selected three names to recommend as my successor had Bill Cassidy as number one on the list.

Is there any more on that era that we're looking for?

Q: From the selection? No, I think that's it.

A: Now, where are we now? We were going to talk about the missile program.

Q: Two major programs that were important during your term as deputy and Chief were CEBMCO [Corps of Engineers Ballistic Missile Construction Office] and the space program, including the facilities at Cape Canaveral and Houston. You have discussed these programs before, but I would be particularly interested in your evaluation of the Corps' contributions to these programs and the biggest engineering challenges that were involved, as well as anything else of significance that occurs to you.

A: Okay. Well you might say I was lucky to have been in the Mobile District when we got introduced to that business back in the 1950s era with von Braun. So I did have a start knowing something about it. First, as assistant chief for military construction I became involved again in some work we were doing in the line of missile support for both the Army and Air Force. Most of my period as deputy chief was wrapped closely around the missile program, particularly for the Air Force. And during my term as Chief, as the Air Force programs began to reach completion, our emphasis on space construction shifted to support of the NASA programs.

They were tremendous. They raised more than what you could call challenges. They were pretty rugged. They had the usual urgency, the necessity to get things done. There was always in the background the obvious feeling on the part of many people in the Air Force and NASA, why did they have to fool with this bunch of Engineers from the Army, why couldn't they be doing all this themselves? It's a good question, but it had been set up all along in the military that we shouldn't duplicate. We would have a strong organization and it would support both the Army and Air Force programs.

Thinking back on it, I still think it was the right approach and I'm glad we did it because we could throw overall support from all our activities into it as I mentioned we had done earlier in the Korean fracas, and we did.

But this thing ballooned very fast. As usual, and this is not said to be critical of the Air Force because there was no way for them to know what they really wanted, the state of the art hadn't reached the point of knowing what you wanted sufficiently to put out reputable plans and turn it over to a contractor and say, "Now, go out and procure and hire people and build this thing." That just wasn't in the cards. It could have been if you'd add a willingness to accept four or five more years' delay in the ultimate completion, but at that stage in life there was a definite feeling that this had to go fast.

We tried to find a way to organize and overcome some of the problems. It was obvious that we didn't want every District in the United States developing the capability to work on building these missiles. It was also obvious that, and rightfully so, the Air Force was going to control the design and hire the architect-engineers for most of their programs. Likewise since they would control design of the vehicles, NASA would participate extensively in design of the earth structures to service them. There would be some peripheral things that we would have to do. We needed to have an office with authority to act, that could work directly with the Air Force, the portion of the Air Force that was doing the design work and knew the most about what they wanted.

We did not want to set up a completely independent construction agency, however, ignoring the capabilities we had scattered around the country. And we had to try and find some way to pull it together. Obviously, since Air Force work was centered in the Los Angeles area, the Los Angeles District became a critical factor. We tried to operate it by setting up a special organization within the Los Angeles District to be the point of contact on that program. Ultimately- it became known as CEBMCO, the Corps of Engineers Ballistic Missile Construction Office, but it started off

with other lesser names and with lesser authorities. I think they did a pretty good job. Colonel Tom Hayes, as I remember it, was really the first head of that organization and stayed with it for quite awhile.112

He did a good job of coordinating everything, but there were lots of jealousies to be overcome, too. The Air Force had it, the architect-engineers that the Air Force hired had their own, probably we had some also, and so it wasn't all sweetness and light, let's all get together and get through with this thing in the best possible means.

