ORAL HISTORY TRANSCRIPT

ROBERT F. THOMPSON
INTERVIEWED BY KEVIN M. RUSNAK
HOUSTON, TEXAS – 29 AUGUST 2000

RUSNAK: Today is August 29, 2000. This interview with Bob Thompson is being conducted in the offices of the SIGNAL Corporation in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Carol Butler and Sandra Johnson.

I'd like to thank you for taking the time out to sit down and speak with us today.

THOMPSON: All right. Looking forward to it.

RUSNAK: You've had a long career with NASA, and I'd like to start, actually, back at the very beginning, if you could tell us some about the interests you had maybe as a kid, before going into college, and the types of interests you had that led you into the career you chose.

THOMPSON: Well, I'm not so sure there's any real anchor point there. At the time I was a youngster in the mid- and late thirties, the airplane was just becoming a part of our society. Not many people traveled by air at that time, but you could see airplanes flying around, so they were a unique machine.

For some reason, in high school I decided to become an aeronautical engineer. I'm not sure why, because I'd never met an aeronautical engineer and I wasn't really sure what they did, but it sounded very interesting, so I decided I would enter that study area, at least.

So I finished high school in 1941 and enrolled in the Virginia Polytechnic Institute [Blacksburg, Virginia], which is a technical college not too far from my home, and they at that time offered an aeronautical engineering course of study, so I entered aeronautical engineering there at that time.

Graduated 1944 with a bachelor of science degree in aeronautical engineering, and like most people who graduated from college in 1944, I entered the service, went into the Navy. Did not get involved in any kind of activity associated with airplanes. I ended up associated with ships in the Navy, and spent two years in the Navy, from '44 to '46, and ended up on a destroyer just at the end of the hostilities in the Pacific, and spent the last year or so on destroyers, as an officer aboard destroyers, mainly operating in the Atlantic area.

When I was released from active duty from the Navy in '46, I was released in September, which was too late to go back to college. I'd gotten a B.S. degree before I went in the service. I had a number of colleagues that I'd gone to school with, working at NACA [National Advisory Committee for Aeronautics] at Langley Field [Virginia]. I had visited Langley once or twice when I was in Norfolk in the Navy, just to look the place over.

So I decided to go to work at NACA as opposed to going to graduate school. The NACA at that time was essentially heavily involved in basic research, and by working there you could maybe learn as much or more than you could in graduate school, so I decided to go to NACA. So I went to work there. I reported in to Langley in early 1947.

After reporting in at Langley, I entered what was called the Stability Research Division. Langley at that time had about just under 4,000 employees. They had been very actively involved since 1917 in aeronautical research. The laboratory was fairly mature at that time, had a large number of wind tunnels. They had been very busy, very active during the World War II years.

I joined one of the basic research divisions, as I said, involved in stability and control, and worked in one of the wind tunnels there that was involved in doing basic research work on aircraft stability and control. Some of the first things I worked on were the early transonic airplane programs. At that time NACA had a number of research airplane projects going, and a lot of those projects were supported by the wind tunnel work that people did.

We also developed just a lot of basic data that went into reports. The NACA reports were sort of a basic element that industry or the military used in designing airplanes. We would just do general research work on general configurations, put it into written reports, make those reports available, and people would use the data in those reports when they were designing airplanes.

So that's where I started to work, and I worked there from 1947 until 1958, when we—"we," the United States—was involved in an International Geophysical Year [IGY] Program. The Russians had not chosen to join the International Geophysical Year, and the Russians chose to put a satellite in Earth orbit just before some of the IGY work in that direction was planned, and it caused quite a reaction in this country at that time. It indicated maybe that the Russians were farther along in their ballistic missile programs than we thought they were. It indicated they had a technology that we did not have at that time. So it caused quite a stir in the country, and it caused a very rapid reaction in Washington [DC] through the Congress, and that caused the National Space Act to be formed or passed in 1958. It caused NACA to take on a mission called National Aeronautics and Space Administration, instead of just the National Advisory Committee for Aeronautics. So the space task was added to the aeronautical task. Shortly thereafter, the Space Task Group was set up at Langley, and that's the transition into the manned space flight program.

As far as I'm concerned personally, I was involved in doing quite a bit of just basic wind tunnel research work on different airplane configurations or different basic wing planform configurations. I got involved in some control surface flutter studies, got involved in some studies on a thin wing to put on the [Bell] X-1 airplane. I got involved in some studies of doing some highly classified work at that time of coupling some bombers and fighters together wing tip to wing tip to do some things. Some work on supersonic bombers, particularly bombers that you could deploy in advanced areas and they could take off vertically and then fly horizontally, the stability and control problems of taking off vertically and then transitioning to propulsion jets to fly horizontally. A lot of that kind of basic work for the ten years prior to getting in the space program.

RUSNAK: At the same time that you're joining Langley is when the aeronautical field is really moving to jet aircraft and these higher speeds, the transonic [range], and you mentioned the supersonic. How did that affect the types of testing methods you used and the ways of gathering data?

THOMPSON: Well, that had a very profound effect on it. Most of the wind tunnels at that time could not generate velocities much higher than, say, high subsonic speeds. In fact, the tunnel had what was called a choking phenomenon. When you tried to drive the air through the wind tunnel, a conventional wind tunnel at faster than the speed of sound, it choked, and no matter how much power you put in, you couldn't make the air go any faster. So there were some people at Langley working on ways of causing wind tunnels to be able to handle sonic and transonic and supersonic speeds. So-called slotted-throat wind tunnels were being developed at that time.

In our division, we actually took a book out of the—some of the people in flight research were putting small air foil models on the wings of [North American] P-51s and diving the P-51 and getting a high velocity over the wing and testing the little model in that high-velocity area. So we put a bump, if you will, a section of an airfoil, on the floor of the tunnel, and we could have the air flowing through the tunnels. It would speed up and go over that bump. You'd have a little local area where you could get sonic or very low supersonic speeds. So we tested small models on that bump in the floor of the wind tunnel so we could get sonic and transonic data.

Then, of course, [Robert R.] Gilruth and some of the people got involved over at Wallops Island [Virginia], of flying the solid propellant rockets and putting the little test models on the front of those solid propellant motors in order to get data. So we were doing it with solid propellant rockets at Wallops. We were doing it with either dropping heavy models from airplanes or testing on the wings of airplanes, testing on the bumps, to actually building full-scale slotted-throat tunnels. So there was a lot of activity going on to try to get data in the high subsonic, transonic, low supersonic speed range, because we were beginning to design airplanes to fly in that speed range at that time.

RUSNAK: Were there opponents of using some of these methods, like the free-flight method out at Wallops? I understand there was some issue versus the value of the different methods.

THOMPSON: Well, there are always people who are pushing their particular way of doing things, but the real answer is, you needed a collection of all that data. The real benefit was the data coming from all sources. Some data could be somewhat better from one source than another one, or you could get it cheaper or easier or quicker or better, but as quite often, "better" is in the eyes of the beholder, because the data that you would take, say, on a bump in the floor of a wind tunnel, you could maybe take a lot more test points, you could afford to do a lot more than you could because you had to generate a flight test with an airplane to go get a few points of data on the wing flow method, or you had to expend a fairly expensive rocket to get a small amount of data from one of the solid rocket motor tests. So each method of testing had some pros and cons and benefits and some penalties. But the real value to the country was the collective data from all sources.

RUSNAK: Some of the projects that were being looked at at this time were even more advanced than the supersonic, where you're getting to the hypersonic range, some of these precursors to Dyna-Soar and the Space Shuttle, where you're looking at very high speeds and different methods of getting spacecraft out of the atmosphere but in more of an airplane sort of sense. What exposure did you have to any of these early DoD [Department of Defense] projects?

THOMPSON: Where I worked at Langley, we had relatively little exposure to the very high-velocity-type work that was being done with some of the projectile kinds of tests. We had a Gas Dynamics Division, where they tried to generate test conditions that would be a short period of time with very high velocities by creating a pressure source and then rupturing a diaphragm and letting the gas flow. We called it Gas Dynamics Division.

The Ames Research Division out at Moffett Field [California] was doing some of that work. Some of the researchers at Moffett Field were doing some of the analytical work. I'm sure you've heard about the work that [H.] Julian Allen and others did at Ames, that led to the ballistic-shaped entry as opposed to the pointed-nose entry. But most of that work was beyond the speed range that we were involved in in the division I was working in.

Of course, working there, you were aware that that was going on. You'd read the publications. At Langley they had inter-department meetings where a department once a month would say what was going on in their department, and you'd go to those meetings so you knew what other people were doing. But most of the work that I was involved in personally was in the speed range up to about 20 percent faster than speed of sound.

RUSNAK: With even your, I guess, limited exposure to these types of things, did you see any future for space flight before things like Sputnik went up?

THOMPSON: Not really. Like most of us, we were aware of the things like the *Collier's* article that Wernher von Braun got involved in, in the early fifties, where you were talking about people flying up to orbital velocities and visiting large orbiting space stations and so forth, but that was still a little bit "Buck Rogers" compared to what we did on an everyday basis.

The main things that were going on in this country at that time were developing the high subsonic transport airplanes that you now fly on. Even on the airplanes I fly on today, when I look out and see the wings, the sweep angle of the wings, the profile of the wings, the flap configurations on the wings, the aileron configurations on the wings, the speed brake configurations on the wings, those were all what we were working on at Langley in the early

1950s, and those wing planforms are very much like what we were testing in the wind tunnels at that time.

RUSNAK: What were some of the big challenges you faced in developing basically the standards for these?

THOMPSON: Well, some of the bigger things that I got involved with personally were trying to develop some unique test arrangements to test some of the things, but the bump configuration and how to put a model on the bump to get the data you wanted. Simulating the power effects on some of the jet airplanes that we were looking at at that time, particularly some of the bomber configurations where a very large percentage of the air that's out in front of the airplane goes through the engine, so you had to simulate the engine flow, the flow in the inlet of the engines and the flow out the back of the engines, to understand the real stability effects of that flow.

So we had to generate some unique test arrangements where we could bring the air flow in through the front of the engines and then simulate the hot exhaust jet out of the back of the engine in order to do the research work we were doing. So I got involved in developing some new techniques of how to develop wind tunnel models that could do that kind of work.

Also in doing stability and control, if it borders on a higher frequency condition called flutter, it's one thing to worry about the stability of a total airplane as it's flying, it's something else to worry about the stability of a wing and make sure it doesn't begin to shake and fall off. There's a boundary there between what is stability and control work, and what is flutter work.

With our unique test facilities, I got involved in some of the higher-frequency flutter kind of tests, wherein we had to build models that were dynamically similar to the full-scale configuration. In other words, the bending characteristics and the torsion characteristics of the wings had to match what the full-scale configuration was, so you had to build models that bent and flexed and twisted like the real models. Then you'd put that in the wind tunnel and see if it would stay stable or whether it would flutter like a flag. So I got involved in some of the dynamic simulation and flutter testing type of work, and that was a unique challenge to develop some new test techniques.

RUSNAK: Were you doing the same type of thing for where you mentioned the bombers being attached to the fighters in doing that?

THOMPSON: Yes. For example, one of the projects I got involved in was classified then, I'm sure it's been long since declassified. One of the principal bombers we had at that time was the [Boeing] B-47, and one of the principal fighters we had was an [North American] F-86, both swept-wing-configuration airplanes. Aerodynamically, if you couple two airplanes together wing tip to wing tip, to physically couple them together, the increase in span causes a very significant increase in efficiency, aerodynamic efficiency, so you do not pay a whole lot of penalty. In other words, a B-47 can fly just as far with two F-86s attached to the wing tip as it can without them because of the large span increase, and aerodynamically the induced drag is not that much higher because of the increased aspect ratio of configuration.

So the military wanted to carry some fighter protection along on some of the B-47 missions, so they wanted to couple the F-86s to the B-47s, and you could shut the engines off on the 86s and the B-47 could fly to wherever it needed to fly, and then if fighters started bothering the 47s, you could release the F-86s and they could start their engines and give fighter protection.

But the stability and control of that configuration, the B-47 with the two F-86s on the wing tip, was what I was really involved in studying, because to make it fly well, you have to skew the coupling angle such that when the F-86, say, hits an air pocket and wants to bob up, it needs to also pitch down so it will come back and be stable. So by skewing the wing tip angle, you could cause the F-86 to fly along nice and stable. So we studied the different skew angles and also hooked the ailerons into that rolling motion. That program was essentially overcome by the ballistic missile program and never really was a practical program.

RUSNAK: Would they then reattach the F-86s to the bombers?

THOMPSON: Yes. It's much like a probe-and-drogue arrangement for refueling. You just fly the F-86. You had a design where you could sort of probe into a drogue, and they would capture and you'd keep them hooked together. Then you could shut the engine down on the fighter plane. Then when you got ready to use the fighter plane, you could release it and start the engine and had plenty of fuel left.

Actually, flight testing was done with [Boeing] B-29s and [Republic] F-84s. In fact, there was an accident that killed a bunch of people up in New York, where the F-86 actually rolled over and tore the wing off the B-29. But that's the kind of thing you run into when you're doing projects like that sometimes.

RUSNAK: Did you find any of these experiences or the skills you learned while working with the NACA that were directly applicable to your later work with NASA?

THOMPSON: Oh, I think certainly the maturity you gain, the experience of relating with people, the engineering skills you gain, and an understanding of design approaches and things of that nature.

One of the real beauties of NACA was the fact that most of the people that worked at NACA were involved in hands-on kinds of things. If you had a project of this nature, you usually were involved in negotiating with whoever was funding the project, whether it came in as a basic project or whether the Air Force was bringing funding or some company bringing funding. So you'd have to negotiate with what you were going to accomplish with the funding. You then had to figure out how you were going to test and get the data. You then have to design a model and get a model built. Had to take the data, you had to analyze the data. You had to write the report. You had to submit the report to your peers for review. You had to defend what you had in the report. So it gave you a lot of experience in carrying out all of those kind of interfaces.

RUSNAK: What about some of these people that you worked with? Did you find that you had any kind of mentors or people who were particularly influential on your development as an engineer?

