

**GENERAL BERNARD A. SCHRIEVER  
NASA ORAL HISTORY**

INTERVIEWED BY CAROL BUTLER  
GEORGETOWN, WASHINGTON, D.C. – 15 APRIL 1999

BUTLER: Today is April 15, 1999. This oral history is with General Bernard Schriever, at his offices in Georgetown, Washington, D.C. Carol Butler is the interviewer.

Thank you for joining us today.

SCHRIEVER: You're welcome. Glad to be here.

BUTLER: To begin with, we'll look at the early developments of the American ICBM [Intercontinental Ballistic Missile] program and in response to the Soviet developments of the ICBM program and how that affected the American program, if you could tell us about that.

SCHRIEVER: Well, I think I need to set the stage a little bit and then I think will go smoother. At the end of World War II, General [Henry H. "Hap"] Arnold, who was my mentor and certainly was the most visionary Air Force officer that we had up to then and, as far as I'm concerned, in the history of the Air Force, he said that, "The next war will not be like the last one. World War I was won by brawn, in the trenches. World War II was won by logistics," and I can vouch for that, because I spent almost three and a half years in the Pacific [Theater], and logistics was very, very important in winning that war, as well as other aspects. "World War II," he said, "will be won by brains," and he went on further to say that the breakthroughs that really occur, that are most important, were electronics, flow of information—the jet propulsion, rocket propulsion.

Let me stop there with rocket propulsion, because the interest in long-range missiles started right at the beginning of the period following World War II, so it had been a long-term interest. We started in the Air Force by building a large rocket facility in California, starting shortly after World War II. We managed to get quite a few of the German scientists who were involved in the V-2 program, and so did the Soviets.

So that's how we really started, and we had a great deal of interest in a long-range missile, but there were other technical problems which didn't really make sense for us to start a full-fledged long-range missile program, but we were certainly well into the program with respect to first the nuclear weapon component of it and other aspects from a technological standpoint. So we started right after World War II. As far as our intelligence indicated, so did the Soviets.

BUTLER: When they did start on the ballistic missile program, was there information that you had about how they [the Soviets] were progressing or what stages they were at, that you could then measure progress against?

SCHRIEVER: Well, we didn't start our program until, really in earnest, in 1953, I mean, as far as a weapon system development and acquisition program was concerned. That was after we had actually developed from the fission nuclear weapon to the thermonuclear, which gave us a much more effective warhead which provided a yield of some—a megaton yield with a weight of 1,500 pounds, which is roughly at least an order of magnitude superior, from a weapons standpoint, than was the fission weapon. That really provided the spark to get our weapon system program going in 1953-'54 time period.

You asked about the Soviets. We didn't have really any hard intelligence information where they were with respect to the ICBM, but our studies indicated, and there was information available that would lead us to believe that they were very much involved in an

ICBM program. That is about all you can say with respect to the '53-'54 time period. We were concerned that they would beat us to the draw; in other words, of getting a thermonuclear military capability going with long-range rockets. And that's what started us by putting a very high priority on getting on with an ICBM program of our own.

BUTLER: As the ICBM program began developing, was there any discussions or thoughts on not just applying it as a missile, but also applying it to space early in the development, I guess?

SCHRIEVER: Well, here again I hark back to General Arnold. He created the Air Force Scientific Advisory Board, and one of the first things he did after the war was to ask the Scientific Advisory Board, as well as RAND Corporation, which was set up to support Air Force thinking with respect to the application of technology to the future, what is the feasibility of a reconnaissance satellite. So we were actually working on the idea of reconnaissance satellite starting back in the middle forties, after World War II. Here again, we were involved in technical planning, as well as some testing, but we, again, did not have the capability of putting anything into orbit at that time. But the interest was there and the thinking and the studies and the kind of technical research that we had always involved in programs of this type. So our interest was very high, starting at the end of World War II, for a reconnaissance satellite program, and we started on that as well, in the same manner as the missile itself.

BUTLER: When did you learn of Soviet efforts for a satellite program and actually learn of Sputnik as well? And how did that impact your job?

SCHRIEVER: Well, that's a long story, but I'll try to make it short. We did approve and provide the highest national priority to the ICBM program when the Scientific Advisory Board, a special committee of the Advisory Board, recommended that the Air Force do so. That was approved within the Air Force circles and also by the political side, the Secretary of the Air Force, and the Air Force gave it the highest priority as early as 1954. It was approved in the White House, but it was not until 1955 that President [Dwight D.] Eisenhower gave the ICBM program the highest priority of any weapon program in our inventory, so to speak.

With that we—as part of the overall program was to get more hard information with respect to what the Soviets were doing, and one way we achieved that was by establishing radar coverage of where they were doing their testing. That was a capability that gave us a lot of detailed information as to where we stood vis-a-vis the Soviet Union in the development, because we could gauge information from their test flights and so forth. You can't hide an ICBM, you know, when you fire it. So we had information within the next couple of years pretty much on where we stood in connection with the Soviet Union in the ICBM area.

From the standpoint of the satellite for reconnaissance, that was a different matter, and it was highly classified, but we were moving forward on such a program, not quite at the rate that we could have, but we were putting first priority on the ICBM. But the satellite program also was very important from an intelligence standpoint, so that was given quite a bit of emphasis and it was also part of the responsibility of what was called Western Development Division [WDD] on the West Coast, which I commanded for about five years. We changed the name a couple of times, but it was initially the Western Development Division. It was changed to Ballistic Missile Division [BMD], and we also had the responsibility for the satellite activity of the Air Force.

BUTLER: When Sputnik actually was launched, what was the general reaction, and when did you actually hear of the launch?

SCHRIEVER: Sputnik?