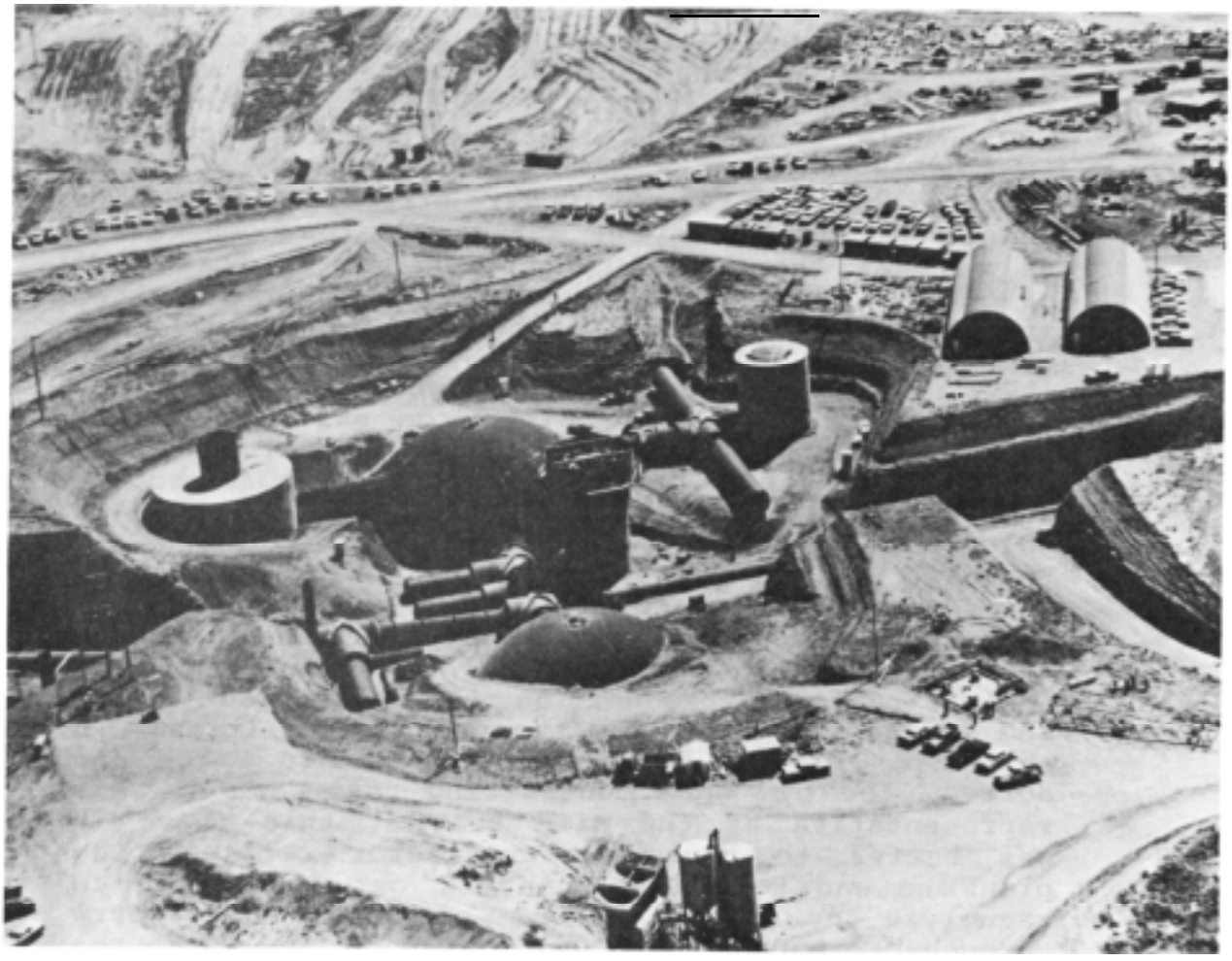
It was rather obvious we were going to have to get into the cost-plus-fixed-fee procedures again if we weren't careful, but we wanted desperately to avoid that if possible because we had seen what happens in CPFF construction. so we tried to come up with some form of unit-price or lump-sum contracts in which, however, the terms would be somewhat vague and need to be flexible because you couldn't know exactly what was to be built. But in all honesty, at the start we didn't realize what extreme problems this would run into also.

I think I'll just diverge a second and talk about that in more detail. The part of the Air Force that was supervising the design *of the silos, for instance, and the general layout of each one of these complexes had a pretty good knowledge of what the widget or vehicle that fired was going to be like. But when they changed one little item on that vehicle that was going up in the air, it changed the requirements for the silo and the connections in the silo and the size of the silo. But again, they never had even tested these vehicles or silos. They were still a dream being drawn on paper. And so as you got into it, there were more and more changes coming on, just rolling on, rolling on, rolling on, and each time there was a little change in the configuration or method of operating the missile itself, or its silo or gun, there was a resultant change in the physical things put there in the silo to send it off.

Now, as an example, on some of the earlier contracts for missile complexes the instructions, advertisements, and specifications would be a stack

about six or eight inches thick, but within six months or so it would have grown to four feet thick. It was just a terrific job to try and keep up with it. The Air Force would say I "You're delaying. You are not moving fast enough. Why haven't you gotten going with this? Why don't you make the contractor do that? This is just a little change, why do you get so excited about it? This shouldn't be very expensive." Well, we all had to learn because, for instance, you change something in the lower end of a missile where it connected on to some firing mechanism or something else in the bottom of the silo. Okay, you don't know where it's going to be, they just say, "Sorry, we are going to move it a little bit.' So what do you do? Do you stop work? No, you don't stop work. You block out, you leave a place blank. That doesn't sound too bad, and it's not too bad. But you go along and it may be six months, nine months, before that's all designed and you begin to construct this small detail. By that time the silo's now come up out of the ground and is a terrific confusion of wiring and tubes, and fuel loaders and everything wrapped around it, so when you finally get around to putting in let's say, one cubic yard of concrete that you left out, it's going to cost you $10,000 for that one because of the difficulties of getting back down in the bottom of that hole and the number of people required.