THOMPSON: Sure. Usually when you went there you were assigned to work on a project with some senior project manager, so your first few years there, you were essentially working under his management control or his tutoring, mentoring. So as you went through, you had a number of people that you worked for in that regard. Langley at that time had an organizational structure that, from a working person's point of view, the division was probably the biggest identity that you were generally involved in, although from the center director, he had several divisions. These divisions had deputy directors that they reported through. But at the working level you didn't really see much of that. You saw your division chief and the division you were working in.

Then those divisions were broken into branches and sections, so you had a section head, which was your next immediate supervisor. Then he had a branch head; then there was a division chief; then there was a deputy director; then there was a center director. But usually the section head. And within sections there were essentially project leaders that were the lower-level mentor. In the Army parallel, they would be the sergeants, then there would be the platoon leaders, then there's be the company commanders. So you had a structure that you worked through.

The branch head of the branch I worked with at Langley when I first went there was a fellow named Rogallo, Francis M. Rogallo. I think "M." was his middle initial. One of the things that "Rog" was working on was the so-called Rogallo kite that became famous later on.

The offices I went to work in at Langley had windows between the offices, and you had eight or ten engineers in each office. We sat at double desks facing each other. Rog's office was maybe three offices down from mine, but I could see through the windows down there. Shortly after I went to work there, getting ready to go to lunch one day and I looked down and Rog is standing on his desk, launching little handkerchief-size gliding parachutes. At lunch every day, instead of going to the cafeteria, he would stay and eat in his office and play with these flexible structures that eventually became known as the Rogallo kite, or Rogallo wing. As far as I know, Rog is still retired now down at Nags Head [North Carolina], flying Rogallo kites out over the ocean. So, yes, people like that. Subsequently, I think Rog got a $35,000 award from NASA for inventing the flexible wing, or contributing to the development of the flexible wing.

We tried some Rogallo-type lifting surfaces in the early space program. The so-called paraglider that we tried on Gemini wasn't really—it was a semi-flexible arrangement. In fact, part of its demise was the fact that it was neither fish nor fowl. It was kind of the worst of both worlds. We tried to have too rigid a leading edge, inflating leading edge on that paraglider and it just never did work real well. We finally had to get rid of it.

So certainly, to go back to your basic question, the ten years' experience I had, eleven years, at Langley prior to getting involved in the space program was fundamental to doing the things that I was ultimately able to do when I got in the space program. I think that was probably true of most of the people that were in the early group brought together by Gilruth there in the late fifties. Most of the people were in their mid-thirties to early forties. They'd been working at Langley from, say, six to ten or twelve years. They had progressed through the project development stages of doing different things, whether it was flight-testing airplanes or testing rockets or testing wind tunnel models, and it gave everyone a good basic foundation to work on, what became known as Project Mercury.

RUSNAK: Did you work with many of the people who became your colleagues at NASA before you joined the Space Task Group?

THOMPSON: Not a great number, in that the original group that were the nucleus of the Space Task Group came out of two different divisions other than the one that I was involved in. The Flight Research Division and the Pilotless Aircraft Research Division [PARD] were divisions that Gilruth had worked with closer. I did not know Gilruth before the Space Task Group. I knew who he was because he was one of the deputy directors, but he was not the deputy director that my division worked up through at Langley. So most of the people that I got to know once I joined the Space Task Group I had known in Langley but had not worked with, so they weren't close associates.

Langley had a system of editorial review of any report that you wrote, and then you would also serve on editorial committees of other people's reports. So the people in Flight Research Division that were doing stability and control things similar to what I did, I got to know them. I knew Chuck [Charles W.] Mathews a little bit. I knew a fellow named Harold [I.] Johnson. I knew Chris [Christopher C.] Kraft [Jr.] because we'd gone to college together; we were classmates in college together. I had visited Chris when I was in the Navy. He had gone to work at Langley right after graduation, and I went in the Navy, so I visited him at Langley while I was still in the Navy. So I knew Chris. I knew Chuck a little bit. I knew Harold Johnson a little bit. But most of the people in the Space Task Group were not close colleagues of mine at Langley.

I think I got into the Space Task Group quite early. I was not in the original thirty-five that I'm sure you've heard the famous letter with thirty-five people on it. I was not in that group. My assistant division chief at that time was a man named Charlie [Charles H.] Zimmerman, and Charlie was helping Bob Gilruth put together what became known as the Space Task Group. When Bob got the assignment from [Henry J. E.] Reid or [Floyd L. "Tommy"] Thompson at

Langley to put together this Space Task Group, he asked some of his colleagues around to help him decide who ought to be pulled out of the Research Center and put in this Space Task Group.

Charlie Zimmerman went over and helped Bob try to figure out who ought to be in the original organization, and Charlie's the one that decided that I might be a good candidate to join the Space Task Group, but I was away on a two-week active-duty tour in the Navy at the time, at the time the Space Task Group letter was set up. Charlie had submitted my name and had called my home and left a message, as soon as I got back from the tour of duty of the Navy to give him a call, which I did. I called him at home and he said to contact Chuck Mathews, or that Chuck was going to call me when I got to work the next day.

So when I got to work, Chuck called, and Chuck said, "Your name has been submitted as someone." I think part of the problem, they were trying to spread the penalty of the Research Center around a little bit to make each division contribute some people to this new group. So I don't know whether it was a compliment or a— [Laughter] Anyway, Charlie put my name in the pot, and Chuck called, and I told Chuck I'd be willing to talk to him, so I went over and soon joined them. So I joined them a couple of weeks after the letter came out.

RUSNAK: Did you know you were going to get into recovery operations right away?

THOMPSON: Oh, yes. Apparently when Bob Gilruth was setting up the Space Task Group, he had already pretty well made up his mind that Chuck Mathews was going to head the operations part of the thing, and Max [Maxime A.] Faget was going to head the engineering design part of the thing. Charlie Zimmerman, the fellow that I told you about, that was our assistant, was helping him try to figure out what to do with the administrative and business part of the thing.

Charlie was doing that on a temporary basis, but Charlie was a researcher at heart, and that wasn't what he was interested in doing, so he was just helping out and helping pick people from around the center so that they could tear a nucleus of manpower out of the Research Center and start the Space Task Group.

So Chuck was looking for someone to begin to think of what landing and recovery was all about, so Charlie had submitted my name, and that's certainly when Chuck called me, said, "We're looking for someone to get involved in the landing and recovery operation, to manage it and lead it."

I said something like, "Well, what's it all about?"

And I think he said something like, "Well, if we knew what it was all about, we might not need you."

So I said, "Well, I'll come over and talk to you about it."

So it was sort of that thing. He wasn't real sure what was involved, and neither was I, but I went over and spent some time with them and began to understand what was involved.

RUSNAK: You mentioned Charlie Zimmerman being a researcher at heart. He probably wasn't the only one who kind of weighed their research interests versus joining this new Space Task Group that they didn't know necessarily what was going to do, if they'd still be able to do research. Did you have that same kind of internal debate?

THOMPSON: Yes. I think all of us who left the Research Center and joined the Space Task Group had that debate. The colleagues that definitely didn't want to leave the Research Center had all the arguments of why you should stay there at a nice stable job and these kinds of things, as opposed to getting off on a silly venture where you're going to kill someone by putting them on the front end of a rocket. So there were that kind of debates going on.

I never really worried too much about that. The Space Task Group thing sounded—I'd had ten years worth of research work, or eleven years, and I was ready to try something new, so I didn't really lose much sleep over making the change.

RUSNAK: So how new was doing recovery things for you? Did you have any sort of qualifications that prepared you for taking this task?

THOMPSON: No, not really, because the task had never been done before. In fact, one of the things that's a little bit unique about my experience, in the three major assignments I've had in the space program, all three of them have been brand new when I went to them. So I never took a job over from anyone else. I always took a task on, but never took an established job over. So recovery was not an established thing. So they were looking for someone to come in and figure out what it was and manage it and cause it to happen, and there was no way of really knowing how big an organization we were going to need, exactly what was involved.

So the first thing that I did in conjunction with the people who were beginning to form up into this Space Task Group organization, one of the very first meetings I went to, Chuck Mathews was chairing the meeting and he had about three or four people in the room, five people maybe, and a fellow named John [P.] Mayer, who had joined the Space Task Group, he eventually became head of the Mission Planning and Analysis Division.

John was a person at Langley who'd gotten involved in the early orbital mechanics and trajectory work. John knew how to run a computer program would create ground tracks over the surface of the Earth underneath where an orbital vehicle would lie. So he had generated a bunch of trajectories and a bunch of ground tracks, so with that work we could sit down around the table and say, "Look, if we launch from Cape Canaveral, if we launch southeast down along the islands, the first pass around will be—" As you go around in orbit, of course, the Earth rotates, so the ground track precesses westward. So you could look along the ground tracks of where the spacecraft would be flying overhead. So you knew pretty well that the recovery operation was going to be somewhere along those ground tracks, and it was either going to be near the launch site if it blew up there, it might be out in the water 100 yards, it might be out in the water 100 miles, it might be out in the water 1,000 miles, it might be over in Africa somewhere, it might be most anywhere.

So you could pretty well see that you were going to be involved in a worldwide activity. Just common sense told you, you couldn't, in front of everyone, load a man on a front end of a rocket, light it off, and then turn around and say, "We don't know where it went." You've got to know where it went. Right? So you've got to be able to go to wherever it went and be prepared to provide some on-scene assistance and some recovery activity.

So I pretty quickly recognized the magnitude of what the total recovery operation was to be, and it became pretty obvious early that that was something we were going to have to go to the Defense Department and enlist their help on, because they were the only people that had the ability to go in those parts of the world and do the kinds of things we needed to have done.

So the fact that I had been a naval officer for a couple of years was of some help in knowing how to go into the Defense Department and do that kind of work, and then the fact that I could work with people like John Mayer and understand trajectories, could do probability analysis and guess what the probability of being at the launch site was, compared to the probability of being in the middle of the Atlantic Ocean, compared to the probability of being in Africa, compared to the probability of getting into orbit, and so forth.

So it soon evolved into understanding, on the geography of the world, where the recovery operations would have to be prepared to be carried out, and then it became a matter of entering the Defense Department and talking to people and finding the right command structure and getting the commitment for them to commit the people to do the job for you.

RUSNAK: How did that process work?

THOMPSON: Well, that process worked very easily and very smoothly, in that, first of all, the National Space Act, published in front of everyone and, of course, approved by the Congress, said as a country we were going to get in the space business. It made it clear that NACA was being converted into NASA, and NASA had the mission.

Prior to that time, there was a lot of debate about whether it should be a military mission or a civilian mission, but by then the decision had been made. The Defense Department was basically extremely cooperative. They were very supportive, so if you would go to, say, a high command in Washington and talk about needing some help, you usually got it. Or you'd go up there and say, "I'd like to work with the Atlantic Fleet people to do certain things," they would send a message down to the Atlantic Fleet or send the instructions down there, and you'd go work with those people. So they were extremely cooperative.

The challenge we had was to really decide what we wanted, what we needed, and what you wanted and what you needed had to be explained to them in such a way that they could understand it and commit the forces to go get it done. Then we had to work with the forces to train them and to equip them properly to get it done.

RUSNAK: How did you manage something like the monumental cost of what you wanted and what you needed from the Navy?

THOMPSON: Again, that was pretty straightforward and pretty easy, in that for a long time in this country the military, the Defense Department had had what was called industrial funding arrangements, so there had been plans within the military that if they are supporting another government agency or supporting a company or something, there are guidelines of how you charge, industrial charging. So early on, we agreed that they would support us under the industrial funding agreements, which means that if NASA goes to DOD and asks them for certain support, what you have to do is reimburse the Defense Department for what they call their Title B expenditures, where they have to use jet fuel or time doing things, taking away from their basic mission. You pay those out-of-pocket costs. Those are quite small compared to what it would cost you had you had to go out and build a ship or build an airplane, train a crew, and so forth. So it was an extremely cost-effective way for NASA to do the recovery operation.

We reimbursed the Defense Department with money that was out of the Federal Treasury, came to NASA. We reimbursed them for those Title B expenses, but they were just a fraction of what it would have cost us had we had to do it from scratch with our own equipment. You could go get a destroyer with 350 people on it trained to go somewhere and do something, and you could keep them involved for a week and pay them for the fuel oil they used and a few Title B expenses, and they'd go on back to doing their other mission and you were through.

We worked very hard to make sure that we designed equipment and designed procedures and developed training techniques and so forth to where we could come in, take an ordinary crew, a very short period of time train them to do the work, give them the equipment. They could go do the work and then they could go on back to doing their job. Same thing with the airplanes and so forth.

RUSNAK: What sort of specialized equipment was necessary for Mercury?

THOMPSON: Well, on Mercury there was a lot of specialized equipment. For example, you had to have the electronic equipment that gave them the ability to fly—the Mercury capsule is pretty hard to see. It's not real big. If you're out flying over the ocean looking for it, you want an electronic signal. You'd like it to be sending out a radio signal and you'd like to have a receiver. So these special transmitters and receivers, to help them with their location of the spacecraft, we had to develop those.

We actually got most of our early support out of a British system that was developed in World War II, called SARAH. SARAH stood for Search and Rescue and Homing. What the SARAH system was, was a little pocket cigarette-pack-size transmitter that the British pilots wore on their flight suits, and if they were down in the channel somewhere, they could activate this little beacon. Had a little antenna about six inches long on it.

That beacon sent out a signal and it had a relatively small receiver on airplanes with a couple of directional antennas up on the front of the airplane. If the signal was stronger on the left side, you would see it displayed in such a way that told you to turn to the left or to the right, and you could fly based on this signal for about—you could find a pilot out in the water from about twenty miles away. So we bought a bunch of these surplus SARAH beacons and we got that idea from the nose-cone-recovery work going on down at the Atlantic missile range at that time.

