MSFC HISTORY PROJECT
KARL HEIMBURG
CONDUCTED BY A. DUNAR AND S. WARING
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DUNAR: ~~As a background~~, could you give us a little bit about your own personal background and your involvement just as a way of introduction?

HEIMBURG: As a young engineer, I went to Japan and spent four years from 1937-41. I went back in 1941 and [was] on leave, 5 months leave. I was under...[001] still in 1941. I was just plain lucky that they made me... the war between the Chinese and Russia. I was a mechanical engineer and I was working with chemical plants in Japan, Seoul. These 5 months leave, I used the Institute of Technology in ....[007] At the end of the 5 months I had my first draft order. The company for which I worked was stationed in Germany could get me out of that. I was drafted after six weeks in France I was transferred to Peenemuende, a place I had never heard of, never knew of. I didn't know what they were doing there. Something I had been told the first stage of ...[015] coming at the same time. Peenemuende had ~~become~~ ....[016] hiring people ..it was an army installation of the army .....[018] Come to find out there are people experienced with several areas of ....[020] So I came to Peenemuende.

I do not know what if that might interest you. (This is what my first chart was in Peenemuende.) [this is] the future projects. They were at that time working on the idea to build the V-IV and V-2. ....[027]so this was an idea, had before the ....[028]a smaller rocket. It was used to try out guidance systems. They had many guidance systems and finally combined five. They used the ...[032] was too small. The idea here was to use the A-5 with wings and try it. There was one type that didn't have a power plant which was just dropped from the aircraft to try out flight characteristics. The second one kept on the aircraft with a power plant of thousand kgs and a third starting from the ground. In the summer of 1942, I came to Peenemuende at the end of the summer. It was not clear to me at that time. People said the war would end earlier before we had finished ...[043] and therefore it doesn't make sense to develop such a plan. After that project was done, the question was "what do I do?" The ...department, we didn't have any projects at that time, so I asked for a truck. .....There were some things that had to improve. Let me give you one example: When you have a Nazi general and you can not work out exactly to the dimension, you have to a curvance. To find that (because you work under really cold conditions, actually, how do you do that under normal conditions?) It took quite sometime until you find out you have to have such clearance. We had difficulties in getting that cleared. We had really offered to change the material. Normally when

you change the material you start over from the beginning again. One example of things,....(refers to chart). This is something you have to find out at the test stand not at the launch site. ....

DUNAR: At Peenemuende, did they have test stands similar to the ones at Marshall?

HEIMBURG: We had one test stand. We had a mounting hanger, and in the mounting hanger, fitted you would be the same as at the Cape .....[086] to such a structure. Then we had a ..... where you used a power plant, without putting a mixture. But you used oxygen and fuel...because you know the combustion chambers. When you see them in the museum was hand-made. The pressure truck in the combustion chamber varied from two to eight atmospheres. So you had ...to penetrate each combustion chamber and put it with accordingly with pumps together, the ones with the higher pressure count, the better pumps.

DUNAR: So you could actually determine that without letting it off?

HEIMBURG: Yes, steamplants which was parts, decomposed. H-2-O-2 decomposed to H-2-o plus one free molecule of oxygen. This drove the turbine and the turbine drove the pumps. Until this was determined, the whole structure was moved

over to the .....[104] so you could burn it. We had two spray test stands and then one test stand where you had combustions. Really important to my opinion, which was not expressed too loud here, you needed instrumentation. The worst that could happen to you if something went wrong.

DUNAR: Instrumentation to read the results of the test?

HEIMBURG: Yes, you could then determine what went wrong. The worst thing that could happen to you was that something went wrong and you don't know what it was. In order to find out you need instrumentation. We had all these difficulties to push very hard for instrumentation. For an example that you should not use for your book. We had a test here still under the Army. The combustion test, when we still had only the power plant and it failed. That was a Saturday morning at 11:00, General Medaris came up and looked at it and asked me, "Karl, I have to know by 12 o'clock how big the damage is." I said, "But General, by 12:00 I can not go into the test stands yet." (The General said) "But I have to know by 12:00." I said, "OK General, if that's the case then I will give it to you right now. The whole center section is going I told him $225,000, but the damage was by far less to be gone...." .....[129]....Six weeks later we ran again. A half a year later I got a call that asked me what I had done with $25,000? $225,000 I apologize and got some people and we ordered some 25,000 dollar instrumentation. Half a year later I got this same call. Never, never.... it was

retired for ten years and Medaris came here one day [and I told him the story,]. His reaction was completely different than what I expected [the rest?]... Don't use this story.