BUTLER: Sputnik, in October '57.

SCHRIEVER: Well, let me say it was no surprise. We had the capability of putting something up into space just to prove that we could put a satellite up there, but we were not given the authority to do that. They had the IGY [International Geophysical Year] year, the International Geophysics, a scientific endeavor. I've forgotten the name of the program, but it turned out to be unsuccessful. It was the Navy involved with [Vanguard]—the launch was unsuccessful. The Navy and NASA were involved in that first launch.

But the Sputnik did one thing that was very much a plus: it woke us up and it concerned the American people very much that they beat us to the draw in getting the first satellite into orbit. But we at our level, with the information that we had, and what we were doing, knowing that we could easily put something up in space, and we did do that, including putting a reconnaissance satellite, because it was given much higher priority really because of the Sputnik. I was going back and forth from the West Coast like a yo-yo, and making presentations to the Congress, to the Pentagon at all levels, and so forth.

So it stirred up a fury, so to speak, and a good one. We need to be awakened from time to time, and that really woke us up. But we didn't have a missile gap, as was forecast in the political circles, particularly in the election of 1960. We knew we were ahead of the Soviets, as a matter of fact. We were building the Minuteman solid propellant, and we were ahead of the Soviets on the thermonuclear weapon, we were ahead of them on the solid propellant, and we had a Minuteman operational in the inventory, in less than six years after

the program started. We were definitely ahead in the solid propellant area, which was much more efficient, from an operational and logistics standpoint.

So we were not comfortable—don't misunderstand me. We had a burr up you know what. But we felt comfortable in our own knowledge, based on the information that was available, that we were really ahead of the Soviets by a year or so, which isn't much, but we were given very, very good support from political levels, the government, and by the scientific community, and by our own military establishment. So it was one of those dream kind of situations where you've got real support for the program. And we had it before, and that's one of the reasons our solid propellant Minuteman program, the Polaris program, the Navy submarine-launched missile, without a solid propellant, you couldn't really build a missile that you could launch, long-range missiles that you could launch from a submarine. So it wasn't just the ICBM; it was also the Navy solid propellant program. So I don't think that's ever gotten clear. I don't believe it's become clear to a lot of people that we were, in fact, ahead of the Soviets at the time that they launched Sputnik. But I thank them for doing so, because it really got us ginned up from the political standpoint, particularly from the space standpoint, because we were getting all the support that we could possibly want in terms of the ICBM and the Polaris program.

BUTLER: It certainly was a motivating factor.

SCHRIEVER: Yes, it was a great motivating factor. I used too many words. That would do it: *motivating factor*. Put that in red ink. [Laughter]

BUTLER: Okay. One of the motivations that came from Sputnik was the creation of a space agency, actually NASA [National Aeronautics and Space Administration]. Had you

expected such an agency to form and that it would be under civilian auspices? What were your thoughts when it was created, and were you involved at all in discussions?

SCHRIEVER: Well, yes. There were discussions and there were studies that lasted for several years after Sputnik in the creation of an organizational structure for doing it, and there were several different choices that could have been made. The Army felt that their Huntsville [Alabama] facility was the facility that should take over the responsibility for the space business. We thought that we should be the ones to take over responsibility for space business. The President's level finally came around and said, "We'll take the NASA organization and the Huntsville organization and put them together and make a NASA," and that was the 1958 act under Eisenhower. Eisenhower was President at that time.

That expanded the NACA [National Advisory Committee for Aeronautics] role, but it put Huntsville in as a beginning facility that moved forward in terms of its capability, but that didn't move the Air Force or what we were doing out of business, but it did put the R&D and the civilian side of the work into the new organization, NASA.

But we, of course, worked very closely with NASA. The first administrator was [T.] Keith Glennan and then came Jim [James E.] Webb, and Thomas [O.] Paine, and I worked very closely with them. Paine came in after I'd retired, but I worked closely with Jim Webb the whole time he was running NASA for about seven or eight years, starting in '51, I think. He was under the [President John F.] Kennedy and [Vice President Lyndon B.] Johnson regime, and I was still on active duty until 1966, so I worked with Jim Webb and not only giving him lip service or things of that kind, we made a lot of people available, including—we were very much involved in the Mercury program, the Gemini program, and in the Apollo program, where George [E.] Mueller came over to ask me could he have Sam [Samuel C.] Phillips. Sam Phillips was running the Minuteman program, later turned out to

be four-star general in running the Air Force Systems Command, so you know we were giving him quality.

You hear, here and there, that there's a big feud between NASA and the Air Force, which is not true. We worked together. I knew Jim Webb well. As a matter of fact, when I retired, he helped me get a job or two. So, you know, you get a bad impression sometimes, but I'd like to straighten that one out. Not that we agreed with everything, but, you know, once a decision was made, we worked together and enthusiastically and provided very substantial help. It wasn't only Sam Phillips, but we must have had, in its prime, something like, oh, fifty to seventy-five Air Force people working full time in the NASA operation, specifically the Apollo program.

BUTLER: A very important relationship there between Air Force and NASA.

SCHRIEVER: Yes, and that same thing was true, we had the job of man-rating the Atlas program and also the Titan program—which was called the Mercury first manned flight—well, first orbiting manned flight was in the Mercury. [Alan B.] Shepard [Jr.] was not in orbit; he was in space, but was not in orbit. There was Mercury and then the Gemini.

Incidentally, there wasn't a single failure. There was something like twenty-five launches; I don't know the exact number. But between the two of them, about twenty-five launches.

BUTLER: That must have been very rewarding to see them so successful.

SCHRIEVER: Yes, it was. It was.