So we did our early work using the UHF homing beacons that were developed in World War II for this personnel location in the ocean. We put these little SARAH beacons on the capsule and we put these special receivers and special antennas on a large number of military airplanes, Navy [Lockheed] P-2Vs [*Neptune*] and Air Force [Douglas] C-54s [*Skytrain*] and so forth. These receivers cost a couple hundred dollars apiece, and the little transmitters cost—maybe the receivers were 500 [dollars] apiece, something like that. Anyway, for relatively nominal expenditure, you could equip the people electronically and find this beacon. So one of the early things we did was to develop that work and take it into the Navy.

The flotation collar, things that we put around the thing, these special recovery hooks for reaching out to helicopters and hooking on spacecraft or from ships, lots of special handling equipment that we designed and delivered to the Defense Department in such a way that they could take their regular forces and get the job done without much interference in their daily work.

RUSNAK: How many ships would you equip with this sort of capability?

THOMPSON: Well, on a recovery operation, say, like John [H.] Glenn's [Jr.] operation, there were probably two or three aircraft carriers and maybe ten or twelve destroyers and maybe forty or fifty, sixty airplanes, and several tankers and things of that nature. So on a recovery operation like that, there might be thirty, thirty-five ships and maybe forty, fifty airplanes. You would have to provide equipment, and we put equipment in places like Pearl Harbor [Hawaii] or Northfolk, Virginia, or Bermuda, places where they could pick up the equipment and train very minimally and go do the job and then dump it off there, and the next time you'd have a different set of ships and airplanes and people.

RUSNAK: Of course, using the Navy assumes that the capsule's going to land in the water. What sort of discussion was bandied about in terms of having the Mercury capsule being able to land on land, or later on once they decided it was going to land in water, to provide for a contingency in case it did land somewhere like in Africa?

THOMPSON: Well, you had two different kind of land landing support areas that we were concerned about. At the time we started Mercury, the probability of success with the launch vehicles was relatively low, and so the chance of an early abort off the pad was there, so you had to be prepared to go somewhere in the boondocks around the launch area. If you go down and look at [Cape] Canaveral, there are a lot of swamps. There are a lot of cactus and vegetation that's heavy, so we had to have some way to go into that kind of vegetation and get to the capsule. So we had what we called launch site recovery forces.

Again, we went into DoD inventory and we found they were developing a vehicle at that time called the LARC. It was an amphibian, had great big rubber tires on it and could travel over water as well as land. It also had an armored personnel carriers.

So our launch site recovery forces was made up of helicopters, armored personnel carriers, and LARCs [Lighter Amphibious Resupply Cargo], and they could traverse any of the terrain around the launch site. Then on a given day we were launching, we knew the wind was coming from a certain direction, and if we launched with the escape tower right off the pad or right after liftoff, we knew where the capsule would go. So we deployed the helicopters or the LARCs or the armored personnel carriers to go into that part of the terrain and take medical personnel and take recovery personnel. So that was one kind of land recovery.

If you were down in the jungle of Africa, fairly early in my setting up the recovery forces, I visited the Air Rescue Service. The Air Force at that time, having come out of World War II and out of Korea, had developed what they called the Air Rescue Service. This was a branch of the Air Force that was specially trained for going in and helping people where they had to bail out of airplanes and things of that nature. So they were essentially deployed on a worldwide basis at that time. They were headquartered down in Orlando, Florida.

So I went down to Orlando and talked to those people and told them what our task was. They were very supportive, and you can understand why they were supportive. Here is a task that only they can do, so it helps them justify their existence. It helps them justify their funding. It helps them upgrade their equipment, gives them an exciting mission to support, and it fits right into what they do every day. So they were very willing to take on the task of air support.

So we then talked about how to equip them electronically, how to equip them so they could communicate from our control center to where they were deployed to, how to get permission out of countries in Africa to let them base in places like Nairobi or Salisbury. These names have all changed now, but anyway, we had bases in Africa. We would put a couple of C-54s with a pair of rescue people and they were equipped to jump into the terrain and provide on-scene assistance if we got down on a land mass or jump into the water and rig the floatation collar if we got into the water.

For example, when we flew the early orbital missions, we had the ability to go anywhere along that orbital ground track. Within eighteen hours we could have been at the spacecraft landing and providing some on-scene assistance. Anywhere within the primary recovery area, we'd be there within three hours. So if you were 100 miles, like [M.] Scott Carpenter overshot 125 miles, we probably got to Scott with people and jumped out of the airplane within thirty or forty minutes, and we had a ship there within an hour, hour and a half, and picked him up, and he was 125 miles from where he was supposed to be.

John Glenn was sixty miles short of where he was supposed to be. We had the destroyer there fairly close by, so picked him up pretty quick. David [R.] Scott and, I guess, Neil [A.] Armstrong, when they ran into some trouble, we had to bring them down in what we call a secondary recovery area out in the Pacific [Ocean]. Our secondary recovery areas, we had a ship, a destroyer on standby, and a couple of Air Force C-54s. So as soon as we decided to come into that area, we launched the C-54s, and they were actually out in the area when they came down, saw them coming down on the parachute, and then took a few hours to get the destroyer there, but the pararescue people sat in the water on the raft with them, and they probably told all kinds of wild stories while they were waiting to get the ship there to them.

RUSNAK: They probably did. Was there ever any intention of using a land landing as the primary recovery method for Mercury?

THOMPSON: Well, when I first joined the Space Task Group in the late 1950s, the people in flight research—Chuck Mathews and been involved in this—had looked at what it would take to build a lightweight winged vehicle that might could land on land, as opposed to the capsule kind of vehicle that Max Faget and the PARD were proposing. It quickly became apparent that anything with wings on it had a chance of landing on land would be way out of range weight-wise what we could do putting anything in orbit. At the time the only vehicle we had that could launch anything in orbit was the Atlas, and the Atlas you had about a 2,500- to 3,000-pound limit, and hanging wings and landing gears and engines and that sort of thing just didn't make any sense. You couldn't come close weight-wise.

We had a tough enough time with the capsule kind, which was kind of a minimal structure around a person with a parachute, which was by far the lightest, plus we were launching—the United States is located on the globe such that it's in a fairly temperate weather area. We have big oceans on either side. We had a very large Navy and Air Force that could go out into those oceans. While you're landing, the water is much softer than the land, much more forgiving. You can be ten miles over here, and the water's the same as ten miles over here. That's not true on land, so lots of thing added up to a water landing for Mercury. There was never much of a debate, but there was what I would call a cursory look at was it possible to build an airplane kind of configuration. That was quickly abandoned, just didn't make any sense, and it became quite obvious that water recovery for the planned recovery area was the way to go for Mercury, and there was never really much of any debate.

RUSNAK: Let's talk about some of the unmanned flights. One of the first big ones, I guess, to test recovery force was the Big Joe launch. Can you tell us what you remember about that particular flight?

THOMPSON: Yes. Of course, it's been forty years, so my memory may be a little slanted. But Big Joe was the first recovery area, our first recovery task of any magnitude that we ran out of Cape Canaveral at that time. It was a test on a capsule that had been built at Langley. It was manufactured in our shops at Langley, and it was a way of testing the ablation heat shield. It was designed to fly a subsonic trajectory. It was to go 1,860 miles down the Atlantic missile range. We were launching it southeast out of the Cape. It was to go 1,860 miles, and we would recover it about 300 or 400 hundred miles out from Antigua. If you go the Cape Canaveral and go 1,860 miles down, staying just north of the islands there, that's where the recovery area was. That was the first fairly large-scaled operation that we ran after we had set up the Space Task Group and after I had set up all the arrangements working with the Defense Department.

We had structured our requirements for that mission such that we wanted a destroyer about every 400 miles from the Cape. So about every 400 miles down that trajectory we were flying, we had a destroyer. Then down in the terminal area, we had a destroyer, and I guess we also had an LSD [Landing Ship Dock] with some helicopters on it, as I remember it. At that time we used either aircraft carriers or landing ship docks. An LSD could carry two or three helicopters, and they could land on the LSD. For that being an unmanned flight, I think we had an LSD and then a destroyer down in the landing area. We had a number of P-2Vs flying out of Roosevelt Roads in Puerto Rico.

We decided to make a night launch, and we were copying some of the things that the ballistic missile people were doing down at the range. They were launching intermediate-range and long-range ballistic missiles down there and testing them, and they were trying to recover nose cones that they had, data cones. So they had certain techniques they used. They had certain communications techniques. They had certain location techniques. We, of course, weren't necessarily interested in inventing everything. If someone was doing something, we took advantage of it. So we had a lot of the techniques that the Atlantic Missile Range had been using. We paraphrased those and put them into our operation.

On this particular recovery operation, I chose to go down-range with the down-range task force commander down in the landing area, and we flew at night, because the capsule entering the atmosphere at night creates—you're seeing a shooting star coming down. That creates a big shooting star effect, so visual sightings were important as well as electronic kind of things. So we deployed our destroyers about every 400 miles so that left that we have maybe four or five destroyers between the Cape and where we were. We had the destroyer that I was on. We had an LSD. We had a bunch of P-2Vs and some Air Force C-54s. John Mayer, who I've mentioned earlier, ran our Mission Planning and Analysis Division, was back at the Cape.

At that time the communications was somewhat antique compared to today. You didn't have easy voice communication through a satellite. We did a lot of communications with CW [continuous wave], HFCW, a code, you know, dots and dashes. So we had a simplified reporting system. We had different reports that you could send by code with short messages.

We had a pre-sail briefing down at the Cape and got all the people together and made all the arrangements. I had the Navy task force commanders. I haven't talked about the command structure in the Navy, but they were just being with us at that time.

In any event, the time we flew Big Joe, one of the first reports that I was supposed to get as down-range recovery manager was an impact report, the launch trajectory. We were to track the spacecraft on the missile as it left the launch site. When it separated, you knew what its velocity was and what its direction was and everything, so you could calculate where it was going to hit. So maybe five or ten minutes after burnout, I was supposed to get an impact report from John Mayer that said the latitude and longitude of where he predicted the hit.

We'd also briefed the recovery force just up and down the line on what we called vis reps, visual [report]. We told them to look for the shooting star and give us an azimuth and send us a vis rep, vision report. So we had a report format that they could very quickly what the ship was and what the azimuth was and when they saw it kind of thing.

Then at that time the landing missile range had a bunch of hydrophoness set up on different islands down there. Then on Big Joe we had a little SOFAR [sound fixing and ranging] bomb, which is about the size of a hand grenade, and when the parachute opened, this hand grenade or SOFAR bomb fell out. It went down to about 3,000 feet, hydrostatically triggered a mechanism and exploded it. That pressure wave from that little bomb traveled through the water and the hydrophones picked it up at the different islands. By getting it from two or three places, they could get a very accurate fix of where that bomb went off. So we had those things all activated.

Well, after the time for launch and we were communicating by CW messages, and I kept waiting for the impact report to come, it was late. We were standing around a big plotting board on the CIC [Combat Information Center] of this destroyer, and all the people were waiting for me to tell them where this thing was supposed to go. This report comes through and I read it, and in today's words what it said, "It left here, but we don't know where it went." [Laughter] What really happened was the two engines on the outboard side of the Atlas, the Atlas was a stage and a half, and after the first couple of minutes, they were supposed to release and slide off of some rails and lighten the load and the center engine continued on to get you your end point.

Well, when the time for the two outboard engines to release, they released and slid back but hung up, which kept a whole bunch of extra weight on the Atlas. Well, instead of getting the velocity to send this thing 1,800 miles down-range—it's like throwing a discus, you didn't throw it but about two-thirds as far as you were supposed to throw it—so it completely screwed up John [P.] Mayer's impact report, and he didn't have any idea where it went. They saw it leave, but he didn't get any good data as to what trajectory it was on.

So when I got that impact report that wasn't any help, I turned to this Captain Wright, who was the task force commander, and I said, "Let's ask the next destroyer up-range for a vis rep," because we hadn't seen anything. So we asked the next destroyer for a vis rep, and so we got a positive vis rep from him, but it was up-range. When he gave us the azimuth, it was up-range. So I said, "Let's go to the next destroyer and ask for a vis rep." So we went to him and he said it was down-range. I said, "Let's go to one more destroyer." We went to the third destroyer up and got a vis rep and it's down-range. So we had two of them said it was down-range, one of them said it was up-range. We had them plotted on the map. I went over and I put my finger between the two destroyers and I said, "Let's go look there."

We had a P-2V coming out from Roosevelt Roads to relieve the P-2Vs out in the recovery area because of on-station time. He was almost out to where we wanted him to go look for this. So we diverted him. He made a north turn to fly to this spot between these two destroyers. So we put all that in gear and started the destroyers up, started the P-2V up. About forty-five minutes later, the mil rep, the SOFAR bomb report came in, and that SOFAR bomb was two miles from where I put my finger on the map. [Laughter] Pure luck. This P-2V flew right to that spot and found the thing.

The destroyer we'd sent there was the *Strong*. The skipper got in there about daylight and picked it up. I told him to meet me at Roosevelt Roads in Puerto Rico. We went there. We had put a big plaque on the Big Joe that said, "This is the property of the United States. It's not abandoned," because anything floating in the ocean, people can pick it up. So we wanted to tell any ship that found it, it was not abandoned. We knew where it was and we're were coming to get it. So he had read that plaque, and when I met on the dock—and I think we'd saved a $500 reward for the recovery, we'd put that plaque on the thing—first thing he said to me is, "Where's my $500?" [Laughter]

But, anyway, we loaded it up on an airplane and took it back to the Cape and declared a complete success because the trajectory we'd been on had given us a steeper entry than what we planned, so we got a higher heating rate. We didn't have quite as much as total heat, but we got all the data we wanted to off the launch. The recovery operation worked out fine, and everything worked fine. A perfect success. We declared a success, and we went on with the mission. So that's my recollection of Big Joe. [Laughter]

RUSNAK: That's pretty good for forty years ago.

THOMPSON: It was an interesting experience. It made us all look like we knew what we were doing. [Laughter]

RUSNAK: Well, you guys passed your first test.

THOMPSON: We passed our first test. We had actually—I don't remember now whether the—the Big Joe flight occurred before some of our launches of the monkeys from Wallops. They were some of our more interesting recovery operations. I can't remember whether—

RUSNAK: I think it was right before—

THOMPSON: I guess Big Joe was just before the launches we had at Wallops. We launched a couple of monkeys from Wallops that were fairly interesting operations that gave a lot of insight into things we ought to do and not do and so forth. So it was a combination of learning by doing.

