Rudolph, Arthur. August 4, 1989. Interviewer: Michael Neufeld. Auspices: DSH. Length: 5.5 hrs.; 101 pp. Use restriction: Open.

Rudolph begins by discussing his engineering education; knowledge of the spaceflight fad of the late 1920s; Max Valier. Discusses Heylandt works; Heylandt rocket car (1931); Valier's rocket engine; its problems, explosion and death of Valier. Rudolph's redesign of Valier's injection system; rocket experimenters; forced to join Army Ordnance, his reluctance; reasons for joining Nazi party; 1934 Rudolph motor. Describes concept of in-house development; origins of Peenemünde and cooperation with Luftwaffe; duties at Kummersdorf (1931-37); early planning of A-4 and later problems: design not finished, drawings a mess, vane motor problems; propulsion research; 1950s publications on Mars exploration; involvement in A-2 launches (1934); JATO project; design of A-3 and A-5 guidance systems. Discusses Walter Riedel, Pietsch, von Braun, Schneider, Zanssen, Dornberger, Speer and others.

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Interviewee: Mr. Arthur Rudolph

Interviewer: Dr. Michael Neufeld

Location: Hamburg, West Germany

Date: August 4, 1989

TAPE 1, SIDE 1

DR. MICHAEL NEUFELD: Okay, as we said before, the book, An American in Exile by Thomas Franklin, talks about your Valier experiences and also talks a lot about your background. I only had one or two questions that I wanted to elucidate about that. One was, you went to --was it Fachhochschule in Berlin? It's called in here College of Berlin.

MR. ARTHUR RUDOLPH: The College of Berlin. This was a Betriebfachschule. A test school, trial school of the Beuthgschule in Berlin.

NEUFELD: Okay.

RUDOLPH: It was not a Hochschule. A university-like.

NEUFELD: Okay, so it was as Betriebfachschule. So we can use German words in here and that will often be easier than trying to translate many concepts. You did mechanical engineering. What was the German term, was it Maschinenbau or was it ?

RUDOLPH: The term Betriebfachschule indicates it was industrial engineering.

NEUFELD: Okay, industrial, you think that would be the best translation?

RUDOLPH: Yes, I think so.

NEUFELD: Okay. One or two questions just preceding your meeting with Max Valier. When did you first hear about Max Valier or the rocket and space flight? There was a kind of fad. I've written an article about this, about enthusiasm for space flight in the late twenties.

RUDOLPH: This of course I read in the newspapers, about rockets and space flight, and regarding space flight, about the machinery Max Valier designed and had constructed. And then there was also a film called "Frau im Mond" and I saw that.

NEUFELD: Do you remember when you saw that?

RUDOLPH: I think it was in 1928. Maybe '29.

NEUFELD: Yes, it premiered in Berlin October 15, 1929, so it was late 1929. Of course it had been in the papers. There'd been talk about the movie.

RUDOLPH: Yes. Yes.

NEUFELD: So you heard about Valier probably first regarding the rocket car experiments.

RUDOLPH: Correct.

NEUFELD: With Opel and --

RUDOLPH: Yes.

NEUFELD: That was 1928-29.

RUDOLPH: And that of course fascinated me right from the beginning, and I was therefore very pleased when I got hired by ? the plant "Heylandt works". The real name of the firm was --

NEUFELD: --yes, Industriegasverwertung.

RUDOLPH: Aktiengesellschaft fuer Industriegasverwertung.

NEUFELD: Yes, I think you're right, that was the title. The "Heylandt works" was primarily a plant for building machinery for liquid oxygen production.

RUDOLPH: As to Industriegasverwertung: its main purpose was to build huge tanks to store it, to transport and to evaporate liquid oxygen.

NEUFELD: Right.

RUDOLPH: And since this was what Dr. Heylandt had in his plant, that was the reason why Max Valier, after experiences with Sander in Bremerhaven --

NEUFELD: --the solid rockets --black powder--

RUDOLPH: -- solid rockets--and with Opel as sponsor, the man who had the money, went to Dr. Heylandt.

