiration for Tom and the guys, Tom [Thomas P.] Stafford and the guys who flew 10, because it must have been awfully hard for them to be that close and not land. But Tom was very good about it. He was the only one of the 10 crew who never flew to the Moon, by the way. The other two subsequently did go to the Moon, but Tom didn't, and I've always admired him for that.

But what happened on 10, when the LEM got down to 50,000 feet and we did an orbit around the Moon, we found out that there were some perturbations in the trajectory that we didn't know about, and it turned out that the mascons, the lunar mass concentrations, had been measured by unmanned satellites that were way up, miles and miles from the Moon, and here we were flying at 50,000 feet. There were some more lower-level mascons that didn't show up on the unmanned tracking, but showed up on our tracking, the LM at 50,000, and we were able to analyze those, find out what they were and the strength and everything, and accommodate those in the software, the guidance and navigation for 11. Because 10 flew basically the 11 mission. It would have gone to the same landing spot, it had the same liftoff, landing, and everything else that 11 was going to have.

So apart from learning everything we had to do about going to the Moon with the LM and everything, I think it was invaluable from the mass cons. Now, some people may say, well, would that have stopped its landing on 11? It may have stopped us, it may have caused us to abort 11, it may not, but when you think about the computer overload we had on 11, along with other stuff going on, and then if we'd also had this mascon effect that we didn't know about, it certainly would have made the landing a lot more touch and go, it really would. Personally, I think it was invaluable, but that's my personal opinion on that, because it was a thing that I was deeply involved in.

Let's see. Anything else on Apollo? Well, of course, we also were working with the Russians in that time. Of course, the Russians, we found, did a lot of cribbing, and so we found a lot of our stuff would be referenced in their reports. I remember the chief physician of the Russian program came over and we met in the MCC [Mission Control Center] and he had his interpreter, who was obviously a KGB guy, and Foggy Bottom—sorry, State Department had their interpreter.

Well, fortunately, we had a white Russian engineer working on NASA JSC staff, and so I had him with me, and he was my interpreter, but we didn't let on that he knew Russian. That was very interesting, because it turned out that the chief doctor of the Russian team made out he couldn't speak English, and so when I got what his interpreter said to us after what he'd said, and then the State Department interpreter said, then my guy whispered in my ear what the real interpretation was, I said, boy, you know, three different stories here.

So finally I got to where I'd test the Russian, you see, and I'd say something and watch his eyes, because if somebody understands what you're telling him, you can see it in their eyes. It won't show in the face, but you can see it their eyes, recognition of what it is. So that was a fun time.

So radiation work went on, flight operations planning went on, I did a lot of the interfacing with Goddard on the network, TDRS [Tracking and Data Relay Satellite] stuff. Let's see. Of course, the other thing on Apollo was 13, and that was pretty bad, although the first really bad thing was 204, Apollo 1. That was a real tragedy and that was tough for everybody because we all knew them, been working with them for years.

"Apollo 13," unfortunately, the movie had to be dramatized, I guess, because it misled people a lot on what went on. The Apollo was on a free return, what we call a free return trajectory. Incidentally, that's why Apollo 8, we were able to turn that around so quickly from when the decision was made in the early fall, to flying it over Christmas, the reason being that Morris Jenkins and the guys at MPAD and MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts] and all those other people, Langley, had already come up with the basic trajectory design of a free return, and, of course, a lunar orbit rendezvous, because there were a lot of arguments about what you should do, whether to do a direct landing or what have you.

So we were doing a free-return trajectory which meant if we'd done nothing else, the vehicle would have come back to the Earth. Now, would it have been an ideal capture? Not necessarily. But as a point of fact, the reason, the main reason that we had to do a tweaker burn coming back manually, using the lunar module, was because we had a lunar module on board and we had to make sure that went in at a pretty deep part of the ocean. And so that's why we did a little tweak to get the lunar module over there.

RUSNAK: And you had the radioactive generator up?

ROSE: It had an RTG [radioisotope thermoelectric generator] which had about 40,000 millicuries of isotope. In fact, I kidded Jim [James A.] Lovell about that afterward. I said, "You know, Jim, we had five KC-135s out there, and only one of them was looking for you guys. The other four all had radiation instrumentation, seeing if they could find some. They didn't find any." Because we put it in—oh, it was about twelve, fourteen thousand feet deep where we put it, and the RTG itself, one of the tests the Energy Department had to do was to do, it was in a graphite carbon-carbon type container, among other things. [I was told] they had to drop it from 5,000 feet onto concrete, with no chute, and make sure it didn't break open, among other things. There was a whole raft of tests they did on it, so we were pretty confident that it would hold together, but you certainly didn't want it hitting into land if you could help it, so that's why we did that part.

The other thing on Apollo 8, the Chinese exploded a device when Apollo 8 was being launched, but fortunately we went through the two layers rather quickly, you know, because we were on the way to the Moon, so the time spent there was very, very low and the radiation dose to the crew was minimal. I mean, it was a matter of—I've forgotten the exact numbers, but under 100 milligrams. I mean, you get more from a dental X-ray, especially if it hasn't been calibrated lately. So it's one of those things.

Apollo 8 was probably—well, a lot of people have asked me, you know, which was the high point in the Apollo Program, thinking that it's 11. Well, 11 was really something, but I think as the high point, Apollo 8 had to take the vote, because as an engineer, it was the first time we'd been out there, and we only had the one engine to come back with.

Now, Rocketdyne and North American and Rockwell would say, "Well, there was redundancy to the gazoos on that engine." I'd say, "Yes, but you only had one nozzle," and if anything went wrong with the nozzle, as we found out on Shuttle not too long ago, you know, a nozzle problem can cause some gas pain, to put it mildly. So it was a gutsy thing.

Anyway, of course, Chris and George [M.] Low and all those people set the thing up in the late summer, and I got the job of putting the profile together. Among other things, of course, at that time, I was on the vestry of St. Christopher Church in League City, and Frank [Borman] was a lay reader there, and so the beginning of October, I think it was, we had the vestry meeting, and Frank says to the minister—he was scheduled to be lay reader at Christmas Eve service, you see, and he said, "I'm going to be on travel," because he wasn't allowed to say where he was going.

Now, I knew where he was going, so I took Frank outside, and I said, "Frank, I think we can work this. If you read the prayer and stuff from the Moon, I'll get it taped in the MCC and whip the tape over to the church and we can play it in the service."

So he said, "Well, gee, okay, that sounds great."

So went back in and told the minister. Jim Buckner was the minister at that time. He said, "Frank can do that. He's decided he can do it." Of course, by the time Christmas got near, everybody knew that he and Jim Lovell and Bill [William A.] Anders were the crew going, and that's when we let the minister in on the secret and we set up the PA system and all that stuff.

Frank was so busy, he said, "Well, would you pick a prayer for me?" And that's when I picked this prayer for work and peace by G.A. Weld. It was in the *New England Book of Prayer* for the Church of England, I think, which is the Episcopal Church. So Frank had that down in his logbook.

In one of the early—I forget, I think it was about the fourth or fifth rev around the Moon, Frank comes on and says, "[Is Rod Rose there?] I've got a message for [him] and for the people of St. Christopher. In fact, it's for people everywhere." I'd called the thing "Experiment P-1," for first prayer from space. So Frank read that and we recorded it, and then, of course, they came out with the reading of the first ten verses of Genesis, which was super. I had nothing to do with that, other than record it.

So that worked in great, because I got off duty and took those over to the church, and I'd set up with the guys on duty in the MCC to give me a call as soon as the vehicle had come around from behind the Moon, because all our trans-Earth burns from the Moon were made behind the Moon, so you didn't know whether it was a good burn or not until they came back. They'd finished the burn, came around from behind the Moon, and then that was the big "uncross your fingers." The timing was exquisite, because that happened just before midnight local time in Texas, and they phoned me at the church and I was able to give a little message, piece of paper to the minister. At that time, we'd had the midnight communion and he was about to dismiss the congregation with a blessing and all, and he was able to tell him that [they were] on the way home. So that was probably the most emotional. [Rose expresses emotion.]

RUSNAK: I can understand that.

ROSE: After that, we had a request from a Catholic priest in New York who wanted to set it down as an anthem, which he did, and the choir sang that every Christmas Eve for several years.

Subsequently, as a follow-up to that, and that's really how I got the picture from Frank and Jim and the guys, the follow-up from that, Hank Flagg, who was chief counsel at JSC at that time, called me up one day. He said, "Rod, we've got a little problem. You and Frank and the guys and George Low and one or two others have been named in a lawsuit filed by Madeline Murray O'Hare, and she's claiming that we're expending government funds on a religious thing because it was called Experiment P-1, so it must have been official." I said, "Oh, boy."

So, fortunately, it went to court in Houston—well, a pre-court hearing—and I don't know who the judge was, but whoever he was, I take my hat off to him, because he dismissed it, said, "That's irrelevant." So that was that, so we never had to appear in court or anything. But, boy, the letters we had from all over the world were incredible, they really were. That was one of the highlights.