The other thing was that it was extremely complicated and each prime contractor needed many subcontractors: you had mechanical subs, electrical subs, fuel subs. You also had a very great requirement for cleanliness. You couldn't have a little dot of carbon in something or it might explode the whole silo or complex. So in certain portions of the work you had an extreme cleanliness as though it were in an operating room in a hospital. All of this gradually soaked into us, and to the Air Force. We were quicker to recognize the added cost. The Air Force didn't want to recognize the added cost because they had to go back and justify it, a requirement for more money. So their natural reaction was well, we'll just hold back on that contractor. He's making a killing. How could he use all those people?



Titan I Site construction.

Okay, I went into a silo up at Denver. It was one of the early ones, it was underground and there were several--well, it was a complex, everything underground--so you had a tunnel over here going to one and one over here going to another, and so on. And each trade and each contractor had his own color on the hardhats so he could figure out where his people were. And there were more people in that damn hole than could be accommodated. But remember they were all under extreme pressure to make their deadlines, each individual subcontractor as well as the prime. And then, to my horror, I discovered that we had a subcontractor going along installing electrical wiring in the tunnel and about 50 feet behind him came another crew removing it, and it turned out they were an Air Force installation crew. The Air Force said that final hookup and installation would be theirs, and they or their vehicle prime contractors would employ subs to do this final modification and hookup. And we agreed since it seemed preferable for the Air Force to control these final crews than for them to step in at this stage and try to direct in detail the activities of our prime and subcontractors who had been dealing exclusively with our contract administration personnel on the so-called "brick and mortar" contract for the ground facilities. In this case it was determined by the Air Force and agreed to by our contracting officer or his representative at the site that at this phase it was better to have our contractor complete the plans he was following than for our contractor to reanalyze the job as a result of this change, carry through to acquaint subs and workmen with the change, and then negotiate the change with the Corps even though this meant that the Air Force installation sub would be taking out something we had just put in.

Well, that's just a little sample. It was almost impossible for any one person, including the president of our contracting firm or the Air Force or anybody else, to really know what he was looking at, or what people were doing. We had to get things put together and start trying to make systems work before you could be sure.

Q: The basic problem, then, was that design was going on at the same time as construction?

A: It was definitely build and design, yes, very definitely. And the problem was the extent and the state of the art. They had good and sufficient reasons, for changing the diameter of one of those things maybe a little bit. Well, that can change the size of your gun barrel, which is what the silo really is. And they were testing these all the time, too, remember. They were firing these off at Vandenburg or down at the Cape or testing them up at Huntsville on the engines. All this kind of business was going on simultaneously.

Q: And new test results might necessitate changes?

A: Nearly every test would call for a change.' It got clear out of hand. Now the contractors were worried because here they were going ahead and cranking the work along and seeing dollars go down the drain because of overtime and extra people around, and they felt like they could do it more efficiently if they could just be given more leeway on the completion or phased timing. We often sympathized with them. We tried and brought that up with the Air Force time and again, but it couldn't be. They had enough backing to say, "No you can't change that. We are committed." They were the ones responsible, so it was a pretty tough proposition. We had several contractors start getting in trouble financially.

One example was the prime contractor of the Omaha missile complex. I hadn't been real happy with that particular combine when they first submitted their bid, but they made bond. They were on our list of qualified people, and I couldn't figure any way to throw them out. Sure enough, they were the first ones to have trouble. But don't get me wrong. All the contractors, the finest contractors in the United States, which means the finest contractors in the world, were in trouble in this thing inside of a year. And the costs: And you get back again to somebody saying, "Well, you only have to put two or three yards of concrete in there or you only have to put a mile of wire in that thing, it can't cost that much money:" Well, no it can't, but it does! If it had been coming along, all the plans had been there, you could lay them out and plan everything, integrate your effort with the different subcontractors, go through and have

no changes, oh man, it could have been an entirely different thing.

Q: Was there a similar experience in the space program in regard to project changes?