NEUFELD: Yes, this is in fact a question that Frank Winter had. Do you think that Heylandt's concern --that he was mostly interested in the publicity? Was he interested really in the applications of rockets? Or was he a space flight enthusiast, or all of the above? Which do you think his main --?

RUDOLPH: I think, all of the above.

NEUFELD: So you think he believed somewhat in the space flight idea at the time.

RUDOLPH: Yes, I think so.

NEUFELD: I guess one question I'm not clear on at this point is, what was liquid oxygen mostly used for? For welding and these kinds of activities?

RUDOLPH: Yes. And of course also it was used by hospitals. Since the oxygen was in liquid form, you needed much less room to store it, because otherwise you would need these gas bottles in which it was under high pressure, but with low volume. Now, if you had such a huge tank, as big as this room here, then you had to evaporate the oxygen of course, so they could use it in the hospitals. And there were also different evaporation methods used which were also sold to the hospitals.

NEUFELD: Okay, so that was Dr. Heylandt's main business, you think, at that time.

RUDOLPH: It was not the main business. It was just one of the businesses. You see, he built machinery to produce liquid air, and by evaporating the liquid nitrogen he got of course as a result liquid oxygen, and he sold the machinery to make liquid air or liquid oxygen all over the world. That was through Heylandt works, and the Gesellschaft fur Industriegasverwertung that was making the equipment for storage, transportation and evaporation of liquid oxygen, and that was also sold all over the world, to the United States, to Denmark, I remember, to Rumania. There was hardly any place where he did not sell his storage equipment for liquid oxygen.

NEUFELD: So you would say that at that time, he was one of the leading figures, his company was a leading company in the world or one of the leading companies in the world for cryogenic fluids?

RUDOLPH: Yes. There was of course the Linde Company. Linde was also in cryogenics. But I might say that Heylandt was of the same stature.

NEUFELD: And Linde was also a German firm as well.

RUDOLPH: Yes.

NEUFELD: Okay, so can you describe Heylandt as a personality and what his education and background were?

RUDOLPH: His education and background, I don't know. I did know him of course when I got employed there.

NEUFELD: Right.

RUDOLPH: He was an interesting fellow, insofar, he would take liquid oxygen in his mouth and then have a glowing piece of wood, blowing the oxygen against it. So it was a trick.

NEUFELD: He was a bit of a showman?

RUDOLPH: I'd say so.

NEUFELD: Okay. So I think your brief encounter with Max Valier is pretty much explained in there, right. Of course, you barely knew him before he was killed tragically in that explosion.

RUDOLPH: I did not know him at all before I got to Heylandt, and there, when I heard the first noise of a rocket test, I knew that it was Valier. Since I had seen the primitive test stand the day before, going around through the plant, and I ran over to him and asked him whether I could work for him, and he said, "Yes, I need all the help I can get." Or "I can use all the help I can get."

NEUFELD: So you already considered him a very famous person.

RUDOLPH: No doubt about it.

NEUFELD: And also I gather from what you told Mr. Franklin or whatever his real name is, that you regarded him very highly. You thought his ideas were good at that time.

RUDOLPH: Yes. Of course he had a philosophy which I could put about as follows. He had to of course develop rocket engines, for transportation into space, and he was an astronomer, so he looked to the stars, and to the means to get to the stars, so rockets were the way to get there. Now, before you could build a rocket ship, he said, "I have to make ground tests. I have to develop the engines to make that possible. And if that works on the ground, for instance in a rocket car, then I will put that in an airplane and try it there, and if that works, then we will be ready to build flying rockets, " and he meant flying rockets.

NEUFELD: Yes, I know that of course in that sense, he had conflicts with Hermann Oberth at that time over a difference in philosophy. Oberth wanted to go immediately to launching rockets, and Valier wanted to build rocket planes, I gather. When did you hear of Oberth? Was it in connection with the movie?

RUDOLPH: I knew the name Oberth. I did not know him. But then when Valier in the accident died, Oberth came to the burial, and said a few words about Valier. And his pioneership. So I got to know Valier. And then --

NEUFELD: --you mean Oberth?

