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ORAL HISTORY TRANSCRIPT

DR. ROBERT B. VOAS
INTERVIEWED BY SUMMER CHICK BERGEN
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BERGEN: Today is May 19, 2002. This oral history with Dr. Robert Voas is being conducted for the Johnson Space Center Oral History Project in Vienna, Virginia. The interviewer is Summer Chick Bergen.

Well, thank you. Thank you for allowing me to come here today and talk to you.

VOAS: Oh, well, I'm most happy to do it. It's looking back a long, long ways, but actually I've had three things come up just in the last week with regard to the space program, which I've been away from for many years.

I went to Montreal [Canada] to a meeting on NASA's flight surgeons last week, and happy to accept an award they were giving to the first life science group on space. So that just happened to come up at the same time that this came up. I've also been working with the daughter of [M.] Scott Carpenter, who's been working on the book that will be released in July as an anniversary, fortieth anniversary, of his flights. So all of a sudden, several things have come up here at the same time.

BERGEN: Things happen that way, doesn't it?

VOAS: Yes, it does.

BERGEN: Well, let's start back at the beginning of your career or even your education. Why did you decide to go into the field of psychology?

VOAS: Well, my father actually was a school psychologist. But I was initially sort of interested in political science, but I got interested in psychology, and I was at UCLA [University of California, Los Angeles] at that time. I had gotten my B.A. from the University of Chicago [Illinois], but moved out to UCLA. It was during still the Second World War, in that period. I got interested in psychology and as a graduate student. Then I worked in experimental psychology.

As I left the university with my Ph.D., I was still draftable, but there were many psychologists during the World War II that worked on military projects. The applied side of experimental psychology is often called ergonomics or human factors engineering, are two other terms. So the first year I was out of school, I was deferred and worked with the Navy at the Navy Electronics Laboratory, and we were looking at a number of engineering issues on defense systems there.

One of them was the dipping sonar for helicopters where they would try to detect submarines by coming close to the surface of the water and dropping sonar heads. So we had some research work on that, on how the pilots could maintain the stability of the sonar head. So that was the kind of work the psychologists or so-called human factors engineers sometimes or ergonomics were doing at that period of time.

But since I had a deferral during World War II, I was basically draftable till I was age thirty-five, and I decided I didn't want to be essentially subject to the draft, not knowing when I

might be drafted for that period of time. So I took a direct commission into the U.S. Navy and wound up at Pensacola, Florida, in the Navy Flight Medical School. There we had a group called the Aviation Psychology Laboratory, and our job was to work on selection methods for aviators using selection tests, and then we were also involved in the process of selecting them during training. In those years, about half of the individuals, of the cadets that would start in flight training, would not complete it. They would either fail to some portion of the program, or they'd drop out at their own request, because of what was called a DOR.

Our job was to try to determine whether there were better methods for selecting pilots so that we might have fewer that dropped out, because that could be fairly expensive. But, on the other hand, it was a good thing that it happened, because when the Navy began to try to get more through and have fewer drop out by lowering the flight standards, when we followed those people into the fleet, we found that it didn't work, that within a year or two they either had desk jobs or they had crashed. So you didn't want to lower your standards. That was the kind of work we were doing there.

After three years in Pensacola, I decided to stay with the Navy, and I moved up here to Bethesda Navy Medical Center [Maryland] to work with Norman Lee Barr, who was a captain in the U.S. Navy and had sort of the sobriquet as the head of Navy space medicine and sort of unusual, because I don't think—there was [Wernher] von Braun working with the Army, and they, of course, had a major market program, and then there was the Air Force, and they had high-altitude flight and rockets. But the Navy really didn't have much of that kind of a program. But one thing that they were involved with was the Project Strata Lab, which was high-altitude balloon ascents, and until Project Mercury that was the highest altitude that man had ever achieved, was in the balloon. He got up close to 100,000 feet.

Norman Lee Barr, who I was working with there, his specialty was telemetering the physiological signs, like they do all the time now in the space program, heart rate and breathing, someone to monitor the physical condition of the pilots in the Project Strata Lab. So I worked with him on that, and we did some other research on high-altitude flight. So that's sort of how I got into the business of aviation and high-altitude flight.

When the space program began to come along, there was interest in sending up animals in spacecraft, and the first of that that occurred out at White Sands [Test Facility, Las Cruces, New Mexico] and was actually, I guess, I think it was either Air Force or Army. There was one of the so-called "Paper Clip" scientists from Germany, from von Braun's group, who went out there, who was a psychologist named Gerthaball [phonetic]. Anyway, he had set up some mics [microphones] in the nosecone of the military vehicle, and I remembered being quite interested in that. Then when Sputnik came along, why, there was interest in the development of manned space flight.

So Norman Lee Barr, whom I was working with there, and a Captain Ashton Graybill [phonetic], who was the head of the Space Medical Center in Pensacola, whom I had worked for before, became interested in the possibility of animal flights in spacecraft. So that was one of the things that fell to me to develop, since I was working with Captain Barr, and we put in an order for squirrel monkeys out of South America and brought them up.

Captain Graybill was sort of the view that we would not be able to have a form of life as high or at the level of a monkey because the military spacecraft, or military rockets, I suppose we should say, unlike manned spacecraft, have a very steep trajectory up and down, so that the acceleration loads would be up to thirty G regularly for an up-and-down flight, and the feeling was that animals couldn't survive that very well. Graybill had sort of felt that we'd have to send

up something like frogs or turtles or whatever. But with like of flying, why, we wanted to have something more in a higher level than that.

So we brought the squirrel monkeys over, and I took them down to Eglin Air Force Base [Florida] centrifuge. We found a way of protecting them against the acceleration by actually we floated them in a sort of dental cement which had a lot of water in it, so that as the acceleration increased, their bodies were compensated with this water pressing down on them, and we were able to have them survive acceleration loads up to sixty Gs.

So actually, the first flight of a primate in the United States was one of our squirrel monkeys. There's one little older alive over, another one called Sam or something. Actually, the animals survived the flight, but it went into the Gulf of Mexico, and they didn't recover the nosecone on one of the flights. Later in Project Mercury, they flew chimpanzees, as you know. But those were the first primates that were in the air.

So we were working on that activity when the Congress decided to award the space program to NASA, well, to then the NACA [National Advisory Committee for Aeronautics]. The NACA was, of course, a premier engineering organization but, I think, by policy had not formed any sort of life science work in its laboratories. They had some what would be called human engineering done by engineers. Human engineering, you can either be, if you like, a psychologist who works from that side of the field, or the engineer that works in from the other side, and you're dealing with controls and integrating a man in with a machine, mostly a plane, of course, but it also applies to cars and trains and boats and everything else.

So the old NACA had a remarkably fine reputation as an engineering group. But, unlike the other two contenders, one of them being the Air Force, wanted that space program, and the

other, of course, was the Army with von Braun, both of which had some medical background, particularly the Air Force. The NACA did not.

So when the decision was made by Congress to award the program to the NACA, which I think actually from what I remember of the newspaper and so on, was an outgrowth of the decision Congress had made about atomic energy. After World War II and the actual use of the atom bomb, there was a contest again as to what branch of the service or who would manage the development of atomic weapons. Again, that was taken away from the services and put into a civilian agency. The same sort of thinking, I think, at the congressional level made this space program move away from a military agency and into a civilian agency, but that civilian agency had none of the human factors and medical background. So when that assignment was made, NASA—NACA at the time—went to the three services and asked them to form a high-level committee to deal with the problem of human factors of medical issues.

They did that, and, of course, when they came to the Navy and looked down the list, here's Captain Barr, that sobriquet that says Chief of Space Medicine, and so he was on that along with a General Don [D.] Flickinger from the Air Force. At their first meeting, I think they were all wise enough to see that you weren't going to be able to run the Life Science Program by having captains and generals meet once a week around a table in Washington. So each service agreed to send one officer to the NACA to actually work every day at the program.

So I came into Captain Barr's office just after he came back from that meeting, and he said, "Tomorrow morning you'll report to Langley Field [Langley Research Center (LaRC), Hampton, Virginia]," and I did. So that's how I came to get to Langley Field at the beginning of the space program.

When I arrived the next morning at Langley Field, they were forming an organization. I'm not really sure whether at that point they had the term "Space Task Group." It was quite new. There were, I think, less than two dozen people in Langley. We were in the Unitary Wind Tunnel Building, and my first interview was with Chuck [Charles W.] Mathews, who at that point—there was Bob [Robert R.] Gilruth, and there were two divisions under that. One was operations, and that was Mathews, and then Max [Maxime A.] Faget was the design team head at that point. I'm fairly sure Chuck wasn't really sure what to do with me. [Laughs] He didn't know what to do with the psychologist who arrived. But, clearly, I, as a psychologist, was to be in some way associated with the pilot of this vehicle. Again, we didn't have a word "astronaut" at that point, and so he welcomed me.

This was about a week before the NACA officially became the NASA, and I think it was in September of—that would have been [19]'58, I think. So that's just forty-four years ago now. But I was there then from that point on through the Mercury Program until somewhat after the early orbital flights, and I left with John [H.] Glenn [Jr.].

About a month to six weeks after I arrived, the Air Force representative arrived. He had to be run down by the police driving across the country. Stan [Dr. Stanley] White had been transferred from the East Coast to the West Coast, and then he was assigned to this job. I guess he was out of touch with them, and they sent out a sort of all-points bulletin to have him come back. So he came there, I think, about thirty days after I got there.

There was a physician came from the Army, but only stayed, well, I don't know, a day, just a couple three days, and they decided that he was the wrong assignment for that. Then they sent, shortly following that, Bill [Dr. William] Augerson. So it was the three of us, myself and

Bill Augerson and Stan White, that formed the first life sciences team, and we were in place about October of '58, when we began working Mercury.

BERGEN: So what was the direction that you were given? What were your instructions as part of this new organization?

VOAS: Well, it was sort of clear that I was to have something to do with, as you say, with the person that was going to ride the vehicle. At that time, we didn't have a name for it either, and "Mercury" came later.

I clearly remember my early assignment was to work on the selection of the astronauts and then to develop the training program for them. But when I arrived, there were just forming the writing-up, the procurement program for the Mercury capsule, the RFP, Request for Proposal, that was supposed to go out to the industry and get responses.

So actually one of the very first areas I was working on was the design of the spacecraft, proposed controls and displays. So we wrote that. I helped prepare the briefing for the potential manufacturers who came in to be briefed on this procurement. Then they responded with their proposals, and I was on the review board for the proposals, most specifically for the pilot's compartment, the controls and the displays and the general provisions for what would become the astronaut.

So that was really one of the early places worked on. There were also tests that were going on. One of the early issues that came to me was the spacecraft was designed to land in water, and if it landed in water, it would be cushioned. But if something went wrong and it landed it on land, then that cushion wouldn't exist. So they were trying to work out ways to have

crushable structure between the astronaut and the ground, sufficient to ensure that if it hit land, they would not be injured.

One of the devices that was developed for that was the so-called air bag, which was behind the heat shield and between that and the spacecraft, and that that dropped off as you were coming down in the parachute. So if you hit the ground, you would have that as a buffer. But beyond that, between the spacecraft skin and the pilot, there was to be a molded seat, and that was to have crushable structure, too, a structure that would crush, and it would reduce the acceleration mode on the pilot.

They were trying to determine how much they needed and what kind of materials and so on, and what they wanted to do was to drop people or to drop someone. Actually, what we needed was to decide what kind of animal you could use in those drop tests, which would give you a good picture of the injury situation that might affect a human, but you weren't actually subjecting a human to being injured. So that was one of the issues that came to me, and I checked around.