A: Yes, but we'll come to that. We had learned something. It came along later. It had the benefit of a learning period, if you want to call it that. We developed some new words in the contracting business. There was the "learning curve," that was one. Of course, that's not too new a word, but it was suddenly a very important word. There was "acceleration, cost of acceleration." What does it mean? It just means it costs more. Well, how do you define it? Well, you don't define it. It's just going to cost more and you're going to have more costs that you can't pinpoint the reason for. But it's going to be there. Nobody's putting the money in their pocket. It's just tough. There were words like this. What was the word we used for design as you go along? 'Concurrent design and construction.' It got to be too big a problem.

The Air Force said our outfit out in Los Angeles, the Los Angeles Missile Construction Office, didn't have enough power and authority. They said the Districts that we had involved were doing the building and had too much power. The Air Force said they needed to make changes in the design, and it took too long to get the word to the various sites of construction in the several Districts. We finally accepted the fact that what we had set up was a good way of doing things more or less normally, but there had to be quicker response in this program and there had to be quicker coordination. There would be delays but we wanted to eliminate our own delays.

Now, again, this was not by any means the Corps' problem alone. It was the Air Force's problem also. The Air Force couldn't get themselves to make decisions. I mean they'd see that they would have to change a particular feature, but they couldn't get the gears meshing to say stop. And we'd go on down the road for a month or two and then finally get the order to stop. Then you'd have to tear more out. The Air Force solution was

to station a man at each site with complete authority, the hell with contracting officer requirements and everything else. This man was to be able to say, "do this" or "do that" and everybody would have to jump. Well, from their viewpoint this looked like a fairly good deal, but from the administration of the construction contract in the millions of dollars it was a rugged operation.

So that's when we modified our organization and took this ballistic missile construction office out of the Los Angeles District and used it as a nucleus to set up CEBMCO in Los Angeles reporting directly to OCE. We picked Al Welling to run it, and we all analyzed it and he analyzed it, and he said that he wanted to divide it into missile types or families. So we had three principal assistants to Al. One running the Minuteman, one running Atlas, and one running Titan. They were completely different kinds of missiles with different fuel requirements, different types of support facilities, etc. So we gave him authority to set it up.

Q: What was Welling's background?

A: .Oh, he had an extensive background in management of construction. He'd been the deputy theater engineer in the India-Burma theater, top assistant to Tom Farrell, and when Farrell went home, Welling became the theater engineer. He'd had the Baltimore District, and he had been engineer commissioner for the District of Columbia and was knowledgeable. And he was the kind of personality I thought that we needed out there. He was somebody who was going to go boom, boom, boom! We'd had a nice-guy type for awhile and now we had to go to the other extreme.

I knew he'd have to stand up and occasionally fight with the Air Force. He was going to be under all kinds of pressures. He set it up with the three deputies. We handpicked three people to be his principal assistants, and they were good. However, under the pressures one of them broke and had to be replaced later down the road. But these three each had complete contracting authority, almost everything. Welling had to retain just a little

bit. As far as the Chief's office was concerned, we gave them pretty much of a free hand. What we were there for now was just to support them and help them and defend them and try to keep a lot of this trouble off of their backs if we could.

Q: So it was another example of decentralization?

A: Well, it was decentralization of approvals and authorities and so on, but it was centralization of control of the missile program itself into that one area. The Air Force had an adjoining headquarters right in the same building, and so these were put together. The Air Force put an officer at each of these major missile complexes, and they gave him a title of some kind to indicate he was the kingpin. We had our resident project officer, whatever you want to call him, at each of these same complexes, and we gave him additional authority. But we had to alert him to the fact that we were building the same type complexes in several other areas, and when we turned all of them over to the Air Force they had to be essentially the same or the Air Force was really going to be unhappy if they had to train operating crews for idiosyncracies at each site.

So these area engineers had to recognize that they couldn't take instructions from the onsite Air Force king without clearing them through CEBMCO in order for CEBMCO to say to the Air Force if appropriate, "Look, we have to keep these complexes comparable. Now what do you really want?" This frequently brought Al Welling head on into the fray with some of the Air Force types. The Air Force had some smart people in this program and of course their systems contractors and designers supported their views normally, so in their viewpoint anything that was going wrong at the complex was the fault of the construction contractor and the Corps. And from our viewpoint we would say, "If you had only come out with the design in time and hadn't changed it every minute, just think what a nice construction job we could have provided."

Many of the construction contractors were getting in financial problems because the processing of a change order was such that our field office and the Air Force king on the spot would have to agree on

the intent of the change order, our people would then have to price it and negotiate price with the Construction contractor, but the Air Force king would have to say, "Yes, I think it's about right," which he wouldn't do. So here would come two separate stories into Los Angeles on everything.