already a .....[138] ..... We were always short on instrumentation. We had these test stands. Besides that we had one test stand for combustion chamber ~~energy~~ engines at Peenemuende. Each combustion chamber had to be tested. ~~Each one.~~ We could run on the test stand a test eight test a day easily. We went over that and didn't even wait until we had the results. We took the combustion chamber out and put the next one in. ...It was one test stand for combustion and later on two test sites, one in Austria and one in the middle of China that were built for combustion chambers only. But before that happened there was a test stand in Peenemuende for combustion. You may have heard earlier during .....the von Braun saga [148] and proposed the what they need now an idea....as a young man we tried .....1942, end of 1942 we were out of..... antiaircraft was developed but it was simply too late. It couldn't ~~What could~~ be build before the end of the war. Maybe you heard about it, "waterfowl" [152] was its name and when the began at the end of the war one in charge of guidance .... had a brother who ....and they came up with the idea that we should build a boat which is on the line of a submarine and passed underwater to New York or Russia .... that was ready at the end of the war too. We had ....broken with ...came out with a second simple stage the A-9 with the idea too, to have a larger projectory. The first one, (I will tell you a story here) the launch site was always pretty close with our 15 regulations, were not specially, it depended on you if you wanted to stand close

you could stand close, it was up to you. If you stood too close, and it didn't work, that was one stand only. That happened to me and I didn't trust that at all. We were standing one a high platform. There were about twenty people and somebody called, "Karl, you seem to be afraid." I said, "Yes, I am." I want to tell you, the staircase is here and you can go down and then you are in the shelter of the ..... but that's only if you need to of course. I slow, slow, slow and the Saturn stood still and with two others I run down the stairs into the shelter, close the door, there was a big bang. I opened the door and went out and the...had blown itself apart! ....You know that was a distance of here to that....

DUNAR: Well, the heat from that alone was ....

HEIMBURG: Yes, you felt that! OK that was a short story about Peenemuende that I could tell you. One of the first times I wanted to be close, but there was a wide ditch where the missile was transported, when the command of the test was given a rocket went up to the..station, for the distance of that they knew....so they could start with that[170]. The two with me, jumped in the ditch and they said that was only ignition and I didn't dare lift my head, because there was a ...~~of~~ an explosion. I looked into the two faces of these men and we ..in that ditch. We didn't dare lift our heads up in that ditch.

DUNAR: When they had the test stands, did they have a channel like they do in the test stands now that will take the exhaust in a certain direction?

HEIMBURG: Oh yes, not in one direction, but in two directions to deflect in two directions.

DUNAR: Were the early test stands water cooled?

HEIMBURG: Yes, and a little bit more complicated. You had the deflector and tubes.....[230]. You had here at the beginning with the Redstone difficulties to get the.... When you are the army and have a post general, it takes a long-time to get construction money. You get money for the project, but the construction money comes considerably later. Since we didn't have money, we tried to figure what we do with a deflector. We used ...rings which we had left over from Germany, but only the plates, not the rings, just the plates. We made the deflector out of these plates. In ten seconds, these plates would light up and you had an enormous heat deflection, deflecting against the vehicle. So in ten seconds you had to....so that was the only way you could run tests. At that time we made all sort of ...because we were short of money. And we stole at that time. As you know each building has to have number. Each store.....on the days when we needed them, but we stole the numbers too! Never

Compromises

was it found out and one day there was a Congressional group here and I told them of the difficulty we had. I said, "Can't you help us ~~our~~ so that we do not have to steal?" I gave him a few examples. They laughed and said, "We stay to our letter. We prefer that you steal before we change!"

DUNAR: The first Redstone test stand, did you use that both for straight test and combustion tests, or just combustion tests?

HEIMBURG: I believe that we did that only for combustion. We didn't run straight....I believe we did that at the contractors test sites, ~~After~~ By the time we got the money for the facilities, the Redstone was finished they said it was ok to use it for the next thing. So we did. The money for the Redstone, which we got finally, was used for the Jupiter. The tower was build from that money, from Redstone money.

DUNAR: The first test stand, though was built before they authorized Redstone, wasn't it? That was the one that was built earlier?

HEIMBURG: No, the Redstone, the poormans.... ["Poor Man's Test Stand"] The Redstone was already approved and the money for the Redstone was there. Only facility money came from a completely different part. You could not use, or it was a crime to use money out of that pot and put it over here. (We did that too!) But you could not do that with large amounts, you could do it

with small amounts. But you had to be very carefully about it. Too many people knew about it.