We decided that a pig was the animal that had an interior structure basically most like a human being. So for the drop tests they began to use pigs. That had a sort of humorous little event because, again, they were using couches, so they molded couches to the pig so that he would be lying on his back with the legs sticking up, and then they'd drop it in that way.

One of the cases, they had the pig all ready to be dropped, and he was strapped in this molded cage. Apparently it was lunch hour, and everybody went off and had lunch and came back and found the pig dead because pigs can't live upside down. So that was sort of a shock, and it was a little bit—that was more sort of funny. But throughout the program, we had planned

to use animals in situations to test for, like, the life support system. That's why we sent monkeys.

But it turned out that you had to be very careful, because the press was following the program so closely that if one of your animals you used died, the issue would be "Wouldn't the astronaut be dead?" and then that would raise a whole issue about whether you were ready to fly or not.

So we weren't able, I think, to use animals as much as we should have to, or would like to have had, to build up the tests. A particular case I remember that was an illustration of this was that there was to be a chimp flight at one point on one of the—I think it was one of the Atlas launches, where you have all these pieces of the system coming along, the booster and the spacecraft. Then there was a tower which would pull the spacecraft off the booster in the event that the booster was likely to explode, or if there's an emergency. So that was the safeguard for the astronaut on the flight.

But when it came to this test they wanted to run, they didn't have a tower ready, and the tower was costing something like $500,000, and they wanted run the test without the tower. But I think the decision came down they couldn't do that, because had something gone wrong and the chimp in the test, they had not been able to pull him away, there would have been a public relations problem.

We also being overseen by the president's scientific advisor. [President John F.] Kennedy assigned to him and to the Scientific Advisory Committee the authority to approve the decision of when we were ready to fly. So everything you did, they reviewed, and you had to be careful, again, about tests that might go wrong, and being that you'd be further delayed in getting their approval.

So whereas biologists and medical people were used to using animals in experimental form where we wanted to make tests that ultimately protect the human, you couldn't go as far in that way as you might well have expected to, because of the public relations problem. It's sort of interesting.

More recently, one of the fellows that worked with me before we worked for the space program had a whole career in training and studying primates, and he came by and said that currently now one of the problems for supporting primate research is that a chimpanzee, for example, which is most frequently used and which we used in the Mercury Program, when they get, oh, I don't know, something like fifteen to twenty years old, after they've been in experiments for a while, they're not longer flexible enough to use, so you have to retire them. But you can't just euthanize them, because that isn't permitted. So you have to have a retirement home for chimpanzees, and you have to put them into the home, and it's very expensive. So a good part of the cost of working with primates these days is paying into their retirement system so that they can retire. It's just sort interesting, but we need to do that in these cases. I know there are people who feel very strongly about it, but it's sort of interesting in terms of the whole use of animals and, in this case, in space flight, because here it was perhaps particularly significant because nobody had ever been in space, and you wanted to have some feel for the problem with an animal as close to the human as possible before you actually launched. But there were a lot of restraints on that eventually, so you have to be very careful.

I diverted. But that was another thing that was occurring in this early period, before we actually had astronauts onboard.

But, anyway, I came in then in late September of '58, and one of the activities that was occurring was requesting proposals for the spacecraft and getting them in. The other activity that

I was most involved with was the development of a selection program. Initially there was a question about what should the selection program be, and it came down, in a way, to what you thought the astronaut was going to do in the project, and this became quite an interesting issue. It's sort of ironic. The Congress, as I said, decided to award this manned spacecraft program to an agency which had a fine engineering program, but had no life sciences. Within NASA, or the NACA, the major flight work was all done out at Edwards [Dryden Flight Research Center (DFRC), Edwards, California], you know, where they had the X-15, and there was quite a bit of work going on in the near-space environment there. But that isn't where the NACA assigned the project. They assigned it to here on the East Coast at Langley, and they assigned it to the Pilotless [Aircraft] Research Division [PARD]. So the U.S. Manned Program was assigned to the Pilotless Research Division of the NACA, sort of ironic, of course, the very fine engineers who well understood the problems of launching and recovering spacecraft, but they had essentially no background, really, in dealing with pilots, and the vehicles that were designed, in some sense, did not need anybody to fly them. They went up, and the design of the Mercury spacecraft was such that when it starts to come down, it is stable only in one direction, so then it stabilizes itself without actually any control. It can have quite a bit of oscillation around that, but the Faget design was such that the flight could be accomplished and the vehicle returned without actually any real control system by the pilot.

So one of our problems initially was just the question of what was the man going to be allowed to do? How would he be built into the system? This cut in several different ways. For one thing, we had sort of heard from the group out at Edwards that no self-respecting pilot would agree to fly in this thing because it was just going to be "man in a can." You know, he'd just be another monkey. So that, you know, unlike the X-15 or the X-1, where the pilot was very

essential to those safe flights, this was one that could go and come, in concept, at least, without a pilot.

Of course, on the other side, the engineers wanted to build, or were used to building, spacecraft that were integral in themselves and would need a minimum of any sort of control. You had to control the launch, the flight trajectory of the booster. But once, in a way, that was done, the spacecraft would return, or once you got into orbital flight, of course, you had to maintain some attitude control on it.

But potentially you could see the man as just along as a passenger, you know, with nothing to do. So one of the early issues was to work out what was going to be expected of the pilot. Much of the subsequent thought about the selection and what went into training rode on that kind of an issue. Was this just someone along for the ride, or were they expected to be a very significant part of the operation?

That was one of the early directions I got from Gilruth. Of course, I was sort of probably young and a little naïve, but I think that we were sort of awed by the feeling that you were involved in the selection program for someone like either [Christopher] Columbus or [Charles A.] Lindbergh, depending on who you wanted to choose. [Laughs] You know, it would sort of be the next American hero, and I think that came through pretty strongly for myself, and probably for the others in the Life Science Program, that one of the things that was going to happen here is that once you had astronauts, there was going to be a tremendous focus by the public on them. They were going to come to not only represent the program, but often that they'd possibly be American heroes and so on. So there would a whole set of, if you like, requirements or features to the job.

But we were working, again, with the Pilotless Research Division, and I think in the old NACA they had pilots, but they were very much a part of sort of the engineering team, you know, but outside of the group there was beginning to work with the X-1 and the X-14. They were not sort of an independent organized group.

So one of the first things I did was to write a little memo for Gilruth, asking him, you know, "What is it that we're supposed to consider in this?" Obviously, I asked these questions about the importance of a man in flying and operating the vehicle, but I also asked about the significance from the point of view of public relations and asked questions that continued to come up all the time, like, were we concerned at all about having a mix of ethnicity? Were we concerned about whether both men and women should be included? Were we going to consider foreign pilots or anything?

But I think that was very premature for the engineering group to think about any of those things, and the focus that Gilruth directed was very much on the engineering, having someone who would refocus on the need for that person in operating the vehicle and not really put anything into the selection program having to do with anything else, you know, like the public relations issues and so on.

So the program became early for the selection very much focused on technical capability, and it was also seen as likely to be very rigorous, physically demanding, because of the nature of the launch here, the seven-G launch, and then you're in space. No one was quite sure what weightlessness would involve, and then you have the reentry.

So we started out by designing a program which would have hired what became astronauts or pilots through the regular civil service system. A Dr. Alan Gamble [phonetic] from Headquarters in NASA, who was with their Personnel Department, participated in that and

helped us develop the standard civil service announcement. The requirements in that were really of two types; one, to have a significant scientific and engineering education background on the one hand, and the other, to have a significant history of having been involved in a physically demanding profession, pilots an obvious example, but we didn't limit it to that. There might be those that were involved in things like parachute-jumping and in the military, the airborne, or those who were involved in underwater exploration, or others. But you had to show this combination of both having the engineering or the scientific background, a significant background, and/or this physical—but not "or."—*and* the physical.

So we started out on that basis, and that was approved up through the NASA Administrator. Just before the announcement was to go out for a national—well, I guess it would have turned out to be sort of contest, you know, a national selection process, the NASA Administrator took it over to [President Dwight D.] Eisenhower just to get last-minute clearance on it.

What I had heard about that meeting was that Ike [President Eisenhower] was concerned that at that point—you have to put yourself back fifty years ago. The Russians had launched these large space vehicles with, like, a dog and so on, and at that point we'd only had one satellite, and it was described as grapefruit-sized. I think that Ike felt that it would be embarrassing, you know, for us to be going out to select astronauts when the best we could do at the time was a grapefruit-sized satellite.

So, anyway, he had agreed that we would do this, and in secret, basically. So that turned the system around. We needed to work through the military, which was the only group where you could call in individuals, pilots, and be able to interview them, put them through tests, and so on, without it becoming a public matter. So in January, that would now be '59, there was a

meeting in Washington, and it was agreed to change the process then and to use test pilot school graduates. So that's where that process then started, which wound up with the selection. I think it was in April then of '59 that the group was introduced.

But that new process then was dictated by Ike. We went to the Pentagon and were able to get the Air Force and the Navy to pull the records, the personnel records, of everyone who had graduated from the test pilot schools for the last ten years, I think, something like that. So our first operation was for myself and Alan Gamble, and Stan White was involved in some of this, too, to go through these personnel records and examine them for a certain set of basic requirements and the minimum set of flight hours. Of course, they'd graduated from test pilot school. We wanted people with a college degree.

So we started off with some 500 of those from the two services. They also had their medical records as well as their personnel records. So they went through the medical records to make sure that each of them was in good physical health as represented by the medical records. Then you went through the flight records to select them based on the reports of their superiors through their military records, make sure that they had the minimum flight time, and look at the type of flying that they had been doing. So we were doing that in January of that year. I remember it was quite cold and snowy. I kept losing my car in that Pentagon parking lot, which is so large. [Laughs] You would have a hard time figuring out where it was at the end of the day.

But that went fairly smoothly, an interesting process. I had one shock at one point because we were given a special room in the bowels of the Pentagon to do this work, and all of these service records were brought down there, and most people don't, I think, really understand the significance of a service record, but the Navy really doesn't have any people in that; it only

has service records, and if you lose the service record, the person's gone. That's where you find them. So you have to be very, very careful with those records.

One time when we went out to lunch and came back, and this big trolley with all the Navy service records, for which I was responsible, because I was the Navy representative, disappeared. [Laughs] I thought my career had just come to an end, but it turned out that someone, the cleaning woman or something, had moved the trolley out of the office while they cleaned up, and so we got them all back. But it was very important to not lose those records, because that's the whole record of somebody's career.

We went through that process and came down to, I think, something like 110 that met the various requirements as we could see them. The main physical requirement, actually, was that they had to be under six feet. That turned out to be probably too simple a definition, because we really weren't taking into account anthropometrics. People who are six feet can be six feet because they have long legs and stubby bodies, or they can be six feet because they have stubby legs and long bodies. It made a difference in the Mercury capsule because you wear molding, you know; they're sitting in the seats. It was more important, really, what the body length than what the leg length was. But what we had in the records was just their overall height, and we really didn't concentrate enough on that.

We were able to fit in everybody we selected, but there were a number of the candidates that were—well, there were several at one point or another that turned out to be just a little too tall. They were sort of scrunching down trying to make the tape on that. Bill Augerson was in charge of measuring folks to make sure that they weren't over six feet when we got to that point.

But that was one requirement, and then they could not be older than thirty-nine. We wanted, again, to look towards a fairly long period of service as an astronaut, so we didn't want

people that were perhaps already in their fifties or something of that sort. So those were all pretty simple requirements.