The Air Force saying, "Bell, they're just throwing this money away. They don't know what to do. They don't even know what it's going to cost." And ours saying just the opposite: And then the change orders would stack up, and who was to make the decision? The Air Force had to get the money. The contracting officer could say to the contractor, "Okay, I'll award you that much," but unless he had money to back it up, it didn't do any good. And the Air Force had their problems procuring the additional money. so the situation got pretty tough.

Q: The contractors couldn‘t get paid?

A: On most of these changes they couldn't get paid until you had a signature on the dotted line. They weren't willing to sign for many of the changes that we, as well as the Air Force, wanted them to sign for on the basis of what we could sit down and analyze and come up with as a dollar figure. But it dawned on us slowly that you weren‘t ever going to be able to justify an exact dollar figure. You might do it ten years later when you went back and studied after the fact. As is always true, you could do better then. But we weren't ever going to get to a point where we could be absolutely certain of cost and state this is what the contractor's entitled to.

So with the assistance of legal branch in the Chief's office, Manny Seltzer and I worked on the problem hard with military construction and CEBMCO. We finally designed some new principles and concepts and got with CEBMCO and told them what we thought they ought to try and do and whether we thought we were being rooked or not. If we didn't break the logjam the whole program was going to go down the drain. So the Chief's office more or less put its neck on the line and said, "You're authorized to do these things, now do them!" And it took a devil of a lot of negotiation.

Again, just like I told you earlier about the dental excavation down at Jim Woodruff Dam, the contractors and their negotiators were honest, sincere people. It was hard for our own people to go out on a limb and recommend approval of some of the costs that were going to have to be approved if the contractor was going to go ahead freely. You might say we should cancel the contract. Oh boy, we tried in some cases, but basically it's too late if you want to make the deadlines. You've got to beef the contractor up and get him moving, and changing horses in midstream in that kind of a situation would really be something.

So over a period of several years, we paid more than we ourselves could clearly see and justify, yet less than the contractors could show it had cost them. Then you are back practically on a cost plus fixed fee. Yes, you are, no question about it, but at that stage in life we're too late to even do that. So we just had to make what settlements could be made.

While this was going on the Air Force picked their opportunity to attack. Curtis LeMay cut loose as Chief of Staff of the Air Force. At the Washington level we had a rugged time for awhile. As I remember it, it all took place when the Chief of Engineers, General Itschner, my boss, was out of the country on an overseas inspection trip. So as deputy I suddenly was the acting Chief of Engineers for all this controversy. I was constantly explaining to the Chief of Staff of the Army, or DCSLOG [Deputy Chief of Staff, Logistics], or the Chief of Staff of the Air Force, or the Secretary of the Air Force, or Secretary of Defense how we got into some of these binds and why we must have that much more money, and why we should not give up and turn it all over to the Air Force.

As a matter of fact, for about two weeks I briefed some crowd in the Pentagon almost every morning. And each time you had to put it in a different slant because it was a different group, different objections, different goals, and I couldn't have made the grade if it hadn't been for our Strategic [Planning] Group at the Army Map Service.113 Colonel John C. H. Lee was running the group, and he and I would be there 8, 9, 10, 11 o'clock at

night trying to figure out what can we say, what do we need data on, where do we go, what are we going to say tomorrow morning? And he would get on the phone after we had reached some conclusions and call the Army Map Service, and then he'd say, "We'll have them ready." On one occasion, I started talking in the Pentagon at let's say eight thirty, and the charts hadn't arrived yet. But I started talking, and as I got to a point I said, "Now on the first chart," and the first chart would come, and I went through that whole thing without knowing whether the charts were there or not.

Q: Was it just a question of the money that was being spent on the missile program or was it also a question of whether the Corps should be doing the construction?

A: That's right, it was the whole thing all wrapped together. The Air Force military thought this was their opportunity to get the Corps out of their business.

Q: Why?

A: Well, because they thought they had a good case here for saying, "This program must be concentrated under one head." And they did have a good case.

Q: When was this?

A: Offhand I don't remember . . . . It was probably July of 1960. This went on every day for about two weeks. The first time we'd be over at DCSLOG, let's say, and we'd try and get their support. Somewhat reluctantly they might give it. And the next time it would have to be up to the vice chief of staff of the Army and then it would go the next day to the Army Chief of Staff and then go to the Secretary of the Army and then the next day we'd start to work up through the Air Force channels, working our way up to DOD level. There were constant innuendoes being given to Congress all this time, and we were constantly in the process of responding and giving the Secretaries an answer that made sense and could be backed up. So it was not a very happy time.