BUTLER: You talked about man-rating the Atlas and the Titan. That's a very important fact in that these were originally designed to be missiles to go out and explode. How did you work to man-rate them?

SCHRIEVER: Well, I can't give you a lot of detail, but just one example is that the Gs, the forces of gravity, a machine can take many more Gs than a man can, so they had to apply a different burn rate to get the Gs down so that the man could tolerate them from a physical standpoint. That was a key thing as far as a man was concerned. Just exactly what had to be done to the missile, it worked, whatever it was. I can't give you the details.

BUTLER: When were the first discussions about using the Atlas for the Mercury program, do you recall those?

SCHRIEVER: No, I really don't recall when they first started, but we were working together with NASA on it right from the very beginning. They were the only boosters we had that could put a man into space. We didn't have anything else. We had the Atlas—period. Then the Titan came along. Of course, going to the moon was another matter. You had a much larger rocket engine, complex of engines for that, and those were all developed by NASA. But we had the rocket stands we had the Muroc Lake in California, were all part of that program as well. We had a very large rocket test capability there, built additional test stands and so forth.

So we were working together with NASA, in addition to just the project. We had people throughout the NASA organization working with them on major programs of that nature. I had General [Osmond J.] Ritland over there for a while, and he was my deputy on the West Coast after that. So we really worked together at the working level, let's put it that way.

BUTLER: Wonderful. In fact, the Air Force was in control of the launch facilities even at Cape Canaveral [Florida], as well, is that correct?

SCHRIEVER: Well, yes. NASA had the responsibility for the launch, but it was a team. But the Air Force had the responsibility for carrying out the launch process, and they worked together. I've forgotten who had the "push the button" responsibility, but I presume it was NASA, because it was their program, and we provided the booster to get the astronaut into orbit. We were working together on that, too, in doing the testing and so forth. It was a NASA responsibility, and we pitched in where—well, not only pitched in, but working together just as a single team.

BUTLER: If you hadn't been able to work together, things probably wouldn't have gone the way they did.

SCHRIEVER: Well, there was plenty of motivation to work together.

BUTLER: Absolutely.

SCHRIEVER: We didn't want to leave somebody up there in orbit, you know, and so forth, or have it crash, or have a failure on the pad. You know what happened as far as when the Shuttle launch went awry [*Challenger* STS 51-L]. It created a tremendous stir. So we had our fingers crossed. We took the risk to bring back the faith of the American people that we could do it.

BUTLER: And, like you said before, those were very successful missions. The boosters worked well, everyone came back well.

SCHRIEVER: That's right.

BUTLER: As the Mercury program was first starting up, in fact, even before anyone had flown on the Atlas, right after Alan Shepard's launch, President Kennedy made the challenge to send a man to the moon and return him safely to the Earth by the end of the decade. What did you think when you heard that challenge?

SCHRIEVER: Well, I thought it was great. I mean, we had been working on studies of putting a man on the moon. That started in earnest right after the Sputnik. We were making studies on man to the moon, and that was before NASA was created. ARPA [Advanced Research Projects Agency] temporarily was given the space mission. I don't know why that was done, frankly, because ARPA wasn't even in existence, and that lasted for about a year, but Air Force was still doing the work, you know, but ARPA was brought into the picture. Then NASA, in '58, which was only about a year after Sputnik. So it took us about a year to create that kind of structure, which included ARPA, incidentally, as well.

But ARPA was given the mission of taking up, you might say, not something between basic research and technology, basic research testing more vigorously technology, which the services normally wouldn't pick up. It would be more scientifically oriented. And that's worked out extremely well. I had my doubts about that, but ARPA has done a fine job filling a niche in terms of an important part of the overall research, development, test, and evaluation process.

Gosh, I've lost myself now. There was a lot of gyrations, you know, during that period right after Sputnik. Again, great motivator, and I think we did—if I had to do it over

again, I'd probably make a change here and there, but I have no complaints about what this particular arrangement has accomplished, which includes, of course, my Air Force, but it's really working for my country.

BUTLER: You mentioned that the Air Force had been looking into some space programs soon after Sputnik. Do you recall what some of the details of those programs were, the plans that they had been developing?

SCHRIEVER: Well, RAND Corporation made a study with respect to space operations and what space satellites could provide, in a study that was completed in 1947, I think. It's available in a report that RAND put out back in 1986 or '87. I have copies of it. Dr. [Louis N.] Ridenour, who was chairman of that particular study, he identified every mission that you can think of that would be of value to our national security, which, of course, includes reconnaissance, communications, navigation, weather, and so forth. We were involved in all of those right quick after the Sputnik. Now, they weren't all funded. We had trouble getting some of them funded, and some of them went to dividing who gets what—the Air Force—and there was some confusion, but, nevertheless, the military started on programs, and they weren't all necessarily in the Air Force. Early warning was another which brought radar and infrared sensors into the picture and so on.

So we had a clear definition of what we wanted to do in space to enhance our overall national security posture, and we failed to get all the fiscal support that we felt necessary, and I still feel we could have done better and gotten capability sooner than we have, but, nevertheless, we are the leading power in the world as it pertains to space applications for national security. There's no question about that. It's very important that we maintain that decision. I haven't begun to name all the things that we did. And more commercial activity, particularly in the communications area, has occurred in the global positioning satellite

navigation. It's much more than just navigation; it has both a commercial application and a military application from a guidance standpoint. So space has become a trillion-dollar industry, and it continues to grow. So it will be important as ground, air, and the oceans, space will take the fourth—not the fourth position. It will probably come out eventually in the first position with respect to commerce and defense.

BUTLER: It should be interesting to see how everything evolves in the future.