The key benefit we had from Ike's system was that since we could use graduates from test pilot school and we were requiring 1,500 hours of flight time, we had people that were clearly stress-tolerant, you know. If they were not successful as pilots, they either had desk jobs or they were no longer alive. So the people we were looking at, you know, had ten, fifteen years of pre-selection. So in that sense for the stress and the basic coordination and that kind of thing had all been done for us, you know, by life itself. It wasn't something we did that altered our selection program. So that was the significant advantage at that point.

So we wound up with these 110 names, and the next step in our plan was to bring them in so that we could do some limited testing of their engineering skills using paper and pencil tests, and they could all be interviewed about their interest in the program and their engineering knowledge and so on, and they could all be checked briefly, gone over their physical status with them. So the plan was to call people in, but we didn't know at that point what the interest level would be in the project. We, as I say, were being told that no self-respecting pilot, particularly a test pilot, would be likely to get in this man-in-a-can situation.

So what we did was, we divided that group of 110 into three groups. We had invited the first thirty-five or so in, and then we had two more groups to come, and we were going to do one each week for three weeks. So when I say "invited," we didn't make any communication. They were ordered in by the Chief of Naval Operations or the Air Force commanding officer. They were just told to report to the Pentagon, and they were not supposed to be told why they were doing it and so on. This was all being done in a top-secret form.

So we got this first group, and, again, as I say, key through all of this was what was this person going to be able to do. In other words, is he just another chimp, or did the astronaut-to-be play a significant role in the whole operation? So they came in, and they met with—well, the Navy folks met with the Chief of Naval Operations, and he just assured them that if they wanted to do this, it would not count against them in their careers for the Navy, and a similar thing for the Air Force.

Then they came in to us, and we did briefings that morning. One of the briefings was done by, I think, Warren [J.] North, was on the role of the astronaut in the system, and the focus of that was to try to assure them that they would have a very significant role in operating the vehicle; they weren't just sitting there being passengers. Then I gave a presentation on what the training program would involve, again, trying to stress that it was built around the concept that they were important to the mission, you know, and not just passengers.

After that presentation, we dismissed them all. I had described the next two steps in the process, which was to go to Lovelace [Clinic, Albuquerque, New Mexico] for a physical and then to Wright-Patterson [Air Force Base, Ohio]. What we indicated was that we wanted them to think about this and then come back and tell us whether they'd like to continue on in the selection program or not. So that first group came in. We really had no idea what was going to happen. We dismissed them all. They all went to lunch.

Then in the afternoon, I had appointments with each one of the thirty-five to just come in and tell me whether they wanted to keep going. You know, we were sort of on pins and needles because we had no idea whether, you know, everybody would just say, "Forget it," you know, or whether we would get some volunteers. So it was very exciting, because all but a very small

handful indicated they wanted to be part of the selection program, which was probably one big "Whew!" It was one of the great days for the selection team, anyway.

But it was very interesting. Those interviews, I think that was one of the more interesting times for me in the space program, because all of these officers, because they'd been through flight school and because they had the 1,500 hours, we were getting pretty mature individuals. These were all in their thirties. In the services, there tends to be a pathway to what's called flag rank and to being an admiral or to being a general. If you get on that pathway and you progress, you're pretty likely to make it. These individuals were all pretty much well along that pathway, and because we had started with 500 but had selected from those, these were pretty much the stars and the premier group who had been through the test pilot school.

We had a number of Navy who were squadron commanders. Now, squadron commander is an absolutely necessary step, but it's a grade step towards being a flag rank, you know. So you had individuals who had every reason to expect that they would move to the top of their services with time, and here they were being asked to take this detour, you know, and so it really was sort of amazing that we got as many to volunteer for this as we did.

The ones we lost were the ones that were squadron commanders who felt that they had a real responsibility for their squadrons. Some were deployed in important fields of the world, and they didn't feel that they could walk away from—you know, go away from that position. I'm surprised we didn't have many more of those. But I don't remember the proportion that volunteered, but probably out of thirty-five, there was only five or six that didn't volunteer.

There was one fellow I remember most in that, because he came in through the door, and he came to the chair where he sat and talked to me, and he sort of slumped into it, and he said, "You know, I just have to turn this down." Then he began telling me why. Apparently he had

just received an Air Force order to go to MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts] and get his Ph.D. in astronautics. He had worked so hard to get this, and now he was going to get a free ride at MIT in the sense that he would be paid by the Air Force to do that. He just didn't feel he could turn that down, you know, to get into this program. So he finally said, "Well, I just have to turn it down." He left the seat, and he walked over to the door, and he stopped, and he turned around and came down and sat down, and he said, "Boy, I'd like to be a part of this program."

He must have gotten up and down three or four times, and finally did not volunteer for the program, but it was just a very interesting experience in seeing the kind of career decision that these fellows had to make.

But it was very interesting because, you know, we had been quite worried that they wouldn't find it an attractive thing to do, and yet, clearly, here were people that had very much more significant things to do, who were willing to give those up to be part of it. So then the long and short of it was that we got a large group out of that first group, and that was repeated in the second week, so that by the end of the second week, we had more people than we really needed. So we never called the third group. We just had those two, and they were the ones then that proceeded through the next two segments.

I again wondered at that point because, as I said, as the Navy representative to this life science team, I was responsible for getting the Navy records, and I sort of assumed that the Marines were part of the Navy record. It turned out that I was dead wrong. Alan Gamble, in going through our list, sort of came to recognize we didn't have any Marines, and he called me about it and checked into it, and, sure enough, the graduates of the Navy Patuxent Test Pilot School who were Marines weren't in the Navy list. So at the last moment we got two Marines,

John Glenn and Bob Soladay [phonetic], who came in and were put into the group that went on to the other two tests. But we just about didn't get John, because he wasn't among the Navy records, and that would have changed history a little bit. But, anyway, that was process.

Then after that first day, they decided whether they wanted to continue on through. We did that at the Pentagon. But then they moved over to what's called the Dolly Madison House here in Washington, and we used several more days that week in having them take some tests we had developed. These were not new or different ones, but they were tests used for college aptitude for engineering. We did have one or two personality tests—one personality test, I guess, but for the most part, their focus was on engineering and on mathematics in the testing.

Then they also had an interview with Warren North and Alan Gamble, and one other, I'll think of the name in a moment, where they were interviewed about their interest in aviation and engineering and their general professional goals.

Then a third activity was that they met with a physician and went over their medical records in some detail so that we could ask questions that had come up on the review of the medical records. I think that took something like another two or three days that week.

Then each night the team met together and we would summarize all the information from the sources and discuss the individuals and make a decision as to who we wanted to invite then to go on the Lovelace and on to Wright Field. When that decision was made, then, once again, I scheduled appointments with each of those who were still remaining in the program and let them know.

I really had sort of three—well, no, there was really two things I said. One was that we definitely wanted them to go on, and the other was that we were holding them in reserve, would possibly invite them onto the other. But, again, that could be quite an emotional situation for

them, particularly, I think they—I remember that Al [Alan B.] Shepard [Jr.] later said that when he was in the interview with me, and I told Al that we wanted him to go on to the rest of the selection program, he later said he almost got up and hugged me, but he thought that might not be appropriate in the situation. [Laughter] But it illustrates, again, how anxious they were to be part of the program, which was very exciting, from our standpoint, again, as I say, because we hadn't been sure about how much interest there would be in it.

Bill Augerson was the one that did the medical reviews in Washington. So we went through that whole process the next week with a second group, and then those that were chosen went on to Lovelace and to Wright Field. The Lovelace physicals were, as has been many times described, very thorough, and they grew really out of two Air Force programs. Randy [W. Randolph] Lovelace [II] was very well known, very important in the Air Force, and he had developed this clinic basically for giving very thorough physicals to high-ranking Air Force officers, and that was its first years. Then when the U-2 program came along, this was high-altitude flights, intelligence flights, over Russia, the U-2 pilots were all put through that physical.

So it was essentially the same system that had been used in those two cases. I was somewhat concerned, in a way, about the fact that the U-2 pilots were involved with this, because Eisenhower had just been embarrassed by having one of the U-2 pilots shot down, and there was some concern, or at least maybe I had some concern, that the space program might be viewed as what it became later, but it wasn't then, as an intelligence-gathering operation.

But, anyway, that program had existed for some time. What was done was really not different, I think, for the astronauts. But they went around from one senior physician to the next and went through these various tests, and then there was a report written by each one.

I think at this point probably in the selection process was where some of the factors that I'd put in my letter to Gilruth at the very beginning began to come into play. Those that were giving all these tests, both at Lovelace and at Wright Field and certainly, I suppose, ourselves in Washington, couldn't help but react to these officers, potential candidates, to a great extent based on their personalities, you know, and how they reacted. So in addition to whether the heart had responded as expected when the foot was put in ice water, you would get a report that clearly indicated how that physician had responded and liked the individual. So you could see things begin to emerge, like, everybody liked—you know, John Glenn always had high ratings, and I was never sure that it had to do with what his heart had done. But this is how people reacted to him.

Some of the officers didn't help themselves because they would complain or get very negative or there would be anecdotes about how they'd behaved. So this process, which in Lovelace was focused on the medical health and physiology, and in Wright Field was more focused on, I suppose, the psychological status, brought in these other features to it by the way that the sort of ratings came in from all of this, and I was to collect all those and summarize them. But you could sort of see the pattern here of factors other than the specific medical tests that were making the tape or play a role.

So there was some selection for individuals that was based on their, I guess, personalities and so on, in that process. But they went then a week to Lovelace, not all at once, but in groups of, I guess, four or so, and then to Wright Field. Then all that information was summarized and we had a meeting down at Langley. That session, besides the selection team itself, we had people like Flickinger from the Air Force, and my mentor, Norm Lee Barr, were there, and they went through all the candidates and came up with a recommendation then to Gilruth. It worked

out very nicely in the sense that we had three Navy and three Air Force and one Marine, which, I guess, from a political point of view, was good, and there was certainly some jockeying for those kinds of positions.

Norman Lee Barr, for example, there was noted in Wally [Walter M.] Schirra [Jr.] in that he had a polyp in the throat, and so Barr arranged for him to immediately get—I don't know if it was up here or one of the Navy hospitals, and have it removed. I don't know if that made much difference. But that was the kind of thing that sort of went on to make sure that there would be Navy representatives in this as well as Air Force and so on.

So they came up with that group of seven, and then they were invited in to be then introduced to the press in April. Now, that was sort of a shock because throughout this whole processing, in keeping with what Ike had required, we were doing this all in top-secret. Now, all of a sudden, once the selection was made, they had a national press conference and presented them all to the country. So that seemed, like, a little anomalous with the idea of keeping this quiet, but I guess partly the feeling must have been by that time that the word would leak out anyway.

The astronauts first reported down to Langley, and actually their very first meeting that they had, they were introduced to this idea of having a contract with *Life* magazine for their personal stories. That occurred before they flew them back up here to Washington to the press conference. So that area was taken care of before the press conference actually occurred, and then they had the press conference, and then from that point on they were stationed at Langley until we all moved to Houston.

I've been going on and on here. Am I covering—

BERGEN: You're doing just fine, but now's a really good time if we could pause.

[Tape change.]

VOAS: —down to Langley, which was now the headquarters of the Space Task Group. So we began then the training program, I guess you could call it as such. The program involved several elements. One element that we had had in there since before we had astronauts was that we would assign each of the astronauts to a vehicle system. The Mercury system, like any of the space systems, has different elements. There's the environmental control and the attitude control and so on, and the booster and operations. So one of the very important features of the training program was that each astronaut would be assigned to one of these systems and would attend the engineering meetings and work with the engineers within that system.