Q: Meanwhile construction was going on.

A: Meanwhile the construction was going on, but the changes in plans were going on too. And we were getting pleas from contractors and, of course, they were getting pressures from us and the Air Force not to ask for any more money. But the price kept mounting and mounting. We really hadn't yet gotten real control of it. We were still negotiating and refining and pricing change orders two or three years after we had started on some of them.

As the later generation Minuteman reached the construction stage, improvement in the process of administration of the contract could be seen. The command setup that had been worked out seemed to be shaking down. Most of the senior people involved on both sides had begun to see how they could work better together and to appreciate the other man's problem. Our people began to realize that no matter how much we say, we need plans, and leave them alone, don't change them. It could not be helped because every day through the testing program something shows up that requires change. And on the other hand, the Air Force people began to see that there were costs in there that you can't quite see because of the complexity in a restricted area.

The work was underground on many of these complexes, and again, as I say, you walk around down there and see all these different-colored hard hats and ask yourself who's in control here? Well, not any one person really has control except that there is a general overall supervision and control. And again, the cleanness requirements in the fueling areas were just out of this world. It was more than the kind of cleanness requirements that you would need in a place where you were putting high-quality watches together. Truly everyone that worked in or entered these areas was required to wear a white apron or coveralls, with canvas covers over the shoes. We were informed that if one little dot of a contaminant--a dot smaller than could be made with a sharpened pencil--remained in the tank or piping or pump when certain fuels were introduced, there could be an explosion. That's hard to understand, but we had to accept it.

But to get back to the controversy in the Pentagon in July [1960], I don't know when the tide really turned. I think that at the end of that two weeks' period the Air Force had gotten tired of attacking and not winning. The questioning just gradually sloughed off and we went out of our way to give them more than they were demanding all the time. I think that just about says it. Actually, the missile construction program worked. It cost more money than it should have, but it didn't cost more money than it would cost again if you started under the same circumstances.

The secret again is to know in advance what you want--that has been learned in many, many fields--and make changes, but not too many. For instance, I learned that when I built this house we're sitting in here in Mobile. I didn't have much money. I wanted to stay within a certain figure that I could finance. My wife and I visited friends and looked at their houses and measured their different rooms that we liked and came to a point where we drew up a definitive plan that we thought was just what we wanted. But to play safe, I turned that over to a good architect to rework so that we wouldn't blame ourselves afterwards. But then the architect and I told my wife she could change anything she wanted right then, but once they started excavating the hole in the ground, she was not going to change anything.

This wasn't too easy, but it worked, and we started construction about the middle of January 1951. There was no rain for 30 days. We got the sheeting on the roof by then so that we lost no time *due to rain. In three months, we completed the house and were in it. That couldn't have happened, as the contractor said, if there had been major changes. And he added that we must have prevented at least a 25 percent increase in what would normally have been the cost. Oh, there were a couple of little things that didn't fit. Just as I walked out of the house a year-and-a-half later after picking my family up to move to Atlanta, I looked up under our bathroom where tile had been cracking for some time and I realized there was a cantilever beam stretching all the way from the back wall about 20 feet to the front. The reason it was cantilevered was because on one end it was sitting on top of the

door frame. No wonder we were getting movement upstairs. But, as I say, I didn't discover this until we were getting ready to get in the car and go So my oldest son and I got a six-by-six and cut it a little longer than it looked like it would take. And with a sledgehammer we whacked that support in and closed the downstairs French door for awhile. It stayed that way until we returned at retirement. We had to design a new way to support the beam. That's why there is a little wall there. We moved the beam over.

My point is that I know that changes are far more expensive than work originally designed and carried out in the normal construction phase. Now, there was terrific pressure on the people that worked on this program. CEBMCO's management people were really under pressures. The Districts were unhappy as we took the management away from the individual Districts like the Omaha District and put it in the hands of CEBMCO. But we did our best to and succeeded in making use of the capabilities of the existing Districts in the area for many of the administrative requirements such as real estate, and auditing, and the like. We borrowed people from the local District for the CEBMCO field office in many cases and then gradually, as the work finally petered out, they moved back over to their original Districts.

So we got some of the best of two worlds. It was not what we had originally contemplated, and part of the reason you'll find later on down the road. Later programs come along like'your missile program of today's era being managed by Huntsville. They have taken advantage of many of the lessons that we learned, and they still take support from local Districts. But, as I understand it, they control it out of Huntsville much as a separate Division; That's basically the same thing we ended up with. Is that enough on the missiles?