Apollo 11—you know, people would say, "Well, what do you feel about Apollo 11?" I said, "Well, a great sense of relief when they landed, for starters." I remember coming off the shift at the MCC and looking up at the moon and saying, "Well, it looks the same, but we've got three guys up there." It'll never be the same. So they left our mark up there.

The later Apollos—see, one of the things the lunar surface experiments plan did was work out all the things for ALSEP, the Apollo Lunar Surface Experiment Package, which 13 was going to be the first one to put one down. That's how come we had the RTG on board. Well, subsequent flights, we landed. We got 14, 15, [16,] 17, got them up there, and that has always, I felt, been very shortsighted, but it was costing something like 6 million dollars a year to run a minuscule little control room. I mean, it wasn't the main MCC. It was just a little room with a comm, just to keep an eye on the experiments and all, because the RTG would power up those experiments for, like, a hundred years.

So there was all this data coming from the Moon, and after a few years, Congress decided that they didn't want to spend [that] money on it, and they ordered us to shut it down. Well, unfortunately, the system was built so that you could shut it down, but you can't power it up again, so we've got all those lunar surface experiment packages on the moon. As far as we know, they're still gathering data, still measuring, anyway, and nothing's come of it, because it ain't going anywhere. So I thought, "Boy, that's shortsighted." So that was Apollo. And then we got onto Skylab, of course.

RUSNAK: If we could take that short break to change out our tape.

ROSE: Okay, we're finishing up Apollo. There was a lot [that went] on. One of the nice things working for Chris Kraft, you know, was that I guess he and I sort of were on the same wavelength. Not many people—I don't know anybody who lasted [seven] years with Chris. Chris suffered fools gladly, let me put it that way. He didn't like people who made bad mistakes, and I guess I didn't make too many bad mistakes, so I managed to stay on. But he would really give me an incredible latitude to make all sorts of decisions. All the FOD stuff that went out, I'd go through it. I'd represent him at all our Level Two boards with the program manager, Level Three with Aaron Cohen, and so on. Altogether, it was pretty nice to be trusted that much, it really was, so I always think Chris was a great guy to work for.

RUSNAK: As someone who's been on both sides of the fence, how do you think the relationship was between operations and engineering?

ROSE: Initially, we were poles apart. When we started Mercury, the engineers said, "Look. We'll build it and you fly it." Typical airplane-type attitude, you know. That's all very well, but when you get to a complicated system and an environment like flying in space, you find that you really need to integrate the operations requirements right at the get-go, because normally, when an engineer's got a problem to solve, there usually are several ways of solving it, any one of which would be acceptable to the engineer, but to the ops guy, two of them would be anathema, and one of them would be, "Hey, that's the way I want to do it."

So that was one of the things the FOP was set up to do, was to actually integrate the contractor and the engineering, Max Faget's engineering people and so on, [Rockwell and] Grumman [Aircraft Engineering Corp.] engineering and all. Get them all integrated with the operations people so they could understand what we wanted to do and, more importantly, why we wanted to do it, and then we could have a vehicle and a system and a flight plan that met all the requirements, the engineers knew which way they needed to go, and the ops guys could fly it afterwards.

Nowadays it's pretty well established, I think. The FOPs are still going on. They've changed somewhat now with Shuttle, because, of course, an awful lot of the flight plan has been standardized. One of the things we tried to do in the Shuttle was to actually standardize all the different pieces like a rendezvous. You'd have standard segments of the rendezvous, and then the flight planning would be more a question of assembling those pieces, rather than going from scratch.

See, on Apollo, we basically started from scratch. It was a four- to five-year plan. A lot of people don't realize that four or five years before 11 flew, we not only knew where we going to land, we knew the precise time we were going to land and the exact time we were going lift off, because we had to, in order to meet all the different requirements.

There was about the best part of two dozen different things that would govern your launch window. Among others was not only where you were going on the Moon, when you were going, get the sunlight between three degrees and I think it was ten degrees, incidence, because it had to show up the boulders and things on the Moon. You had to get the deep-space tracking stations in the right place because of communications and so on. So it was a tricky thing. So, getting all that integrated was something.

Now with Shuttle, we've managed to standardize things so much that a lot of the mission planning, not all of it, but a lot of the mission planning is done by technicians, basically. They're people who've got a high school diploma. MPAD were the first ones to set this up. You train them in the application of these things, and they're able to assemble these standard pieces and put together a Shuttle mission and all that, with the stuff that goes with it.

It's a lot different than when we started. When we started, like I say, it was four to five years of slog work, really doing it. Apollo especially raises a little bit of philosophy, because in the Apollo days, manned space flight was a pretty hard mistress, in that it required an extensive amount of one's time and energy, to the detriment of your family. I think the unsung heroes of certainly the Apollo Program were the wives and children, because we didn't spend enough time with them. [Rose becomes emotional.] That's for sure. I know I didn't with my two sons. Made up for it now, but, you know, when you're working all the hours of day and night and travelling all over, you just don't get to spend time with your family like you should.

So it came at a price. In fact, the divorce rate—I don't know what it was overall, but certainly at JSC, especially with the flight crew, there were a lot of divorces. And there were some with the engineers, although surprisingly, I don't know whether it's because we're all a bit old-fashioned or what, but of the group that came from Canada, there were very, very few divorces, probably only about two out of the whole lot. Eventually there were thirty-one of us, because six came down after the first twenty-five. Maybe it was our upbringing or something that was different, I'm not sure, but we all worked pretty hard, I know that.

RUSNAK: I think a lot of Americans don't appreciate that sacrifice that all of you made.

ROSE: Well, yes. I think it was the wives and children that made the sacrifice, because the engineers were so wrapped up in doing something that they wanted to do. I mean, it was a fantastic thing to be on as a career, and we tended to forget the other half of the family. I remember saying to someone once, they said, "Well, who do you think were the heroes of the Apollo Program?" I said, "The wives and children, the families, because they were the ones, you know, the wives had to take the kids to school, feed them, clothe them, make sure they did their homework, and all that stuff, get them to football games, soccer games, band practice, the myriad things they get into, and basically without the help of their partner." And they also learned to look after household problems, too.

So it was a tough time for them, and they really didn't have the excitement or, I was going to say, glamour. Glamour is really with the flight crew, but with the engineers, the excitement and thrill of running a program, you know, doing a program. So they are the ones I take my hat off to. They were the supporters. Couldn't have done it without them. You know, they keep saying, well, there were thousands of contractors and all that stuff. I say, yes, but there were also thousands of contractors in NASA, wives and families that contributed every bit as much as any engineer did. Couldn't have done it without them. So that was Apollo.

Anyway, then we went on to Skylab. In Apollo, by the way, I was in the MCC, but not on a console as such. I was on semi-console, because I had to make sure that all the activities, any events that went on during the day, were properly reported in the daily flight log, and also was on the editorial board for the post flight [report] and all that stuff. And real time, I kept an eye on the radiation group, because we had them off in the weather room. Alva [C.] Hardy and his people were there, and Tim [C.] White and those folks, and I'd just keep an eye in case—well, like, with Apollo 13, we had to have a conflab with that, and the MPAD guys, the MPAD people, to figure out what we needed to do and when we'd do it sort of thing, and why, and then convince George Low and all the other people why we had to do it. So that was what I did real time. As a matter of fact, after MR-2, I have never watched a real live launch. I've always been in the Control Center. I just see mine on television like anybody else, plus I'm looking at some charts and things.

Skylab, I didn't get involved in too much, although we did have quite a bit of radiation aspects to consider, one of which was, of course, the French, at that time, were doing their experiments in the Pacific, and whilst they were not exoatmospheric, the problem was that, in Skylab, the crew were doing a lot of ground observations, and had they been doing that as they flew over the site, when the event went off, then it's highly likely they'd have been temporarily blinded. Now, it would only have been for a matter of three, six, seven seconds, but if you're doing an EVA [extravehicular activity] or something like that, that could be pretty crucial. So we used to have what we called a heads-down command to the crew, and, in fact, we had to give it on one mission, because the French wouldn't tell us when they were going to let it off, mainly I think because their explosion time was related very much to local weather, etc., etc., so they had a nominal time but couldn't tell us exactly. So we had a heads-down time and we'd just have the crews keep their eyes inside the Skylab as it went over the site, and that was it.

One always had to worry about exoatmospheric events. In fact, that's probably the biggest threat, I think, to the Space Station, because if somebody lets off an event outside the atmosphere, it can be pretty bad. You know, we had one, when, in 19—oh, whatever it was. We sent one up with radioactive pieces of wire, if you remember, and that polluted the environment up there for years before it came down.

So on Skylab, our main concern was that the crew limit the EVA—and this is true, by the way, for Space Station as well—limit the EVA when you're going through the South Atlantic anomaly, because there's about four or five passes a day where you would subject the crew to an increased radiation environment, depending on what the solar activity has been like, of course, because that squashes the South Atlantic anomaly closer to the Earth.

So with both Skylab and the Space Station, years ago we recommended that they either not do EVA during the period of that time or get somewhere where they get a bit of shielding, if they're doing EVA, because, you know, radiation's accumulative, and even low-level radiation builds up. And as best as I can see from the latest reports, it doesn't dissipate like they thought it did, so that happens.