The development of the spacecraft, it was very interesting because the weight was key. The boosters we were working with, first the Redstone and then the Atlas, were limited, of course, in the amount of weight they could throw into space. So if you're designing a spacecraft, you have to stay within that weight, and you have several different systems that you have to accommodate. You have to accommodate the structure of the spacecraft itself, whatever weight that's going to take, and you have to accommodate the weight of the electrical system, and of the thruster attitude control system with its fuel, and of the environmental system with its oxygen and so on. So they had essentially teams working on each of these systems, and they were each sort of assigned some piece of this overall weight. They had to develop their systems and get them to function reliably within that weight, and if they were having problems, then they'd have to request the chief engineer, Faget, in the early days anyway, to provide weight from

somewhere else. But if Faget was going to give more weight to the environmental control system, it might have to come out of the electrical system or somewhere else, because it's zero sum.

So these engineering meetings, I felt, were fascinating as an example of technology and human beings interacting or, stated better maybe, technology being advanced by interactions between persons. The chief engineer for the space system had to have a good understanding or feeling for all of his systems engineers, because as you sat at those meetings, you could see some engineers who were struggling with like this weight problem, would be like the squeaky wheel. They would be bringing up all the issues and pointing to the dangers and things. Then there might be others, with the other systems, that were just sort of sitting there stoically. But the requirement on the chief engineer was to understand well enough so that he would make sure that each of these systems engineers actually had the weight they needed to have a successful system.

If, for example, he ignored the one that was quiet, that system might fail, and the whole thing would fail. So it was sort of aside from the technology itself. There was this human interaction now, which I guess as a psychologist I thought was so interesting. But, anyway, the astronaut was to sit in on those sessions and to become fully acquainted with the system and to be able, among other things, for example, to answer the questions of the other six astronauts about that session, so that among the seven there would be an expert in each of the major systems.

So that was one segment. I imagine you could almost call that the most important part of the training program. The public was fascinated with things like the centrifuge and so on, but I

think the real center of the training program was their working with the engineers and coming to know those systems. So that was one part of it.

We did have a few sort of classroom lecture presentations, starting out with the general principles of rocket propulsion and flight and so on, and then dealing more specifically with the systems themselves. So there was that sort of, if you like, classroom, more didactic training.

But, I think, more essentially for this relatively mature group was working with the engineers, and that was important, too, because this was a development process, where the unit they were going to fly hadn't really been built yet and where there were a lot of decisions that had to be made along the way and where you would have tests which would fail and then you've had to decide what you had to do to make it right. I think it was important that the astronauts could participate in that. So that was probably the heart of the system.

Now, another major part, and the part the public tends to focus on more, was to put them through, to the extent that it was possible, all of the physical situations, environmental situations, that they would face in the space program. So one of those, that was considerable concern, was the very high G-loads, gravity loads, as they would launch, and particularly if there was an abort, so that then this spacecraft, rather than coming in at a rather shallow angle as it normally would on a flight, would come in steeply and there'd be very high G-loads. So the astronauts, we took them all up to the Johnsville centrifuge [Naval Aviation Medical Acceleration Laboratory, Johnsville, Pennsylvania], and they all had a chance to experience the seven-G launch profile, and some of the higher-G-load reentry profiles, we didn't put any of the astronauts up at 20 G and so on. There had been individuals who had experienced that, to show that humans could survive and so on, but we didn't want to damage any astronauts unnecessarily. So that was one example of one condition.

Then there was the weightlessness. Now, at that point you could achieve a few seconds of weightlessness by flying what were called ballistic trajectories, where their plane became weightless because it was like a projectile from a cannon. We had one large plane somewhat. It was basically a jet airliner, where we cleared out the interior so that you had something like thirty feet in length and probably about ten feet around, open. They'd fly that trajectory, and you would have twenty seconds when you were weightless. Everybody was worried about weightlessness, but that was just the most fun ever. You were Superman. You could jump and you just flew through the air, you know, and you could bounce up and down. It was like bouncing on a bed as a kid. Everybody thought that was so much fun.

One of the funny things or, you know, the humorous things about the whole thing was that, I think, the public and particularly the scientists that we were dealing with on the President's Scientific Advisory Group, all thought weightlessness was a great threat. But once you'd experienced it, you know it was just fun. Of course, unfortunately, in the Mercury spacecraft you weren't going to be able to fly through, because you were all bound down, you know. The only way you knew you were in flight weightless was that things floated around the cabin. But in this big interior you really had a good time for the very few seconds. Of course, now it's commonplace because we have large space units up in the Space Station. So everybody went through that, and that was fun for those of us who were working the space program. I got to, I think, make more of those fun weightless flights than any of the astronauts did, and I also got the experience of riding the Johnsville centrifuge.

BERGEN: What were your responsibilities on those weightless flights?

VOAS: Well, I was an appointed Astronaut Training Officer, so I was nominally responsible for the training program. But, of course, we developed the program with a lot of people contributing to it and certainly the astronauts themselves, as to what they thought they needed. The principal contribution initially from the astronauts was that they wanted to be able to continue to fly, and that caused the first public relations issue to arise in the space program with the astronauts, because they were given relatively old, limited jets to fly, which was the only thing that was available at Langley at the time, and they were very unhappy with those. Word got to a congressman, and there was something like some speeches in Congress. Then NASA felt—Headquarters felt pressured by all of this, "We're not providing the proper training for the astronauts."

There was a certain amount of ambivalence, I think even on perhaps our life sciences team part, because flying very high-performance jet aircraft is somewhat of a risk, and we didn't want to lose astronauts flying high-performance aircraft. Obviously they were very skilled and they didn't see it as a risk, but, you know, just on probabilities. We lost one astronaut, you know, [Elliott M.] See [Jr.]. In fact, we may have lost several since then. But we didn't lose any of the seven. But, anyway, the whole result of this was that they got more high-performance jets, and they were satisfied with that. I guess it was nice from my standpoint, too, because I got to ride in a couple of those.

But that was the first indication, I think, to the engineers at Langley of the power that the astronauts would have. The public was going to focus on those astronauts and what they said and wanted and did, with, you know, going to be what, in some ways, I suppose they initially thought of it as the tail wagging the dog. I think that many, again, coming from the Pilotless

Research Division, were not really recognizing how significant the power of the astronauts relative to the public relations issues would be.

Later on, mostly after I'd left, there continued to be quite a contest between Headquarters and the Manned Spacecraft Center [Houston, Texas] over who should control some of the time of the astronauts. I know at the Manned Spacecraft Center there was a lot of feeling that the Washington office was putting pressure on to use astronauts for public relations purposes. Of course, Headquarters was struggling to get budgets passed and things, so they needed the astronauts for that kind, —so that was not the kind of controversy you had then. But this was just the first sign of what was to become a part of the manned space program for some years and maybe still is, in the sense that the astronauts are still the focus, I think, of the program.

But I was trying to get at people who contributed to the training program, and while I was, as I said, Astronaut Training Officer, nominally in charge, we brought in ideas from a lot of sources. It was one of these early inputs from the astronauts that they wanted to be able to have the flight time. So that was one element. We had the key element of participating with the engineers, a secondary element of some classroom science and technology presentations. They had their aircraft. Then we had this whole process of finding situations in which you could duplicate the conditions they were going to face. I mentioned, too, one was the centrifuge, and the other was the weightlessness.

Another one that came up was in Cleveland [Ohio], there, the NASA Center there [Lewis Research Center]. They had a device which was a three-gimbaled ball basically, where you could moved with very—essentially no friction in any one of three directions. That is, you could go head over heels one way, or you could go sideways, or you could spin around. All of these systems were gimbaled in such a way that there was very little resistance, so once you started

moving, you would just keep moving that direction. This was used to practice on this control system that was going to be in the spacecraft, where you had a control handle, and you would be looking at gauges, which would tell you whether you were rolling or pitching or going from one side to the other.

The key here was that you were dealing with acceleration, which is measured in the inner ear, and that system has basically two sensors. One just tells you whether you're sitting upright or not. It's sort of a stone lying on grass. But the other is a semicircular canal, and that has the system that tells you whether you're moving or whether you're under the effect of acceleration. So when you would sit in this device and you look at the gauges, the gauges would tell you, well, you're going head over heels, you're pitching, or it would tell, you know, you're rolling, you're going from side to side, and you could see that on the gauges. But what they would do with this is that they would get you spinning in all three directions at once, and then there were little jets on the seat so that you could stop yourself, and your job was to overcome this tumbling.

But the problem was that if there was any acceleration, it would blur your vision, because the inner ear would blur the vision. It was controlling the eyes to fixate on the instruments. So the astronaut would have to look at the instrument and say, "Well, I'm pitching, so I need to control in this direction and stop the pitch." Well, as soon as he put in that control action, the ear would sense the motion, the vision would become blurred, and he couldn't see. So he'd have to wait until he could see again and then put in another correction and another correction. And so it was quite a problem to stop the tumbling.

But this was a way to train them for the effect of tumbling, where even when they were in space, when there is motion like that, there's acceleration, their inner ear would be feeling that and it would be affecting the vision. So that was another thing that everybody was on, and that

was almost—well, for anybody but those fellows, it would make you sick about in ten seconds, because you're tumbling, you know, you're just tumbling all around. If you think you have any problem with motion sickness, whether it's seasickness, whatever, but, of course, pilots are used to motion, so they're pretty well protected against motion sickness.

However, it's an interesting thing about the human physiology, that you can get used to one kind of motion and yet still be subject to motion sickness of another kind. In World War II, for example, out in the Pacific, we lost a number of pilots due to dehydration because they would have to ditch their planes and they'd get in their little raft, and they'd be bouncing around out in the ocean. While they were quite used to motions from doing the dog-fighting and so on of the jets, they weren't used to that motion on the water. They would tend to vomit and then they would dehydrate, and that became part of the medical problem.

So even for these trained pilots, test pilots, getting in this thing could still produce some motion sickness, and one or two had a little problem with it. Ultimately, as you know, Al Shepard was grounded, not at this time, but later because of an inner-ear problem. So that was another example of a kind of test we had.

So basically we were doing all of these different types of tests in an effort to demonstrate that there wasn't any physical stress on the body that would make it impossible for the flight. So that was another area.

Then another area of the training had to do with visiting the sites that were involved in the manufacture of the spacecraft, like McDonnell Douglas in St. Louis [Missouri], or visiting the launch site at Cape Canaveral [Florida].

One of my special memories of that early period would have been probably in the fall of '59, was the first time we took the astronauts to the Cape, and we watched from quite nearby a

launch. The wonderful thing about the Cape, particularly sort in those days when you were more intimately related to the launches in some ways than now, they're so large and involved, so big that I think you're more separated from them. But whoever started that whole process had guidance from Cecil B. DeMille and the movie colony, you know, because they would launch early in the morning, but all night they would be doing the fueling. So you had this large silver rocket with spotlights on it, and the LOX [liquid oxygen] is boiling off, so steam is coming off of it, and it's just a spectacular sight.

Then as the launch comes, why, at first they tie it down so that the engines are fully operational before they release. But you see this great fireball come up. It's somewhat reminiscent of the pictures we used to see of the atomic burst. Then out of it comes the silver rocket. So it's a very impressive thing, and I remember that first time when the astronauts—you could see their faces thinking about they were going to be sitting on top of that, riding it away. But that was quite a fun experience.