Q: Yes, I think so.

A: I might mention something interesting. As I say, I've been involved off and on in the missile business from 1950 until I retired and later, actually, and I have never seen one of these widgets take off from the ground. Every time I

have gone there--and it has been a number of times in places all around the United States--as I got ready to watch it take off something happened, and they have to postpone the operation. Usually I've said, "Well, I'll wait and see it another time." I've found out also that you can see a whole lot better on the TV or the movies than you can at the site. Finally, I got to the point where I said, "Don't schedule me there at a time when they are going to have an exercise because I'll jinx it." I went up to Tullahoma, which the Mobile District had been constructing for the Air Force-1 went up there as deputy chief or Chief, I've forgotten which--and they said, "Well, we can run you a test in our wind tunnel anyhow. That's for sure." so I said, "Fine." We went to look at the wind tunnel test and they lost their power! So I've never tried since.

Q: Shall we move on to discuss the space program and your involvement in it?

A: Yes, the space program followed along logically. After I became Chief it was obvious that there was going to be a space program, and I wanted to offer the services of the Corps to help on the construction if NASA was interested. I felt that with all we had learned in the missile business we ought to be able to help them no end. We had talent. We knew the industries that would do the work. I called up Senator Kerr and said, "Okay, now I want to come and ask you something." so I went over to see him and told him all this. And he said, "I have been thinking along the same lines. I wanted to find out if you would be willing to work with NASA. Now we don't want you to take over NASA.@' And I said, "We don't either."

Q: Was Senator Kerr one of the great friends of the Corps at that time?

A: Not necessarily the greatest but he was one of them. He was also the man who I believe had recommended [James E.] Webb as the administrator of NASA. So I said, "If you think it's worth it, are you willing to get me an appointment with Webb to discuss it?" He said he'd do more than that, he'd set it up and we would both be there. I don't remember the exact detail but we did get together

in Webb's office or the senator's office, I don't remember which. I was in the senator's office two or three times and in Webb's office a lot of times. He was just getting set up and the prospect of letting the Corps act as the agent for NASA on the construction side was brought up, and Webb said they had been thinking about it and they didn't know whether they wanted to or not. There were advantages both ways. And I said I could see that. There is a tremendous amount of talent that is available that could go on it instantly and there is some experience that has been learned the hard way that could be useful to you. As I remember it, it was just left that they were going to think about it and would be back with me. And before too long they were back with me.

Now, what all went on behind the scenes during that period I have no idea. But I believe we did sell the job on the basis that we had the talent: the organizations were intact and could be used. CEBMCO could pick right up on NASA work. As we had learned, we could make changes in our organization and procedures in order to fit their requirements. We had already been doing the work down at Canaveral that they took over. By we. I mean the Jacksonville District of the Corps. We had good connections with Huntsville through the Mobile District. Again von Braun shows up. I had asked Webb to check with von Braun to get his reaction, and I think probably he was one of the stronger supporters we had in NASA. At any rate, they accepted the concept of the Corps being NASA's construction agency under their overall management, and we started to set up the organization necessary to give them this support and to work out the usual arrangements for handling the funding, preparing the defense before Congress, and all this kind of business. But it was relatively easy.

Now they were in the same fix as the Air Force had been earlier. They were still designing [to] some extent while they were building, but to a much lesser extent than the missile program. Much of the state of the art had been developed under the missile program. So there were some of the same problems that had to be overcome or lived with or lived around in the space program as there had been in the missile [program] and that was natural. But