DUNAR: On that first test stand, [it only cost] about $25,000, I believe I read?

HEIMBURG: I do not know anymore. If you want to know,...test money.

DUNAR: How did you get the material and equipment for that? Was it all of that money or did you have to get it from other sources too? Did it come from the Army?

HEIMBURG: It came partly from the Army, partly from we organized...to buy the material. It came out of our different budgets.

DUNAR: So this test stand, (the first one) was not even as good as the one you had at Peenemuende?

HEIMBURG: No, not at all. But the main push and thrust was, it doesn't have to be elegant, it doesn't have to be build in such a way that you can make big changes. You have to build it only for one week. Normally when you build a test stand, you take a look at the future too. However, what does a ...look like. Maybe I go one step ahead here: When it was decided to go to the moon. Russia had the

opinion that you had to launch about 18 vehicles a year. We here, especially von Braun, took his time to convince them that you could not do that, it was an impossibility. Because you go through a development so that you will never have to ....but he was unable to convince them. Von Braun saw me one day and said "It was decided that a new test facility would be built. What is your opinion, should we built it or let someone else build it?" I said "we should build it because we didn't ....[270]. ~~We should~~ need the competition, if we let someone else do it. So we built the Mississippi Test Facility. Just to give you an idea, the Mississippi Test Facility cost $165 million dollars. ~~Few~~ We here could have, with one test stand, ...$1 million. That would have taken care of the total program without any difficulty. The test stand for the second stage, the second stage we were to have the test stand on. Even in Mississippi, we built ..static test stands. One for the first stage, Static test stand one for the second stage, static test stand. During the build-up Russia, meanwhile saw the possibility. So we canceled one stand.....[295].

WARING: So there was over-building, because they had anticipated there would be far more launches.

HEIMBURG: And we only out of our experience could say, "Look, it takes development time. You need the results from one week to the other, before you can go into mass

production. That means, positively, that you can't mass produce from the very beginning."

DUNAR: The difference in expense, is that because of building other facilities around that the Mississippi site, or was it because of this notion?

HEIMBURG: No, Huntsville, alone, could have taken care of the total problem, as it really came out.

DUNAR: Because of duplication it cost so much more?

HEIMBURG: Yes. There was a lot of disadvantage. You know where the design takes place this is where you ought to have your test stand. So that whenever you have a problem, you get the designer up and say, if you have ....I don't believe it. Here, take a look for yourself. If this is in Mississippi, this is very difficult to do that. You have to wait one day until he comes to see you. (If he was here) he calls and says I will be out there in 10 minutes. Then you convince him that it doesn't work this way, do it a little bit different. There is nothing wrong with that, it is absolutely normal. Only, my point is, if you have a distance between the test stand and the designer who is responsible for it, you create problems where there are none.

WARING: So did people at Marshall resist establishing such a major test facility in Mississippi?

HEIMBURG: Yes, that is what I mentioned. We tried our best, especially von Braun, "we do not need it because of the impossibility you cannot launch 80 vehicles per year.

WARING: Was it NASA headquarters that wanted the larger facility in Mississippi or Congress?

HEIMBURG: NASA headquarters I think. I do not know the politics behind it. This I could say one thing: a Senator from Mississippi was during the building time not involved, because I know we looked at different sites. One out in Southern Texas, one in Mississippi, one in Georgia. We decided for Mississippi because it was close to the manufacturer itself. We said only that it makes sense that we are close to the manufacturer site even on the way of the manufacture test stand and ....you have to transport it on barges. It is not a fast operation. Only after Mississippi was built, and NASA had to cut down, that is when the senator from Mississippi, said "Look I was not involved in the building of the facility, but now I am involved." I could understand him at that time, that he really objected with quite some success.

DUNAR: Was it Stennis?

Heimburg: Yes

WARING: Were you involved in the test stand throughout the Saturn project?

HEIMBURG: I was involved in Mississippi and I was involved in Huntsville and in the third stage in Sacramento. Every week two of us changed ~~the~~ (Dan Driskow and D. Either), he was in Sacramento or I was in Sacramento because the third stage was slower. Difficult thing, because when one part is not finished you have to push that especially.

DUNAR: What was in Sacramento? The contractor?

HEIMBURG: Yes, the contractor. This was the third stage. (The contractor was Aerojet) it was a test stand of Aerojet. McDonnell-Douglas operated it. But, Aerojet was definitely the one.