So we went to the Cape and we went to McDonnell, and they generally visited those areas where activities were occurring that were building the units. We also went the Redstone Arsenal [later Marshall Space Flight Center (MSFC), Huntsville, Alabama] and saw the development work that was going on with the Mercury-Redstones. I had personally a very interesting evening there, because von Braun invited us out to his house to have dinner, and the astronauts went off to something later in the evening that was going on, but I remained with von Braun, and he pulled out all his scrapbooks from his days at Peenemünde in Germany and showed the effects of our bombing raids.

Very interesting in that, too, was the designs he had for essentially civilian uses in space. He had a design for a spacecraft that would go transatlantic and so on, all of them done back

when he was in Germany. He had an amazing group there, because aside from himself, he had this one engineer-pilot who made then what must have been the most amazing flight that had ever been done to that time. During World War II, Germany produced two types of rockets at the end of the war, which were fired at Britain. There was the so-called V-1, which basically it looked like a bomb with a little engine on it. It went putt-putt-putt-putt-putt, and it would fly over and you could hear it coming because it'd go putt-putt-putt-putt. Then it would stop, and then you knew you wanted to get out of the way, because when the engine stopped, it just fell and blew up. Then they had the V-2 rockets, which were like our rockets today, the ballistic ones.

But this little putt-putt-putt one was interesting, because Hitler became more and more desperate towards the end of the war. Germany had invented the jet, and so they had superior jet aircraft to ours at the end of the war, but he was unable to interdict the bombing raids. So he was pressuring von Braun to come up with essentially a rocket kind of plane.

So apparently von Braun took this little putt-putt thing and more or less just put a saddle and a windshield on it, and they attempted to fly that, and the fellow who flew that, you'd have to be crazy to do it, but he was there, and he was such a small, nice, Milquetoast kind of a guy. It was just very interesting. I couldn't feature him doing that kind of flying. But it was very interesting. But, again, the astronauts got to go and talk with von Braun and see all that work.

So what I'm trying to describe here is the visits to all of these operations, and so that was another way to get the technical training. Then another key issue that came up, and this came up, I think, early in '59, before we actually had astronauts, was the issue about whether we were going to build a fixed-base trainer for Mercury. There were arguments against doing it because at the time the flight schedule was to occur next year or something. Anyway, it was coming up

very rapidly. It was very unrealistic. So that one argument was that you couldn't build the trainer in time to have it be in use. Then the other issue was just the technology of what would have to go into building it.

But the decision was made to build two of them. One was at Langley and one was at the Cape. This turned out, I think, to be very, very important as a training element, because we could do training runs at Langley for all of the astronauts using the fixed-base trainer, and even more importantly, you could do them at the Cape, and at the Cape they tied the trainer into the control center that Chris [Christopher C.] Kraft [Jr.] was setting up for the flights, so that the flight controllers and the astronaut could interact in a very realistic way, as you would in flight.

That was probably much more significant that I realized at the time, because one of the things that was occurring here, which was interesting, was that you had all of this information being telemetered back from the vehicle that came to the ground and wasn't available to the pilot. In other words, the ground team had more information than the pilot had. This, I suppose, is not too atypical of experimental aircraft. But generally when you're flying, the pilot has the most immediate information and most of it, you know, in terms of how the aircraft's operating.

But for Mercury, they had a lot of readouts of information on the ground, which the pilot didn't have, and there's another feature of the system, was that it was much more complex than you might think on its face, so that a malfunction in one area could produce an appearance on the instruments of the pilot that the malfunction was occurring somewhere else. For example, the electrical system ran many of the gauges, and if something went wrong on the electrical system, it could give you a false reading, say, on the environmental control system. So one of the major tasks of the pilot was to troubleshoot to try to determine what was going wrong if there seemed to be something going wrong.

So it was a much more complex job than you thought, because while all these instruments were organized in clusters, the environmental control system, the attitude control system, and so on, in fact, behind all that was a complex electrical network which could possibly give you misleading things. So the astronaut had to be trained to check out a problem, not just to react to it, but to check it out and so on.

Well, a lot of the information you needed to do that to, of course, was on the ground, and they were doing the same thing. So that made some issues which were quite key to effective operations of sort of who's in charge and where is the command for this system. Of course, pilots are used to being in charge, and they yield to no one. In fact, there's a famous old experiment where a pilot and a co-pilot were wired up for the sweat response in the palm, which indicates tension. Then that measure was taken on the pilot when he was flying and on the pilot when the co-pilot was flying, and, of course, the pilot was much tenser when the co-pilot was flying. That, I think, is a very typical feature for pilots. They're most comfortable and least tension when they have control. As soon as you start taking away control, then I suppose it's like being the right seat of an automobile here. You're not in control, so you maybe are more nervous than the driver.

Anyway, there was then this potential situation where the ground had more information than the spacecraft. So you had to have a situation in which the flight controller, at that time it was Chris Kraft, and the astronaut had a carefully worked-out system for who was going to make decisions when. Chris was the type of person, quite adamant that he was going to make all the decisions, and generally that was what happened. But that was quite a problem for the astronauts because they were spending a whole career getting one flight, and I think the biggest threat to

them was to have something go wrong or to lose their opportunity to fly or to have the flight aborted for some reason.

So we needed to work out a system where this astronaut up in space and the ground control could work together well, and you wouldn't have problems of conflicting command. As it turns out, having that trainer so that you could actually work this system on the ground before the flight, I think, turned out to be more important that I thought it would be. I thought it principally from the point of view of just going through the flight sequence again and again and getting it down. But I think that was an important feature. So that was another feature then of the training program, was this fixed-base trainer which then could tie in with the ground control.

So I think those were the principal features of the training program, which ran, of course, from April, when they came in in '59, to, I suppose you could say, with Alan Shepards's flight in '61, and those were the kinds of activities that they were going through. I had a small training group at Langley, and I accompanied them on some of these trips that they made and would take them to the centrifuge and the other areas. We'd help them work up schedules for their use of the trainer and keep the records up of all the things they did during that time. So that was principally our job in the training office up to flight time. Then once the flights began, it took on a somewhat role of flight preparation and mission preparations. But during the training, I think those were the principal things that were allowed.

I got involved during that time in a couple of other somewhat interesting activities. One, as I mentioned, Chris Kraft was forming this ground control system and setting up the worldwide system that would be in place for the Atlas flights. One thing I think I was able to sell at that point was, as I mentioned, there's this problem about who's in control. The pilot could feel perhaps doubly threatened, because besides Chris Kraft and all his engineers who could make

decisions to call the flight down for reasons that since he didn't have the information might not seem appropriate, there was, of course, the physicians. The astronaut was wired up to measure heart rate and breathing rate and so on, and they had a physician at every station around the world. Again, the physicians, who came to be called "Sir John" for surgeons, I don't know how that name quite developed, but somebody was a surgeon, so eventually it became Sir John, and those were the medical folks. Well, they could find that the astronaut was in some sort or medical distress and call him down, too.

So they got acceptance for the idea that there would be at every station one of the seven astronauts, and these were the so-called CapComs [Capsule Communicator], and the thought behind that was that the man up in space would always have someone down on the ground who he knew well and could represent him and would be the one that would be talking with him, too, but could represent him when these issues came up as to whether the flight was go for three orbits or whether they were going to have to abort and come down early.

So that was another activity we got the astronauts into, was to go out to—whenever there was a man in orbital flight, and take up their place all around the world. I think that tended to work very, very well and to help this issue or concern about whether the surgeon might, or Sir John, might call you down, or the flight control might call you down. So, that was another development during that period of time.

Another kind of activity was the working of the problem of mission reliability. Of course, there was a great deal of concern about having a highly reliable mission, and the spacecraft was built with all the major functioning components being redundant. There were two of them; in some cases, three. Of course, the idea was that if the prime system failed, the second one would take over. But there is a whole engineering discipline built around reliability, and the

concept of that was that if you had a component, you would test it in such a way that you'd make sure that it would function for the period of the flight.

So, for example, when Al Shepard went up, he had a fifteen-minute flight, so every component needed to be tested, but not for fifteen minutes. You would test it for something like ten to a hundred times that length of time. In that way, you would develop a statistical number on the reliability of the unit, and you did that by doing this much more lengthy testing.

Well, so they were going through this whole process with the Mercury spacecraft, and it began to be quite a challenge because on a fifteen-minute flight, you know, during fifty times that length is manageable. But now you have a four-and-a-half-hour flight and you go fifty times, you're testing the equipment, and, now, you know, and you start having multiple orbits. It was beginning to be get out of hand in terms of having a statistical method of predicting the reliability.

My function, or the way I got into that, was that the astronaut was indeed an important part of this program, and he had a redundant way, a second, another way of overcoming every major system malfunction. So, for example, the attitude control is something like that. One system fail, the other would kick in automatically, but there was still another way that the astronaut could take over.

So the issue came up, well, how reliable is the system if we count the astronaut in here, because he adds reliability. If both your systems fail, he's still there. But nobody had come up with any estimates on how reliable the astronaut was going to be space, and there was a tendency to say, "Well, he would be perfect." But we knew that human beings are never perfect. So we spent a good deal of time trying to tease out and figure out how much the astronaut added to the reliability of the flight. But as it turned out on the Mercury flights, they added a considerable

amount that probably saved a couple of the flights. So that was sort of another activity we were involved in.

Then there was the emerging engineering of the spacecraft itself. When I first arrived, back in September, October '58, the structural engineer who was responsible for the structural integrity of that Mercury Program, I was talking to him about how the astronaut got in and out, and I asked him where the door is, and he said, well, there wasn't really a door. They were going to weld the system shut. But the metal was very thin, so if the astronaut had a can opener, he could cut himself out of there. I had this picture of pilots accepting a can opener to get out, but, of course, it didn't ever go that way. But it was an illustration of, you know, the thing is that the structural engineer, he was very concerned about the pressure integrity inside the vehicle. But you also have to think about there's somebody in there. He's going to want to get in and out and probably isn't going to want to cut through the metal. So they did have a door and a mechanical system, but, as it worked out, the astronauts found that hard to operate and hard to get in and out fast.

So one of the developments was to put on the explosive hatch, and that was an illustration of human engineering failure there, because this occurred late enough so that the first flight with Al Shepard just had the mechanical system, and then when Gus [Virgil I.] Grissom came along was the first time there's a flight with the explosive. But it had been developed so rapidly that there had not been much time to train on it or to test it. So from the human engineering standpoint, we had a not optimally designed hatch, and the result was that Gus hit it inadvertently and it blew when it wasn't supposed to, and we lost that spacecraft. But that kind of engineering re-tooling was going along, and a good deal of it was influenced to some extent by the astronauts themselves. The door was certainly one.

The other that got into *The Right Stuff* and became famous was the issue of the window. The first spacecraft design had a porthole up about here and another porthole down below and then there was the instrument panel, and then they had a large periscope which looked out, and really it was designed around using the periscope because you could get a 360-degree view out through that periscope. From the engineer's point of view, that was the best way of seeing the world. The portholes didn't help much because they were too far from the eye, so, you know, if the porthole's right like this, I can see quite a bit. But if it's farther away from the eye, all you see is just the little round hole.

So there was sort of immediate pressure from the astronauts when they first began to see these spacecraft come down the assembly line, to have something that they were more familiar with, which was a windscreen, and so that was substituted in. But, in fact, that wasn't available for Al Shepard either. He had the periscope and the two windows. But that turned out to be a useful thing, because actually Scott Carpenter used that quite a bit to maintain attitude when the attitude control system went wrong. So that was another development during that period.