Then, of course, you also have to worry about rogue events, terrorist-type things, and they don't have to explode it anywhere near the vehicle, by the way, because the beta tubes go around the Earth and follow the electromagnetic lines of force. And so if you happen to be flying through a tube at the time the electrons are coming through, you get a zap like you're in line of sight, which is not too smart. So, you know, I think radiation is something that—well, the Center is still concerned about it.

The other thing is, as was illustrated recently, was collision avoidance. That will get me through Skylab. ASTP [Apollo-Soyuz Test Project], had to learn Russian, sort of. Funny language, that Russian. Didn't get too involved in that, although we did do the radiation aspects, and then we got on to Shuttle.

Now, Jim Chamberlin, by this time, was looking after the early development of Shuttle, and again, his office was just down the corridor from Chris' area and mine, and very often he'd call me in. He'd say, "Well, what do you think of this, Rod?" and he'd have a layout of something on there about the Shuttle and so on. That's how I got involved in that.

Then, of course, we started Shuttle FOPs and radiation [constraints] for Shuttle, and then we had a gentleman from Goddard who was going to do all the data systems and integration communications for Shuttle, review it all, and he moved down to JSC, was there six months, and retired. So guess who got the job? So I ran what we called CADSI panels, communications and data systems integration, and that's where we followed the data from the sensor or the instrument, whichever generated the signal, through the payload, the interfaces, the Shuttle, the communications system, the satellites to the ground, or if it was on the pad, through all the connections on the pad.

We did schematics of each stage of the Shuttle flight. Those were quite horrendous. Of course, I was supported with contract folks, you know, [Bob Legler and Ray Schultz] who supported me and did the secretary work and everything [under Lynn Croom]. They did the technical write-up of the minutes and so on. I didn't have to bother with that. But we would typically have probably fifty or sixty people in the actual meeting, and then anywhere up to about fifteen loops all over the world, to the various DoD sites and KSC, Goddard, and headquarters, and overseas, and to the Australians and so on, so it was a pretty involved thing. So I did that until we wrapped it all up.

Then on Shuttle, apart from being in the evaluation group and all that stuff, working out of the Chamberlin Hotel, by the way, back there again, I got volunteered to be the range safety manager, and at that time apparently the Eastern test range [ETR] and the Western test range [WTR] didn't talk to each other very much, for some reason, and the relationship between NASA and the Eastern test range apparently was not of the best, so yours truly got volunteered to see what could be done.

So we got down there, and the first thing was, I got the two commander's [range safety people] together and said, "Look, guys, I'm only going to go through this once, not twice. We're going to fly from the Eastern test range, the Western test range, we're going to have one range safety system. We're not going to design it twice, we're not going to have one system for the east and one for the west, so we need to all sit down together and work it out," and that's what we did.

We'd alternate meetings at ETR and JSC Houston, and over on the Western test range. And apparently, at least the working-level guys in the safety offices there thought it was great. I said, "Boy, this is really good. We're working together here on this stuff." I had some terrific people, like Morris Jenkins, who was one of the group from AVRO, was instrumental in that, and Bob [Robert E.] McAdams, I know, headed up the group that did all the external tank stuff.

That's where we come to this little picture, which was one of the few we've got of an external tank coming in. You can see it's already broken up into pieces. The width of the footprint was fairly narrow, about sixty nautical miles, but the length of the footprint was over 1,200 nautical miles. Now, that doesn't mean that the debris would cover from alpha to omega. What it said was, statistically, the debris could be in an envelope anywhere in that footprint.

And that's where we got involved with the Australians, because, of course, we'd had Skylab come in with a degrading reentry, and there's four tons of lead somewhere in the Outback in Australia. Somebody's going to find it one day and think they've found a lead mine.

See, we had a lead-lined vault, film vault, on Skylab, to keep all the film and emulsions in that were sensitive to radioactivity, because that was one of the things you had to protect in order to [not] degrade the data, and that thing sure as heck didn't melt as it came in. I mean, it was a solid chunk. Some of it would melt, obviously, but not all of it.

Anyway, the Australians were very antsy about the Shuttle, so headquarters decided that I'd be volunteered to go to Australia. I think they thought I spoke the language. When I got there, they called me a "pommey." I said, "No, I'm a Texan that talks funny." So that went better. I had to brief the Minister for Science and Technology and his people about the external tank.

Now, to understand the external tank, reason for the concern, on orbiter, on Shuttle at first, the external tank, Marshall had designed it, and they were going to have a retro pack and a platform and all this stuff, weighed tons. Well, weighed a lot of pounds and cost a lot of money. Well, the MPAD guys came up with a super idea, I think, and that was, they said, "Hey, why don't we cut the main engines off slightly suborbital, like 130, 170 feet a second shy of orbital velocity, separate from the tank, and the tank will go in at the antipodal point in the middle of the Indian Ocean, on its own." You know, as long as you tumble it so it doesn't fly. And meanwhile, the Orbiter can then coast around to the [apogee] point and do a little burn and either circularize or go higher up or whatever it wants to do. So that was fine.

So in the FOP we were setting up for the first two flights, I said, "Well, we'd better put this ground track through the Bass Straits," because we weren't flying due east the first flights, we were flying, I forget, it was about thirty-odd degrees, thirty-four degrees, I think. I'd have to look it up. But anyway, we moved it so the ground track went through the Bass Straits, because I figured, well, if the computers didn't cut off the main engines and the crew had to manually cut them off, they had to do it within half to one second, or you got a significant downrange of the tank. So I thought, well, we'll put it through the Bass Straits, you see.

So I get over to Australia. First thing they say to me is, "You realize 70 percent of Australian oil comes from offshore drilling in the Bass Straits." I said, "Oops. We've only got two missions." [Laughter]

And then the third mission, we went more due east, and at that time the ground track came over the northern outskirts of Melbourne. That's when the guys first brought it to me in the FOP, and I said, "Well, gee, that doesn't sound too swift. Melbourne's a pretty big city and a lot of folks there. Let's move it north a bit." So we went a little more due east and that moved the ground track up a little bit.

While I was over in Australia, by the way, they had a little Control Center, and I set up with them that we would give them a heads-up on when the Shuttle was going to launch, when the tank was going to impact, or if was going to overfly and so on. It wasn't until two flights later that the State Department found out about it, raised hell, because they said, "Who made this agreement with the Australian Government? You're not allowed to that." I said, "Well, we are, and it's working, and they'll be very mad if you cut it off," so we kept on doing it.

Anyway, I was then talking to the Secretary of the Science and Technology area. Now, Australian Civil Service, like British Civil Service, the secretary really runs the whole department. The minister is a politician, and the secretary is really the guy who makes all the decisions, etc., etc. If you ever watch "Yes, Minister," or "Yes, Prime Minister" on the BBC series, they have it on PBS, you understand how that works.

Anyway, I was talking then fairly regularly with the secretary, a very pleasant guy. So on this third Shuttle flight, I said, "Well, I've moved the ground track a bit north of Melbourne, because I didn't want to overfly Melbourne. It's about sixty miles north of Melbourne. It flies over some valley." He said, "Valley? North of Melbourne? Wait a minute. You wouldn't like to put it a little further down, would you? That's the best wine grape-growing area in the country." So we moved it a tad down, but still off of Melbourne. Unfortunately, he's since died of cancer, along with several others, but that was part of the thing. They were very sensitive to stuff coming in.

One thing we did do, though, that opened my eyes in Australia. They provided us with a tape of the population distribution in Australia, with their latest census, because on the due east flight now, the tank, if it overflew, crossed the west coast of Australia, north of Perth, way north of Perth, and over the east coast. And it was quite a surprise to all of us, I think, when we discovered that the total population we overflew was less than 200. In fact, the biggest place was about three dozen people, I think. I mean, it flabbergasted me, because until I talked to a Qantas pilot when I was over there, and he said, "Well, you have to look at Australia as a bloody big saucer, and people don't live in the middle, just around the edge." And that's about what—except for Alice Springs, which is a—and *Woo*mera or Woo*mera*, whichever you like to pronounce it. Other than those two places, that's about it. So anyway, that was the Australian bit. They seemed to feel that we knew what we were doing, and we got on quite well with them.

So we've covered the radiation thing. The tank, by the way, we would deliberately tumble it so it would break up. Otherwise, you worried about it trimming and flying before it reentered.

Let's see. I have to look at some memory ticklers here. Oh, I know. On Shuttle, the other thing with range safety, I also got involved with DoD and the people up at Cheyenne Mountain, at the Space Defense Command. One of the things was, we had to set up a program such that in real time they would notify us if a piece of debris was getting anywhere close to the Orbiter, and then we'd have to do a maneuver.

In fact, that happened with the Space Station just a few weeks ago, and it's the same setup, same sort of program as we had set up way back in Shuttle days. They came a bit closer than we'd have allowed them in Shuttle, by the way, but I think they've gotten braver since we flew Shuttle or something. Because one of the dangers in space flight at that altitude is the debris problem. A lot of people think NORAD [North American Aerospace Defense Command] tracks everything that's in orbit. Well, they really don't. They can only track down to a certain size. I won't say what size, that's still classified, but I mean, they can only track to a certain size.