WARING: The Saturn rocket was far larger than any of the rockets constructed before it, was there special problems to testing the Saturn rocket, in comparison to some of the previous types?

HEIMBURG: I would say no and I will tell you why. Meanwhile you have to explain this and you can't percieve that point or that point or that point. Especially ...you know. The larger you get the more elements are very

complicated, the more you have to watch. ....especially at the beginning when you do it for the first time, you do not damage any part because it is a matter of simply experience and handling. After you did that two or three times, there was no problem anymore. At the beginning, the first and second time, you didn't feel well in handling it.

WARING: Could you describe the relationship between the design team and the testing team?

HEIMBURG: You mean of the test stand or of the .....

WARING: The people that ran the test stand, itself, such as yourself and the people who designed the rocket. What was the relationship between those two groups?

HEIMBURG: Of course we had to work together. The design group was actually the dictator. It had to be that way it only has one area here that you get your ....center. You of course have numerous....in the design of the test stand, where you have to go back to the vehicle people and ask can we do it this way, can we do it that way? Where would be advantages and disadvantages on the site. So it was done from both sides. Both sides were involved.

DUNAR: Were the same people involved in designing the test stand that were then managing the test procedure?

HEIMBURG: Oh yes, the same people.

DUNAR: I was wondering if you could say a little bit about the changes in the instruments used in measuring the tests over the years from that first "Poorman stand" until the Saturn project.

HEIMBURG: We had at that time mainly writing instruments, which are not very sensitive as far as time is concerned. (With the ink pen and all), but this was the main part of our instrumentation. Then you had the sylographs****. You had a sylograph especially for the engine at the start. (You know when you start it is not longer than 1.5 seconds) If something goes wrong within that 1.5 seconds you can not draw it on a piece of paper. You couldn't determine what went wrong.

WARING: Did instrumentation get better over the years?

HEIMBURG: Oh yes, the instrumentation got more sensitive and that what you needed, because whenever something went wrong during the test, the main thing for you on the test stand, "What went wrong?" We expressed it this way, "Successful failure is when you know what happened. A plain failure is when you didn't know what had happened. This of course you read ..from all sides when you couldn't save up

from.... So you were highly interested in finding out the instrumentation that could be valuable to you. You had enough instrumentation that you had mistakes, but the mistakes were not so bad because you had this instrument and this instrument that you had in the beginning too. This sounded to most people far too complicated. ~~This~~ Rees was the one, ~~they~~ who always said you are too complicated with instrumentation, but ~~then~~ when we had ~~to~~ a test and the test was cut short by von Braun... what do you mean? We shut it down 5 seconds ago and now you want to have the answer? I first have to take a look at the instrumentation that you like so much. [Rees would want to know immediately what went wrong.]

WARING: Were these instruments constructed in the Marshall Center?

HEIMBURG: Yes, you found them everywhere. Every contractor had the ~~same~~ site instrumentation. The developer, for example, for the combustion chamber. You had to make sure you had the instrumentation that was similar to what we had. That we had enough difference between the contractor so that you could say, this and this and this. If you are not in shape, "we have to make a change here."

DUNAR: What were some of the major things that you would look for in testing? Would it be for fuel? What would be some of the most important items to check?

HEIMBURG: That was repetitive, that you did not get at this time, this ignition and at this time this ignition. You had to make sure you got exactly the same curve. In order to avoid what you had happen on the Cape, what you told us is wrong. You had to completely,...Let me give you example (again, not for your book) Davis was complaining very often that we did not prepare the vehicle properly. One day I said, "Ok we will do that." Then we built. That was for the Jupiter test stand, which we called the "Hot Test Stand". Where it would be loose for six or eight feet and then carded again. What we had exactly same conditions, he had there. This was a completely superfluous, but it was one of the complaints we got from the Cape.

Global change to Debus

DUNAR: Were there problems between Huntsville and the Cape and other Centers?

HEIMBURG: .....Whenever you get people, they will not necessarily have the same opinions. There opinion differences. I think this is not something that there were big differences. Big differences one or two times. When they would make a mistake and try to cover up. Which even Davis didn't know that his people covered up. They gave him a story and then he would complain you made a mistake here.

WARING: Who had more influence when it came time to ~~watch~~ launch at the Cape ~~it~~, was it basically all under the control of Davis' team by that point and Marshall was just observing?

HEIMBURG: Yes, that was Davis deal and it had to be that way. He had to be the man in charge. He would ask for your opinion and not necessarily ...did he share the opinion.