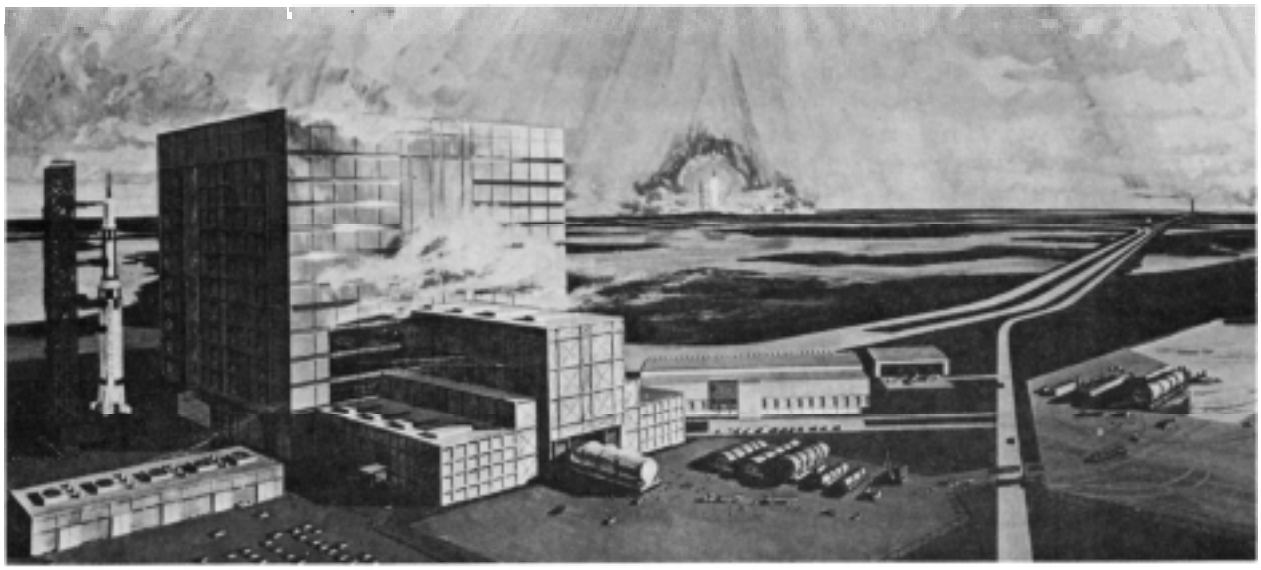
there wasn't nearly as massive a problem as there had been, and many of NASA's people and activities had learned from the missile program.

Everything that NASA did, however, was tremendous in size and scope. When we took on that big building down at Canaveral, they impressed it on me by giving me a ride in a helicopter. I was sitting way, way up in the air and the pilot says to me, "You are sitting on the roof of that new building, the missile assembly building." And I must admit that I was somewhat impressed.

Responsibility for the design work was split as you probably realize. For much of the physical brick and mortar business, we handled the design as well as the construction. The technical part of the design was strictly NASA's, and the construction was the usual team effort where our construction contractors would carry up to a certain point and then the air space operators would move in and finish it. We had far less problems fund-wise. There was some disappointment on the part of some of the working level in NASA that they weren't doing all the work. Here was that Corps of Engineers showing up again. But it was nothing to the extent that had gone on in the other system.

We put out a lot of effort. We put special assistants in several field activities. We did everything we could do to speed the program up. We put an officer over in the NASA office as our liaison with them. I went over there frequently, as did the top OCE people involved, and sat down with him and was briefed. We went out of our way to maintain an attitude of here we are, what is it you need, and tell us what you want and what the ground rules are and we'll get going. It was a tremendous program and it's really something. I still look at a full moon and say, "Well, I know they got there, but I don't believe it." It's really something!

Everything wasn't sweetness and light, but there were nowhere near the problems that came up in the missile program and for good reason. We had one problem that interestingly enough involved the foundations for that big building down at Canaveral. After the building was erected,



Vertical Assembly Building, Complex 39, Merritt Island, Florida.

somebody remembered that we had cut some piles off down there in a little cluster, and he wondered what happened. So they ran a little exploration hole down in there and discovered that the piles were cut off long before they reached the so-called rock. So then we had to design a truss to support the building in that area and tried to find out what had happened. And what had happened was real easy. We should have known better. The contractor was using a vibratory hammer and it was just doing fine, but at the end of a shift they shut it down. It wasn't until the next morning that another shift started working on it and by then the pilings were "frozen" in the sand and didn't move when they reapplied the pressure to them so they figured they were down to rock. Fortunately, as I say, one of our people down there got curious. It cost some money, but at least it didn't have any serious consequences to the program.

Q: How much of your time as Chief did you spend involved with this program?

A: Well, that first six or eight months or so, I spent quite a bit. But thereafter I didn't get bogged down in the thing. Webb was a good man to work with. We had a good friendly relationship. When I retired, he awarded me the NASA Medal for Leadership, which was real nice of him. I had a lot of respect for him, and NASA had some pretty good procedures and certainly produced results.

Q: Would you say that the contributions to the space program were the outstanding achievement of the Corps during your term as Chief?

A: Well, they were sure one of them. It depends on your point of view. I personally think that one of the best accomplishments was to keep the Corps of Engineers alive. Of course, you also had the war in Vietnam beginning to develop, and we had the civil works program boiling along at a pretty good rate. We had changes in the military organization and so on. I don't know, it's kind of hard to say.

The Arkansas River program got going along, and to this day I am amazed at its success. Long before I retired I was down in the Arkansas basin area, and they just kept pinning me down on when it would be