Not that I was firsthand involved in this, but I was aware of an Orbiter coming back one time with a crater in the windshield, which is bulletproof glass. I mean, you could fire a gun at that thing, close to, and the bullet wouldn't go through it. This one had a crater that was quite deep and quite big and it turned out, on analysis, that the only thing they could find that would have caused it was a fleck of paint. So they did some tests in the hypervelocity tunnel and found out, sure enough, that a fleck of paint could do that. And so that's one of the reasons, as well as micrometeorites, that they've got the buffers around the station.

Because a lot of people say, "Well, how on earth do you get all that debris in space?" Well, it's quite simple, really. In the early days, especially the Russians, but we were as guilty as well, we'd put up third stages and wouldn't bother about what happened to the propellants that were left, so they'd be in a tank and eventually, boom, they'd go, and you get pieces go all over the place. What happens is, it's like a dog with fleas. You know, each flea has fleas and lesser fleas have lesser fleas. Well, these little pieces eventually would—some of them would impact and break up into more pieces.

[Don Kessler] the expert, or was, at JSC, got a plot of all the debris and he actually got an experiment run where they had a [special] radar looking upwards that just measured everything that went over in a twenty-four hour period.

And it turns out that NORAD only got about a quarter to a third of what went over. All the rest of the stuff was real small, but equally embarrassing if you got hit with it. And it doesn't come out very quickly from space, that's the problem. There's a belt of it around and it's there and it's not growing as fast as was originally projected, because now there's an international agreement that all the ultimate stages will be vented so they don't explode.

But the fact is, if two spent stages happen to hit, you know, and everybody says, "Well, boy." Because you've got stuff going at polar orbit, you've got stuff going due east, you've got stuff going fifty-seven and whatever in between, and sooner or later, some of them are going to hit. When they do, you get a big cloud of debris. So that, to me, is one of the concerns I would have for the Space Station, is radiation and debris, are two of the things. Of course, that's why we've got the crew escape vehicle, if the Russians get it built in time, you know, to get the crew back off the vehicle. That's why I wish they'd used the microballoon sachets. Because if the Russians had had one of those when they had the leak on Mir, it could well have stopped the leak, because, you know, it'd get almost anywhere if there are small enough little packets. Anyway, those, to me, are two of the things, I think, you have to worry about on the Space Station.

As far as after Shuttle, or after NASA, I retired in '84, and joined Bob Miner, he was the head of the Rockwell effort, and we did three proposals. I was involved in doing three proposals with him. The first one was the STSOC contract, which was running the Shuttle and everything for him. Then there was the Space Station Phase B studies and the DoD payloads integration contract. I was the director of that one.

When I retired from Rockwell, I said, "Hey, I've done three proposals, they've all been successful, I'm quitting while we're ahead." Added to which, we had moved up here.

And then for a little while after that, I was a consultant and did some consult work for Rockwell, or for a company that supported Rockwell. Then there was a small group of us did some for the Hermes, the European spacecraft, but quite frankly, I think—we had a group of French come over and I think they were just trying to get a lot of information for nothing. We never did get a contract. We spent a whole day with them, going over all sorts of stuff, giving them a few pointers on networks and ground systems and so on, radiation and so on.

After that, I retire retired and said, "That's it," after forty-four years in the business. Some people ask me, "Well, where do you see space going, and why are we doing space?" Well, apart from the obvious of communications and so forth, I look at a much longer term thing. Being an old mission planner, I say, well, our sun's got a limited lifetime, not that it's going to affect me. I don't think it'll make me live that long, golly, I hope not. But anyway, it's a limited lifetime, and in order to fly at the speed of light or faster, we've got to do a heck of a lot of research and work, and the sooner we start, the better.

Also, I'm glad to see that finally people are waking up to the danger of meteorites, or whatever, asteroids, because that's been a concern for some of us for a long time. We said, you know, you aren't going to be able to develop something in twenty-four hours or a month or something. It's going to take years. And the sooner you start the better, and then you've got your ducks in a row and if something happens, you can do something about it. Because I think going to the Moon showed us that eventually something's going to hit the Earth. It does anyway. There are about 1,500 objects come in and hit the Earth every day, but they're all small, thank goodness, usually, although the Russian occasion and Meteor Crater and the Gulf [of Mexico] evidence that other things have happened, and sooner or later, it's going to happen again. We'll get something. I mean, I know they've made movies and all, but finally the administration and people in control here and elsewhere have finally said, "Hey, we really need to start thinking about it."

Well, likewise, I think people need to start thinking about what's going to happen as the sun starts burning down, because it will. We know already from Hubble [Space Telescope] that stars degenerate. I mean, when you look at the millions of pounds of matter that the sun gets rid of every day, you say, "It ain't going to last forever, guys, and we need to do something about it." Because if humankind is to exist and continue to exist, then we've got to not only find out where there's something else that would be favorable for us to live, but we've got to have the means of getting there and get a significant number of people there to recolonize humankind. That's a long—that's thousands of years, probably, but as the Chinese say, "A march of a thousand miles starts with the first step." We need to make the first step, because it's a long road, a long road. And that, to me, is the ultimate of space, when we get that far.

The other thing people keep asking me is, "Why manned space flight?" I say, "Well, a good example of that is Hubble." We launched Hubble and there was a major problem with the optics, among other things. And because we had the manned capability, we were able to go up there and fix it. If it had been an unmanned thing and we didn't have a manned capability, we'd have lost all that. Hubble would have gone. And as it is now, we can go up and we can renew gyros, platforms, software, and keep the thing going for a long, long time.

So, you know, when people say, one or the other, I say, in exploring space, each complements the other. You need unmanned and you need human. I won't say "manned" anymore because now we've got a nice lot of female astronauts that raise their own problems as far as radiation is concerned, by the way, but we can protect that. But, you know, the two branches of space flight really have to work in coordination and conjunction with each other, because each is essential to the other.

Now I know that's heresy to a lot of the unmanned people who say, "Boy, all this money's gone down the drain on manned space flight." Well, yes, but just think, you know, MIT in the year 5000 and something might need some capability to send some MIT people off somewhere. And if you don't work on it, you won't get there. So that's it.

It's been a fascinating experience as a career, though, one I'd never dreamed I'd have, and looking back on it, it's quite something to feel that you've been involved in the first twenty-five years of manned space flight. When you look back at the first twenty-five years of aviation and realize how much that moved, and then you look at the first twenty-five years of manned space flight and see how it's moved, you know, you say, "Boy, we're on an exponential curve." It's incredible.

When I started, for example, the only computers we had, when we wanted to get accurate stuff, we'd prefer, we'd use a three-foot slide rule. You know, I mean, that gets your eyes going. And then we used to have to solve quartics, you know, quartic equations, and the only thing we had was a Friedan mechanical calculator. And if you've ever tried to do square roots, because you turned the handle and the numbers chunked over, you know, I mean, it's painful. It used to take us about four to five days to do one solution for a wing lift on a swept-back wing. Now, of course, a computer spits it out in seconds or milliseconds.

That's why I always had a bit of fun with all the engineers that were involved in the flight ops. They'd come to me with some data, and I'd say, "Well, I want to see it graphically." They'd say, "Why do you want to see it graphically?" I'd say, "Because I like to see where things have come from, where they're going to."

So they'd come to me with data that would be graphic and I'd say, "Well, why is it doing that?" And they'd say, "Well, that's how it came out of the computer." I'd say, "I don't want to hear that. You go away, and come back and tell me what fundamental thing caused it to do that, and then explain it to me."

Invariably they'd come back and say, "Well, there was an incorrect data entry" or, "The computer program had a glitch in it," or whatever, you know, and I said, "Folks, think fundamentals, because if you can't explain it from fundamentals, you're going to be in trouble." And that's my little take on the education system, because I think we're getting far too many specialists and not enough people who are trained in the fundamentals, who can look at the big picture.

I was fortunate enough to have a bit of both, although I didn't use directly a lot of the specialist information I gleaned in the course of my studies, but at least it prepared me to be able to look at the big picture and understand the fundamentals behind everything. And we need a good slice of people like that. We still need the specialists, don't get me wrong. You've got to have them, but you also need people who can look at the big picture.

RUSNAK: Let's pause for a minute so we can change the tape. Looking back on your career as a whole, what do you think the biggest challenge for you was?

ROSE: In aircraft or space, or the whole thing?

RUSNAK: Both, if you'd like.

ROSE: The biggest challenge, probably, looking back on it, was getting Apollo 8 to the Moon and back, closely followed by Apollo 11 landing, although at one time, on Little Joe, you know, there was a move afoot to put Al Shepard in Little Joe, because we knew the Russians were going to go, so some people were pushing to just put Shepard in a couch with a bottle of oxygen and a mask and send him off on Little Joe, because it did basically the same flight as his Mercury flight did. But that got squashed by headquarters. They said, "This is a scientific program, not a publicity stunt." So we didn't do it, and the Russians beat us into space.

There are several highlights going through. I'm sometimes surprised at how much of space work and aeronautics work are interrelated. See, the Shuttle really is an airplane. It's a lousy glider. It's got a lift-drag ratio of about .7, 1.4, I don't know, it's a terrible thing. Anyway, it flies like a brick. But you can maneuver it and you can get cross-range out of it, because it starts off at a lot higher altitude.