WARING: Were the relationships between the Cape and Marshall helped considerably by the fact that Davis had been a member of the von Braun team?

HEIMBURG: Yes, it helped. You shouldn't forget that Davis and especially people who had .....who was in charge of instrumentation communication, they had their contacts with different people. So it was not only Davis, but quite a few of. That of course is the hardest part. If something was coming up and in spite of the fact you tried to avoid the.....difficulties

WARING: Did contractors become more involved in the testing as the Saturn program when on, or was it strictly an in-house affair?

HEIMBURG: As far as the first stage was concerned it was an in-house affair. Let me explain to you something. Peenemuende ...you built the vehicle completely in-house up to the launch. We started with Redstone exactly the same

way. After the third and fourth stage, it was given to the contractor, which was Chrysler. Chrysler was completely new in the aircraft industry .... But we had difficulties with the other contractors and Von Braun said, "Ok, [?] ....." Of course industry didn't like that a bit. In the 60's with the Saturn V, we built the test vehicle in-house and the first two...until it was given to the contractor. What industry didn't like was since we make it ourselves here, we knew what it would cost. They would come out with a flat sum that was three times as high as it should cost. We said if you do it this way we will manufacture it ourselves. So you see they didn't like it at all that we dictated it. Therefore they finally succeeded to get Marshall out of that business, including testing too. Because in testing ... you could really show our problems and you should have known them before. [?] .....until they find out, by that time, we will have improved it.

DUNAR: Could you describe from your experience how this relationship went in terms of them getting Marshall out of that business.

HEIMBURG: This was a political affair that went through Congress.

DUNAR: So you were observers?

HEIMBURG: Yes, we were just observers!

DUNAR: When you were dealing with contractors, did you run into any problems with the unions?

HEIMBURG: No. We ran into a couple with Northern American. We had considerable problems with North American. We did not have problems, for example with Aerojet. North American we had our load with problems. Not only from the testing side, but from the manufacturing side.

DUNAR: What kind of problems?

Don ~~Brison~~ Briscow

HEIMBURG: I should show you a letter from... that was just sent to me last week. It characterizes North American.....[SWITCHED TO OTHER SIDE OF TAPE AND RESET COUNTER TO 0]

DUNAR: Was it just a matter of the people of North American wanting to do things their own way?

HEIMBURG: No you had the idea that there was some, not on the ......

DUNAR: So it was internal problems in North American?

HEIMBURG: Yes, I had a very good relationship with North American. When it became too hard....He couldn't show

.....correctly....but he couldn't. But when it became too obvious he could do something. In the .... ~~years~~ engineers, which was not in one spot. [?]

DUNAR: Concerning the Saturn test stands. I have read a little bit about them where they describe some of the shops that are in the legs of the test stand. Not knowing too much about the procedure, is that there because of the convenience, assembling and preparing of the test? Or a matter of monitoring the tests themselves?

HEIMBURG: You mean the shops?

DUNAR: Having the shops right there, is that for evaluation process or construction of the tests themselves

HEIMBURG: No, here comes the following parts: We had in the test division one shop that you may have heard about, he was a typical craftsman. Very good craftsman. In the Normal way they would say, we have to make the design. After the design is finished you have to buy the material that you couldn't buy before. Then you manufacture it. That costs you a long, long time. In order to overcome that we had that shop and you called... we proposal for that. He would say, I will do such and such. Sure. You could see that it was adequate or not. It caused a shorter time by doing it that way. This was done mostly without any ..... He sent his

people .....and manufactured it. You have the same thing on the test stand when smaller things appeared. ....If you had an industrial arrangement, they do not like that at all. They like to go the long way. Be there always under pressure. Therefore, especially the older people, knew this was a better way. It was a lot simpler. Do it out of hand, so to speak.

DUNAR: If you were making modifications like that did you have to check with the design people first, or did you have a certain amount of latitude to make.

HEIMBURG: We had latitude. ...this was a power plant...I have to come back to Peenemuende...so I came to Peenemuende as a private, but it was something that was done in Peenemuende only one time. On the military side did not like that at all. General Dunberger said, " If I want to have engineers that work as engineers, then I cannot ~~retain~~ treat them as privates." So there were two in one room and we had even running water in that room. That was something completely unthinkable in the normal army. And the military side did not like that. If you have one company with master degrees only. So Hunts[?]...was in that company and quite a few others. When you have excellent working conditions because ~~of a long~~ at night time you ~~work~~ were together, too you could discuss things, which would be far more inconvenience. .....This of course

since he came here too, was a very good working condition between both of us.