In today's mature world, we wouldn't do a lot of the things we did then, but a lot of the things we did then allowed us to move on quickly, much more quickly than we would today. Things that didn't go exactly as planned didn't worry us quite as much. We didn't stop and have two or three investigating committees look at everything; we just took the learning from it ourselves and went on. We were all learning at that time.

I think the recovery operation was one that we put a lot of capability into, and we had plans for no matter what happened, you know. If the thing took off on some under-velocity condition and ended up halfway across Africa, you at least had a plan. You could go talk to someone. You could send some airplanes in. You could go do something. The same thing was true if you aborted on the launch pad and it was over there five miles from the launch pad in the swamp and the alligators. You could go over there and do something. The activity had to cover all those possibilities.

RUSNAK: I have ask you about some of the monkey flights out of Wallops Island there. Like Little Joe 2, I guess, was the first one, with Sam on board.

THOMPSON: That, again, was one where we learned a lot in recovery, and, again, that was very early. I personally tended to go out in the recovery area during the very early years and then stayed in the control center once I got more people in the organization and got better organized.

But we were launching Sam, this monkey, and Sam came from the School of Aviation Medicine in San Antonio. We were going to launch Sam from Wallops on a capsule built at Langley, Mercury kind of capsule built at Langley, launched on the Little Joe solid rocket booster. If you've interviewed Max Faget, he'll tell you where Little Joe came from and all that sort of thing. Anyway, Max was at Wallops, as best I recall.

We were launching from Wallops, and the recovery area was about 200 miles off Cape Hatteras. We were launching southeast out of Wallops. It was December, and the weather on the East Coast for the United States off Cape Hatteras in December is generally not real good for water operations, but, anyway, it turned out that was the time. So, again, we had a destroyer out in the primary area with the task force commander on it and I was there with him. We had an LSD with a couple of helicopters from MAG-26 [Marine Air Group] in North Carolina, and I think we maybe had one other destroyer between Wallops and where we were, or an ARS [Air Rescue Service], had another ship somewhere along the line.

But when we got out there and got ready to launch, we got involved in a very heavy storm, one of the typical East Coast storms hit, and the seas were much too rough to think about operating. We had maybe thirty- or forty-foot seas out there, so we were just hanging on out there trying to wait for it to get better. So we wallowed around out there a couple of days, and finally the weather got some better. The seas got down to maybe being fifteen or twenty feet instead of forty. The skies cleared a little bit. So it got to where we thought we could do it, so I sent a report back to Wallops saying, "We could handle it." They had been putting a monkey in the capsule each day getting ready to launch and then would have to hold, so they were more than anxious to go. So the minute I sent them a half-way favorable report, boom, here it came.

Well, the weather was too rough for the LSD to launch the helicopters. They were down, stowed below. They couldn't get them up. So we had to do the recovery operation from the destroyer. We didn't have any problem. We had a P-2V out there. We didn't have any problem. The capsule went a little bit farther than we had planned, a couple or three miles. The P-2V found it right away. We went alongside with the destroyer to pick it up.

I had been up on the bridge talking to the skipper on how to approach the capsule. What we really wanted to do was to have the wind in such a direction that it set the ship down against the—if this is the capsule floating, you'd like to come along this side with the wind from that direction, so it'll blow the ship down against to kind of harbor the capsule under the ship and keep the ship moving to where you could maintain steerage. It actually allowed you to go across the seas a little bit, so it cut down on the roll of the ship, and then we'd go alongside and reach out from the side of the destroyer with what we called a shepherd's hook, with a hook on it, and we had what I called an Easter basket hook on top of the capsule. You had to hook into that and when you did, you pulled the pole away and it left a lifting line over the ship's davit, and then that line went back to a winch on the deck in the aft end of the destroyer. You'd winch the thing up and pull the davit in by hand and set it down on the deck.

Well, as we went alongside and as the sailor was trying to hook the recovery hook in, the pole that we had designed for a recovery hook was a little bit flexible, kind of like a fishing rod, so he was having trouble hooking in. He had to go down a long way along the ship before he finally hooked into it. The skipper that was conning the ship got more interested—I left up on the bridge and went down, once we got alongside the capsule—and he let the ship slow down too much, and the ship broached to, which means it turned sideways into the waves, so that the waves were hitting it sideways and making the ship, instead of rolling ten or fifteen degrees, it started rolling forty-five degrees about the time we hooked onto this capsule.

Well, one minute the capsule would be in the water, then another minute it'd be twenty feet in the air and swinging like a wrecking ball, but, anyway, it banged against the ship once or twice. Finally as it started swinging in, we said, "Turn it loose," and the sailors released the line a little bit. It hit up against the side of the bulkhead and hung up on the deck, and we threw a line around it. So we got back aboard the ship pretty quick, but just as we got it aboard ship, one of the sailors who was out on the deck got washed overboard. So we got the capsule here, but here's this kid in a life jacket just waving like mad, going up on the top of one wave and down another one. So we got the capsule lashed down and got under way and went back and picked him up.

This capsule had been designed, as I said, at Langley, and it wasn't very efficient for work out there. You have to take the whole afterbody apart, had to take seventy-two bolts out and lift about 400 pounds of afterbody off to reach in and get the little capsule where the monkey was, and the monkey's in here all this time. But, anyway, we rigged the canvas and we took a heading into the seas to keep that side of the ship away from the weather. We got those seventy-two bolts off.

Most of the technicians that I had taken from Langley with me were seasick, so I had a bunch of sailors, and we'd never seen this damned capsule that the monkey was in. But in any event, we got these bolts off, lifted that afterbody and set it off and got this aluminum can that was about the size of a big waste basket, and the monkey was in there.

I'd never seen it before, because we'd planned to hand it to the Air Force technicians from the School of Aviation Medicine, but they were all over on the LSD, and it turned out they were all seasick over on the LSD. In fact, they were over there giving themselves the sugar solution that they were going to give the monkey to keep themselves from dehydrating, or whatever it was.

But, in any event, I got the capsule apart and got the thing out, and I talked to the people back at Wallops, and they said, "We would like you to get the capsule over to the LSD where our veterinarians are, if you possibly can."

So I said, "We'll take a look at it, but if we don't like it, tell me, you know, how to get in this thing, and how to get him out." They gave me seven instructions of how to take this thing all apart. I wrote them down.

So we went alongside the LSD and sent a line over. The seas were pretty rough. We hooked the line up, and the next you know, the destroyer hits one wave and the LSD hits another, and we part the line. So we tried again and we part the line. So I said, "No, let's not do that anymore. Let's just take the monkey down into sick bay and get him out of there."

So with the skipper and the pharmacist's mate—there wasn't a doctor or anything on the LSD—the three of us went down to sick bay, took the top off of this damn thing, and here's this little old monkey in there, and, boy, he was happy to see someone. He stuck his hand up. I wasn't sure whether he was going to bite or not, so I put my finger in. He took a hold of it real friendly. So we took him—he was in a contoured couch, just like an astronaut, took him out of there and unhooked everything, set him up on a counter there in sick bay, and send for some apples and oranges. We fed him a little bit. We decided since we'd been out there wallowing around in the seas, we announced to—the crew want to see this—because then anything that had been to space was an oddity. We told the crew if they wanted to see this monkey, they could come down and walk by sick bay. We opened the top part of the Dutch door in the sick bay, set the monkey up on the counter there, and let them walk by and, you know, ooh and aah at the monkey while he was eating apples and oranges.

We headed back to Norfolk. We cruised into Norfolk, and the Air Force veterinarians were waiting on us. They came running aboardship, had a little cage, and they got their monkey and put him in a cage and put a cloth over it, wouldn't let anyone see it, took it out and put it in a station wagon and headed back across to Langley over the ferry there and wouldn't let anyone see this damned monkey. I never did tell them we'd been playing with it all the time on the ship. The monkey was fine, as far as I could see, and so Sam had a lot of fun once we got him out of the damned capsule. But he banged up against the side of the ship a few times.

But what we learned from that, and I came back home—a fellow named Pete [Peter J.] Armitage who was working at that time. By then we had built up a reasonably good-sized organization. We had people designing equipment and so forth. So I explained to Pete what our problem was, that we needed to design what we called a hold-off rig, that hinged on the side of the ship. As soon as you hooked into the capsule, you could lower this over the capsule, over the rope to where the capsule was, and you had a ring around it, so when the water broke the water, he would hinge them right up, and it would prevent it from swinging.

So from then on, every time we sent a destroyer at sea, we had a hold-off arm that we rigged with it, so we didn't get in the wrecking-ball condition where the thing banged. But that was learning. We also stiffened up the poles that the sailors used to hook the hooks in. So we learned by going out and running those kinds of operations and so forth. I don't know what we should have done about the veterinarians. I guess we should have had more veterinarians and had them on all the ships, but we didn't think about that at that time.

Anyway, that was the last—no, it wasn't the last. We recovered a couple of other animals. We recovered a couple of chimpanzees. I'd forgotten about those. We had a chimpanzee called Ham. We had an interesting operation with Ham, too, and Enos. Then we launched a Miss Sam. We launched a female Rhesus monkey from Wallops, but there wasn't anything very remarkable about that. We just set her up on the pad and shot the escape tower and picked her up with a helicopter maybe a mile off the beach and brought her back and set her down on the beach and gave her to the veterinarians. We didn't have as much fun with Miss Sam as we did with Sam.

RUSNAK: Any of these sort of learning experiences that you had with either Sam or Enos?

THOMPSON: Well, Ham was fairly interesting in that Ham was a—now, the Rhesus monkeys were about this big. The chimpanzees were, you know, sixty, eighty pounds, reasonably good-sized animals that are subhumans, whatever you call them, I guess, primates. The unique thing about the Ham operation, it was the Redstone flight, and it occurred just after we began to be concerned about damage to the pilots, injury to the pilots, if we hit on land with the spacecraft the way it was designed. The Mercury spacecraft, as originally designed, did not have the so-called deployable heat shield. Some tests showed that if you hit square at the velocity that the parachute let you come down, even in the contoured couch you were probably going to hurt someone. It was just above the human tolerance.

So it was decided, and I'm not sure whether this came from McDonnell-Douglas or it came from someone on the Space Task Group, it was decided to deploy the heat shield on a fiberglass bag fabric. After you opened the parachute, you would release the heat shield, and it would drop down, so that you would have an air cushion between the heat shield and the bottom of the spacecraft, with this bag. So the heat shield would drop down maybe four feet. Then when the heat shield would hit, it would squeeze the air in that bag out some holes that were in there and act as a cushion to cushion the landing and reduce the impact on the crew.

So we had just gone to that modification to the design just before we flew Ham. So we had this what I called deployable heat shield at landing. Once the parachute came out, you released the heat shield. That's the same thing we worried about, had prematurely released when we flew John [H.] Glenn [Jr.]. But, in any event, the Ham flight, we flew from Canaveral on the Redstone. The Redstone rocket had an integrating velocity meter that told it when it had gained the velocity and gave the missile a cut-off signal, and that cut-off signal disarmed the abort tower on the spacecraft and activated a separation sequence.

Well, the Redstone integrating velocity meter didn't work just right, so the Redstone didn't give the spacecraft the cut-off signal it was supposed to get. When it burned out, the spacecraft thought it was an abort condition, so it fired the retrorocket. So Ham got the planned boost out of the Redstone plus the additional boost out of the retro rocket fired when it wasn't planned to fire, which sent him about, I don't know, maybe 100 miles farther than he was supposed to go.

I was back in the control center at Cape Canaveral, at that time, and this fellow named Don [Donald C.] Cheatham, who was my deputy in the Recovery division at that time, was down-range with the recovery task force planner. Don was on the LSD. We had an LSD with helicopters at the planned landing point. We had a destroyer down-range. Well, Ham overflew every one and went forty, fifty miles over the destroyer's head, so he's down-range. So we sent a destroyer down as fast as he can go, and we sent the LSD as fast as he can go. They arrived in the landing area of the capsule, maybe, I don't know, forty-five minutes after landing. When they get there, they find this spacecraft, instead of floating upright in the water, it's floating over on its side, barely visible, about to sink.

So the destroyer hove to, put a couple of sailors in a rubber raft to paddle over and hook a line into it. While they were doing that, we had launched the helicopters also from the LSD. The helicopters came in and reached down with a recovery hook and grabbed the spacecraft and lifted it out of the water and took it back up-range to the LSD. Don Cheatham's on the LSD. When they get to the LSD, the heat shield's gone. It's all fatigued off and got a bunch of straps and cloth and so forth hanging. He sets it down on the deck, and they open the door, and Ham's fine, but he's got water about up to here.

It turns out, as we reconstructed and measured the water that was in the spacecraft, it was just about ready to sink. What happened, we hadn't tested this as thoroughly as we should. Two things happened. When the heat shield deployed and then you hit the water, the heat shield struck the bottom of the capsule. This capsule came down and punched a hole in the bottom of the capsule, so it was taking on water. Then the heat shield would sink on down on this fabric bag in the water, but as the wave action would come along and try to lift the spacecraft, as a wave would come by and try to lift it up, the suction forces on the bottom of that heat shield, it's kind of like when you try to pull something out of the water, the suction force.

As the wave action moved the spacecraft up and down and those suction forces, it fatigued this bag in about twenty minutes. So the bag fatigued off, and with that gone, the spacecraft turned over on its side, but the hole was still under water, plus we're taking a little water through one of the other air intakes. So Ham was sitting there with a leaking boat about to sink when we got to him, so he was really happy once he got out of there.

So we quickly learned that that bag wasn't strong enough. We put the capsule with the bag the way we flew it in the tank at Langley, hit it with waves for about twenty minutes, and it just tore all to pieces in twenty minutes. So we put a whole bunch of steel cables in to reinforce the strength between the heat shield and the bottom bar of the capsule once it was deployed, before we flew John Glenn. We also then put a whole bunch of aluminum honeycomb on the bottom of this capsule so that when the heat shield hit there, it would hit honeycomb and not knock a hole in the bottom of the capsule. And went on. I mean, we just fixed what we had and went on to the next flight, and I guess the next flight was Al [Alan B.] Shepard's flight.