I think the thing that probably, I know, got to a lot of my friends was when the Orbiter came in and it crossed over the hill country in Austin and Houston and I had the data track on from NASA and there it was still well supersonic, going over the west coast of Florida. People say, "How can that happen?" I say, "Because it slows up real fast coming in." That was quite a sight. That was good.

Anyway, the highlights, I think, were probably the space flights, no doubt about that. It was certainly the epitome of a space career, the height of it. In fact, that's one of the problems with the Shuttle. Shuttle flights are not quite the same as going to the Moon. You know, it's hard to get wrapped up in the same—not enthusiasm, that's the wrong word, but the same sense of really exploring that we did on Apollo.

And that really raises one of the problems with the Shuttle, because people have to realize that it was a vehicle put together that relies intrinsically on an awful lot of dedicated people doing trajectory work, getting the vehicle ready, turning it around, you know, everything. There are fifty million places where something could be done wrong, or, you know, a wrench could be left in the wrong place, or a nut could be dropped and left and it's a disaster, it can be, a potential.

People always ask, "Well, was the first Shuttle flight the worst one?" I say, "No. To me, the worst one's going to be somewhere along the line where people tend to get, almost from human behavior, you tend to get a little complacent." Been there, done that, you know, and it becomes routine. When Shuttle becomes absolutely routine, that's when I get concerned, because it basically was designed relying on a lot of people being really dedicated and knowing exactly what was needed all the way through, at every turn. And somebody says, "Well, are we liable to lose another Shuttle?" I say, "Probably. You know, I've been in the aircraft business and, believe me, you lose a lot more vehicles and people flying new airplanes than we have so far, flying spacecraft."

I used to kid the astronauts about that. I'd say, "Hey, you guys got on to a much better streak than test flying." Typically, you'd have ten test pilots start a program, and if you finish with half of them, you're doing pretty good. Whereas, you know, in actual space-related stuff, Challenger's—other than [Virgil I.] Gus [Grissom] and the guys on the pad—but in flight, Challenger's the only one we've had. So we've been lucky, and I hope the luck continues, because we've only got four of them left, and there's no way we're going to build another one like them.

So there were definitely some high points, and I think I was remarkably fortunate to be involved in it. As I say, I'm still a Texan that talks funny, but that's all right. "T3F," I call myself. I can say a few words in Texan to the amusement of my true Texas friends. They think I'm murdering the Texas language. I say, "Dead already." [Laughter]

RUSNAK: While we're talking about Shuttle, the Shuttle we ended up with is a lot different than the Shuttle that they had anticipated in the late sixties and early seventies. When did you first learn of our efforts to have a Space Shuttle, and what did you think of it then?

ROSE: Well, that was when Jim Chamberlin was doing sketches and things in his office, and called me in to look at the different layouts and things. He got a separate group, went off to another building doing that. I didn't get so involved then, but I knew early on the internal tank versus external tank, etc., arguments that were going on. So once it got involved with more or less the configuration it is today, I was more deeply involved in helping to solve all the problems with it that could invariably come up when you design something.

One of the things I remember, for example, that people are not too familiar with except those involved in the thing, but when the Shuttle's on the pad, it's held down on the solid rocket boosters and the Orbiter is sitting quite a few feet off. Well, we start the Orbiter engines first. One, two, three, or three, one, two, whatever their sequence.

But the point is, you've got a heck of a bending moment, and you have to realize that the whole Shuttle is a flexible structure. When it goes up, it's quivering like an arrow, you know, and from calculation, we found out that when you fire the main engines, the pilot's eye moves [about] twenty-one inches that way and back again, and the secret at launch is to time the—it's rather exquisite to milliseconds—the ignition of the solid rocket boosters, such that you catch it when the bending moment's at a lower level, otherwise you'd have busted the thing on the pad.

So the fact that the engines start first, get up to max thrust, is all designed and it's a pretty unique and fairly exquisite time line, because the SRBs [solid rocket boosters] have got to fire at a certain time in the bending moment curve in the Shuttle's position so that it doesn't overstress [it] and clears the tower and all that good stuff. And so there's a lot of things that go on with that, that way.

RUSNAK: Moving backwards a little bit, you were talking about Apollo 13 earlier. What kind of studies did you make into using the LM as a lifeboat prior to the accident? Were you involved with that?

ROSE: Yes, we did some very cursory ones. Quite frankly, the probability we felt at that time was so low, we didn't want to spend a lot of time on it, so a lifeboat concept was schemed, but we didn't work any of the real details out. We did enough to know that it could be done, but we didn't do what I consider as the last few months of an FOP, when the flight director takes all the people involved and goes into the fine nuts and bolts and tuning.

That's why we had not run a dry run, for example, of how you circulated the air from the LM system to the CSM [command and service module], and that's where the guys did a lot of incredible work, you know, overnight, real time, getting that done. As I say, the maneuver, the Delta V that was done, really was basically just a plain old trajectory solution to get the lunar module in the right place, although we had the capability, obviously, to do a tweak like that to get optimum capture in the Earth's atmosphere, because if you come too steep, you burn up. Too shallow, and you bounce out. So you've got to get it right, and it's 36,000,090 feet a second. You're moving along at a fair lick.

But the manual control was definitely tricky. The crew had practiced manual control, but not, I don't think, in that configuration. I think that was probably a first time, I don't know. But I know from the mission-planning point of view, we'd sort of done the preliminary work that we knew that from a performance point of view the LM could do it. But it was always nip and tuck on consumables, we knew that right from the word go, but then we didn't want to put extra consumables on the LM because that iterated all the way down [to] the LM performance landing, ascent, and so on, so you just had to do a risk versus gain and say, "Well, [the probability of] this happening so low, we won't spend a lot of weight and time on it."

Now, the normal non-nominal trajectory behavior and procedures actually comprise probably about 90 percent of our work and training. A lot of people think the crew just spend all their time training a nominal mission. I say, "Hey, that was the easy one." The ones that really get you is when, you know, everybody's thrown all sorts of problems in the sims [simulations], the crew as well, and when we run integrated sims and start throwing problems, that's where the training comes, and so I would say over 90 percent of the training was all off-nominal stuff, because that's the way you train.

We probably became the best "what-if'ers" going, which drives your wives crazy. I know it does mine, because, you know, if anything and everything comes up I want to sit down and say, "Well, let's go through the pros and cons and what-if here and what-if there." They say, "Oh, gee, just make a decision." I say, "No. Been too many years doing it the other way." So going to have to put up with it.

So, 13 was a lot of new stuff, and I take my hat off to the folks involved, because they did a great job, but it wasn't totally—it wasn't something we thought of at the time the accident happened. It was there but we'd never really wrung it out, so there was an awful lot of new stuff had to be done. But fortunately, it worked.

RUSNAK: Yes, it did, and it worked out well enough to get them back safely.

ROSE: Yes, that was good. That really was. Well, that's one of the beauties of the free-return trajectory. That was one of the first things that MPAD came up with and we emphasized it in the FOP. We said, "Look, the only sane way to go to the Moon is on a free-return trajectory. If something happens, you can coast back." And so that was our first sort of ace, if you will, that we held in reserve.

One time, you know, with communication, we were talking about putting a satellite off to the side, not behind the Moon, because we couldn't have that, but off to the side in the dead zone, because there's a dead zone between the Earth and the Moon, you know, where you can put a satellite and it'll stay there "forever." And we thought about putting a communications relay satellite there. One, one side; one, the other, so that we could communicate while around the back side of the Moon.

But then we got into the expense and everything involved, and the fact that we're only thirty minutes behind the Moon and we said, "Hey, we're just going to have to bite the bullet and breathe hard when they're behind the Moon." But, of course, the trans-Earth burn was always behind the Moon, so I would say on all the Apollo missions, apart from the touchdown, which is always a sensitive point, the trans-Earth burn was always one where you breathe a sigh of relief when you got comm again. The same as reentry, you know. When you hear the crew answer back on the comm loop, that's, whew, you know, made that one.

So trans-Earth burn, you've got that, and after reentry. Because we did have one time, people were pushing to try and get schemes to get communications through reentry, like trailing a long wire behind them, and all that stuff. That's not too swift operationally.

RUSNAK: They tried that in Gemini, didn't they, in one of the experiments, maybe on Gemini III?

ROSE: What, for reentry?

RUSNAK: Yes.

ROSE: Yes, but not very successfully. Wires burn off, they discovered, rather rapidly. Added to which, it's liable to mess up your aerodynamics as you come in. And Shuttle, there's too much stuff at the back to think about that, because basically, Shuttle, you've got to translate from a spacecraft to an airplane, and a supersonic airplane at that, and then you've got to go through the whole range of speeds. So aerodynamically it's quite a challenge.

But we finally, with the blackout, we came to the conclusion that you just bite the bullet. Of course, it would have been nice to have communication. I know on Glenn's flight, when finally we heard his voice after he came back, that was a real sigh of relief. I guess that was probably one of the big sigh-of-relief points in [the] programs. We knew that the heat shield had stayed on. That was quite something. So there were some key points going on.