DUNAR: So that is the relationship? That would go out of existence once you began working with contractors to a large extent.

HEIMBURG: Yes, you had some contractors with whom you had similar working conditions. For example, doctors have very good working conditions. No complaints.

DUNAR: Would they allow you to make adjustments in any way?

HEIMBURG: Yes. We would discuss that and iron it out. This was impossible with North American. But with Aeroject and McDonnell-Douglas, no problem.

DUNAR: Could you say a little bit about your own opinion about von Braun and the way he operated and managed the whole process?

HEIMBURG: I could give you a few examples. When I came to Peenemuende what I did not like was the estimates. They were always very low. And you knew that you could not do it for that price. One day I had an occasion to have a conversation with von Braun, and told him what I did not like, these working conditions. He said ..."I want to tell you one

thing, if you do it your way, you have lost the project before you have it, so don't. I found that out. You have to stay below. Actually should express it plainly light in our estimates. I will give you one example that illustrates. The Secretary of Defense was before the top man of General Motors. He came here one day and said the Russians have the first rocket motor. It has five million pounds of thrust. We know that the Russians have a good motor, we have to act accordingly ~~have the economy~~...von Braun told him to develop [?].....It was done this way in Europe, here it doesn't take that long. Von Braun seeing what he was after, he must have thought at that time under the sign of the p-4, P-2 motor that was a compromise design, because we didn't succeed with .....So they came up and said we have one combustion chamber, one for....which works perfectly why don't we test them? ....this is how the motor was built. Von Braun must have thought in a similar way, and he told him, "Look, you have your one engine of the Jupiter 4. You can't trust them. ..on the vehicle and you can do the same thing with the tanks. You take the Redstone Tanks, the Jupiter tank and we can start manufacturing them tomorrow. ..was surprised. Why don't we do that? That is how it was created. About 4 weeks later there came a commission to Huntsville, they have the first 15 million for their project. That had to be divided. Who gets which part of the money. We all knew that wasn't sufficient. I asked von Braun, what do you think we should ask for. Wait and see

how the whole thing is going and then you know what you can ask for. It was not a question of what does it really cost, but what can you save. I was the last one to be asked, "Karl what does your ~~best estimate~~ test stand cost?" I said, "$75,000." About 8 weeks after this meeting, the same commission came back and now they had $45 million. Same people, I was the last to be asked. "Karl, what did you say the last time your test stand cost?" I said, "$750,000." "Didn't you say $75,000?" " Yes, but at that time we were on the foundations, now we are above ground!"

You have asked about von Braun. He said, "Watch out you might lose the project before you get it. If you come out with your figure too high from the beginning. ~~They~~ If I had said 1.4 million, they would have despaired. The project itself went through. What I recall personally, is that when we had that accident at the Cape, we were ready at the Cape, we knew had....we told them, which caused a lot of time. What should we do, should we wait? Then von Braun came up with the idea. We took the Skylab. It was tough. The Skylab was built. As I recollect it was very much that the Skylab was dropped ...from NASA Headquarters and instead of finding out how a human being over a long period of time live in space under weightlessness. What conditions are created which we have to watch and which we have to improve and how we are going to improve? But that was tough after these 3 men flights. Which I think was a mistake. Different

opinions. Again, von Braun was the one who came up with the idea of Skylab.

I will now give you another one. Typical von Braun. After Kennedy had said we would go to the moon, we could ~~have~~ of course only wait until the Houston ...would give us the weight of their capsule. So we asked. They of course didn't have any design either, they could only guess. We asked what is the weight of your capsule? They said 40,000 pounds. We started out with the first and second stage with three motors. Mr. Brown said, "No, its 60,000 pounds our capsule." Von Braun called and said, "Stop." We had just started to pour the concrete for the first foundation and we stopped. Von Braun came out and said, "Five engines." He was accused ~~of~~ by outsiders ....~~as~~ of a wasting of money. ~~He threw some~~ and throwing money out the window.... Anybody ...blamed about ...the system, the last payload of the Saturn V was 180,000 pounds. He never could have done it without the five engines. This has nothing to do with science, it was just plain "horse sense". Since you asked about von Braun, this just characterizes him. ~~How~~ and how he would take responsibilities. He had one characteristic, no matter what, he could explain it in a way that everybody would understand it. I had worked with people before and they listened to a speech and they did not understand what was said. Then von Braun would stand up and would say I don't know if I understood that. I will say it in my own words and you tell me if I understood correctly or not. Then came out very ...simple, primitive explanations with a

few sentences. Is that what you wanted to say? You could see the really surprised face of the speaker. "Yes. He could bring that complicated thing into such simple words. In that respect von Braun was excellent. [the speaker would reply]

DUNAR: We have heard a little bit about the meetings he would have weekly. Is that what you would do in those meetings, summarize what people said and how...?