RUDOLPH: I got to know Oberth. And then after the death of Valier, a few years later, I was out of work but still living in Berlin. Fortunately I lived near the patent office in Berlin, so I went there and read the book of Hermann Oberth.
NEUFELD: The first edition, DIE RAKETE ZU DEN PLANETENRAEUMEN?

RUDOLPH: The first book.

NEUFELD: Or the big one, the second or third edition?

RUDOLPH: I don't remember the name.

NEUFELD: "WEGE ZUR RAUMSCHIFFAHRT".

RUDOLPH: Correct. I understood only half of it.

NEUFELD: Yes, it's very mathematical.

RUDOLPH: So I got acquainted with the thinking of Oberth, and I admired him. Now, there was also the Verein für Raumschiffahrt.

NEUFELD: Were you ever a member?

RUDOLPH: No, I was not a member. I was not a member because I didn't have money.

NEUFELD: Yes, even in a period when you were still employed by Heylandt from 1930 to 1932, you didn't have money because of the Depression.

RUDOLPH: No. For some reason I did not join. And since I belonged to this Heylandt group, we were none of the fellows who joined the Verein für Raumschiffahrt -- a colleague was Riedel, Walter Riedel.

NEUFELD: Right.

RUDOLPH: And then also one was Alfons Pietsch. None of them were members of the society.

NEUFELD: At that time, for a brief period, '27, '28, '29, the Verein fur Raumschiffahrt had broader membership. But I think at that time that you're talking about, it's mostly identified with Nebel and his Raketenflugplatz group.

RUDOLPH: Right. They were the Raketenflugplatz fellows, because they flew rockets. They flew rockets. We got even an invitation to see them at the Raketenflugplatz Berlin. So Riedel and Pietsch and I and the chief engineer of Heylandt went to the Raketenflugplatz.

NEUFELD: What was the chief engineer's name, do you remember it?

RUDOLPH: Yes, Ehms.

NEUFELD: Okay, was that 1932 or '31?

RUDOLPH: That was after the death of Valier. So it was probably 1931.

NEUFELD: Now, I remember from the Franklin book that after the death of Valier you continued, you and Riedel and Pietsch continued to work on the rocket car, Valier's rocket car under Heylandt.

RUDOLPH: Yes.

NEUFELD: Without Heylandt's permission.

RUDOLPH: Well, this was of course -- ja. When Valier died, Heylandt was so shocked that he forbade any work on rockets. But especially I think, I was so fascinated with the work we had done, and especially, why did the rocket motor explode? Why?

NEUFELD: Right.

RUDOLPH: So I went into the laboratories and with water, I tried to simulate the flow of the liquid oxygen, and the Brennstoff, which was in the case of the explosion, an emulsion of diesel oil and water.

NEUFELD: Yes. I remember, of course, they had to use that because he got that from Shell, wasn't that right, the fuel, that he had committed himself to using that.

RUDOLPH: That could very well be, because I remember there came people from Shell to Valier.

NEUFELD: Do you think that was -- I'm sorry, go ahead.

RUDOLPH: That was way, way in the future, because we did use very little diesel oil, and then of course from the diesel engine which was driving the machinery for making liquid oxygen.

NEUFELD: Do you think that was a poor choice of fuel, Brennstoff?

RUDOLPH: Well, not in itself, but for the time and the state of the art, it was. They don't explain the explosion. Let me go back. First, it intrigued me, why did the darned thing explode? Therefore I ran these tests. I did that in a corner of the laboratory which was not in use any more. And I had to go to the window to observe. And there expose myself to Dr. Heylandt who was just walking by. Oh oh! He came in and chewed me out and told me, "If I see you again doing rocket work, I fire you." So that was enough, in a very bad time, when unemployment was very high,

and the great Depression in USA came rolling over,over Europe, Germany. But I didn't stop. I continued, but I was very careful to look around when I had to go to the window that no Dr. Heylandt walked by. So I re-designed the ejection system of the engine Valier and Riedel had designed.