RUSNAK: Of course, with Glenn's flight, there was the problem where they thought the landing bag had deployed. What was the impact of that, from your point of view?

ROSE: Well, we had a bad sensor, that was the problem. Fortunately, people decided that rather than gamble as to that it was just a bad sensor, they'd do another gamble which was a risk versus gain. They said, "Well, let's leave the retro pack hooked up and hopefully it'll burn off without messing up the capsule." And that gave John quite a reentry. Of course, we see chunks of the thing going by, so we probably put his heart rate up a bit, but at least it worked. But the heat shield was firmly attached anyway.

Again, it was a question—in operations, we always try to have a fail-op, fail-op, fail-safe—"FOFOFS," we call it in NASA acronyms—FOFOFS—which is fail-op, fail-op, fail-safe, and basically that's what we tried to do in most of the programs, is to do that. And that's one of the probably—I don't know, but I would suspect that was one of the underlying reasons that Chris and them decided to keep the retro pack on, because, hey, the odds of it messing up the heat shield were less than the heat shield—because if a heat shield came down, it was curtains. You were done. Whereas you may or may not be done if the retro pack messed up something. So it was the lesser of two evils, and it worked, fortunately.

RUSNAK: On Gemini, you were talking earlier about some of the problems with the ejection seats. Who decided to have ejection seats instead of a launch escape system, and why?

ROSE: Well, I think Jim and McDonnell were involved in that quite a bit. Jim, because he never did like the escape tower system. He thought it was a lot of mass you took up that you didn't need to. Of course, Max was responsible for the escape tower and all, and so that's why we went to ejection seats. It was a cleaner thing.

It allowed you to lift off with less payload penalty. But as we got into it, we found that it did have its own problems, but I think we basically resolved them all, because, like I say, we solved, we think, the problem with the fireball and the heat, the suits, and so on, protection of the crew. What we finished up with were a set of launch constraints, in terms of wind velocity and direction, and if the wind was blowing such that astronauts [heads] were going towards the ground, then you'd have a much lower permissible launch wind than you would if it was blowing the other way, just because of the seats. And of course, we had the usual bunkhouse and everything for them to go to when they landed.

Yes, we had quite a program with the ejection seats. Of course, Jimmy Baker of Martin-Baker used to regale us with all sorts of tales, but I've known him back in England. His big boast was that he had one pilot who ejected off a carrier takeoff and had the presence of mind to stay in the aircraft while the carrier went over and then ejected out. That was his line. I'm not sure myself. That sounded a little flaky. But they certainly have saved a lot of people, certainly have. But the ejection seats had their problems.

The chutes had to be made with special fabric as well, and that's where we got into rip stop, by the way. There's a lot of things that were intrinsic to the space program and the industry came up with them and then it turned out that they were applicable. For example, on Mercury, just going back there for a minute, on-orbit photography. The [McDonnell] people, for a long time, thought, well, you can't expose color film in orbit because you're in space. I said, "You're in a capsule, for heaven's sake. What difference does that make?" You know, film's film. It'll work.

The only thing was that we didn't have a big enough capacity in the cameras. So at that time I worked with Kodak, and that was a fun time, as a matter of fact, because I worked with Kodak and that's where they came up with this ultrathin base, which is now standard, by the way, to all films, just about. But in those days, it was new, experimental, and that was nice, because they used to send me rolls of 35mm film and say, "Well, try this and see how you like it," and I'd say, "Great." You know, go out and take pictures. So we had all sorts of film speeds, emulsions, and I'd send them back to Kodak to be developed. That was good fun. That's really where the super-thin emulsion came from, because it enabled us to have twice the length of run time on a given camera size than we would have had, which we needed in orbit. So that was one thing we had.

The rip stop on the chutes. The suits with the heat protection was another thing. All of these things were, you know, necessity is the mother of invention, and we needed something, and industry came across with something. So it helped, apart from Teflon frying pans and all that stuff.

The funny thing was, as an aside, on Mercury, everybody was worried about the ablation of the heat shield and all that stuff. One flight, we had a piece of good old masking tape left stuck on the side of the capsule, and that came back with flying colors. I mean, it was just a little bit golden around the edges, but it survived reentry like gangbusters.

Just to give you an idea of some of the other applications of the space thing, we used RTV, which was that red gunk on Mercury, you know. God, we almost stuck the capsule together with RTV. And of course, it had a very high ablation capability. So some years after that, I was over in England at the Shuttleworth collection in Old Warden, and that's where—do you remember "The Magnificent Men in Their Flying Machines"? Well, most of those airplanes are at Old Warden and they fly them. I'm always interested in old airplanes anyway, but they had a Gloster Gladiator, which was the sleeve-valve engine biplane of the beginning of—well, it was faith, hope, and charity of Malta, you know. Their defense was three Gladiators. They called them Faith, Hope, and Charity. They had one there, and the Townend ring that collected the exhaust, had a little stubby exhaust, the Townend ring that got the exhaust was burning out, and they'd swapped the non-flight-worthy one they had with the Duxford people, the museum at Duxford, because they weren't going to fly theirs and they wanted to fly the Gladiator at [Old Warden].

So when I looked at it, I said, "Well, you know, there's something we did in the space program you might try. If you spray RTV on the inside of the Townend ring, it'll take probably many hours of flying to ablate it and then you can just clean it off and spray it again and then you can keep using the same Townend ring." Whether they ever did or not, I don't know, but it certainly was another application.

RUSNAK: One more question from me. Did you have any involvement in going into Apollo in the earth orbit rendezvous, the lunar-orbit rendezvous, direct descent debate, and did you have thoughts on that at the time?

ROSE: Not too much. I left that to Morris. Morris Jenkins was the big man on that, and, of course, Buzz Aldrin, who "became the rendezvous expert." We had some super guys in MPAD who worked on that. Morris was just one of them doing the lunar rendezvous stuff.

The thing I used to take the guys to task with, when they set up the Gemini Program, they had a bunch of acronyms, you know, for the different burns and things you did. And when we got to Apollo, I'll be darned if they changed them all. Chris used to complain and he'd say, "Damn it! I've just learned all these other acronyms. Now you've changed them all."

So, yes, I was involved, not in developing it, but using it, in the FOPs. We'd go into some depth about the various rendezvous and how to do it and so on, and that's where we came up with the technique for the Orbiter to approach something, you know, to rendezvous with it, beneath it, and then just come up. Otherwise, when you went to put on the brakes, so to speak, you'd blow your object away from you. And that's really where the crew learned that flying by the seat of the pants didn't work anymore, because a certain gentleman hosed out an awful lot of his RCS [reaction control system] propellant because he took over manually on the controls. So you don't do that anymore. You've got to fly it by the computer. I think nowadays, of course, most of the crews, they've been weaned on flying with computers, so it doesn't bother them, but the first astronauts, you know, they were more of the old stick-and-wire type, I call them, and they had a hard time believing that it could do it.

The one thing we haven't done yet, that I know of, by the way, is that one thing we developed for Shuttle is the automatic landing system, and as far as I know, they've never actually used it yet. But we did a lot of work on it, setting it up and landing it. It's really not a lot different to a 747 landing. I always laugh when I'm flying now. You get a smooth landing, everybody applauds, and I say, "Yes, that computer did a good job." The pilot only does it once every six months to keep his hand in.

RUSNAK: Of course, the Soviet Shuttle, Buran, landed automatically, because it went up unmanned, the one time.

ROSE: Yes, it did… Sometimes having a person on board is beneficial, and sometimes it gives you problems, but generally, a well-trained person is a heck of a flexible capability to have, it really is, because computers, they can only do what they're programmed to do, at this stage of the game. I keep telling people, "Artificial intelligence is when you can give me a system that I feed it in the basic equations and it does all the derivations from that. So I feed it Newton, Galileo, and what have you, and then if it can think through all of that, then you've got artificial intelligence." At the moment, we've just got what I call "enabled intelligence," where we put some human logic in and let the computer do all sorts of weird things with it. So anyway, it's fun.

I'm glad to see, for example, the Canadians got involved in Shuttle. One of the old AVRO group turned up as one of the chief guys in the Canadian arm [remote manipulator system] program. That was Bruce A. Aikenhead. So that's how I got to meet Bruce again when he came down on the arm. And [R.] Bryan Erb, of course, is now the Canadian representative at JSC, mainly because he never took U.S. citizenship.

RUSNAK: Yes, he was telling us that story.

ROSE: Well, I have sympathy with him because at the time we came down, we were already committed to thinking about, we're going to be a Canadian citizen, so not being able to go back to Canada as a citizen didn't worry us too much, because we said, "Hey, we've cut the umbilical cord already." But the Canadians at that time, if they took out U.S. citizenship, they lost their Canadian citizenship, and they had to reapply as an immigrant. So I can understand how they were reluctant.

In fact, the first group of us that took out U.S. citizenship, I think it was about seven or nine of us. Jim Chamberlin was one. I know John Hodge. Let's see. Tom [Thomas V.]