HEIMBURG: ..and explain, yes, in these meetings, too, things like that would happen. (but this other would happen) in public speeches. Explain it to a larger group. At that time, not necessarily was it somebody from us, it could have been somebody from outside, too, some contractor who came out with a new idea. But I have seen him work that way more than one time.

DUNAR: Concerning those meetings and the way in which he managed things. We have heard from other people the fact that he kept everybody informed and drew everybody into decisions. Do you have any examples of your own experience that might speak to that issue?

HEIMBURG: I think that I can give you one. I once had a problem. I thought I better ask. I told him, "this is the problem" and I can solve it this way, or this way, or this way." He looked at me and laughed and said, "Look, that's

not my problem that's your problem. I tell you afterwards if that..." This is typical. I give you another. You may have heard about the main...[223], that was our static control in the design. If you control the design from the static...whenever Heller said, "This will hold" von Braun would say, "Ok, I go along with you." Because he couldn't touch him. If you see the sign, that it is calculated now and if the assumptions are proper, will hold or not, you can only say, "Ok I trust you." Basically the difference is in the design convection of design, it says different things. Often the aircraft design will affect .... the vehicle design goes considerably below in order to save weight. We had at Peenemuende, a brilliant system. In order to press the weight down.

DUNAR: Did they use that here too?

HEIMBURG: No.

DUNAR: What is the difference between working for the ABMA, (working for the Army) and once NASA was formed as a civilian agency? Were there any differences that you noticed?

HEIMBURG: No. I would say not. You had as far as your family was considered, in both somebody who really took responsibilities. This may be made it possible to create the first

satellite. Medaris took the responsibility and ...to find out how to do that. We want to go to space and this was as you know suppressed from the top side. I remember, by the way, that one ~~weekend~~ meeting that we had here, a group of 5 and we told them what we intended to do. Three were for us and two were against us. One of us made a mistake and said, " We are ~~only~~ unsure ....since we want to use different fuel, we have not tried it out....." I'm not so sure if it can work." (This was against any rule that Von Braun had.) So...that moment he turned one man around and the committee decided against us and they created then, at that time, their own new group to develop a launch vehicle for a space vehicle. After that didn't work out, Medaris was told he could go ahead now. We came out within two months with the Redstone.

DUNAR: When you say that was against von Brauns' principles, do you mean in terms of von Braun....

HEIMBURG: Not risky. You have to risk, not bad risk but sensible risk. With this fuel there was enough information about fuels so that we say, "ok we wouldn't risk...." ...in this direction, made quite a few additions which were correct. ...before 2 000 meter of the exhaust.....up to 2,400 and that was correct. Just to say something about ~~Hover~~ Oberth(?)....[296], he was an excellent mathmetician. On the practical side you had to watch out!

DUNAR: I think that raises an interesting thing about von Braun as well. There is an element of risk-taker and yet, everybody says that he was a very conservative engineer. How do you think he balanced those two things?

HEIMBURG: I would say basically, he was not very conservative, but he was conservative. Whenever there comes a question and a risk had to be taken, the risks were thoroughly discussed and you could say "Ok, its time." So I can only say from an engineering point of view whenever you are an engineer and whenever you come into a new design, someday you have to take a risk. The question for you is, " Does it make sense to risk it?" Every once in a while you fail it.

WARING: When did you retire?

HEIMBURG: The end of ~~1971~~ 1973

WARING: Did you retire voluntarily, or did you feel that you were pressured out during the reductions in force?

HEIMBURG: You know, you could really see NASA was on the way down. When you have that age...and you know so many people have to go out. If you stayed (and I could have stayed) a younger one had to go out. The question for me was, " Is that the right thing to do or not." You could clearly see

as far as projects were concerned, this was a bad time. So in my mind it didn't make sense to stay. This is how quite a few scientist felt. It was a very hard thing to handle.

WARING: So you don't feel bitter about that?

HEIMBURG: No, I don't. This was something which was dictated from the top side. We had over 7,000 employees. That was ~~the ire of~~ high ~~hired~~ for many NASA people, most of the Centers. We were at least twice as high as anyone else. They were always pushing that you have to go down.