NEUFELD: I gather from this book that you had propulsion instabilities, combustion instability in the thing, that it was --

RUDOLPH: Oh yes.

NEUFELD: That the injector was poorly designed.

RUDOLPH: Yes. And so I redesigned it, and from then on, the engine was very smooth, very smooth. Of course, in all the tests we ran, that was at a time when I began to know Valier and until after Valier's death, we had explosive jolts of terrific strengths, so since we used as a thrust indicator a modified kitchen balance, the indicator would jump up and down, with huge vibrations through the whole system, much -- Valier would move around the rocket engine which had a diameter of about four inches and about thirty inches, 2 1/2 feet or so, long, and everything was shaking. Riedel would control the volume of the Treibstoffe,propellants --

NEUFELD: The fuel and oxidizer.

RUDOLPH: And I would regulate the pressure. And Valier would keep by signs indicating saying for instance, "Thumb Up, pressure up, Thumb down, pressure down," and, hand up, volume up and hand down, volume down. So I think I could give you a copy of this redesign of mine.

NEUFELD: Yes, that would be wonderful. Can you describe how you changed the injector?

RUDOLPH: Yes. I think the main problem in the whole combustion instability was the flow of the Treibstoffe. Treibstoffe means oxygen and --

NEUFELD: --fuel --

RUDOLPH: --fuel, yes. There was let's say an egg-shaped injection head which had holes drilled into it. Since the surface was curved, it was difficult to drill these holes.

NEUFELD: To drill.

RUDOLPH: To drill these holes. And our workshop was not one to make precision work. They were good in sheet metal and in doing welding, but not in precision machining as was required for the

injection of the fuel. So the fuel would come out in all different directions, but all very, very irregular, and so some of these fuels hit the wall at one spot, and therefore Valier had to walk around the engine and look for red spots. If there was a red spot, that meant danger.

NEUFELD: Right, it was too hot.

RUDOLPH: Too hot, and then if the metal, the steel was red hot and there was excess oxygen, the darned thing would burn through, and that happened, of course. So therefore, Valier had to give the signs to change volume and pressure, so it wouldn't burn through. So this was one point. And then, the oxygen ran along the wall of the engine. Then there was no controlled inlet. Now, if you had these explosive spikes, then it probably retarded the Treibstoff flow, but then when the spike, the pressure spike was gone, another shot of Treibstoff came in. And so I had decided to redesign all that, and I redesigned the fuel injector so that the fuel can come in like a lampshade. And I did the same for the oxygen.

NEUFELD: Okay, what do you mean like a lampshade, a diverging cone from the center of the injector?

RUDOLPH: Yes. I hope I have a sketch I can give you.

NEUFELD: Okay. That would be very good.

RUDOLPH: So, like a lampshade from the center came the fuel against the wall, and from the wall came a cone, a lampshade cone of oxygen into the center.

NEUFELD: So the cone of liquid oxygen was opening upwards or downwards?

RUDOLPH: Upward.

NEUFELD: Upward, so the --

RUDOLPH:--from the bottom of the chamber, like that, to the center point of the chamber.

NEUFELD: Okay.

RUDOLPH: And the fuel from the center point of the chamber towards the wall.

NEUFELD: How was the LOX injector designed? Did you have a ring of injector holes around the inside of the wall?

RUDOLPH: It was just --Valier or Riedel designed it, it was just open, it went anyway it could, and I changed that too by creating

that cone-shaped injection, so that it was controlled and directed to the center.

NEUFELD: Okay. I guess my problem is, I have a hard time picturing where the injector is exactly.

RUDOLPH: Maybe I should try to get you the sketch now.

NEUFELD: Right. Okay, we can stop for a second. ... Okay, I am holding in my hand a drawing that you made in 1978 of the differences between the two engines.

RUDOLPH: From memory.

NEUFELD: This was done for Mitchell Sharpe?

RUDOLPH: Yes.