Chambers, [Pete Armitage, Morris Jenkins]. There were a bunch of us, anyway. And that was interesting, because afterwards, of course, NASA wanted pictures of us in the chambers with the judge, and I remember the judge saying at the time—I've forgotten his name—he was one of the well-known ones in Houston, after we finished, he said, "Well, congratulations, you're all Texans. Oh, by the way, you're U.S. citizens." [Laughter] I said, "Great. Now I'll learn to talk like one."

RUSNAK: Which shows where their priorities are.

ROSE: Yes, that's right. Brown, that was it. Judge Brown. Bless his heart. So that was the group of us. And then, of course, subsequent to that, we discovered that, in fact, we didn't give up British citizenship as such. We have a form of dual citizenship, which Canadian citizens can now have. There's a bilateral agreement between U.S. and U.K. that as long as you don't vote in a British election, the British consider that, "Okay, so you took out citizenship of whatever country, but you're always welcome back," sort of thing. And the Canadians finally did that so maybe some of their people wouldn't feel quite so cut off if they came down to get U.S. citizenship, but we did it.

Originally, it was just an expedient thing because when we came down, we couldn't do any classified work unless we'd signed a declaration of intent in a court of law and all that stuff, which we did. And then we said, "Hey, you know, when in Rome, if we're going to live down there, we want to vote. We pay taxes. If we want to vote, by golly, we're going to become citizens," so we did. And that was '65, 1965, so we've been citizens since '65 and Texans since '81. I've lived longer here than anywhere else. Still talk funny.

RUSNAK: I'd like to ask my colleagues if either of them have any questions for you.

ROSE: Sure.

BUTLER: I have a couple of questions. And speaking along the lines of citizenship and such, your group that came down from AVRO filled some pretty key roles at NASA. Do you have any thoughts of when you were coming down, or how you were received? Did you just fit right in? Did people accept you well, and do you have any thoughts on the role you did play?

ROSE: Well, some of us were a little apprehensive coming down, because, yes, we were going into pretty senior management roles and we had a pretty good idea of how that would be if the shoe was on the other foot, and there was people coming up from the States to Canada, or England, for that matter. There was always a lot of kidding, I mean, by some of them, but we understand that.

But the fact is that here was a group of engineers and support staff at Langley in the Space Task Group, I think there were 130-odd of them, when this mob of strangers came down, you know, and not only that, moved straight into management positions. I had, I don't know, four or five guys working for me, and just about everybody else had people working for them, Americans, and I was really astonished at how well we were received.

Now, one thing that we didn't do, which I know the Germans did at Marshall, we did not form an old AVRO group, you know, and stay close together. We integrated from the word go, and some of our best friends were Americans, you know, rather than Canadian or English. So I was pleasantly surprised, and I really take my hat off to the folks. They really accepted us, although obviously every now and again there would be a statement, like one time one of my colleagues was a person from Georgia, and I remember him, we had to converse on the phone when I was at St. Louis. He'd say [imitating accent], "Rod, I wish you'd just talk English." And I'd say, "My dear Jerry, I speak nothing but." [Laughter]

And then every now and again one or two would make a few slight digs at the old dominion and the old country and so on, but it was all in good fun, really.

That's why we came down, because Gilruth was short of really experienced people to put in at that level. He'd robbed Langley of just about—in fact, the Langley director told him, he said, "Bob, I know what you're trying to do and I'll support you as much as I can, but you can't rob any more of my people. You've got to take some dead wood." And Bob said, "I don't want dead wood. This is a young tree." [Laughter]

So that's when he—you know, when Arrow was canceled, Bob knew to some extent what we'd been doing, because he'd been involved with PARD, the Pilotless Aircraft Research Division at Langley. And we'd fired stuff off from Wallops and been involved with the tunnels at Langley and Ames and so on, so they had an idea of some of the talent. And all of a sudden there was this talent available up there, and so that's how we came in.

We came in pretty quick, because when we went to the consulate in Toronto, they said, "Boy, somebody's pulling strings for you guys," because we went within a week or two of accepting the offer, and they said it usually takes six months just to get an interview. Two months after the Arrow shutdown, we were crossing the border, coming to the States. I understand later that it went up pretty high, probably to the White House, I think, to get approval.

For some years, at least the early years, I didn't think much of Diefenbaker. I thought old Dief had done us a pretty dirty trick, but as time went on, and I got more and more into the space program, I finally realized old Dief did me a good turn, because he put me in on one of the most wonderful careers. He didn't know it. [Laughter] He probably wouldn't have done it if he'd had known it, but he accidentally put some of us on a really fascinating career. So now I don't think so harshly of Dief as I used to. I say, "Well, he stumbled into that one, but it was luck, dumb luck."

So I think our acceptance was quite remarkable, it really was, and I can't praise Bob Gilruth high enough, though, because he was really the one who set the tone. To give you an example of the sort of thing Bob would do, when I went to St. Louis, I was the resident capsule engineer, and under Civil Service regulations, you were on travel for six months before you got a paid [trip] to come home, and Bob said, "I don't like that. I'm going to have a staff meeting every other Saturday morning and I want you there."

So I'd fly from St. Louis Friday night and get home a bit—well, I'd get to Newport News Airport, such as it was, about 1:30 in the morning, Saturday morning, and have about four hours' sleep, go to the staff meeting. Bob would run it from about nine till noon, and then he'd say, "Well, you don't need to go back till Sunday afternoon." So I got to see the family every other week. Otherwise, it would have been a pretty tough row to hoe, but that was the sort of man he was. He had a lot of concern for his people, and he was a great engineer, too. Of course, he got me on paraglider, but that would have been good if it could have worked, but we were trying to match a research program with a production, and that's always tough, so that was that.

Anyway, I think the way people accepted us was tremendous, it really was, and I can't say good enough things about it. It was good. Because it would have been so easy for there to be a "we/they" sort of thing, but I guess we were spread through the organization so much that there weren't too many of us working side by side.

An interesting thing is that when it came to, like by the time Apollo 11, a lot of Canadians would like to say, "Well, the Canadians helped put Apollo 11 on the Moon." I said, well, you know, of the thirty-one of us who came, there were eleven left on the program by the time of Apollo 11, eleven or twelve, and two-thirds of those were all U.S. citizens, because we'd taken out citizenship. So that sort of squelched "the Canadians landed the men on the Moon," much to the disgust of some Canadians, but, you know, I said, "Well, you've got to tell it like it is," so that was that. But it was a good experience.

BUTLER: It sounds like it. I do have a couple other questions, but if we could go ahead and change the tape.

ROSE: Sure.

BUTLER: You mentioned earlier that you would have never imagined where your career would take you, and that, actually, you at first weren't even going to accept the NASA offer, but you did. What did you think when you first heard President [John F.] Kennedy's challenge then to make it to the Moon in ten years?

ROSE: I thought it was a heck of a challenge. [Laughter] A lot of people thought it was nuts, but we said, hey—well, we'd been working on it, you know, doing some preliminary work, so we knew that it was feasible, but we knew there was an awful lot that had to be done, and so we just looked at it as "Hey, it's a challenge. We'll go do it."

You know, the nice thing about working for NASA as opposed to working in the aircraft industry, all too often in the aircraft industry, you'd spend years and an awful lot of your time designing, developing an airplane, only to have the darn thing canceled, or, you know, six of them built and that was it. Every program that I was involved with in NASA went from alpha to omega. That, really, from a professional point of view, is one of the most satisfying things you can have, is to really see the thing through, all the way through to the end. It makes a big difference, I think, because the cancellation of the Arrow was about the last straw.

I did have another job offer. That's why Jim Chamberlin had to twist my arm, because after we'd heard all the speeches and everything, the Aeronautical Research Council, I think they called themselves, at Ottawa, who did wind tunnel work and stuff like that, had called me up and offered me a position there. Well, Ottawa, if you haven't been up there, it's a pretty cold place in the winter. I thought about it, and, in fact, they called me with the final offer the day after I'd got the offer from NASA and was set to cross the border. I said, "Hey guys, you're just a couple of days too late. I've just agreed with NASA. I'm going."

So they said, "Well, why don't you go down and try it for a year, and if you don't like it, come back. There's a job here waiting for you."

And I said, "That's nice." So that's what we did, but after a year, I was so enmeshed in the work that I didn't even think about it. We got looked at as those bunch of folks that talk funny. I mean, even the Canadians would say "aboot," stuff like that. So we generally had fun that way.

BUTLER: It sounds like it all worked out pretty well.

ROSE: Yes, I think it did. I know Bob Gilruth was pleased, I think, I hope, with what he got, and we certainly were pleased to be down here. It was a great thing to be involved in it. It was an opportunity that you couldn't dream of, and certainly not one you could say, "Well, I'm going to work towards that," or something like that. It hadn't happened.

When Kennedy made his announcement, it really wasn't so much a surprise as it was a confirmation, because initial studies had already been done, and it was a question of getting the administration wheels in motion and then getting Congress behind it and getting the money and everything like that. That was one of the really helpful things with Apollo and that was…I won't say there wasn't any limit on money, but from an engineer's point of view, you could approach every problem two ways and you could follow both solutions through to the end, do testing on them and everything, and then pick the best one.