SCHRIEVER: Well, look how fast we've—after all, Sputnik occurred in 1957, in October 1957, and you talk about—what did you mention that we were—

BUTLER: Going from flight with the Wright brothers up to—

SCHRIEVER: Yes, but motivation.

BUTLER: Motivating factor.

SCHRIEVER: Motivating factor. That motivating factor has really worked, particularly in the commercial side and in the military side. So the twenty-first century will be a very interesting one, but since I got started fairly early in the twentieth, I don't know that I'll see much of the twenty-first. [Laughter]

BUTLER: Well, hopefully you'll see at least some of it starting out and everything.

SCHRIEVER: I hope so.

BUTLER: You seem to be going along fine now.

SCHRIEVER: Yes.

BUTLER: It's not far away.

SCHRIEVER: That's right.

BUTLER: And you've certainly seen a wide change in technologies and abilities so far in your lifetime.

SCHRIEVER: I started out in fabric, wood, and open cockpit, a very glamour kind of helmet and goggles and scarves and so forth. And look what we've got now.

BUTLER: Did you ever imagine where your career could lead you?

SCHRIEVER: No. I had more feel for it after World War II and I spent a couple of tours in the Pentagon and National War College. I think my vision was a little bit more than just sitting in the cockpit.

BUTLER: Looking back at relations between NASA and the Air Force, were there formal agreements made or did everything just kind of flow together? How did that work?

SCHRIEVER: Well, there were agreements made in writing. I can't recall them in detail. But there were also, I would say, the major factor of people getting together is working together and having a responsibility and motivation for the job that they're working on. We didn't

need any paper that told us what to do with respect to the Apollo program. We made people available.

I was asked by George Mueller—"Mueller Miller," we called him, George. He had manned space flight under him, and then he had Sam Phillips running the Apollo program. "Mueller Miller," we called him, he was a TRW man and he brought in and headed the manned space flight activity. Well, we'd worked together for a long time. He came over and asked me whether he could have Sam Phillips to take over the Apollo program. Well, you know, that's like pulling all my teeth. Here he was running the Minuteman program, which was the most important missile program that we had, as far as the Air Force was concerned. The Navy would say probably it was Polaris. But they were both important, let's put it that way.

I called Sam in, and I said, "I'll not stand in your way. I think it's a good opportunity for you from a career standpoint. If you want to take the job, I'll make you available, but only on one condition. I'm going to see the Chief of the Air Force and also the Secretary of the Air Force," who at that time was [Eugene M.] Zuckert, I think. Yes, Gene Zuckert. I said, "If I get the green light that they won't forget the people that they send to NASA, forget them when promotion comes around, I'll make Sam available and other people available, but I want to be sure that it's understood that these people are not going to get lost from a promotion standpoint."

And I got sufficient satisfaction that that would be done, and it was done, because Phillips at that time was a brigadier general, and he turned out to be a four-star general. We had a number of—several others promoted while they were doing the work at NASA, so they carried out their word.

So what was done, much of the relationship really related on people getting together and having that team spirit, you know, plus everybody wanted the Apollo program to be successful. We had a lot of people in the Air Force who could manage big programs and had

a very high rating from the industry that they dealt with, so why not make them available? And I think it worked out extremely well. I guess you still have some Air Force people over there.

BUTLER: Absolutely.

SCHRIEVER: I don't follow it closely enough. I know [NASA Administrator] Dan [Daniel S.] Goldin, he also came from TRW. I knew him out there quite well, and I see him from time to time.

BUTLER: That's an interesting relationship, too, with TRW, which originally started as Ramo-Wooldridge, working on the ICBM program.

SCHRIEVER: Yes.

BUTLER: Can you tell us about how that relationship worked and grew into your work, then, with NASA?

SCHRIEVER: Well, it wasn't aimed at that. It was aimed at having—we were thinking about—it was necessary to integrate the major subsystems. If you take a look at the ICBM, starting from the top, you have the atom bomb, the weapon. You have the nose cone, which has to reenter. A lot of people thought we could never reenter without burning up. Then you have the structure. Then you have the propulsion. Then you have the guidance. All of these things had to be put together in one machine, which had never been done before. So naturally we didn't have an industry that was in tune exactly, particularly not any aircraft industry. They were not guidance. A number of things that other parts of our industry could

do better than the aircraft industry, so our decision was that we'd do it on an associate contractor basis, but the integration and the interface of the technology among the various subsystems that I've just given you, that kind of oversight, you might say, engineering-wise, was what Ramo-Wooldridge was doing.

We had no preconceived ideas on how to organize to do this job. It took us about six months of different approaches. As a matter of fact, a lot of people in industry were opposed to the associate contractor approach. They wanted a prime contractor approach. So we had some difficulty in finally making the decision that we'd do it the way I just outlined. And Ramo-Wooldridge, which had really a major group of high-quality not only engineers, but scientists, and also the power to draw from universities and so forth, because this program really got the scientific community ready and able, so we really could get the topnotch people in this country on board with Ramo-Wooldridge to do that integration engineering job. That was the background of it, and it was successful.

We had the priority from a political standpoint. We had the authority to make decisions at the working level. We got the good people that were necessary, and we got the job done. It wasn't only the Air Force; the Navy got its job done insofar as the submarine-launched missiles were concerned. These were both major programs, major new challenges, and we both did it. And the management approach was very, very successful and very important to the success of the program.

BUTLER: Absolutely. Very critical. It's interesting that looking at the space program and the ICBM program, you mentioned that so many Air Force people came to work for NASA, and TRW people came to work for NASA, and NASA used the Atlas and the Titan. Really, the space program wouldn't have gotten where it did without all of you and the work that you had done. It wouldn't have been able to put man in space as soon as they did. It seems quite a contribution.