NEUFELD: Okay, so the injector in the design that originally, was it the fuel injector or the oxygen injector in the Valier design that was sitting in the middle?

RUDOLPH: It was the fuel injector.

NEUFELD: It was literally sitting in the middle of the chamber. You see to show liquid oxygen entering at the bottom, right.

RUDOLPH: Yes, here, see the liquid fuel, here liquid oxygen.

NEUFELD: Okay. And so you continued to have the fuel injector in the middle now?

RUDOLPH: Yes.

NEUFELD: And the oxygen injector around the circumference at the bottom of the combustion chamber. And the gas flow jet was out this, the top of the diagram.

RUDOLPH: Up.

NEUFELD: Okay, as it is drawn here, the gas. Okay, so that when did you complete this redesign? Was that for the rocket car?

RUDOLPH: Yes, that was for the rocket car. Notice down here, that was also used in an airplane, later. But that development was already with the German Heereswaffenamt and the Heinkel aeroplane works.

NEUFELD: Right. Okay. So a design of this type was used first in the rocket car, and you described in this book, in the Franklin book, that that was not very successful as publicity, I gather.

RUDOLPH: Will you repeat that please?

NEUFELD: The Heylandt rocket car was 1931 I think, right.

RUDOLPH: Right.

NEUFELD: And that had not been a big success from the publicity standpoint.

RUDOLPH: Correct.

NEUFELD: And after that time, Alfons Pietsch was fired by Heylandt.

RUDOLPH: Yes.

NEUFELD: Because of doing it without Dr. Heylandt's permission?

RUDOLPH: Yes. Right.

NEUFELD: Yes, Frank Winter had wanted to know whether you could describe Alfons Pietsch, what his background was and what his personality was like.

RUDOLPH: Well, he was a graduate engineer. He was a sort of a strange fellow.

NEUFELD: By graduate engineer, do you mean diploma?

RUDOLPH: An academician.

NEUFELD: Okay. Diplom-Ingenieur.

RUDOLPH: And when I met him, he asked me all sorts of strange questions, at least they seemed very strange to me at that time. For instance, when I wanted to take over his position, He had just hired me as his assistant, so -

NEUFELD: --this was before Valier's death that he asked you this?

RUDOLPH: Yes. That was before I met Valier. I had first Pietsch as my superior, for whom I worked really. He was my boss, not Valier.

NEUFELD: Right.

RUDOLPH: That was sort of characteristic for him. But he was also a very, very courageous man. When the rocket engine caught on fire accidentally was at "Tempelhof" air field, he used his bare hands to put out the fire. He also was very set in his ways. If he had an idea, then you could not shake him. But on the other hand, he was bright enough to realize that my design would become

a great improvement over the Valier Riedel design, so he let me test it, build it first and then test it, and it worked very well, no explosive spikes or any more burning thru the wall. So I sat myself next to the engine, which was about that long,

NEUFELD: About 30 centimeters, you're indicating with your hands.

RUDOLPH: Ja, and 1 looked at the exhaust flame. The body of the car was not put on yet. So it was just the chassis, and I sat on it next to the engine burning, I would look at it, and I looked of course at the exhaust, and from the exhaust and its formation, the forming of the Mach waves, I could judge the combustion, and if you had these Mach waves very clearly, sharp formed, then I knew we had good combustion, and no shaking, no vibration, no explosions.

NEUFELD: By Mach waves you mean as in Ernst Mach the physicist?

RUDOLPH: Mach. He introduced the Schlierenfotographie (photography), where the different shock pressures and velocity waves are very clearly seen.

NEUFELD: Was that stroboscopic photography?

RUDOLPH: No. No, it was not stroboscopic.

NEUFELD: What was Schlierenfotographie (photography)?

RUDOLPH: They used this expression for the photography of smoke. If you had Ueberschall.

NEUFELD: Supersonic velocities.

RUDOLPH: Supersonic velocity, and you had smoke, and you saw these Mach waves forming in the smoke.

NEUFELD: Okay, you're now talking about the wind tunnel testing at Peenemünde.