When we got to Shuttle, things were a lot tighter, and we had to—we, not me, but collectively—we, as an organization, we had to make decisions very early on about the path we were going to take, and then you had to suffer with whatever decision you made, because there wasn't enough money to do two separate approaches, so you had to hope you guessed the right one early on.

The other thing that happened, which has plagued, I think, the program all the way through, is spares. One of the problems, any logistics guy will tell you, "You guys were crazy, because you only operated on about a quarter of the logistics you should have." You know, a good military logistics guy would say, "I don't know how you could work that." And the net result was that something would go wrong on a system or a subsystem on Shuttle and you'd have to rob Peter to pay Paul because you didn't have a spare, so the next vehicle on line you had to break into a system, take that component out, put it in here, check it out here, then when the new component came, you had to put it in this one and recheck all that, and that's pretty expensive and time-consuming. That's one of the problems of not having enough spares. But it was a choice that was made deliberately.

I know Bob [Robert F.] Thompson would have loved to have had more spares, but the budget just wasn't there, so, you know, you had to pick the lesser of two evils and you gambled that you wouldn't need X number or two X spares instead of half X, or something. And very often it worked, sometimes it didn't and then, you know, it'd give you hiccups. And then the media would get on to you for delaying flights and things.

BUTLER: Talking about spares and situations like that, you talked some about Apollo 8 and that it was a very big highlight of the whole program, but when they initially made the decision to go and there weren't any spares, like the single engine and so forth, was there a lot of discussion surrounding the wiseness of that choice?

ROSE: Some people did. From the ops point of view, we didn't, because the program office—I know I had lots of discussions with Owen Maynard about this, because he was heading up the effort in the program office, and Owen wanted to do a deep space flight, out to the lunar vicinity and come back and we said, "Owen, if you're going to go that far, why the heck don't you go around the Moon?" Because you're in deep trouble either way, if something bad goes wrong.

And that's when we started putting down all the pros and cons and everything and said, "Hey, if you're going to go that far out—" No, not for Apollo 8, I'm sorry. For Apollo 10. Owen wanted to do a 10 that went out a long way and came back, and we said, "Hey, if you're going to go that far, go the whole hog with a LM and put it in orbit around the Moon, and then we can practice lunar rendezvous and all that good stuff."

Sorry, that wasn't 8. Eight wasn't a big debate. Well, there was a debate about sending 8, of course, but we didn't have a lunar module and we didn't want to do another Apollo 7. I mean, we'd been there, done that, so what was there to do? Well, I don't know who first came up with it. I suspect it was George Low.

I've worked with George, by the way, ever since I started at NASA, because when I first came to NASA and got the Little Joe [systems] engineer, George was the manned space flight contact at headquarters for the head of the program out there. I got to know George real well, because he and I would spend a good two or three hours every evening, going over every detail of what had gone on during the day, on the capsule, the booster, and everything else.

George was a meticulous engineer. He was a damn good engineer. I got to know George pretty well, and he was a good troop, he was really was. I enjoyed working with him. I have a sneaking feeling that he was one of the people who came up with the Apollo 8 thing, but like I said, the free-return trajectory already existed. Morris and the guys had already been there and worked that, because if we hadn't done that, Apollo 8 couldn't have flown, because we certainly couldn't have got it ready in that short time. I mean, there were probably at least two years of work had gone on beforehand, getting all the T's crossed and the I's dotted in the translunar trajectory and everything else.

I was not involved in terms of doing what I call the detail slide rule work. I was the enhancer, if you like. I'd just get all the right people together and make sure that they were going in the right direction or move them this way, move them that way. Say, "Well, we're not doing this, we're doing that," sort of thing. So I was the implementer, if you will, of the thing, an integrator. But somebody's got to do that. A lot of people said, "Boy, terrible job." I said, "Well, it's a fun job." You get to corral all these people and get them working together and doing the right thing. It's pretty satisfying. Hard work, really, because at one time on FOPs we were running—oh, [well], we had three or four mission FOPs a week that we were running, as well as CADSIs and radiation constraints panels.

I was the perennial meeting attender, because Aaron Cohen ran Level Three boards I had to sit on as a board member. Bob Thompson ran Level Two boards I had to sit on as a member, so I did an awful lot of sitting and what have you. I was, I'm afraid, rather renowned for not being what I call a head-nodder. You know, when you have a big board meeting, a certain percentage will agree with almost anything, and I was one of those who would always say, "The king's got no clothes. What do you want to do that for?"

Eventually, I don't know whether people objected to it too much, but that's why Bob Minor hired me to be his guy at Rockwell. He said, "I want someone who's independent, who will tell me which way is which, whether I like it or not." And I said, "That's what you're going to get." So that's what he got for four years.

But on Apollo 8, I know Chris and George and them were involved in that and we just got the thing, you know, Chris said, "Hey, we're going to go to the Moon instead of another around-the-Earth thing, and get going." And so that's when we started the FOPs on it and got going on it.

BUTLER: Apollo 8, obviously very successful. Apollo 11, very successful, and they started the whole program of the actual lunar surface activities, but then by Apollo 17, it all came to an end. What were your thoughts at the end of the program?

ROSE: I thought it was a terrible waste. We had at least one more booster that we could have done a flight with. When you stand back and look at it and think of the terrible waste that goes on with other stuff that Congress, bless them, in their infinite wisdom, get involved in, and then you think, boy, you know, what could we have done? But I guess politically, you know, the public had got to where it was ho-hum. I mean, the networks hardly even carried the launch anymore. It's amazing how rapidly the public can lose interest in things. I mean, the first Shuttle launch is, boy, you know, it was, wow, real-time coverage and everything. Pretty soon you got to the state where you've got a two-second blip on the six o'clock news if you're lucky. They say, "Well, so and so was launched today and it's going in orbit all right." You know, that sort of thing.

So I'm afraid the attention span of the average Joe Blow, Jane Blow, in the American public, is remarkably short, unfortunately, [and] Congress, unfortunately—I always look at politicians, they either have a two-, four-, or six-year attention span, and if it ain't on their watch, they're not too interested. Now, the Apollo Lunar Surface Experiment Packages, you see, would have gone on for a long time, and when I think of all the waste that goes on and the fact that we lost all that data and a chance to get more lunar material, I think it was tragic. We did all that work. We got all that skilled team together. I mean, that team, I don't think we've ever had it before or since. It was a remarkable team of contractors, NASA personnel, military, and it was just one heck of a team. I think psychologically it was really a booster for this country. I know it was a Cold War thing, eventually, as it turned out, but I mean, psychologically I think it gave the country a real shot in the arm.

Now, of course, all we hear is, "Well, if you [could] send a man to the Moon, why can't you do so and so?" I say, "Money, people, skills. Give us those three and we'll do anything." Give them time. Sorry, you have to have time as the fourth element.

So, it was sad. Really, it was sad because we had everything in place. We'd done the planning, we knew we could do it, there was another all set to go. It just seemed a horrible waste. But, you know, having lived through many aircraft cancellations in my career, I said, "Well, ho-hum, another one." At least we landed on the Moon and did our stuff. So, really, you have to say the program overall was a tremendous success.

BUTLER: Tremendous success. And like you said, it took tremendous people in many situations to make it happen. You've mentioned some of them today, Gilruth and Chris Kraft. Are there others that you can think of and their impact on the space program?

ROSE: Oh, yes, [including Bob Carlton, who was my right hand in the later years]. You could go through the telephone book of people at JSC, [GSFC, KSC,] and Rockwell and Grumman and MIT and Headquarters, even, bless them. I mean, we had to have the headquarters people. Marshall, I know, used to kid that Uncle Willie, [Wernher] von Braun, you know, because at one time we were sort of deadly enemies, but that was all by the board. And there was a lot, a lot of people who really sacrificed an awful lot of their lives and effort and contributed enormously. I mean, that was the beauty of Apollo. It wasn't one person or one team; it was really an integrated army of an awful lot of dedicated people, and not just the engineers. I mean the support people, we couldn't have worked without them. And like I said earlier, the wives and families. So it was really a terrific, concerted effort.

I even hated to name any names at all, because I'm terrible on names to begin with, but there are so many people who were involved. Max, for example, was intimately involved. There are so many people involved. Out of our group of twenty-five, I've only named about three or four of them, and everybody played their part. You know, there were loads of them. A lot of people tended to just give the astronauts the main praise and then NASA, and I said, "Well, you know, there's an awful lot of contractor people who put in just as many hours as we did, worked just as hard and everything else. It was just a terrific team effort." And that's what it takes.

If we're going to go back to the Moon or go to Mars, it's going to take a similar dedication of the administration, the people of the country, and putting teams together like that, because it's a big challenge, and we're trying to do Space Station on less than a full team. It's like playing football with only seven guys on the field. You're liable to get clobbered. I mean, that's not to denigrate the people that are in it, they're doing the best they can with what they've been given, but I wish they'd have been given a bit more. You know, it's a shame.

But I always liked the—we used to have a motto they put on the old, I think it was the Space Roundup when it first started. It was a Browning quote, it said, "Ah, but a man's reach should exceed his grasp, or what's a heaven for?" I said, "That's it."

BUTLER: That's great. Very good motto.

ROSE: So, that's space.

BUTLER: Thank you.

ROSE: Thank you.

[End of interview]