SCHRIEVER: Well, I think so. This country can do anything if it sets its mind to do it.

BUTLER: In 1959, you moved over as commander—

SCHRIEVER: We had the policy of the hard jobs we do overnight, the impossible jobs take a little longer.

BUTLER: [Laughter] Take a few days, at least, right?

SCHRIEVER: Yes.

BUTLER: And you certainly achieved what once was considered impossible. I believe one of the science advisors for one of the Presidents one year said that ballistic missiles wouldn't be possible for many, many years down the road.

SCHRIEVER: Well, that, unfortunately, was one of the scientists. I knew him well. I can remember having a meeting with him in the Pentagon. He said, "Bennie—" And he was a tremendous man and a wonderful man. "Why don't you take it a step at a time and move forward on a shorter-range missile?" And I said, "Well, we're going to be doing a shorter-range missile, but I don't think we need to do it in sequence." That's what most of the scientists said. I said, "This isn't my decision from a technical and scientific standpoint, but they say we can do it, so I think it's important that we shoot for the moon, so to speak, and get the range that we need." Because a short-range missile, after all, the only major threat at that point was the Soviet Union, was Communism, represented by the Soviet Union.

So it certainly wasn't unanimous, and particularly with respect to the reentry phase of it. That was the one that quite a few scientists thought was very, very almost impossible thing to do. And we figured out a test program to actually carry out a test of that by taking a nose cone into space and then having enough rocket power to accelerate it so it goes back into space essentially at the same velocity that our nose cones would be coming back in. And we proved it could be done that way, or else we'd have been delayed probably for a couple of years or longer. We called it the 117-L program, which Lockheed Aircraft did, very successful program, and got a lot of people off our back.

BUTLER: Was that the Corona and Discoverer program?

SCHRIEVER: No, no, it was long before that. That was the first testing that we did with respect to nose cone recovery. The Corona program, the Discoverer program, was really—we didn't make a fast return into the atmosphere. We had slowed it down with a parachute. We recovered it by air snatch in the Hawaii area. So that was a capsule. That would have burned up if we hadn't slowed it down as it entered into the upper part of the atmosphere.

BUTLER: When you were looking at the reentry and bringing the capsule down safely, was there a lot of discussion on that involved with the heat shielding? Was that a lot of the—whether to go with the ablative or the—

SCHRIEVER: Yes, there was a lot of discussion on that early on, and then the heat sink versus the ablative, and the ablative won out only after we'd actually succeeded in making some reentries with an ablative test program, which the Army did, as a matter of fact. They were there first. We were also doing work on it in the Air Force, but to play it safe, we were going

with the heat sink approach on the initial Atlas program, but we switched over to the ablative, and the ablative worked fine.

BUTLER: Worked fine for the Air Force, for NASA, and got everybody back down safely. We've talked a bit about your interactions between the Air Force and NASA, and we know early in the program you were in command of the Western Development Division, but you moved over to be in command of the ARDC [Air Research and Development Command]. How did that change your roles and your responsibilities and the interactions, or did it change it to any extent?

SCHRIEVER: Well, it changed it only in the sense that I wasn't running the ICBM and space programs on the West Coast in a daily, detailed manner. It was still part of the command, that ARDC had the responsibility. WDD, or the Ballistic Missile Division, reported to me as command of ARDC, but I had the whole ARDC, which included the Electronics Division, the Aircraft Division, all the propulsion work, the Armament Division down at Eglin Air Force Base [Florida], test range at Cape Canaveral, and so forth. All of that was part of ARDC, reporting in to Air Force—well, first ARDC, then became Air Force Systems Command.

I had the responsibility for the procurement of the acquisition phase. Once it started to be bought in a routine manner, then the buying was switched to the Logistics Command, who supported the operational forces. I didn't have anything to do with supporting the operational forces except going through the process of getting something that would work, and once it's working satisfactory, then the Log Command takes over and has the buying responsibility. But the R&D and test phase is over with. That's the way we were operating in the Systems Command.

Now the Air Material Command is back in—well, we don't have to go into that. I'd go on forever on that.

BUTLER: As you were working with the ICBM program and with NASA, weren't you also involved with some of the Air Force programs such as Dyna-Soar and Manned Orbiting Laboratory [MOL]?

SCHRIEVER: Well, I was director of the Manned Orbiting Laboratory.

BUTLER: Can you tell us about that program and how it evolved and then even how it came to its demise?

SCHRIEVER: Well, it had two purposes, one having to do with ability of man to operate over extended periods, but it also had a mission to perform, which I don't know whether it's declassified yet or not, so I won't tell you what it was. But there was an operational mission involved.

A new administration came in and decided that that mission could be carried on adequately by unmanned and more cheaply with unmanned satellites, and that's what led to the cancellation of the MOL. It was in being for about, oh, four or five years, I guess, maybe longer, but around that time period. So as commander of Systems Command, I was also given the job of being director of the MOL program, so they reported directly to me and it was a unique arrangement.

BUTLER: Certainly a unique arrangement and a unique program, too.

SCHRIEVER: Yes. Well, I think actually that it made sense to determine man's capability. I think that actually NASA had not picked up at that point in time an orbiting laboratory such as they are doing now, in conjunction jointly with the Russians. I don't know who else is involved in it. Well, you know, after all, we were involved in something brand new, and it wasn't just a plaything that we were dealing with.

BUTLER: Certainly not.

SCHRIEVER: What else was on that question? MOL.

BUTLER: That was most of it. That was most of it. As the programs moved forward from the ICBM and then into NASA with Mercury, then into Gemini, you were, I believe, involved on the Gemini Program Planning Board. What did that entail?