Deke [Donald K.] Slayton was putting on some pressure for having rudder pedals, because he was the test pilot's test pilot, and he very much wanted to have this thing look like or operate like an aircraft. But, of course, in space, a spacecraft doesn't operate like an aircraft because you don't have any of the lift from the atmosphere. So then in the Mercury, of course, they just have the hand controller.

One of the interesting things to speculate about on a longer-term basis would have been whether had we had gone ahead with the original selection program or if it had just turned out that engineers flew these things, whether we would have a fairly different kind of space program. It's, of course, been very handy to be able to land the Shuttle in a normal aerodynamic way. Of

course, the Russians have gone up and down just by the old Mercury system. Probably if engineers had flown these things, they wouldn't have started using that. I mean, once you're outside the atmosphere, you probably won't have things that look like—that won't have wings, because they would only be useless weight. That might have made for a somewhat different direction for the space program possibly, speculation. So there were these engineering configurational things that were occurring for the spacecraft because of the input of the astronauts during this period leading up to the flights.

I think those are the things that I recall leading up basically to the flight period itself. Well, of course, we had the animal flights in there. It was sort of amazing, I think, to many of us that we got so close to the [Yuri A.] Gagarin time launch with Al Shepard because it was sort of fortuitous or lucky for the Russians that their technology, in terms of the packaging of atomic weapons and the general control system, was so far behind us that they had to build much bigger rockets to lift all their big clunky weight. But when it came to space program, they all of a sudden had very powerful rockets relative to our Atlas, and that they could throw up all the weight, and they were in the better position to do the manned program.

In fact, we were beaten in terms of the orbital flight. But they didn't launch until just before Al Shepard was to go up, and that was probably one of the problems that we had as an open space program, was that they knew exactly when we would be ready to fly, and it would probably, no matter when we had launched, have been probably impossible to beat them because whereas we didn't know when they might be launching, they would know more or less exactly when.

There was that sort of feature that led some of us to joking that what we should do is to announce a chimp flight and send out one of the astronauts in a monkey suit that, tape the flight

that way and catch the Russians unaware, and we'd have the first man in space. But, of course, that was just a joke. The space program from that standpoint was very carefully and very well managed in that I think most of us who had selected the astronauts were inclined to believe that we'd be likely to have some losses, and we never did, and that, I think, a great deal of the credit goes to people to Bob Gilruth and Max Faget, because they took it step by step and made sure that we were quite safe and ready to go before flight.

So that sort of covers the period then leading up to '61. The flight program, I guess, for the public, began with NASA announcing that there were sort of a three-man first team, which was Glenn and Grissom and Shepard, and that that team would be flying the early Redstone flights. That's where I missed out on a fortune, because the press immediately assumed that John Glenn was the one that was going to be in the first flight. So if I had gone to Las Vegas and laid down a little money, I would have been—because we knew that Al Shepard had been selected for the first flight with Gus as his backup and then John with Scott as his backup.

But nobody else knew, and they kept the secret, I guess, fairly well right up until Al Shepard's flight, at least as far you could see in the press. But it was sort of amusing to us, this part, because John was known, you know, before the space program because he had done the transcontinental speed record. While they were all sheltered from the press, John was the one more likely to be featured. So, anyway, they all thought that.

I guess that was the other feature of the training program, was the matter of press coverage. The astronauts were all contracted as part of this *Life* program, so that gave them sort of the excuse for not granting any interviews, and there was a great deal of effort to protect them. They brought in "Shorty" [John A.] Powers from the Air Force as the press official to control things.

One of the results of that was that the networks and the other media, the only people they could get any information were those of us who were working with the astronauts. So quite frequently you would get interviewed, not about yourself, but about the astronauts, you know, what they were like, and so on and so on, because they couldn't get direct, and that became quite a learning experience for me, because typically as we were preparing at the Cape, the networks would send down their teams to make a videotape of interviews, and you would perhaps be on camera and be interviewed for thirty minutes or so. But when it came to the nightly news for the flight or whatever, you might be on thirty seconds out of that thirty minutes, and so you were always wondering, what did I say that was so shocking?

It was very hard to say anything. It was taken out of context because of the way it was handled in New York. The crews would come down, and you'd be interviewed, not by [Walter L.] Cronkite [Jr.], you know, but by whoever they sent down, but the camera would be over the shoulder of the interviewer and on you, and you'd get the question and then, you know, they'd be taping your response. Then that footage would be sent off, and when it was aired, they would show Cronkite and then you, and the appearance would be that the two of you were together, so that Cronkite was asking the questions.

One of the problems was that whoever they sent down to ask the questions, they didn't record the questions often. They just wrote them down. So two or three times you'd find yourself answering questions that weren't asked for in that situation. But it was very hard to deny because it was so realistic, and there you were, there was Cronkite, and there you were talking.

I really got kidded at one point because when they announced these three first-team members, some of the networks sent down individuals to, since they couldn't interview the

astronauts, they came to interview us, and, you know, they'd said, "What's Al Shepard like? What's Gus Grissom like? What's John Glenn like?" I attempted to deal with those by saying, "Well, when we're in the office together, John's like this," or, "Al's like that." "When we fly, John's like this, and Al's like that," or, "When we go to centrifuging," just sort of naming all these things. In the general list of things, I'd say, "And, well, at a party John's like this, and Al's like that."

Well, apparently I was the only one that mentioned anything social, and they had this program on the three of them with a lot of the engineers and so on describing what they thought John and Al and Gus were like, and they brought me on three times, one for each, but the first words out of my mouth were, "Well, at a party," and they had that thirty-second piece over a half hour of mine, but every one started with, "Well, at a party," so I became the big party boy. You couldn't deny that you had said that, but it was so realistic. So you learned to be pretty careful about what you were saying in those situations, because they could select whatever they thought, and normally what they wanted was a sort of exciting or different comment.

So there was a training program for all of us that was supposedly the trainers and the engineers. But we had this announcement that it'd be one of the three. But those of us who were working with the astronauts knew, of course, that Al was going to be first.

Once the flights started, I'd come down with maybe one other member of my team to the Cape, and we spent usually at least a month ahead of the flight at the Cape using this simulator I mentioned that was tied to the control center. The astronaut would also be working with the launch team at the gantry and getting up into the spacecraft itself and running through some launch simulations with that. If he wasn't doing it, the backup might be taking that, one or the

other, so that they were kept pretty busy. Then, of course, they did their normal physical workouts and all of that. So it was quite a busy time.

My group during that time was also—we were responsible for preparing all the materials that the astronauts took into space, and there were a number of these. There was a worldwide weather map, which was sort of in two pieces, and under the dashboard, if you'd like, where all the instruments were, there was a pocket where you could put things and pull them out during the flight. One of the things the astronaut had was a weather map over the map of the Earth, and when the astronaut left the astronaut holding facility for the gantry on the morning of the flight, the weatherman would ride with him and had prepared before that the local weather situation around under all of the orbits. So that was one thing that we put together for the flight.

Another item was the flight plan, and that was probably one of the more critical things. The flight plan was a sort of card about four inches wide and six inches long, which they had two of them, ultimately to—they had actually three, to cover all three orbits, and what we'd do is list every minute of the flight in the center.

Then they had an indication of what stations they would be in communication with during each of those minutes, so they could tell at any time whether they were in contact with the station or normally should be or that they were out of range of communication. Then it had an indication of what control system they should be in, whether it'd be automatic or their fly-by-wire kind of system. So they switched during the flight from one to the other.

Then we also had things that they could observe, both in the sky and on the ground, as they went along, where they went across the coast of Africa, the west coast, and then the east coast, and then where they were when they hit the coast of Australia and so on. All of those were marked on their flight plan so they could look at any time. They had their watch, so they

could look at the time, they could look at the flight plan, and all of this information was on there for them.

Then another thing we had was a set of star charts. These were just for the orbital flights. Once a spacecraft is launched into an orbit, it's fixed with regard to all the stars, and so we had a star chart, again it was about four inches by six inches, and we had one of these for every half hour that they might be launched in. Generally we give them a half a dozen of them. They would say, like, 7:00 a.m., 7:38, 8:30. Whenever they were launched, they would pick that one, and they had something that looked like a slide rule, and the slide rule had a picture of the window, or the windscreen that was in front of them, and it had a little marker for the time, and so if you put the right time on it, and you put the window over this star, it would show you what stars you should be seeing outside so you could navigate by using the stars in that way and using the window. So, a number of these kinds of things. We also had to make sure you had things like the food that he was going to try out, and we built some special instrumentation for Scott to use and for John to use. So that was another activity of our group in getting ready for the flight.

The first flight with Al was, I think, particularly memorable because we had had a great deal of practice at the Cape in this trainer connected to the control center, as well as at Langley. There was a very detailed and specific voice routine, where, more or less, every voice communication had been pre-set because he's reporting on this and that and the other thing. So that got to be sort of a regular routine. What would happen is that the launch came along is that they would count down, you know, the usual thing, five, four, three, two, one, ignition and liftoff.

The response that was to come from Al was "Liftoff, and the clock is operating." You know, he'd been through this a hundred times, and it was very routine, and in the trainer, you

sort get "Ho-hum, liftoff, and the clock is operating." But on the morning of the flight when I was in the control center, because we were the debriefing team, that was another activity for the early Mercury flights, I was on the astronaut debriefing team, so we were at the control center. But, of course, we're all listening to this, and we heard, you know, the countdown, and then Al comes on and he says, "Liftoff, and the clock is operating." [Laughter] You could just hear the voice change, you know, as it really was happening, after going through what must have been fifty or a hundred times, and this is different. He could feel it.

So that was really fun to listen to this whole routine go, but go for real, and, of course, that was a highly successful flight that went very well and very much according to routine. But, of course, it was a very short flight.

Gus' was much the same except for this problem that occurred when the hatch opened. I didn't get very much involved in the work on the recovery of the spacecraft as from the human engineering standpoint. The astronauts had gotten a little more involved in that than I did. But we clearly needed more work in that area because the helicopter—we almost lost Gus because the helicopter's so busy trying to save the spacecraft, and meanwhile Gus was about to go under. So there was a little problem in the system.

But they later developed the—it's sort of flotation devices to go around the spacecraft, and we got much better at that. But that was not a very good show, and, poor Gus, I think, got blamed partly for that, and that was another potential problem for the astronauts, was when things went wrong, they would tend to get blamed. So that produces, you know, again, some tension, vis-à-vis ground control and medical and so on.

I think the public had a view of what was stressful for the astronauts, which was, I think, quite off target. Of course, the public viewed them as heroes, but they viewed them in part in

that way because they were risking their lives. But these were all pilots who had risked their lives for years. I think some literally saw the space program as much less risk than the combat missions they'd flown or some of the wild rides they'd had as test pilots. Here, I think, when they got in the space program, if anything, I think they felt that there was an over-concern with their health and safety. I'm sure they felt that the medical attention they were getting, the medical monitoring, was way overdone, so that while they were not unmindful of the fact that they could lose their lives in this process, I don't think that was their main concern at all. In fact, probably, if anything, they were concerned that there was too much of concern about that.

But there was, I think, more concern about, was that fate, one way or the other, would conspire to keep them from flying or ground them. Deke Slayton was one example of that. Al Shepard later was another. The other thing was that probably the worst thing that could happen is that they would personally foul up and that the mission would fail because of their own mistake. So that, I think, was a significant problem in terms of developing a good command structure for the flights and getting everybody to work together. Things went very well for Shepard's flight. There wasn't really any problem. But as soon as you got a problem like Gus Grissom's, that was tending to revolve back on Gus, even though I think that there were several elements of that that illustrated that we had been pushing hard and been trying to do things maybe a little too rapidly and that we had not applied some of what we should have from a human engineering standpoint.