RUDOLPH: Right.

NEUFELD: But at the time you were looking at your engine at Heylandt in '31 you just had to visually look at it and see that the Mach waves showed an even combustion. Okay, so you used that design for the rocket car. Did you continue to perfect it afterwards, before you were fired or released by Heylandt?

RUDOLPH: We improved it. See, in this design here there is no Kuhlmantel.

NEUFELD: Right, no cooling jacket.

RUDOLPH: No cooling jacket. But later on we welded onto here a cooling jacket, and that included the nozzle too. The nozzle was also surrounded by a cooling jacket.

NEUFELD: That was using the fuel.

RUDOLPH: Yes, it was injected at the nozzle end and ran around it and the combustion chamber and then came in here, as you see it here.

NEUFELD: Okay, so you then actually made it a regeneratively cooled engine, quite, after the rocket car, was that?

RUDOLPH: No, that was introduced with the rocket car.

NEUFELD: With the rocket car, so that you did have some regenerative cooling with this design.

RUDOLPH: It was called regenerative cooling.

NEUFELD: Actually I'm not entirely sure, I think you had explained --

RUDOLPH: I asked myself, what is regenerative, what is regenerative? Was it simply cooling?

NEUFELD: Yes, I myself am not clear where the English term came from.

RUDOLPH: Where this term came from.

NEUFELD: I know that Oberth discussed it in 1923 in DIE RAKETE. Obviously I don't know what the German terminology, what German term would be used.

RUDOLPH: It would be the same as in English, regenerative. You regenerate something. Okay. I don't know. By the way, when we introduced this jacket, and welded it here at the nozzle end, we had to introduce an expansion and retraction form into the sheet metal cooling jacket because otherwise the different expansions of the inner chamber and the cooling jacket would create cracks.

NEUFELD: Right.

RUDOLPH: Even so it created cracks. And then we would have a crack--the design was of course then much different as it is here --anyway, a crack would appear here, and so fuel would run in here, and would leak down the inner wall of the combustion chamber. And this was later on, for a later development of the V-2 engine of extreme importance. But I noticed it already and its benefits, when I saw it, I noticed that we had much less problems with burn through, so I noticed the effect of it very

early.

NEUFELD: That's very interesting, because I think one or two people have credited that film cooling idea to Thiel's assistant, Poehlmann, and much later than that, 1939 or '38.

RUDOLPH: We had the same application independently.

NEUFELD: So as far as the development of that idea later was concerned, it did not stem from you, although you had already thought of it. It was an accident in some ways that you then were able to use.

RUDOLPH: Yes.

NEUFELD: But you did not contribute that idea later on to the Thiel group.

RUDOLPH: No.

NEUFELD: Okay. I guess later on, the problem of the differential expansion was solved by making the cooling jacket and the wall essentially the same, right? That is, in this design you have a wall and then you have a cooling jacket on the outside of the wall.

RUDOLPH: No, it was in principle the same as introduced at Berlin-Britz. There was no striking difference in concept.

NEUFELD: I just meant in terms of the actual incorporation of the cooling jacket running fuel alongside the combustion chamber outer wall, eventually one Thiel group actually ran fuel through numerous small nozzles in the combustion chamber wall itself, right, in the A-4 engine? That it was made up of a series of welded tubing, as I understand, or something.

RUDOLPH: No, no, I think we don't understand each other.

NEUFELD: Right, Okay.

RUDOLPH: The cooling jacket, the jacket was formed by the combustion chamber wall, like it shows in this sketch, and then adding another thinner wall parallel with the combustion chamber, so the room in between was the jacket.

NEUFELD: Okay. That makes more sense. So the cracking problem came at the top, towards the top of the engine, when you had --the top of the combustion chamber and then the cooling jacket, was that where the differential? I hate to spend too much time on this problem but --

RUDOLPH: It was of course here at the inlet.

NEUFELD: Okay, the oxygen inlet, that's where you had that expansion difficulty, Okay.

RUDOLPH: See, at that time when we had tests we burned flame upward, not downward, because we would create problems by burning downward, by eroding the ground.