WARING: So it was expected that when there would be reductions at NASA that Marshall would take the blunt of it.

HEIMBURG: That's right.

WARING: Is that one of the sources of rivalry between the Centers too in the late 1960's?

HEIMBURG: Not in the larger scale. In the smaller scale, yes there was. We had rivalries with (for example) the Skylab, something they didn't like at all. We on the other side said that we didn't want ....and you have to redesign your capsule.

Now I want to tell you something which may sound strange. That accident with the capsule would not have happened to

us. There is no question in my mind. The reason is the following:

WARING: You mean the fire?

HEIMBURG: Exactly. You know we were the average, 16-20 years older than the Houston team. On the average we had made by far more mistakes then they had, because we had burned our fingers before and would be far more careful. Therefore we would not have allowed, (if you have the oxygen rich atmosphere, electricity conductors as they had on the Cape) we would have refused that. No so much because we were more clever, but because we had burned our fingers before with accidents. There is the difference when you come with younger people and they have to learn and learn by their mistakes.

DUNAR: Can you think of any other things (in general terms) that you would suggest that we ought to pay attention to as we do our research? Something that we might otherwise overlook?

HEIMBURG: I don't know if you can express that. You know when we came here we had young ...and our first came from an attack on the American system of educating engineers. If you go to Europe, no matter if its England, France, Germany, ~~which country~~, you are not admitted to any technical college

or university if you do not have some practical time. This practical time is described to some extent, you have to spend at least so much time on your.....so much time as a ....[393].... This is missing. Some ....has quite a bit of experience. There are others too, companies take the young engineer and put them on the practical side first, so that they get the necessary understanding, but this was something that drove me nuts once in a while. You have a chance to be on the test stand. You know that ...about 3 and 1/2 hours. ...I could not stand on the test stand and wait. You went wild. You did that with the intent that you could work on Saturday. They succeeded!

Carpenter, Craftsmen, etc.

WARING: So the American engineers education was primarily through books and theory and not hands-on experience.

HEIMBURG: Yes, which, as I say, we all have. Scientist have only a few which are average and all of our engineers had to ....at the colleges.

accepted

WARING: These younger American engineers as they entered Marshall Center, did they feel some resentment toward their more experienced engineers?

HEIMBURG: I would not say resentment. Resentment is to hard an expression, too hard a word. Marshall really opened ....test stands, ...attention too. ...bring the young

manufacturing

I would propose to

engineers that you just get out of college...if you can not do that here, send them to a company, so they get that experience. You save that later on. What is surprising, you have heard on the Cape, first it was said ~~let me~~ that it takes so and so along. .....You can again say that mishap should have happened on the test stands and not at the Cape.

Ok this is what we have to do and that takes so and so long. That was missing.

WARING: Are there any people in particular that you think we should talk to? Do you have any written records that might be helpful to us?

HEIMBURG: Let me say something here. I got a letter from NASA and it was from Mississippi where they want to bring test by computer scans. There is such an emphasis on our liabilities, so much on that, etc.... When you have to have.... I can only say for myself [?], that depends. You cannot have that before. The first thing is that you have to check all your details, including the bolts. Check ~~that~~ to see that they really are what they promise to be. One aircraft has their own bolts that they used and therefore the aircraft fell apart. That's when they say where was my liability group? This is very hard for me to understand. What I mean is that you have to check your details very, very carefully. You have to tell your manufacturer whenever you make a change in the materials. Let us know because you can not check each and every item. Somewhere you have to stop checking. But in the beginning you do have. Then you

go and your testing from that scheme or that scheme...On the Spray test stand too, you had to build up where we could ~~penetrate~~ pinpoint very accurately ...our engines. Then when you find out things in the engine, then you do not have to make the complicated..then you have the test that you need to have and then you have the information that you need. During the time of the development, ...you find that out during the testing, something never you find out ~~that everything~~ except ~~is~~ in ~~order~~ orbit.

.....you had all the combustion test time, all the combustion chambers on the premises, but not the complete vehicle. But sometime, we stopped that. Of course you had to be very careful in checking your details. .....if you have the occasion you should test the..... I do not know if you want to take younger people too, who had to suffer! You might hear quite a few complaints that will be justified.

DUNAR: Could you give us some of the names of these younger engineers?

HEIMBURG: One is in Mississippi and I'm not sure if he is still with the company..... He came here directly after college. He started as a young engineer. It would be for you very interesting to talk to him.