SCHRIEVER: Well, I can remember one problem. There were several problems, actually, bringing in smoothly the G loading on the individual, on the astronaut. Gemini [Titan], being a two-stage device, had what they called a pogo, uneven application of G loading, which was, of course, a propulsion problem. And I've forgotten now whether it was the first stage or the second stage where the problem was, but we did have a panel or committee set up to take a look at that, and that's the only time that I can remember being involved in that kind of a look-see, because normally—but it was important enough that I think I was chairman of it, if my memory's right, but that's the only problem that I can remember that we had with the Titan, which we really were caught out on a limb, so to speak.

We never did get rid of the pogo effect completely, but at least we got it down to a—it was a random kind of thing, so that was a worry. Uneven burning created the G loadings that man couldn't take, so we solved them to the point where we never had a problem with it

in flight, but I've still heard some of the astronauts saying they got some fairly substantial jolts.

BUTLER: I guess as long as they got up there and did the job—

SCHRIEVER: They got there and got back.

BUTLER: Shows some of the intricacies of the various systems.

SCHRIEVER: Well, we don't have to deal with that, you know, as far as a missile goes. [The missile] can stand very high Gs, many more than a man can stand. We talk about eight Gs in an airplane is about the maximum. We go higher than that once in a while with test-pilot work, but I don't know what the ultimate—you have to be young and all kinds of things to take high Gs, else you pass out.

BUTLER: Yes, the human body doesn't like to have too much pressure on it.

SCHRIEVER: But we probably had some other problems, too, but that was the main problem as far as the Gemini program was concerned.

BUTLER: That program, with the pogo and then also on the Atlas, there was a few difficulties. I know on the Atlas they'd have some weaknesses sometimes in the early launches, would have a tendency to explode occasionally. Were there times when they would look at both the Atlas and the Titan, and when you would look at it, wonder if it was going to be able to accomplish the mission? Or did you think that it would just take enough work and tweaking to make it work?

SCHRIEVER: Well, we thought we could make it work or else we wouldn't have done it. You can say that maybe if you'd had something that wasn't as important as showing the American people that we were still in the ball game, you know, then we might not have taken that risk, but there was a certain amount of risk involved. We had five Atlas failures in a row in one instance during the test program, but that was behind us, you know, when we got to the Sputnik thing. This was in the early sixties that the manned space flight started. I've forgotten when the first launch was made.

BUTLER: 1961.

SCHRIEVER: '61. Okay. Early sixties. That's right. Well, by that time we had Atlas operational in the inventory up in Cheyenne [Wyoming]. Not just one. I mean, we had one there in 1959, I think one or two. You know, you have to look at all factors, and in some instances you take more risks than others. Certainly where life is concerned, that's the highest risk that one takes, because the reaction of the American people is very bad publicity for the guys who did it. "What the hell did you do it for? You should have known better."

BUTLER: We've talked about your interactions with NASA. Were you also involved working with [Wernher] von Braun's group down in Marshall Space Flight Center [Alabama]?

SCHRIEVER: Well, yes. The only times we were very closely working together was on the Thor and the Jupiter. See, they were both intermediate-range missiles, and the Jupiter was being built for shipborne launch from naval vessels, later changed to ground deployment, and they were deployed when Italy and—Italy, I know. And we deployed the Thor in Great

Britain. So they were using the same rocket engine that we were using. The Thor and the Jupiter had the same rocket engine. So we worked together on that fairly close. On most other things, we were not working that closely, because when they got involved in the lunar program, we were not involved in it at all in terms of working with them. I'm sure we had some liaison people there, but they were not really part of his team.

But I knew Wernher quite well. One aspect you have to remember is that I worked very closely with Keith Glennan, worked very closely with Jim Webb, and it took a little while to get really—we were working together during the most heated phase of what we do and what they do, and so forth and so on. But from a personal standpoint, we got along very well together, although we didn't always agree. But I had a great respect for him, and I think he respected me, too. But I liked Jim, and he was a little explosive at times, but we had no personal problems. We had disagreements from time to time, but we worked them out.

BUTLER: I think disagreements—nobody can ever get along perfectly, so disagreements are—

SCHRIEVER: Tom Paine came in third, but I think—I'm pretty sure I had retired by the time Tom Paine took over, because I retired in '66. I don't think he took over until about '68 or something like that.

BUTLER: I believe that's correct.

SCHRIEVER: But he had been the number-two man under Webb for a while, I think, before—I'm pretty sure he was number two for a while, for Webb. A good man, too.

BUTLER: Were there any others that were key factors in this all coming together so well? Any other people?

SCHRIEVER: Well, not so much in my case. I worked pretty much with the top group. Because we had so many Air Force people at various levels working together, they were the emissaries of either good or bad, and that was essentially all—not all, but essentially all very good.

BUTLER: In general, the space program and the manned space program, in particular, what effect did it have on national security?

SCHRIEVER: Well, space overall has had a tremendous impact on national security. We haven't really gotten to the point yet that we understand just how much of a revolution warfighting is going to be, because a major war is very much different than what we're doing now over there in the Balkans [Kosovo/Yugoslavia]. I think that it's hard to compare that situation to one where you really have a war. Now, it's a war in the sense of the implements that are used, but the objectives are different. I think that we're in what we call a revolution in military affairs, and it's playing out now.

It's going to be a while yet, I think, before we restructure and rethink some of the ways in which we are going to have to arm ourselves, because we're in the space business now, but there's still that interaction between ground, sea, air, and space, and they have to be integrated, and they are being integrated now, but they weren't really integrated. They did a great job in the Gulf War. That's the first war that I would put in the category of Arnold's brains, and brains are going to play a more and more important role, because the sophistication of precision weapons, the speed of light that relates to information. We talk

about information warfare and so forth. That's going to have to be integrated in the military actions of hardware and so forth.