NEUFELD: Right.

RUDOLPH: You know, later on in the big engines, and already in, Kummersdorf, we had then created, established a Schurre which was water-cooled and therefore stood up under the heat and pressure of the exhaust flame.

NEUFELD: Yes, a sort of deflector, a water-cooled.

RUDOLPH: Right, deflector.

NEUFELD: A water-cooled deflector later on, Okay. Now, to remember where we are --so after the rocket car thing in 1931, Pietsch was fired by Heylandt and you continued to experiment on your own?

RUDOLPH: No.

NEUFELD: You stopped for a while?

RUDOLPH: No, there was nothing done at all that time, and the plant had difficulties in further existing because of the Depression.

NEUFELD: Right, it was so bad.

RUDOLPH: So then I had to do all kinds of work. I had to pump gasoline. I had to give out tools and to do shipping of the big containers for storage of liquid oxygen, and all such kind of things. But then the situation became so bad, and also I was fired. That was 1932.

NEUFELD: I think you say in there, it's May, 1932. As far as this rocket engine development was concerned, it stopped until you met Pietsch again at the Arbeitsamt.

RUDOLPH: That's right.

TAPE 1, SIDE 2

NEUFELD: So the work stopped altogether. I had wanted to ask you about Walter Riedel. Later Walter Riedel I or Papa Riedel. Did you --he was a bit older than you?

RUDOLPH: He was about four years older than I, and he was the one

who was assigned by Dr. Heylandt for the chief engineer to help Valier. So he made a design. He saw to it that the design was established in the shops. And he also saw to it that tests were prepared and run. Now, there was one mechanic who did the manual work. And then when I came to join Valier and Riedel, we did it together, the three of us. Riedel was definitely a bright engineer. He had, however, his also strange ideas sometimes, which does not deteriorate in any way his brilliant design work.

NEUFELD: So you think he really made an original contribution to rocket engine design.

RUDOLPH: Yes, he definitely did.

NEUFELD: And can you describe him at all as a personality? Maybe you've already said as much as occurs to you.

RUDOLPH: He was sort of a short fellow, broad, and he was a typical Berliner.

NEUFELD: What would you say were the characterisics of a typical Berliner?

RUDOLPH: Well, he had a sort of a dry humor.

NEUFELD: Now, he continued, did he work with you, when you were experimenting against Heylandt's permission, you were doing that with Riedel then?

RUDOLPH: No. He kept strictly to the orders of Heylandt, where Pietsch did not and I did not, and I worked for Pietsch. But Riedel kept out of it.

NEUFELD: Do you think that he then didn't have much to do with it for a while, after Valier's death, that he stopped working on the rocket engine?

RUDOLPH: He, to my memory, did not do anything, until Dr. Heylandt went to USA for a quarter of a year or so, and then Pietsch said, "Let's design a new car, a Heylandt car, not a Valier car any more, a Heylandt car." And there he gave, in a way, gave Riedel the task to design the system, incorporating into the car the equipment which was necessary to drive it by a rocket. But I concentrated on the rocket engine itself, that I designed.

NEUFELD: Right. So he was involved in the rocket car design in 1931. Or was it late 1930? In that period, at any rate.

RUDOLPH: Let's see, 1931, there was the accident in 1930. In 1931 we built a rocket car and drove it at Tempelhof Airfield, and before, on the grounds of Heylandt.

NEUFELD: Then Riedel was not involved again in rocket engines for a year or so?

RUDOLPH: That I don't know, because when Pietsch was fired at Heylandt, we sure didn't do a darned thing any more, neither Riedel nor I.

NEUFELD: Right. You needed the job.

RUDOLPH: And then I got together with Pietsch at the Arbeitsamt, and there we decided, it was a shame that we had to stop that most interesting work, and so we came to an agreement that each would find a sponsor for the future work, and I would design an Aggregat, call it an assembly, that had all the elements of a rocket, but it wouldn't fly. We had to demonstrate it on the ground and that was the purpose with all the elements, a rocket assembly needed, with the engine, the tankage, the pressurization system, the pipes, the valves and so on.