But, anyway, we did rescue Gus. Now we have his capsule back, I guess. So, ultimately everything was recovered.

BERGEN: Why don't we pause right here.

[Tape change.]

VOAS: Through much of this time, there had been the plan that would be seven Redstone flights, one ascent for each of the astronauts. Actually, I think when I first saw an operations plan for Mercury, before we did any selecting of astronauts, there was something like up to seventeen Redstones planned. We were talking at one point about that number of astronauts originally. But as a result of the experience in the selection program itself, those interviews in Washington and then the whole process, I think that there was confidence with the seven that were selected, we'd have enough to do the Mercury missions. So right away that tended to cut back, I think, on the numbers of Redstones that were going to be used in the sense that rather than maybe having seventeen astronauts, each of which would need a flight in the Redstone, they were down to seven.

But it wasn't really until the Grissom flight, I guess, that a final decision was made that we didn't need to have any more of the Redstone flights. That had always been something that would be somewhat up in the air, because you had two development programs going on. You had the Mercury Redstone and how soon it would be ready to fly. Then you had the Mercury-Atlas, and one of the question was how soon we'd have the spacecraft ready for that and particularly how soon the Atlas would be tested for it.

Those things, I think, seemed to come together right about the Grissom flight or right after, which made John Glenn a very, very lucky man, because originally it looked like he would be sort of number three on the Redstone, and instead he got the first orbital flight. It was interesting that, you know, there were these sort of chance events, in a sense, that occurred that

way, so that, in effect, where maybe the press and the public had always sort of expected that John would get the first flight, in a way he got the first major flight, but it turned out to be sort of by chance or by happenstance rather by being first in line. But he was the next up, and they decided to go the orbital flight.

So that major difference there, of course, was that that did involve the worldwide web, and so it involved the astronauts going out to the CapComs and around the network. We had to move to the Atlas gantry. There were a number of delays, some of them relatively unimportant in the sense that whereas you may have been scheduled to go on the Atlas—I don't know which of these states and where I think it would be in the history—at one point before the astronaut actually got on the pad and started the countdown, the flight would be postponed again.

But there was one case in January then of '62 where everything went down to the actual countdown. We got John ready and he went out to the pad and got in and went through the whole process. I don't know where the count was held and aborted, but it was very close to the actual launch time, I think, and he had been in there all night.

That sort of had an interesting feature, for me, at least. One of the problems we often faced in that was that people completely outside the program would come up with concerns or issues or ideas that you would have to deal with because they'd get publicized, and then all of a sudden you'd have inquiry about them. This was an example of that. John had been in the spacecraft all night and then aborted, and actually we flew a month later. But there was a New York psychiatrist who said that anybody who had been in that spacecraft all night would be in such a bad psychological state that he ought to be scrubbed and another astronaut take the flight. This was, of course, just absolutely amusing to those of us in the training program, because we

knew that there was nothing that would so threaten John Glenn as being scrubbed out of that flight. [Laughs]

It turned out Shorty Powers arranged for the news conference in which I could go basically tell the psychiatrist he didn't know what he was talking about. But it was sort of frustrating to have some of these individuals with significant scientific degrees and so on, sort of pontificating, who had no knowledge of the program at all. There was some rather bad aspect, I guess, that came in later with the scrubbing of Deke Slayton. The person who raised that issue was somewhat really outside the program. But we had to keep in mind these kinds of critiques that came up and be sort of prepared to answer them.

I think the most difficult issues for us came with this President's Scientific Advisory Committee, because they actually had the authority to sort of determine when we'd be ready to go. One of the things that happens sort of in everything that's new or any development program is you have this phenomenon that you call the "what-if" phenomenon. What that is, is somebody said, "What if the booster blows up?" or, "What if this?" or, "What if that?" Well, those are the kinds of things you have to think about in terms of developing the program, but they're basically sort of unanswerable because the people can sit around and think up all sorts of what-ifs, and if you chase every what-if, you just would never get off the ground.

So, of course, part of what we did was to deal with the what-ifs by putting the astronauts on the centrifuge and in weightlessness and wherever we could, test out that sort of what-if. But it's very discouraging, working on some new things like this, to have people sit around who can just freely speculate, and they can then keep you from going ahead because you're so busy trying to answer this what-if. So what-if is a legitimate process in science, but it can be used even

politically to thwart action, and so we had a lot of those what-ifs to settle or to persuade people to put aside before we could launch.

But, anyway, John Glenn went through this whole process of being on the Cape and then being on the gantry and then in the capsule, in January of '62. Then he did launch a month later. He launched on February 20. I remember that because it was the day before my birthday. That day we actually got him off, and I was very lucky on all these early flights because we were allowed to be at a table in the corner of the control center, so that we could listen to the voice communications. So we could be fairly aware of everything that was going on.

Then what would happen after the flight, after the astronauts and spacecraft were recovered, they would be brought into some location like Grand Bahama or Grand Turk Island. Then we would fly out there as soon as the word came that the spacecraft had been recovered. We'd spend a couple of days on the island with the astronaut. It was a principle to give the astronaut a little change to rest up and primarily to give us a chance to get as much information from the astronaut as we could on the flight before he was whisked away for the public relations activity that would go on. So as a member of the debriefing team, I got to be in the control center and then we all flew out.

Actually, the debriefing situation was somewhat interesting. I'll back up a moment. Like Al Shepard's flight, the physicians had decided that there should be something like twenty-four hours there, maybe not quite that much, at least twelve to fourteen hours for Al to have no contact except with the physician, so as to be able to rest and recuperate and so on. I think that just didn't go with Al at all. Anybody that makes one of these flights is so excited, and he wanted to talk to people and tell people about it. I think that's where the medical group was mistaken about what was really needed for the astronaut. Again, it may be one of the symptoms

that the astronauts feared, of their being overly solicitous and keeping them sort of under wraps and taking too much precaution. But once they landed, they were anxious to talk about it and to go over the flight and so on.

So we would fly out for that, and then the astronaut would come back. We did that for both Al and Gus and then for John and Scott. The only thing that would tend to happen is, of course, the agency was trying to keep the high political managers away long enough for us to accomplish the thing.

I think for John Glenn, the vice president, later President [Lyndon B.] Johnson, did fly out for the day we were flying John back and had breakfast with us out there. But it was hard to keep people like, particularly Johnson was very enamored of the program and got very involved with it.

Of course, when we'd get the astronaut back at the Cape, there would be a parade, first of all, at the Cape, with speeches and things, and a visit, a look at the capsule, and that sort of thing. Then they'd go to Washington to go to the White House. John had quite a parade on Pennsylvania Avenue, it was in the rain, and a New York tickertape parade.

So once the flight was over, they got quite a bit of attention, and then John had a speech to the joint session of Congress. That was a very, I guess, exciting time, when that was going on.

But my job was to be part of the debriefing team, and then when I came back to the Cape, I would work on and help the astronaut write their chapter of the flight report. So I'd spend some time at the Cape afterwards analyzing the information we had, the voice records, the control records, and so on, for the astronaut, and getting this draft of the report written before going back either to Langley or to Houston. That was sort of my participation in that.

In John's flight, I think we had another indication of the sensitivity of this ground control-astronaut or -pilot relationship in the decision that Chris Kraft made not to inform John about the potentially developing problem with the heat shield, which turned out, as you know, just to be a false alarm. But, again, I think in his recent book Chris sort of says that he felt John had enough to worry about to not tell him about that. But, again, this, you know, this overprotectiveness kind of thing, you know, it's a misjudgment to have—the pilots want to know everything, you know, and the more you keep them in the dark, the more threatened they are. So it's a misjudgment to do that. As it turned out, everything was fine. John was a little bit upset when he found out about it, but there wasn't any real concern there.

The whole issue came up more in Scott Carpenter's flight because of the overshoot particularly and the issue about the fuel supply. But, again, there was this sort of issue of who was in charge and who was taking control. But there that was probably the first example of a flight we had where the spacecraft might not have come back had there not been an astronaut in it, because the attitude control system, sensor system, failed, and it was necessary for Scott to take over manually and use that window, the little picture will show it, which had a line in it for where the horizons was to be had. You could use that to make sure that you had the nose-down position that you needed in firing the retro rockets.

It was more difficult to tell whether the nose was pointing in the right direction, that is, the yaw angle, so-called, because to do that visually through your window, you had to see the ground running below you and see that it was streaming straight out behind you. If it was going crosswise this way, then you weren't pointing in the right direction and you needed to come—but at night there wasn't enough configuration on the ground to make that very easy. So [Scott] had to use a combination of systems to line up the vehicle. But, again, that worked out well

except for going further down-range. They had, aside from partly that issue about—I think it's an interesting thing, because from Scott's angle, I think he thought that the flight had just gone very well.

It had one comfort problem, which I think [L.] Gordon Cooper [Jr.] got later, too, which was that the suit ventilation system wasn't working very well. But, otherwise, I think Scott thought things were going pretty well, except he recognized that he had this control problem he had to take over with. But once he went along and landed on the water, everything was just fine for him. But I think Chris never really forgave what he thought was Scott's failure to follow orders.

Then the fact that Scott was out of—well, Scott was in radio communication with the recovery units most of the time he was on the water, but for some reason that information didn't get back through Shorty Powers to the public. So Walter Cronkite was producing a lot of concern that Scott was lost and nobody knew where he was and so on. So that created a lot of tension and some public relations problem that was probably unnecessary, because he wasn't at that much of a risk. But, anyway, that was another feature of that flight.

There was this issue about, aside from managing the spacecraft, to what extent should the astronauts be tasked with making observations. They were the first men in space, U.S. men, anyway, and there were a lot of interesting observations that could be made. Of course, the emphasis from the engineering point of view, I think, and certainly from the flight control concern was "Let's just sort of get it and get it back down safely and take a minimum of risks, and the focus of the astronauts should just be on operating the vehicle." But there was also a strong feeling, I think, in some quarters, which I shared, which was that we needed to demonstrate that when you put a man in space, he can do some useful observations, and we were

concerned about showing that was the case for a couple of reasons. One is that the whole issue of budgets was beginning to come up, and you wanted to be able to show that it was likely that humans in space would be able to make scientific discoveries and get some support from the astrophysicists and the scientific community. Also, it was another way to show that man could perform well in space. Aside from just operating the vehicle, he could do other things which he might not be able to do in any other way.

So John had a couple of observational things to do, and then particularly Scott, because he was very interested in astronomy and in science, had a number of observations to make. Scott made a couple of useful scientific discoveries in his flight, and he made the one that public heard most about, which was that John Glenn had reported the fireflies, which were actually, I guess, small gas particles that were escaping from the exterior of the spacecraft and were caught in the light, and John sort of described them as fireflies. Scott found that when he hit the side of the spacecraft, that fireflies would appear. So it was clear that they were coming from the spacecraft and not some other extraterrestrial being or something that was out there. So he made a number of those kinds of observations on his flight.

John Glenn's was just a very great success. Everybody was happy. I think Scott Carpenter's was a very useful flight but lost some of the impact it could have had on the public and perhaps on Congress, too, in that, as I say, because of a malfunctioning of the attitude system of the spacecraft, it might not have come back had it been an unmanned flight. But Scott brought it back. But I think because of Chris' irritation over that, we didn't really make as much of it as it could have been made as a public relations feature that the man had performed and brought back a damaged craft, or a partially nonfunctioning spacecraft, which could have, I think, helped enhance the support for man in space and shown that that really was important [static on

microphone]. That thing was picked up again, I guess, later by Gordo's flight, where things went wrong and he was able to take care of them. So it came back up again then.