So we have a challenge of optimizing our capability in a completely new environment. Space has intruded, you might say, in many ways, and in other ways it can bring about what I consider a spread in our deterrent overall capability. We can deter by—deterrence requires the deterrer to have the credibility that what he has is something that an enemy can't really do anything but, in the end, lose. Then he's deterred. But if he doesn't, for any reason at all, believe that we can do it, then deterrence flies right out the window.

So we are in a state of rethinking a lot of things, and I think we've made a lot of progress, but we're still in the phase that is—I mean, we're no longer in the trenches. We talked about bringing people over, bringing ground troops into the Balkans. I'm not going to make any comments on that one way or another, but there are—we need more time to come out.

When I started flying, when I was at Texas A&M [University], we still had horses pulling French 75s around. Now, mind you, this was 1931 when I graduated there. And look where we are today. So it's an awful lot to swallow, and I think we've done extremely well, but we still have a ways to go.

BUTLER: A ways to go, and we should go carefully.

SCHRIEVER: Yes. I mean, ways to go to integrate the ground, air, sea, and space, from a military overall capability. And our first job is to have a military force that deters. The military is there really to prevent wars, and to prevent wars, you have to be able to fight them, and they have to believe that the U.S. will win, or a group, a coalition will win, like NATO [North Atlantic Treaty Organization]. Using NATO forces has a lot of critics, too. So we're in a very interesting period of history. It may take some years. I'm talking about

optimizing what we have. We have a tremendous capability today, but it's not just the military force, it's the political and many other factors that relate to what one does. But the political element has to be an optimized one, and one that will have the least in the way of manpower casualties. And that's what's hard to control in a situation like the Balkans now, and Vietnam earlier and so on. But there are a lot of good brains working it, and it's going to be done, I think.

BUTLER: And hopefully we'll never see that World War III that does apply all that brainpower. Hopefully we can keep it on a smaller scale.

SCHRIEVER: That's right.

BUTLER: Talking a little bit about the political involvement in space, actually, when Apollo-Soyuz was first pulled together, this was in 1975, so I know you had retired, but did you have any thoughts on that at the time, of having a joint mission between the Americans and the Soviets?

SCHRIEVER: No. I've always felt that cooperative programs is one way to eliminate antagonisms and have a better understanding. I think Communism, that threat still exists, it exists in China, and we still have problems.

But I think we have a period here where we do have such overawing capability that we can afford to try to get closer cooperation where you really have a trust, you know, and that this visibility—you know, if you don't trust somebody, you can't really ever make much headway, but the way you trust people is to get to know them, and the only way you really get to know them is work together. I think this period right now is one when if we can get Russia more Westernized, so to speak, I think would be a very major step forward in

ensuring—it reduces the emotion that always goes with wars or getting close to a war situation.

Well, let me put it this way. I think cooperation is a good thing, and we ought to try to do it to the maximum extent, but keep our guard up.

BUTLER: Looking back over your career specifically with the ICBM program and then with the involvement with NASA, what was the biggest challenge for you?

SCHRIEVER: Well, you know, it's one thing when you are doing it. It's another thing when you review it in retrospect. For example, I never thought that the ICBM program, we were working in the program, and I guess being younger and having access to real topnotch people and so forth, there's no question our greatest challenge was the ICBM program, and creating the management structure that really, I think, was absolutely essential. It wouldn't have been possible if we had not had really major support from the scientific community on that.

As a matter of fact, the committee report that [John] von Neumann headed up turned in the Teapot Report in February of 1954, and that was not just a report talking about science and technology and the fact that that was available now to get the job done that we now have in the way of missile forces long range and submarines and so forth. We got out of that report a portion that was signed by von Neumann himself, in which he pointed out that we would never be able to get it done unless we changed our management structure so that bureaucracy couldn't stop you at various detailed levels, that you needed a special management approach for the ICBM program. And that's what we spent quite a bit of time on, which I pointed out earlier.

It turned out that we had a unique management approach that's not around anymore, and I think it should be applied to those programs where you really have a major, major breakthrough, from a military standpoint, that you can afford a streamlined management

approach. You take a lot of nay-sayers who say no, but can't say yes, and that's a problem that we generally have. Many layers of review, with lots of no-sayers, but they can't say yes. And it exists today. You have to eliminate that. And it existed in the early part of the ICBM program.

Looking back, I think that accomplishing a management approach that is streamlined in the decision-making process, and got top level, including the President himself, Eisenhower, behind it, probably was the most challenging job I had, but I didn't know it. Because in retrospect, I know a hell of a lot of people were fighting like mad to prevent that management approach to be undertaken, because it broke up a little china here and there, you know. Chinaware, not China.

BUTLER: Luckily, you were able to bring that up and meet that challenge and make the program successful.

SCHRIEVER: Well, not only that, it proves that management was the key, because we hadn't had that kind of—both the Army and the Navy also did the same thing. They were bringing things into being, to operational inventory, in five to six years, and that's unheard of, you know, in today's environment. I think time is money, you know. Time is money. And they don't ever measure, hardly ever measure time, except overall they measure what they're paying for what they're getting, but it takes a hell of a lot longer to get it, so you have to add that additional amount of money you spend that's taken up by additional time. Ten to fifteen years it takes to get a new weapon into the inventory, major weapon.

BUTLER: After that amount of time, technology has almost outpaced that system.