RUSNAK: Before we get into his, if we can take a short break to change out our tape?

THOMPSON: Fine.

RUSNAK: We were just finishing up talking about Ham's recovery, so if we could just move on from there. I don't know if you want to talk about Enos' flight any, or if you want go ahead and move onto Al Shepard.

THOMPSON: I don't really recall anything that remarkable about Enos' flight, except I think we brought him down one orbit early, if I recall, but the recovery area was still in the Atlantic and still pretty close to what we had as a primary recovery area, as I recall. I guess if you've talked to other people about the Enos thing, that the most remarkable thing about Enos, I think, was he passed away when they were trying to remove some of the sensors, shortly after his flight, where Ham lived twenty or thirty years and lived in the Washington Zoo for a long time. So Ham turned out to be pretty lucky. Enos, from that standpoint, was pretty unlucky. But getting that Enos flight behind us was a good thing as far as the progress of the program was concerned, it being an orbital mission and a precursor to getting on with the John Glenn flight. The Ham thing was sort of a precursor to getting on with Al Shepard's flight.

RUSNAK: Would you do anything different for like the manned suborbital flights than you would for the previous ones?

THOMPSON: No, the way in which we set up the recovery force structure for the other missions, we set it up purposely as a kind of a precursor, so we didn't have any more or any less, really, except that we used the LSD for the primate mission. We used an aircraft carrier for the manned mission, of course, because we needed much more medical kind of support out there for the post-flight testing and that sort of thing, and, of course, the manned flights being much more significant, much more valuable flights to us. So we replaced the LSD as the helicopter ship with the carrier as the helicopter ship.

One of the things that we might want to do in trying to set the history straight is to talk a little bit about some of the people that came in to help me in recovery operations by this time. We've moved on into some of the operational things, but to go back to shortly after I joined the Space Task Group in the 1950s, in early '59 Canada canceled a military program [Avro *Arrow*] they had up there and made available, as a result of that cancellation, a number of engineers that came into the Space Task Group.

One of the engineers that came in was a fellow named Peter Armitage. He's still in the area, and I don't know whether you've interviewed Pete for this or not. If not, he'd be a good person to talk to. Peter came into the recovery organization as it was growing and took on the task of designing the kinds of equipment that we've been talking about.

Also, one of the early things that I did after joining the Space Task Group was go down to Cape Canaveral and spend some time with the Air Force people that were doing recovery operations down on the Atlantic missile range. They were having an Able-Baker monkey flight launched on a—I can't remember whether it was on—I believe it was on a Jupiter rocket. It was, anyway, an Army rocket being built by the Army Ballistic Missile Agency. They were carrying two animals. This was before we did any of our animal flights.

The Army was flying a monkey called Able, and the Navy had on there a monkey called Baker. The Baker monkey was a little squirrel monkey, a little bitty monkey. The Able monkey was somewhat larger. They were in a nose cone, a recovery section, and this ballistic missile was going to fly them down, very much like our Big Joe launch, and then the Navy was supporting the Air Force down at the Air Force Flight Test Center at Cape Canaveral with recovery operation. I went down to watch that operation.

After that operations was over with, I learned a few things. One, the communications from out in the recovery area, as I told you, back then communications were sort of difficult, and they were trying to communicate with a classified system, a CAT-code [phonetic] system they had, so that the people out there would send certain codewords, and the people ashore were supposed to know what that meant.

The people out there that went out, the veterinarians left their code book and forgot it, so they couldn't communicate very well the condition of the animals, and they were afraid to come in clear communications. So it left a lot of confusion back at the launch site about whether the animals had survived or not, and that caused a lot of grief on the part of a couple of Army generals that were getting ready to go to a press conference down there, and they could find out the condition of the animals. I don't know what ever happened to that veterinarian that left his code book in the hotel. I didn't get into that.

But the Navy employee who was responsible for the down-range recovery of the little Baker monkey was a gentleman by the name of Don [Donald E.] Stullken. After that recovery operation was over with, I got to know Don there in Puerto Rico as the thing was winding down and started a relationship with Don. So one of the things that I talked to Don about, found out that he worked out of Pensacola [Florida] for the School of Aviation Medicine, the Navy School of Aviation Medicine, Pensacola, so I really approached Don on two things. One, would he come to work for me? Two, could he help us design some kind of a floatation device to go around the capsule to give us some enhanced capability in the water?

Well, Don took on both of those tasks. In fact, he did come to work for us and worked for many years and would be a great person to interview. He's retired and down in Pensacola, Florida. I don't know how you'd interview him and get a hold of him, but he'd have a lot of these kind of stories. Then he, along with his colleagues at Pensacola, really were the ones that developed the floatation collar, that really significantly enhanced our helicopter operation out in the water.

The helicopter operation was a questionable operation from day one. You know, you could ask yourself, why in the world fool with helicopters? Why not just sit out there in the water and wait for a ship to come? Well, that's fine as long as you aren't sinking or if you don't have a problem out there, right? There's no way of knowing. So the helicopter was a very good benefit. It could get there quickly. But once it got there, you know, it's somewhat handicapped. You've got a man down in a little bobbing buoy down here and a couple of people up in a helicopter. How do you make something manageable out of it?

Well, if you can get a couple of swimmers in the water and add floatation devices around that thing, like a big raft that hooks to it, now the helicopter becomes much more useful to you. You can take the man out of the capsule and put him up in the helicopter. The helicopters back then, particularly the external recovery hooks, were really designed to make sure you could release the [unclear] rather than make sure you couldn't release it, so we had to do a lot of systems analysis and systems design changes to make them safe enough to where we could afford to pick up the spacecraft, and we never did convince ourselves we wanted to pick up people with it if we could avoid it.

So the floatation collar gave us the ability to put more capability in the area, use the helicopters more effectively, get the people out of the capsule, get them up into the helicopter, where they were in no more danger than the helicopter people, because if we had an engine failure or something, if you could autorotate into the water, you could probably survive that. But if you're down underneath and got dropped into the water, you were in pretty bad shape.

So Don's contribution in helping us make the floatation collar was a significant contribution to the recovery operations. Then Pete Armitage took on the design of all this equipment I've been talking about. Then they ended up running the two branches in the Recovery Division that finally we grew into. If you look at most of the recoveries all the way up through Apollo, Don Stullken is usually the person on the aircraft carrier, that he's there getting them out of the capsule. He usually always went down-range with the recovery operations. So they were two very key people, and they headed the two divisions, the Operations Division and the Test and Development Division, or branches in the division. If you go back and look at some of the organization charts of the Recovery Division in that time period, you'll see those names, and they came into the program very early and made significant contributions.

The command structure in the Defense Department I haven't talked much about. I ought to maybe mention that. When I first got involved with the Space Task Group and first began to put together in my mind the scope of the forces that were going to be required for recovery, it was pretty clear that, number one, you had to go to the Defense Department. No one else had the number of ships and airplanes and so forth. Two, we wanted to do it in such a way we could use routine operational forces. We weren't interested in buying a bunch of ships and airplanes and only using them occasionally, and there was no way to practically do that.

So we made some contacts in Washington but then asked very quickly if they would shift the planning task down to the Atlantic Fleet in Norfolk, which was right across from where we were at Langley, so we could go right across there and work with them. Then I first went over and talked to the chief of staff of the Atlantic Fleet at Norfolk. We talked for a few hours, and he asked me if I thought destroyers could do a good deal of the work. I told him, yes, I thought they could and that I thought it would be beneficial if we worked with a destroyer flotilla command.

If you understand the Navy's structure, or the Defense Department structure, ships like destroyers or supply ships or aircraft carriers, they all have type commanders. There is a commander in the structure that's responsible for those, that class of ships. A destroyer flotilla commander may have thirty or forty destroyers that he's responsible for, but then when you put those things into an operation, you create a task force. So you create a task force commander who gets so many destroyers from this flotilla command, he gets an aircraft carrier from this guy, he gets cruisers from these people, he gets supply ships from these people, and puts together a task force. Now, that task force commander runs that group of ships, but this flotilla commander is responsible for making sure that destroyer is trained properly, is crewed properly, is maintained properly, and so forth.

So at that time we worked from Washington down through CINCLANT [Commander in Chief Atlantic] Fleet into the Commander of Destroyer Flotilla 4, located in Norfolk, right across from where we were at Langley. It was that particular flotilla commander that took on the task of doing the recovery planning and the recovery operation. It was the people on his staff. There was a Navy commander named Norton Girault [phonetic], who was a commander and he was soon appointed as the Project Mercury planning officer. He was the staff man that we worked in, and in using the strength of that flotilla commander, who was a rear admiral, he did most of the task force planning. The destroyer flotilla commander was also the commander of Task Force 140, which was the task force that did all the early recovery operations.

Now, once we got to where we moved from the Atlantic as well as having some things in the Pacific, we also had a Commander Task Force 130 in the Pacific, and he came out of a command in the Pacific, as opposed to the command in the Atlantic. They would both be operating. By then we had set up, where there had been set up a DOD overall commander, who turned out also to be a general that was down at the Atlantic missile range.

But, anyway, back in that time we were setting up all this command structure. We used the basic DOD planning, that recovery task force were planned with the same procedures you would plan a military task force, you know, the communications plans, the chopping or assigning all the forces to the task force commander. So it was just a matter of going into that structure, coming down that command chain, using their existing procedures so that we could put forth a set of recovery requirements stated in a way that they were willing to accept them and understand them. Then they would turn that into assignments for ships and airplanes and people and helicopters and so forth, that became a task force structure that would get deployed for each mission. That's the way that all worked. So the commander of Destroyer Flotilla 4 in Norfolk and his staff were very instrumental in the early planning of all the recovery operations.

Then it was through that task force commander in Norfolk that we got to the Marine Air Group, MAG-26, in North Carolina, where we got all the helicopters. Then what we would do, we'd go along behind that and work with these destroyers or these aircraft carriers or these helicopters or these pararescue people or these Army LARC people. We would just go penetrate with our staff to give them the equipment, give them the training, give them the briefings that they needed to go do their job.

Then we would usually send, out of NASA's manpower, our Recovery Division. I don't know, maybe by the time that we were at the peak of those operations, we maybe had seventy-five people. You would deploy thirty or forty people on a mission. If you had a ship in the middle of the Atlantic, there'd be one NASA guy and all the rest would be Navy people. That NASA guy there was mainly there as an information coordinator.

In that way we were able to utilize the DOD forces over a brief period of time. They'd go on back to their normal mission. We'd have a different group of people next time. Of course, some people got involved over and over, but we'd see the same ship sometimes. Sometimes it'd be a different ship or a different group of airplanes, and commanders came and went, and so forth. But it was a very effective utilization of a two-ocean Navy that we had at that time, and one of the real benefits of water landing, water recovery.

RUSNAK: Would you find that world events had any effect on the availability of the types of ships and the recovery forces you were able to muster?

THOMPSON: Yes, but, again, the DOD was extremely cooperative. The program had a high enough priority within the DOD, plus enough appeal, you know, public appeal, that they, the DOD, would take on the hardship of maybe taking a ship that had been deployed to the Med [Mediterranean Sea] for a period, was back home supposedly to be left in port, and all of a sudden, he'd have to go back out to sea and do a recovery operation. So I'm sure there were a bunch of sailors and sailors' wives that weren't happy with us from time to time, but I saw very little complaining about that, because usually the missions weren't that extended. You know, they'd go out for a few days and have some excitement, come back home, or go out for a few days and not get involved and come back home. So it wasn't like getting sent off to the Med for six months or nine months. Plus they're used to that sort of thing.

But, yes, Vietnam was beginning to build up. We saw some of the Marine people, some of the helicopter people disappear and go off to other assignments and so forth. But, by and large, we were never turned down on any of our requests. Probably were fussed at a few times that we didn't realize, but we were pretty busy, too, so, you know, it was all a kind of national effort.

RUSNAK: I'm sure even the people that maybe were pulled off of leave or whatever were still excited to be participating in the space program in some capacity.

THOMPSON: Yes, well, again the power of television is there, you know, the fact that if you're doing something that appears in a newspaper or if appears on television, it's something you can tell your family and friends about, as opposed to a military deployment where you can't talk about it. They found it very exciting. They were all very cooperative, very much pleased to be a part of the operation.

RUSNAK: Speaking of the effect of TV, right before Shepard goes up, the Russians put [Yuri] Gagarin up. Did you see this as you guys were behind at all?

THOMPSON: Oh, yes, I don't think there's any question. I don't know, it may have amplified through the years, but I think, even at that time, there was a pretty well-accepted feeling that there was a competition, kind of like a golf match, you know. You're behind. I don't think it was a fright kind of a competition, but there was a lot of debate going on in the world as to whether the Russian system was a better system than ours, that central planning can utilize resources better than, you know, an economy driven by the dollar. I don't think many of us felt that that was true, but there was a feeling of the whole world watching the golf match, and you wanted to make your progress.

And this was all before the lunar commitment was made. The lunar commitment created a different kind of environment, in my opinion, because it was almost made a challenge and kind of a commitment. But there was a strong feeling, particularly on the part of a person with my training. An engineer able to get involved in these kinds of systems problems, systems designs, and these kind of operational problems where you can go design a piece of hardware and go test it tomorrow or go see the need for something and create it and fix a problem, it's an exciting way to work. Plus we were going from this kind of flight to that kind of flight to that kind of flight. There was a lot of interest in it.

Compared to the pace that we had at the [Langley] Research Center, I found the space program to be much more exhilarating from that standpoint. The Research Center, although you got a lot of personal satisfaction out of what you had done, you'd work maybe eighteen months and end up writing a report about that thick and that would go into the library somewhere and then you'd go off and do something else. Or maybe you'd developed enough of a reputation where someone would call you and have a problem they wanted to talk to you about. That was an exciting day when someone called and asked you for some information.

So it took a bunch of us out of a research environment and put us in a very exciting, fun kind of environment, but there was still a challenge on you. You know, your wife was left at home with the children while you were off running around the world. We did most of our launching at night, so you were up all hours of the day and night and that sort of thing. But it was fun. Whenever you finished one thing, you never really finished anything. It was a step to the next thing, to the next thing.