But those of us who had been involved with the training, selection, and the role of the astronaut felt it was very important to try to demonstrate that it was important to have a man in space and not just send up empty spacecraft that were completely automatic.

I think that that controversy has remained with us, because putting a man in a spacecraft is an expensive proposition, and the general field of astronomy in science has often argued that the manned space program isn't worth supporting relative to investing the same money in unmanned vehicles like those that we've sent to Mars or past the planets. So I think that may continue to be somewhat of a drag on the manned space program until we can show more and more that going to the expense of putting the man in space is really, really worth doing. But that was an issue that was somewhat in the background, I think, in those very early days but was very much, I think, on some of our minds, to be able to demonstrate that the pilot, the astronaut, could be a very important component of the system and could safeguard when other things failed, and also that man being in space could do things and bring back useful information. I think those got demonstrated, though those concepts may not have been dramatized to the public and may not have been accepted by some, I think, at least at that time, Chris.

But, anyway, all of those flights were fairly successful. Wally's [Schirra] flight was very much influenced by what had happened on Scott's flight because the whole emphasis on that flight was saving fuel, because there'd been the big furor over the using up of fuel. So Wally had a very successful flight, but it was a very unchallenging flight relatively because the pressure and emphasis on him was not to use fuel, not to maneuver around, not to do very much. So, unfortunately, that moves more back to the man-in-a-can kind of thought about it.

One of the unfortunate things that, in some ways, that happened here, again, one of these chance developments, of course, was the substitution of Scott Carpenter for Deke Slayton. Deke was very much respected by, I think, everyone, including all the astronauts, as probably the most dedicated test pilot, one who really was very much into flying and into test pilot mode. He was the one that would have been the next flight after John's flight, but for the issue that was raised where there's an irregular murmur. That had been noted sometime before, but it had been decided it was benign. It wasn't a problem. But it was raised again, and sort of ultimately the Administrator of NASA made that decision.

That was another kind of problem that the astronauts faced, I think, was that if there was any doubt, you wouldn't do it. They could scrub Deke because some said that there might be some doubt about whether that was a problem, because, after all, you had people like Scott and Gordo and Schirra all ready to take over. So you didn't have to take any chances. So if there was sort of any question or controversy, potentially one of these astronauts could lose their flights, simply because the Administrator wouldn't need to take any changes.

The other feature, of course, was that Scott, who had been the backup to John, was viewed as having the most immediately appropriate experience because he had gone through this whole thing with John. So when there was an issue about Deke, he was the one that was put into that. But I think Chris had a lot of respect for Deke Slayton, and it might have been that if Deke had been on either of those next two flights, I'm sure Deke would not have just sat and not used the controls. He would have been all over the sky, as long as he was the test pilot, and that might have avoided the negativity that at least Chris felt about Scott's flight.

But the major thing was that they all basically came back alive, and all of those flights worked well. I left the space program at about that point. I left in January of '64 because I'd

been working quite closely with John. John, of course, after his flight, he's such a charismatic and effective spokesperson that he was essentially kidnapped by the Headquarters almost immediately and used in PR [Public Relations] work. This was not really his choice, though of all the seven, John was the one who was most adept at that and most comfortable doing it.

NASA was constantly working on budgets, particularly at that time we were beginning to plan both Gemini and the lunar flights, and so it really helped having a very charismatic, highly popular national hero to go visit congressmen and speak at joint sessions and be sent around the world and so. John was also the oldest of the group. So I think he came to the feeling fairly quickly that he was very unlikely to get another flight, and he had always been interested in government, and so he became interested in the possibility of running for the [United States] Senate in Ohio, and I worked with him on plans for that.

He was encouraged to do that by the Kennedys. He and Jack Kennedy took a very strong liking to each other, and the Kennedys had John and Annie [Glenn] out to their home on more than one occasion and to the White House. There's sort of a funny story told about, I think, the Glenns' first visit to, what is it, Kennebunkport, the Kennedy home up in New England. The Kennedys were always known for being very active athletically. They played touch football, and they did a lot of that sort of activity. Typically, apparently, when you visited them, they would take you out for a morning of sailing, and then there'd be touch football, and they'd be going most of the morning, and then have a little lunch. Then they normally allowed their guests sort of a quiet period, you know, from one to three o'clock or something in the early afternoon to let them sort of rest and regenerate before they started the afternoon's activities.

When John and Annie visited, they went through the same routine, and then when the one to three o'clock period, rest period, came, why, John and Annie went out walking and looking,

you know, hiking around the area and so on. I guess that was sort of impressive to John Kennedy and Bobby, that these two were not worn out and were still going.

But, anyway, they hit it off very well, and Bobby Kennedy invited John to go to Ohio and run for the Senate and offered the full White House support behind that. As it turned out, there was an old crotchety, I suppose some might have felt lovable, Democratic senator there already, but the president agreed to appoint him as an ambassador somewhere and clear the way because Ohio was going to be a very critical state in the upcoming election. So they needed a strong candidate, and John was certainly likely to be that. So John decided that he'd do that.

I agreed to go up and meet with some of the Democratic party leaders in Ohio in the fall, in November of '63, to sort of set the stage for John to come later. He would resign from NASA and from the Marine Corps so that he could run. He could retire from the Marine Corps for this decision. I remember going to the airport there, Houston. That was still when it was Hobby Airport before the new one was built. We were held up because Kennedy came into the airport, and his whole entourage was moving into Houston for a speech or something, and then he was going on to Dallas.

I came up to Washington for a day to work at the NASA Headquarters and then went on to Ohio. When I got into the taxi after my day at NASA, they were telling about the assassination of Kennedy in Dallas. So I arrived in Ohio to meet with the Democratic leaders there on the day that Kennedy was assassinated, which was not the best time to start a political candidacy. But John did decide to go ahead, and in January of 1964, even though Kennedy was no longer president, Johnson was, he started the campaign there in Ohio. Then I resigned from NASA to go with him and work with him on the campaign. So that's how I came to leave NASA.

John was not able to complete that campaign because he fell, was injured, and had an injury, actually, to his inner ear so that he couldn't stand up for a while. Even when he later was able to, he would tend to get motion-sick. So he dropped out of the campaign.

I didn't feel I could come back to NASA, because the senator we were running against in Ohio, who everybody thought would lose, but because of the big Johnson landslide in the election, didn't lose, he'd won and was still a source of power, I was afraid that if I went back, among other things, if I went back with NASA, it might affect the congressional appropriations and things. That's the way politics works.

So I wound up instead going with Peace Corps with Sarge [Sergeant] Shriver [founding director of the Peace Corps]. So I spent several years there before I went here with the new reformed Department of Transportation in 1968. The Department of Transportation was founded in '67, and I basically then worked in highway safety and public health ever since that time.

I look back on the space program very, very fondly. It was obviously a very exciting time for all of us, and it would have been fun to remain with it. I think in many ways for those of us who were privileged enough to get there at the very beginning, by the time I left, it was such a big program that you no longer had nearly as large a view of the effort or participation in it. Because when I first arrived, which was quite early, I remember when Chuck Mathews brought Chris Kraft around and was introducing him [static on microphone] as a member the group [static on microphone], as they say, perhaps two, maybe three dozen people in the program. But by the time I left, there must have been, I don't know, but there were several hundreds, if not thousands, employed by the government, but there was probably a million people working on it with all of the airframe manufacturers. So over that time, from when I was first there, from the first year, everything having to do with an astronaut would come across my desk. But by the

time I left, you were only seeing a little tiny piece of it. So it wasn't quite the same. I think for many of us it was most fun those first years.

BERGEN: Before we close, I was wondering if you could tell us a little bit about how—well, you mentioned something when we were off-tape about your first impressions when you heard about the Apollo Program. I was wondering if you could share that with us.

VOAS: Yes, we had been working at the Space Task Group on a program to fly around the Moon, a circumlunar mission. There had been some development and just some initial planning on that. But apparently John [F.] Kennedy had asked for an assessment of—those were still in the days when we were competing with the Russians—an assessment of what race that we should undertake that we would be sure to win, or at least that we had a good chance to win. The feeling, the report back from that, was that given the big lead that the Russians had in these very large boosters, in a way, because, as I mentioned, their electronic and their payload engineering was far behind us, so they had to thrust larger payloads, they had large enough boosters that they might beat us to a circumlunar flight. For that reason then he chose to call for the lunar landing flight.

Well, to a certain extent, that caught everybody by surprise. Some of the planning for that had also gone on. But all of a sudden this was a much bigger mission now. So there were concepts on the drawing board and beginning to be developed. Since we were still working on Mercury, but part of my role was to keep working in what I described as the human engineering or ergonomics area, we were brought in to basically consult, I guess, on some of the early

engineering of the Apollo module and what types of tools and displays and things that might be needed and might be designed into the space that was going to carry three astronauts.

But part of all that was to see what was at that point being planned for the whole mission, and one of the things they were talking about and showing drawings of was the concept for having this large assembly center and then actually moving thirty-six-story-high rockets with the spacecraft on top for two miles or something like that to the launch site.

I think many of us just thought they were completely out of their minds. They couldn't imagine that. Apparently that was the system that the Russians had used in moving their boosters to the pad. But when you first see it, you just say, "No, you're out of your cotton-pickin' mind. You're not going to be able to move those size units." But, of course, again, it was a tremendous feat of engineering, and it was exciting for us because it was so far beyond, really, what we had been dealing with in Mercury, and it would have been great fun, I think, to have gotten more involved in that. But it didn't work out that way for me. But it was exciting seeing that program come along, and it was another one that had a very high rate success, even though it had that tragic fire [Apollo 1] on the pad.

That was in some ways left over from decisions that were made in Mercury. One of the issues in Mercury was what kind of an atmosphere would you have inside a spacecraft. One possibility was to have an atmosphere that would be more like the atmosphere on Earth, that is, a mixture of oxygen and hydrogen. But the problem was that we were unsure we could sense the two gases separately well enough, whereas if you just had oxygen, you could simply use the pressure gauge, which is very easy. So you could use essentially 5 pounds [per square inch, psi], 4.7 pounds of oxygen in place of the 14.7 pressure on the ground.

But the problem with that is that oxygen is very flammable, and we got too confident, I think, that you could handle that problem, and they started doing these practice runs, pilot runs on the pad with a pure-oxygen environment, but not at 5 psi as it would be in space, but at 14.7 psi, which was sort of like a bomb. We lost that one crew. But it was another example of how these early decisions you make get frozen—no, "frozen" is the wrong word—they get built into the systems and into the procedures, and they may continue into the next stages without enough examination of whether they're still appropriate or not. So you get caught out sometimes by decisions you made earlier.

But I think, all in all, the space program was quite safe compared to what we all were concerned might be the case when we went into this. Mercury and then Gemini had no losses at all, and for a while, the only loss we had was from the astronauts flying their own regular planes, until we had that one and then the later. But I think that's a testament to how those programs were managed, starting with Bob Gilruth and going through. I think particularly with this view we had of looking at Apollo when it was first proposed, with the dramatically 300-foot-high launchers and the spacecraft and so on, and, thinking of that, you'd never would imagine we would get away with so few losses. [Laughs] It looks a little out of this world.

BERGEN: Well, I appreciate your taking your time today and sharing your oral history with us. It's been very interesting. I'm appreciative—

VOAS: Well, I'm pleased that anyone would be interested.

[End of interview]