SCHRIEVER: Well, I don't know about that, but technology is lasting longer now. You have Stealth technology. That's going to last for a long time, but there will be some breakthroughs on that on the other side from a defense standpoint. What they are, I don't know, but now we're talking about defense against ballistic missiles. We thought at one time that here was a weapon that could never be destroyed by the enemy, but I don't have that same feeling now. I think it can be. But I think you can take actions to counter the defenses that might be set up, too. So it's a game of offense, defense, defense, offense, and so forth, so therefore technology continues as long as we have the world that we're living in.

BUTLER: Absolutely, it does. If setting up the management system and making it all work was your greatest challenge, what do you consider as your greatest achievement or success?

SCHRIEVER: Oh, I don't know. I guess—well, it's hard to say. I think the greatest success was my opportunity to have assignments that dealt with creating a new force structure as it relates to the Air Force, because I was at Wright Field [Ohio] prior to the war, and at Stanford University [California] when the war started, and came back and had the assignments which I think gave me an opportunity to be involved in what Hap Arnold was talking about, applying technology, new technology, to overhauling, you might say, the Air Force, because we were in the Air Force.

Getting into the long-range missile and space activity, I was a disciple, you might say, of Hap Arnold, and particularly his jet engine, his rocket engine, and the application of nuclear weapons. Thank God they have actually deterred a major war. We haven't fired another nuclear weapon since the one that was dropped on Nagasaki [Japan]. That's been quite a few years ago.

BUTLER: Quite a few. That was quite a success, that you were able to bring the program to where it needed to be to do that [deter war].

SCHRIEVER: Well, of course, I'm talking about being involved in maintaining it. I was involved in all of those things, and putting them into what you might call a peacetime environment, although there hasn't been a peacetime as far as regional wars is concerned. So I think our next big challenge is how do we really stop them before they start.

BUTLER: That is going to be quite a challenge.

SCHRIEVER: That's deterrence.

BUTLER: Looking back over the involvement between NASA and the Air Force, are there any last thoughts that you have on how that interaction went or how much the ICBM program helped NASA, or any last thoughts on that?

SCHRIEVER: Well, I don't really believe the ICBM program helped NASA. I mean, the technology that was involved was important to NASA as well as important to the military. One thing that I commiserated with Keith Glennan and Jim Webb and, since I've retired, with various other administrators of NASA, was that we weren't putting enough money in aviation research, but whether they were pushing it enough or not, the amount of effort on aviation went down.

I worked before the war, when I was at Wright Field as a test pilot, I went to Langley [Research Center, NACA, Hampton, Virginia] quite frequently. I have a high regard for the Langley operation, the Cleveland operation [Lewis Research Center], and the propulsion area at San Jose [Ames Research Center, California], did a tremendous job. I think we can't

forget aviation. It still needs a lot of additional work. But I don't really know how well the services are working with NASA today, because I don't get at that interface that often. But it seems to me that I don't hear much that—you still have military people working over there, and I think they're all working well together where aviation and space meets. That should be stressed, and I think it is being stressed. I don't have enough knowledge, really, of the details of the operation at the moment, what they're doing in the way of detailed projects and programs, but my message is, keep working together.

BUTLER: For the future—and this is just speculating, based on your experiences—do you see a specific military space agency developing at all, or do you see things just kind of progressing as they are?

SCHRIEVER: You mean a military space agency? For research and development and so forth?

BUTLER: Or to just pursue military and defense initiatives in space.

SCHRIEVER: No. I see a possibility of a Space Force coming into being, from an operational standpoint. I hope it doesn't, because I don't think we need one. But we need an organization that pushes very hard on space and fights the battle here in Washington [D.C.] for budget support and so forth. I think that sometimes I get the feel that there aren't enough people fighting for that piece of the pie, you know, that's necessary. Look how long it took the Army. I was in the Army Air Corps for more years than I think I was in the Air Force, because we didn't become an Air Force until 1947.

So there's talk about a separate Space Force. I'm talking about logistics and operational responsibility, doing the same function that relates to space that we are doing in

the Air Force as it relates to the air. But I personally have always said I'd prefer to have the organizational arrangement stay the way it is, but let's be sure we have the necessary advocacy to push space, because it's that important as far as military operations are concerned.

See, I had four stars for almost six years, I guess, and it's important that we have in the organization—I'm talking Air Force now—it's important that we have someone that is of sufficient rank to be representative of what's necessary in space and who really believes it, you know. We have the Space Command, which is out there at Colorado Springs [Colorado]. I think that's very important that that remain a major CINC, or Commander-in-Chief, Space. It's a very important step.

From the standpoint of the Air Force as a service, I think we have to elevate the whole future, the future's part of the—you need a four-star general who's looking in the future, who fights like hell, and that includes space, because that's the area that you're going to need the most advance in, in terms of operational applications. I can't name them all, but we need that four-star guy who sits at that decision table and says, "Damn it to hell, I need this and I'll argue with you until the cows come home." You know, you may not win, but you need that advocacy. I don't see it right now. Let me put it this way. I'd like to see it. There's a lot of it; it seems to be more words, and I'd like to see a little more action with the words. Because they're saying the right words, and they're fighting the battle, but I think they can still do better.

BUTLER: Hopefully we'll see that follow through in the future.

SCHRIEVER: But as far as changing the organizational structure of NASA, I wouldn't do anything there. Improve internally, you can always do that, and the same thing with any

other organization, but overall organization, I think is pretty good. You never can get something that's perfect, you know, in that regard. People aren't perfect either, you know.

BUTLER: Absolutely not. Well, I want to thank you for joining us today. It's been a pleasure.

SCHRIEVER: Well, I hope that you get that in the file there and somebody says, "Well, there's Schriever popping off again." That's okay as far as I'm concerned. [Laughter]

BUTLER: I'm sure they won't. I'm sure they won't. It's been very informative.

[End of Interview]