RUSNAK: In this case, the next step is finally getting a man into space, with Al Shepard.

THOMPSON: Yes, from a recovery point of view, the Al Shepard mission was just kind of a textbook mission. First of all, we had, as we often had back then, we had two or three delays in getting going, but once the launch occurred, the weather was good. The flight went pretty well, right on trajectory. We had a carrier and helicopters in the area. As soon as Al hit the water, the helicopter was there. We put the floatation bag around and everything—or maybe we didn't have a floatation bag then, I can't remember. I don't think so. I think we just moved him from the sill of the spacecraft. We didn't have a floatation bag yet. It was just being developed at that time. He sat in the sill of the capsule, and we took him up in the helicopter, and he was back on the ship and in sick bay in about ten minutes after landing. So it was a very straightforward, very routine operation, and it went very smoothly.

Yes, I recall now, the helicopter was flown by a fellow named Koons, Wayne [E.] Koons. He was a lieutenant in the Marine Corps, down at Marine Air Group 26. He had grown up in Lyons, Kansas, on a farm. So he was a staff officer at MAG-26, that got the planning job for Mercury. So he came and worked with us a lot and flew that first mission. Then when it came time for him to retire from the Marine Corps, he came to work for us. So he came to NASA and worked in the recovery operations and then worked in the program office in other programs. In fact, he worked on Skylab. He actually worked through a good part of the Shuttle with us. Then he retired from NASA, and he's back on a farm up in Lyons, Kansas. Wayne

Koons, you ought to get a hold of him and talked to him. He flew the helicopter that recovered Al Shepard on the first flight and then came to work for us.

The fellow who flew the helicopter for Grissom's flight also came to work for us, Jim [James L.] Lewis. He's still around in the area here somewhere. He was out when they recovered the [Virgil I. "Gus"] Grissom capsule on the—Jim Lewis was flying the helicopter the day we recovered Grissom. After he retired from the Marine Corps, he came to work for us. So we recruited a little bit while we were out there. [Laughter]

RUSNAK: Obviously they must have like what they were doing and liked what they were seeing from your perspective.

THOMPSON: Well, it was also good to get some people that knew the thing from both sides, too, that could come in and help. Jim Lewis went into the Crew Training Division. He went back to the University of Houston and got a degree, got a Ph.D. in some kind of human psychology degree and worked for many years in our training program. If you get a chance, you ought to talk to him. He'd be an interesting person to talk to.

RUSNAK: Of course. Since you mentioned that he was the helicopter pilot trying to rescue Grissom, his flight wasn't so textbook in terms of the recovery.

THOMPSON: No, that's one that probably we need to talk about a little bit. I don't know what's been recorded by other people on the Grissom situation. Again, it was a flight just like Al Shepard's flight. Recovery structure was exactly the same as Shepard's. At that time you had a launch-site recovery force that could go anywhere in the Cape and help with the LARCs and the tracked vehicles and helicopters. Had a ship part of the way down there. Had a carrier and some destroyers down there in the recovery area. The plan was, after the spacecraft landed, to come in with a helicopter and take the astronaut out of the capsule, lift him into the helicopter, and then lift it up and take it back aboard the carrier.

Well, the Grissom trajectory went fine. The mission went fine. Then landing was fine. We traditionally had three helicopters involved. We would have the primary recovery helicopter. We would have an alternate helicopter in case the first one had any problem. So we had two recovery helicopters. Then we had one just kind of a camera helicopter in the background, to not get involved. The procedures that we were following at the time, the procedures that Al Shepard followed, was after the astronaut landed, the helicopter would establish communications with him on UHF and appraise him on what was going on.

The recovery task at that time from the helicopter amounted to hovering over the spacecraft. The lift capability of the HUS helicopter [Sikorsky HUS-1 (UH-34D) *Seahorse*] we were using was such that only two people could be on the helicopter and have enough lift capability to lift the spacecraft with the astronaut once he got in the helicopter. So the pilot, who was on the right side of the helicopter, would stay in his seat flying the helicopter, and the co-pilot would go back to the door of the helicopter. He had two tasks to perform.

The spacecraft, when it landed, automatically sent up an HF antenna that was there for long-range communications for contingency recovery. If we got out in the middle of the ocean somewhere, that was a way of sending a signal from the capsule. It had a telescoping antenna that fired after landing, that stuck up about six or eight feet. So you had to get that out of the way so the helicopter could hover down, so you could hook the lifting hook into the Easter-basket handle on the top of the capsule. So the co-pilot had to go back and use two things like tree pruners. He had to reach out with a tree pruner and cut that antenna. We'd designed this equipment; Peter Armitage's group had designed this equipment. He had to then cut the antenna, lay that down, and pick up the recovery hook on another shepherd's crook and hook into the basket.

Then the helicopter would take up a certain number of rpms, lift, which would lift the capsule out of the water about eighteen inches and get the base of the door above the water, because the door was below the water. At that time the astronaut was supposed to then sit in the sill of the spacecraft with his helmet removed and his neck dam on and his ECLS [environmental control and life support] neck closed, and go up into the helicopter and then the whole thing would go back. That's what Shepard did. Took us ten minutes to get everything over with and back aboard the ship.

Well, the flight of Grissom's went fine. The helicopters were in the area. Waited till the parachute came down. Jim Lewis and the *Hunt Club 1*, which was the primary recovery helicopter—and I'm in the control center back at the Cape monitoring this, so I'm not down in the area, and this is a couple of hundred miles down off Grand Bahama. We could hear *Hunt Club 1* talking, or we got word that *Hunt Club 1* had established communications. They came in and hovered. The co-pilot reached out and cut the HF antenna, put that aside, got the primary recovery hook antenna, was just reaching out for the spacecraft, when the door blew open.

At that time, the capsule, we didn't have a hold of it and weren't lifting it, so the door was below the water, and, of course, once the door opens, the water rushes in. Of course, once the water rushes in, Gus jumps out of the capsule because he doesn't want to sink with the thing. So he's in the water under the helicopter just as the co-pilot hooks into the spacecraft.

Well, the floatation the astronauts had then, with the neck dam up and the ECLS thing closed, the buoyancy, the air trapped in the suit gave him plenty of buoyancy. He floated about up to here, so they could just kind of float out there in the water for extended periods of time. Of course, down under that helicopter, it was like being in a little bit of a hurricane. You know, you're down under that wash.

But since the co-pilot had hooked into that spacecraft, now we've got the helicopter hooked to the sinking capsule, so there's nothing for Jim Lewis to do but to try to rev up the helicopter and try to lift the capsule. He could have pickled the whole thing, but his first instinct was, "I'll get out of here and let the other helicopter pick Grissom up. He's in his suit, and everything's fine."

So he's straining to get the capsule airborne. Well, the capsule weighs too much for him, because once that much water got in it, it was beyond his lift capability. So he goes up to maximum rpm trying to get the capsule out. You can see as the capsule comes out of the water, the tug of war is stuck there, but fortunately he gets what's called a chip warning light. Whenever you're beginning to find some metal in the oil of your engine, there is a magnetic detector that says, "You're tearing up a bearing. Your engine's going to seize up in about fifteen to twenty minutes." The procedures are to drop anything you're doing and get to a landing site. So he was within his basic training. He pickled the capsule and got the hell out of there, and the other helicopter came in quickly and threw a horse collar down and got Grissom out of the water.

They got back on the carrier, and I'm in the control center. Bob Gilruth and Walt [Walter C.] Williams come in and say, "What went on down there?" and I said, "I don't know. I'm not sure, but I'll go find out and let you know."

At that time we kept a Navy S-2C [*Tracker*], a Grumman twin-engine Navy airplane on the skid strip at the Cape. Wayne Koons, this lieutenant from the Marine Corps was there in the control center as the liaison officer. I said, "Wayne, come on. Go with me. We'll go down and see what happened."

So we got the Navy airplane and flew from the skid strip down to Grand Bahama. Sent a message to the carrier to have Grissom and the two helicopter pilots come to the Grand Bahamas. We were bringing Grissom there anyway. That's where the doctors were going to meet him.

So we fly down to Grand Bahama, and about the time I get there, they bring Gus in by chopper and bring the two pilots in the chopper. There was a barracks there that we were going to do some debriefing in. I told Gus to go into the little private room in the front of the barracks there, and I talked to the two helicopter people, got their debriefing pretty quickly, and then went in and sat down and talked to Gus, just the two of us in the room. He sat on one bed and I sat on the other one. He took his boots off and dumped the water out and so forth.

So I talked to Gus about what went on. Well, after about five minutes of talking to Gus and the little bit of conversation I had with the helicopter pilots, I was pretty sure what the problem was. As far as I'm concerned, the problem was Gus got out of sequence.

We had two safety devices on the door-activating mechanism. Now, this is something that we never did make a big to-do over after it's all over with, and I'm just telling you factually what went on. To open the door of the capsule after it landed, the two safety devices, you had to take a cap off. There's a cap that covered the plunger that fired the door. You had to take that cap off, turn it ninety degrees and take that off. Then you had reach up and put your finger in a ring and pull a pin out of the shaft on the plunger that fired the door, and then push a little fiftycent-size plunger in. Once that plunger went in about an inch, it lined up a hole that the firing pin came through that fired the door.

So the picture here is, you've got a door-opening mechanism with two safety devices on it. The procedures were, he was supposed to stay there and not activate either one of these safety devices until the helicopter told him he had 1,800 rpm, which gave him above the water. Then he was supposed to take his helmet off, put his neck dam on, take his ECLS loose, close this, take the cap off, pull the pin, slide the plunger in, blow the door, sit on the sill and go out.

Well, he wanted to do such a good job, that while he was waiting for Hunt Club to get everything ready, he says, I'll just take the cap off, and I'll pull the pin, but I won't push the plunger. But now he's in a bobbing capsule, all kinds of stuff in there, and it's right here. Now, did he push the plunger? Of course not, you know, but it's kind of like you had a gun with two safeties on it. You took the two safeties off and you put it up and you pointed it at somebody, but you didn't pull the trigger, right? So he merely got out of sequence, trying to do such a good job. And not only that, but when the door blew, he went in the water, he didn't close his neck dam, he didn't seal his ECLS suit, he's now flooding. We didn't know that. He's about to sink. Instead of floating up here, he's beginning to float right here, and he's fortunate as hell that that chip warning light came on and Jim Lewis got out of there, and the other guy got in in time and get him out of there.

Pretty clear to me what happened, but I agree with Gus. He didn't push the plunger, and we never made a to-do over that, and I don't think we should have made a big to-do over that.

So I went to the Cape that night, found Bob Gilruth, went out in the parking lot, told him what had happened, and we went on with the program.

Did Gus push the plunger? No, he didn't push the plunger. Did he get out of sequence? Yes. He told people that he got all ready, and he just shouldn't have done it until he was told to do it. It's just that simple. But there was no point in making a federal case, and we went on about our business.

It's been interesting, I've heard lots of speculation since then as to pros and cons, this thing of, did he panic? Of course, he didn't panic. No, there wasn't any panic at all. Actually, once you took the cap off and pull the safety pin, there was nothing that held the plunger. There was no spring behind the plunger. The plunger just slid in. There were two O-rings on there, and, you know, just the bobbing of the capsule, it could have been something loose in the cockpit, or he could have inadvertently touched it with part of his shoulder here and never even known it, because it was right here, right by this shoulder, and he's in there bobbing around in a capsule.

So, you know, there's no doubt in his mind but what he did not activate the door, and that's correct. He did not push the plunger and activate the door. We ran a few perfunctory tests to see if—but, again, that's a positive thing. We did not let it bog the program down. We didn't have a federal investigation case over the thing. Just made a judgment call and went on with the program.

RUSNAK: What'd you think about them recovering the spacecraft last year, I guess it was?

THOMPSON: Well, I found it pretty interesting. A little side issue, shortly after that incident occurred back in '61, whenever it was, I remember getting a TWX [teletype transmittal, pronounced "twix"] from the Hughes Tool Company in Houston, Texas—we were back at

Langley at that time—saying that they had technology that would allow them to locate and recover the capsule. It was technology they were using in the Mohole Project. The Mohole Project was the project that dealt with drilling a hole halfway through the surface of the Earth, the deep hole. I don't know if you ever heard of the Mohole Project. Anyway, it went on for two or three years and finally got canceled. But some of that technology allowed them to find those kind of small objects on the bottom of the ocean.

We wrote back, or I wrote back and said, "Thanks, but no thanks. The capsule is not worth that kind of expenditure on our part. We got really everything we needed from the flight without it."

But I found the thing here recently to be very interesting. I thought the condition of the spacecraft was remarkably good to have been in the ocean that long. The technology of going and getting it, and expense, I don't know from an economic standpoint whether that's a good thing to do, but from a historical and artifact standpoint, I understand they're going to put it on display in Kansas City somewhere. Again, the thing that I'm extremely pleased over is that there was never any criticism or second-guessing Gus on that. Gus was one of the better people we had, and I think that that whole incident allowed the program to move on and not damage that individual, which was the right thing to do.

RUSNAK: Obviously the fact that NASA selected him for the second flight and then for the first flight of both Gemini and Apollo shows their confidence in him as well.

THOMPSON: No loss of confidence there at all. I do think it does illustrate that people at the working level, people like Bob Gilruth, could make a decision to "Let's just leave that behind us and go on," was something that maybe we have lost some of now, that we tend to get more and more people involved as NASA gets bigger and it gets to be a bigger bureaucracy, more attention. Most anything that happens, whether it's an airplane accident or anything these days, requires a fairly major reaction of some sort. That's not all bad, but I think it tends to—it will really bog you down on a program sometimes, if you let every little incident like that.

You know, the Ham incident of the flooding of the capsule could have bogged us down for a couple of months. The Grissom incident could have bogged us down for a while. There wasn't any point in letting those kinds of things bog you down. The Apollo fire, you know, threw a big glitch in the program for about eighteen months, but once that was over with, the decision to move on to Apollo 8, which was kind of a significant jump over what had been planned before, recovered a good deal of that time. So there were lots of those kinds of things that, had they not been managed effectively by the project team, I think it could have hurt us a lot.

RUSNAK: Certainly there wasn't any undue delay between Grissom's and Glenn's flight due to this kind of issue. It's just getting him in orbit.

THOMPSON: I think we understood it, understood it enough. We made a few check tests on the way the door was designed and the way it was configured. We were very comfortable with the way it was designed, very comfortable with the way it was configured. We went right on.

The door always gave a little bit of problem to the astronauts. Pushing that plunger in was kind of like shooting a shotgun. I don't know if you've ever shot a shotgun or not. If you put a shotgun up against this part of face and shoot it, you're going to get cut over your eye, and it's going to be bloody. So a shotgun, every time you shoot it, will bloody yourself, right? Not if you put it against the fat of your arm in this part of your cheek and shoot it. Well, this plunger was kind of like shooting a shotgun. So what you want to do is you want to slide it in with the meaty part of your hand so that the recoil would hit there. But if you take your knuckle—John Glenn, for example, decided to take his knuckle and push it, and it banged him on the knuckle pretty hard.

In fact, the astronauts said, "Gee, it's pretty clear that Gus didn't do the door. He'd be bloody somewhere. The thing, every time you shoot it, it's got to beat you up somewhere." Well, that's not necessarily true. You can shoot a shotgun without getting beat up, or you can shoot it in such a way to get beat up. The door worked fine. You just had to understand the system and use it properly.

RUSNAK: From the Mercury orbital flights, do you remember any particular challenges for the recovery? For instance, you mentioned Scott Carpenter's before and him going quite a bit down-range.

THOMPSON: Well, from the recovery standpoint, it was a good exercise of our contingency recovery responses. Scott got a little bit behind the power curve on the checklist and so forth, and was late in coming up on retro and didn't have the spacecraft oriented exactly the way it should have been for retro-fire, and he was off a considerable amount in yaw. The retrofire maneuver then was much less efficient, which caused him to go a couple of hundred miles farther than he was supposed to go.

It did force Scott to do an egress from the capsule, which was not easy. An egress from a Mercury capsule, you had to take part of the instrument panel out, move it to one side, and kind of weasel your way around the instrument panel and push the parachute compartment out and go over the top of the capsule into the water and the rig your floatation device. But Scott was a reasonable-size person. He wasn't huge, fat, or overweight or anything. He was able to weasel through there nicely, able to get out of the capsule and get in the water, get in his raft. It was a nice day, so he was comfortable down there, enjoying the sky and everything. The doctors back in the control center weren't sure whether he'd had some medical problems. They thought maybe he'd had some heart problems or something. They weren't sure.

Anyway, we sent a [Beech] C-45 [*Expeditor*] down there, and they found him right away. It was a nice day. They homed in on the beacon, jumped a couple of people in the water. They swam up with the floatation equipment and rafts and so forth. I thought his comment when he came back was a little bit silly because he said they broke up his tranquility. [Laughter] If I was sitting out in the middle of the ocean, bobbing around in a one-man raft, I'd like to have my tranquility broken up. But, anyway, they broke up his tranquility, as I recall.

The carrier and destroyers went down, and we had an Air Force [Grumman] SA-16 [*Albatross*], which is an amphibian, that we could have landed out there and take him by airplane back to Puerto Rico. We discussed that in the recovery control center and it was my recommendation, which the DOD followed, that we not do that and that we could get there almost as soon with the helicopters and take him back to the ship where we had the doctors that were pre-briefed and planned to do all the post-flight stuff on him. In fact, we could get him to medical help quicker on the carrier than we'd get him medical help by loading him in this SA-16 and flying 900 miles back to Puerto Rico, plus even though the seas were reasonably good, landing an amphibian out there and then taking it off, you can have some problems. So we didn't want to be get involved in that. So we decided not to use the SA-16, decided to wait and let him sit there with the pararescue people till we got the helicopters there and flew him back on the carrier.

There was a little bit of crabbing from some people who thought we ought to land the SA-16, and there were some meetings held within the Defense Department to make sure there were no interservice rivalries and so forth. I remember getting a phone call one day from some people in Washington asking my opinion of what went on. I told them, "My opinion of what they went on, they did actually what I'd asked them to do, and that's what we wanted them to do, and we were perfectly happy with the support we got, and that was the end of it." So I think probably there were probably some people to fund the SA-16s that would've liked to have used them that day.

But the only thing I had with Scott, Scott was kind of a free spirit, and he was having fun out there by himself. He said he'd as soon be alone, but we were interested in getting him and getting him back and getting it over with.

But from the recovery standpoint, it gave us a chance to use the contingency aspects of our planning that worked fine.

RUSNAK: Were there any of these sorts of issues with any of the other flights during Mercury that you recall?

THOMPSON: No, as I recall, John Glenn very much—each time I talked to John, he very much said he'd like to stay in the capsule and get picked up by a ship rather than use the helicopter. I told John, "Gee, you know, depending on what happens, we'll certainly try to let the task force commander out there make whatever the right decisions are on the scene." As it turned out, when it came time for John to come down, that concern with whether or not the heat shield was loose, we left the retro pack on and the drag change due to the retro pack caused him to land about sixty miles up-range of the carrier, right close to where we had the destroyer. So John got picked up by a destroyer, just like he wanted to, and it worked out fine. Of course, it wasn't planned, but it worked out that way, and everyone was happy. But John did take the helicopter ride from the destroyer over to the carrier. But, no, John's operation was very routine, except for being sixty miles up-range.

But we had a primary recovery area that was, I don't know, roughly a hundred miles up and down the range, fifty, sixty miles either side of the primary target point. We had usually a set of helicopters and a carrier at the point, and we had destroyers up-range and down-range. The probability of landing was such that the highest probability, of course, was near the carrier, and the lower probabilities were up- and down-range. John ended up up-range sixty miles. Scott was down-range about a hundred miles, a hundred and twenty miles. The rest of the people were all pretty well toward the center of our elliptical recovery area.

RUSNAK: So, during the missions, would you be flexing these recovery areas based on whatever was going on in the flight? Like, if they were thinking they'd have to bring them down earlier, whatever, would you be moving assets around?

THOMPSON: You didn't really move assets as much as you did deciding to use which set of assets. For example, on the Gemini [VIII] mission—I'm jumping quite ahead—when [Neil A.]

Armstrong and [David R.] Scott had to activate the RCS [reaction control system] system to stop the tumbling, when they docked to the Agena, one of the thrusters on the Gemini vehicle stuck and was causing them to gyrate, pitch, and roll wildly. They finally were able to separate and isolate that it was a spacecraft problem and by activating the RCS on the spacecraft, they could overturn the force of that thruster until it could isolate and cut it off. But once you activated that RCS ring, the flight rules said you need to land as soon as reasonable.

Well, they were at a point in their flight where it would have taken several hours to get back to the primary recovery area, but we had what we called secondary recovery areas set up at different places on the ground track. This was on a ground track that came up to a recovery area near one we had set up out south of Japan near Okinawa. At a secondary recovery area, we had destroyer in port with steam on the boilers and everything, ready to go, and a couple of Air Force C-54s on strip alert.

Well, once we had that kind of problem on Gemini, we had forty-five minutes to an hour's notice before we were going to retro-fire and come down in that area. So you would send out a message and activate the airplanes and start the ship on its way, because you were trying to land in that area. Well, by the time we went around the Earth two-thirds of the way with Gemini and fired the retros and came in for landing, the airplanes had already gotten airborne and were in the area. In fact, they saw them on the chute before they hit the water. So then they put the swimmers in the water, rigged the floatation collars, and they had to sit there in the spacecraft with the floatation collars and rafts around it for the six hours it took for the destroyer to get there. So they were out in the water six or eight hours.

So what you would do, our Recovery Control Center was adjacent to the Mission Control Center at the Cape, and you would sit there and monitor what was going with the mission and then you'd alert the recovery forces accordingly. If you had something like this develop, then you'd tell the people and the air crews were on strip alert, which meant that they were sitting in the ready room with the planes fueled and all ready to go, so they'd just go out and get on and get airborne. But in all of our missions, that's the only time we really had to use the secondary recovery area. Fortunately, we never had to use the contingency one where they're off, where you can't get there for eighteen hours.

RUSNAK: So from the beginning of the Mercury Program to the end, how did your techniques or the types of ships and other things you would use, how did that change or did it stay consistent through the whole program?

THOMPSON: It stayed consistent. We never really changed from what our basic planning was as we started. We started with the idea we'd use carriers and helicopters for the manned missions in the primary areas. We'd use LSDs and helicopters for the unmanned or the animal flights. We'd use destroyers for most of the support in the primary areas and support in the secondary areas. We'd use both Navy and Air Force airplanes for the search and on-scene assistance thing. The Air Rescue Service, in conjunction with some of the Army parachutist groups, manned the contingency recovery areas with what we called the swimmers and the on-scene assistance people, people trained to go out of the airplanes and go under water with additional floatation and so forth.

So once that basic structure was put in place, it was used on through of all our water recovery operations, on through Apollo. The equipment had to change. The floatation collar was a little different design for Gemini than it was for Mercury and a different design still for

Apollo. The Apollo capsule was unique in that it had two stable trim points. The Apollo capsule, if it came down in a high wind, was highly likely to turn over and put its nose down in the water, and we had those bags that came out that would inflate to turn it back up and get floating right in the water. But that was a peculiarity of the design of the Apollo capsule, as compared to Mercury. So you had to make those kind of hardware design changes, and those kind of equipment changes.

But the process of interfacing with the Defense Department, the process of utilizing the operational forces, process of equipping and training them with things that had minimal effect on their primary mission, the deployment of a few NASA people and hundreds of DOD people in the recovery forces, and the cost, the reimbursement structure, communications structures, the command and control structures, those things, once we developed them in early Mercury, were utilized through the entire program.

RUSNAK: One thing I'm curious about is the space in between missions, in some cases you may have a couple of months between flights or whatever. What types of activities are you doing when you're not directly supporting a mission?

THOMPSON: Well, first of all, you're running some training exercises for the people who—usually the force structure was different for every mission. It was different in sense that it might be the same destroyer. It would be a destroyer, but it may not be the same destroyer. It'd be a carrier, but maybe not the same carrier. It would be a bunch of P-2Vs but maybe not the same crews that were before.

So there was a certain amount of training going on, from the time—there was probably a couple of months' lead time between the time the task force orders would go out, before the mission was flown. But during that two-months period, the ship knew that it was his assignment to go on. You had to then sent some people on that ship, make sure they got the right equipment. You had to go out with them. We had a bunch of boilerplates that they would take out and train to pick up and so forth. So we had to go coordinate with those people. So you were training a new set of people all the time, and the time between missions was just about minimal to leave this set of people and take a new set of people. Then you were always then going to pre-sail briefings because it was a different group of people involved, not at the basic command structure, but people changed a lot. This ship commander would come and go, and that ship commander would come and go.

Then we were in a process, my own self and the division, in addition to doing the things I'd been telling about, I also ran a test operation where if we had any parachute tests we wanted to run, or if we had a gliding parachute we were working some development on, I would work with the people in our engineering department, and our people went out in the field and ran those tests for those people. So we were doing some R&D [research and development] work out of the division at the same time we were supporting the ongoing basic missions. So it was a pretty busy time for everyone.

You know, gee, some guy going out on a ship, say, in the Canary Islands, he had to leave home two weeks before the mission. He had to fly to Norfolk, and he had to get on a ship that went right in the middle of the ocean, and then he'd get transferred over to another ship going to the Canary Islands, so it took him ten days to get there, ten days to run the mission, and ten days to get back. So there were people coming and going a lot. We would try to take people and not give them two or three missions in a row. They'd deploy on this mission, skip one, and deploy on the next one. So there was plenty of activity all the time for people.

RUSNAK: Did you have any responsibility for, or coordination with the tracking ships?

THOMPSON: No, the tracking ships were really basically part of the network that fed information into the flight control team, trajectory information or ground-to-air communications and so forth. I sat in the Mission Control Center and communicated with the flight director. Those tracking ships fed information into the flight director's activity, and recovery people used the total trajectory information, total mission information in our readiness posture. So the tracking ships were never really a part of our landing recovery operation, nor were the tracking airplanes we used later on in the Apollo Program.

Now, the Defense Department, after we had been under way for a period of time, set up an overall NASA support coordinator. I mentioned that the commanding general down at the Atlantic Missile Range [AMR] got the additional duty of being the DOD support function, so he theoretically had responsibility for all the DOD forces. If the tracking ships came from the Air Force inventory somewhere, he had the responsibility to supply those, just like the AMR resources he was responsible for. Theoretically, the recovery forces were also his responsibility, although he had an in-line command responsibility, but the Navy really ran all the recovery command and control kind of things as part of his overall task force.

RUSNAK: I wanted to know if you wanted to make any other remarks about Mercury and the types of techniques or lessons you developed there.

THOMPSON: No, I think that as we progressed on into the later parts of Mercury, the recovery area moved out to the Pacific, so we took the things that we had done with the CINCLANT Fleet people here, just took them to CINCPAC [Commander in Chief Pacific] Fleet and set up a structure out there much like the one we had here in the Atlantic, so we could set up task force out there, and they ended up becoming the primary recovery area, say, for Gordo [L. Gordon] Cooper's flight, we landed in the Pacific. If you stayed long enough, the ground tracks in the Atlantic progressed to the Pacific, and what became nighttime in the Atlantic became daytime in the Pacific. So we moved the recovery activity on out there.

Of course, once we got on into Apollo, the central Pacific seemed to be the right place to bring the Apollo back as opposed to the Atlantic. So the Apollo recovery moved into—CINCPAC got to be primary and CINCLANT got to be kind of a secondary support for that. Basically the concepts, they stayed the same all through all three programs.

RUSNAK: Did you want to go ahead and get into Gemini today, or do you want to save that for next time?

THOMPSON: I'll leave that up to you. You all used to quit at five. We can knock off today and pick up on Gemini. We got a long way to go here. Although I don't have much more to say, I don't think, in recovery. I've worked recovery from the start through 1966. We were about halfway through the Gemini Program, as I recall, when I left and went over and became what was called the Apollo Application Program manager. So we're going to have to kind of get out of recovery and get into that thing if we follow chronologically. Then I worked that until 1970, and then the Shuttle Program from ’70 to ’80, and then, of course, left NASA and went to McDonnell-Douglas for a while. I don’t how much more of this stuff you really want to dig into.

RUSNAK: I did have a few questions.

THOMPSON: Why don’t we use the rest of the time with your questions.

RUSNAK: Okay. You had mentioned some of the test support and R&D work you were doing, and I guess this leads us into Gemini, and I’m thinking about, there was a much more concerted effort to use something like a paraglider to land the Gemini spacecraft on land. This goes back to your watching Francis Rogallo down the hall and stuff.

THOMPSON: Well, yes, I think it’s probably a good discussion for a few minutes here. The Gemini Program was a natural outlet of Mercury. I don’t mean to be negative here, but once you set up a bureaucracy to do something, that bureaucracy very seldom recommends that you don’t do anything else and cancel. So we weren’t interested in canceling in manned spaceflight after Mercury because we thought there were many more important things for man to do than just sit in a Mercury capsule. So even while we were flying Mercury, there was a desire to go on to something bigger and better. So the people over on the engineering side of the house, the natural thing was maybe just take this Mercury shape and make it a little bigger and put two people in it and do some different things.

One of the things was, well, maybe we ought to land it on land like an airplane rather than out in the water like, you know, like a poor boat, like Mercury was doing, because there are many good things about landing in the water, but there are also many bad things about it. You know, we came close to finding some of them with Grissom and with Ham and so forth. So as part of the rationale of going on to Gemini, the people involved—and Bob Gilruth was very strong in this—felt that the land-landing demonstration would be a good thing to do. In addition, the maneuvering, the rendezvous, the docking, the EVA, you know, all those potential things were there. So the country wasn't ready to quit manned space flights, so the Congress supported us and the money was appropriated and we went to work on Gemini even before we finished Mercury.

Well, one of the things in Gemini was to demonstrate land landing, but, again, the throw weight of the Titan missile was such that you couldn't have a big, heavy winged vehicle. It just couldn't put it there. At that time Rogallo had progressed and people were flying flex kites. You know, if you take a piece of cloth and put the right kind of support lines to it, and configure it such, and hold it this way with the air blowing on it, you can create a pretty good lift-to-drag ratio. The problem is to get that cloth inflated and flying right. Now, if you jump out in basically a zero-lift parachute, you're falling in this direction, and that thing will inflate itself nice and symmetrical, and you can make a parachute open pretty well. But to make a chute open that is shaped to give you a significant lift force at the same time it's giving you a drag force, you now have to contour it. You can't just have a symmetrical thing like a parachute.

So your problem with generating a lift-to-drag characteristic with an inflatable chute, the chute that you can throw out of a spacecraft and it will inflate, is the tricky part, and that's what Rog was doing sitting on his desk, trying to fold this thing up in such a way that he could throw it and it would still inflate itself and take a shape that would give it a glide, a lift-to-drag ratio that would allow you some glide.

Well, the challenge for Gemini then was to get some kind of a fabric device that you could afford weight-wise out of the spacecraft, inflated while you're falling at a high velocity, and inflated into the shape to where it will give you a lift force at the same time it gives you a drag force so that you can come down at a glide angle rather than straight down, and that glide angle is under control such that you can hit on a runway and dissipate the energy without hurting yourself.

Now, as the designers and McDonnell-Douglas, as a follow-on to Mercury, took on the Gemini Program, that led Gemini to have ejection seats because they wanted to be able to eject out of the thing. So we got rid of the escape tower and put ejection seats. But now you were left with how to throw all this fabric out and make it inflate and make it take up the lift-to-drag characteristics you want, and land this thing such that you don't hurt someone on a runway.

Well, the beauty of what Rogallo was to do was he was just trying to take a piece of cloth and fold it up in such a way that when you threw it out, it took the right shape. So it wasn't anything too complicated about that. But as we got involved in the paraglider, which is what this thing is called, the mind started working. Well, what we want is a great big boom on the front that will assure that we got a leading edge like the leading edge of a wing. So now I've got to fold up a great big hunk of heavy canvas called a leading edge boom. I've got to throw that out and I've got to have a bottle that'll blow this big balloon up, blow this thing up on this thing up on the leading edge. Then I've got to pull all these drag lines out and rig them in such a way that I've got this semi-rigid wing over the thing.

Well, the next thing you know, when you get through doing that for six months or a year with a bunch of engineers and so forth, you've got so much claptrap, it won't work, basically. It gets too complicated. It gets too heavy. The sequence is not forgiving. You know, you jump out with a parachute, you've got to throw a bunch of cloth out there, but the air will go up there and inflate that cloth, and it'd work 99.9 times out of 100, or 999 out of 1,000, which is very reliable. But when you have to throw out a bunch of stuff and unfold a bunch of stuff and inflate a bunch of stuff and pull out a bunch of lines and have those lines on controls and so forth, it gets to be very complicated.

Well, as that paraglider began to try to be developed, it just got more complex and got heavier and less reliable. The longer we went, the heavier it got and the less reliable it got. The leading-edge boom got bigger and heavier to control the inflation pressures to give it the rigidity people wanted. It began to look like you weren't going to get out enough L/D [lift over drag] to where you could have more D than L, so you'd be coming down more vertically than gliding. How to attenuate the force when you hit the runway because it wasn't practical to put a bunch of oleo struts and landing gears on the spacecraft. So the more we worked on the paraglider, the worse it got.

After eighteen months, two years, $27 million, whatever was finally spent back then, it was decided, to hell with it, we'll just go ahead and put a parachute system on it like Mercury and use the landing procedures that we had. Now, during that time period, I was still running the landing recovery operation. One of the things we were doing while they were trying to develop the paraglider—did they call it a paraglider?

RUSNAK: It was also the parasail.

THOMPSON: No. I can't remember what we called that thing on Gemini, but, anyway, parasail maybe, or paraglider, whatever it was, we were developing a portable Recovery Command Center that would allow us to pick up the spacecraft on radar and, with a person sitting at a console, very much like a GCA [ground controlled approach] controller in an airport, he could give him turn instructions, because with that Gemini system, it had some motors that ran the risers up and down. You could do turns and flares with the thing, of limited capability.

So we spent a fair amount of time developing a GCA trailer to take to wherever we were planning to land it, whether it be Edwards [Air Force Base, California] or Pecos, Texas, or where we were going to land the thing. So I had a bunch of people developing, and we had a contract with Philco. We were going to put a Philco radar at that time on the top of this tower and put a console down inside. We had a bunch of people trained. While the Gemini Project Office in McDonnell-Douglas was trying to develop the system they were developing, we within the NASA organization here put a more flexible parachute, that was more like Rogallo's parachute, on a Gemini spacecraft, boilerplate spacecraft, and we took it up at Fort Hood and we landed it very successfully twice at full-scale. Had we flown Gemini XI and XII, we might have put that more flexible parachute, gliding chute on Gemini and tried a land landing. But we did it also in conjunction with the retro rocket. So we had enough maneuvering out of this more limited gliding chute.

First of all, you could deploy it. It weighed a lot less. You could deploy it safely, but it wasn't the sort of thing that you could land on a skid, the way they were trying to do on Gemini. It took a retrorocket to kill the vertical velocity at landing, but you could land out in like Pecos, Texas. We found areas out in Pecos, Texas, where there was a twenty-mile area with very few obstacles, not many fence posts, not many telephone poles. We were very confident we could have landed safely with that system with the Gemini spacecraft, had we wanted to go on and fly Gemini XI and XII.

We actually demonstrated that system full-scale up here at Fort Hood. We took it and threw out of an airplane at 15,000 feet, deployed the chute, gave the instructions from the ground to turn over here and go over there and turn into the wind, and fire the retro rocket, and it settled down. So that would have been the way we would have made the first land landing had we not gone on and built the Space Shuttle.

For a number of years, I thought the first time we came back from space and landed on land, it would be with a parasail and a retro rocket and a Pecos, Texas, kind of a landing area, not an Ellington Field [Houston, Texas] or runway. The problem with the thing they were trying to do on Gemini, in my judgment, it tried to do too many things like an airplane. Getting on a runway wasn't important. Getting out in a field safely and attenuating the landing load was an important thing to do, and that was better with a retro rocket than it was done with a Gemini that had a landing gear and a bunch of skids on it that were supposed to skid out. It got off on too many of the wrong tangents, in my judgment, for that time period.

We could have landed Gemini on land, but it was decided it wasn't worth extending the program two more flights. In any event, we were very heavily involved with Apollo at that time and more anxious to get on with the Apollo Program, and Apollo was clearly going to be a water landing. So landing a spacecraft with a gliding parachute and a retrorocket never quite caught on in our historical sequence of things, although we did demonstrate it could be done effectively with a full-scale system up here at Fort Hood and before I left the Recovery

Division. This was done probably in '64, '65. Pete Armitage's people were the ones doing a lot of that testing. That probably didn't show up in the history anywhere. It never got used.

RUSNAK: You do see a little bit of it, but not too much, unfortunately.

THOMPSON: Well, have you interviewed a fellow named Rod [Rodney G.] Rose?

RUSNAK: We sure have.

THOMPSON: Well, he'll give you a few thousand words on the paraglider, won't he?

RUSNAK: Yes, he talked to us for a little bit on it, yes.

THOMPSON: Rod's probably still sure he can make the paraglider work. He just needed more money and more time. [Laughter]

RUSNAK: Something you mentioned in conjunction with this was the ejection seats, and they kept those even they didn't keep the paraglider. How did that affect recovery?

THOMPSON: The only effect that had on recovery, it gave our launch-site recovery people a little different task, but it didn't change our launch-site recovery structure. When we first took a look at the area around the launch pad at the Cape, as I told you, we decided we needed something like the LARCs that could go through the palmettos and the marsh down there and get to certain areas, and the LARCs could do that or they could go out in the surf. The M-14, which was a tracked personnel vehicle, all DOD vehicles, and the DOD would send people down there who could operate those machines.

In fact, kind of an interesting story, when we first found the DOD developing the LARCs, we found them by going from Langley up to Fort Eustice [Virginia], which is a military place just north of Langley, and found that they were building these vehicles called the LARCs and they were testing them out in California to come in off of the beach. They were built to bring people in on amphibious landings across the beach and carry them in. Well, we talked to the DOD and said, "Gee, why don't you shift your test activity down to Florida from California. The Florida beaches are just as critical. In fact, they're even rougher behind, and you can run your development down there, and whenever we're making a flight, you can support us."

And they agreed to do that. They moved that operation from California down to Florida, moved some officers and warrant officer down there with the research program, and they did their research right there at the Cape. Then when we would have a launch, they'd send the LARCs over and support us and then they'd go back to their development testing.

So having the ejection seats on Gemini just meant you had the task of having a couple of people out on parachutes in that area, but the same forces that went to the man in the capsule would go to the man whether he was in a capsule or not. So it didn't really change our on-site recovery activity, per se.

We used to have some extremely interesting training programs down at the Cape for the launch-site recovery forces. I remember we had an Air Force aeromedical office named Bill [William K.] Douglas. Bill spent many years with us. He was in the Air Force originally, and then he was detailed to NASA for many years. He was kind of the personal physician for the astronauts. Then Bill worked with me at McDonnell-Douglas after I went to McDonnell-Douglas. A very fine person. He died here unexpectedly about two years ago. He's the one you see, if you see Al Shepard coming of the trailer and looking up, well, Bill Douglas is the guy behind him.

Anyway, one day I went to see Bill, and I said, "Bill, we need a medical doctor on our launch-site recovery team down here. After you've buttoned the people up in the capsule, you haven't got anything to do. Why don't you agree to be the medical doctor right along side the recovery forces?"

He says, "That's fine. That's good. No problem. I'll do that."

So then a couple of months later, it came time to run a launch-site recovery exercise, and I called Bill and said, "Bill, you need to come out and join the launch-site recovery forces. We're training out here."

"Well, okay, be fine." He put on his fatigues and his boots and came out. We loaded him on a LARC, and we carried that boilerplate capsule around. What we do is we take a boilerplate capsule and just drop it off in the boondocks 200 or 300 yards from the pad there, and wherever it happened to hit, they had to go do something with it.

So this thing dropped out there in the palmettos and the swamp. Bill's on this damned LARC. He's going through the palmettos in the swamp, and the next thing you know, I went out there and Bill's up to here in the damned mud out there in the alligators, fulfilling his function. He looked at me and said, "You didn't tell about this when you asked me to join the recovery forces."

But Bill was very supportive, and he was our doctor on the launch-site recovery forces on that. But we'd take Bill and his team and throw them in the swamps out there with the alligators and the rattlesnakes and train them, and they were prepared to go do what they had to.

The LARC, we designed a crane and put it on the LARC so that it could lift the capsule up and right it. In fact, we used them on one of our unmanned flights. The Atlas didn't program properly, so we had to abort the spacecraft off early in the launch. It came down out in the surf about 200 yards off the beach. The LARC went out there and picked up and set it on, started back to shore, and I left the recovery room and went out to meet them.

The antenna was up on the spacecraft. As the LARC started along, and the antenna stuck up and they couldn't get under some electrical wires because this damned antenna was sticking up there. They were just sitting there. They didn't quite know what to do with it. I drove up out there, and I said, "What's the problem?"

They said, "The antenna's in the way."

I said, "Oh, just a minute," and I jumped up there and broke it over. I said, "Now you can go on."

"Oh, that's not much to that, was it?" and went on. [Laughter] They were used to handling this equipment, you know, in the white room environment there. No one ever just took an antenna and broke the thing over there, but when you're out in the swamp, you do things sort of different than you do there.

But Bill Douglas was a great asset to us. It's a shame you can't interview with him.

RUSNAK: Yes, it is.

THOMPSON: Well, I'll let you all go home, and we'll pick up on Gemini and then maybe get on into Skylab and the Shuttle.

RUSNAK: Okay. Thanks for spending the time today.

[End of interview]