NEUFELD: In the book, both in his interviews and in the interviews that are printed there with the OSI investigators, you say that you had to go out and search for money, of course, to do, to finance this.

RUDOLPH: That was the task of Pietsch.

NEUFELD: And he went at first to the local SA commander, you say.

RUDOLPH: He went with me, I went with him, and his name was Graf Helldorf. And he was very nice, very interested, but he said to us, "I don't have any money either. I'm just as poor as you are. So, sorry." Pietsch went to industry and to the Kaiser-Wilhelm Gesellschaft, which was at that time highly prominent, like the Max Planck Institute.

NEUFELD: Right, which is what it became after the war. So that was a sort of state research institute, sort of like universities but without teaching. So he went to Kaiser-Wilhelm Gesellschaft. I wanted to ask you, when you went to Count Helldorf, was he an SA member as well?

RUDOLPH: He was an SA member of high ranking .

NEUFELD: Okay, so Pietsch and you, and how did he eventually run into I guess at that time Captain Dornberger?

RUDOLPH: Well, one day after quite some time, I had this design long ago ready and we could have started building, but no money. So as I mentioned, I went once with Pietsch to Graf Helldorf, and Pietsch went to industry and to the Kaiser-Wilhelm Gesellschaft, but no money. Nobody had any money. And then one day he came beaming, "I got a contract from Heereswaffenamt." So we started

building. And then after a while, we had made quite some progress. After a while he said suddenly, "No money any more." I said, "Pietsch, that cannot be possible." But as it turned out, he had used the money for himself, or part of it. He was married. He had to pay rent. And so he used the money, I might say, in desperation. Now, I asked him to restore the money, so we could go on and build further on that assembly or aggregat. I asked my former bride, now my wife, for some money, and she had a few hundred marks she could give us, or to me, and so that brought us a little bit further forward. But this money didn't last long. And so I kneeled on Pietsch, "You restore that money," but I knew already he would not restore it, so I made a proposal, "You go to the Heereswaffenamt and tell them what happened, and plead for forgiveness and more money," and he promised to do that, but he never did it, and so, after months and finally years of struggling with him, a mutual struggle, I could not even get hold of him any more. And I had warned him, if he didn't go to the Heereswaffenamt, then I would go, and so what choice did I have? I went.

NEUFELD: Okay.

RUDOLPH: And I had met Dornberger before, together with Pietsch, and that was after we got a contract, Pietsch and I, we went to Kummersdorf Schiessplatz, to look at a test stand that the Heereswaffenamt had built there for liquid rocket engines, and there were of course all of the military and also Wernher von Braun whom I had also met before.

NEUFELD: Right, at Raketenflugplatz you met him, once.

RUDOLPH: And so I went to Dornberger, and he knew me, of course. We had met in Kummersdorf. And he gave me some 300 marks, and I had calculated with 300 marks I could finish the work. And I did, of course now with a delay of two years, caused by Pietsch. If we had done our work in 1932, then we would have been proven real forward looking and accomplished rocket pioneers, but so we came now or I came now belated in '34 and could demonstrate it, the Aggregat.

NEUFELD: Okay, the rocket assembly. Okay.

RUDOLPH: So I asked for a new contract from Dornberger. That was, I did not want to work for the government. I wanted to be a free-wheeling inventor. But Dornberger said, nothing doing, you work for us. So despite my resistance, I was out of work, I had no other choice than to join.

NEUFELD: Okay, yes. There are a lot of specific questions I want to ask you about that. That's a very interesting story. To pin it down, it may be hard of course to remember exactly when things happened, but you don't know at all just when Pietsch first met

Dornberger, or how he heard that --because I know that Dornberger said in his memoirs and places that he had been looking, he had been scouting out the scene in Berlin and elsewhere. He'd been going to rocket experimenters and, you know, looking to make contracts and going to companies to make contracts. You don't know how you heard of or how Pietsch heard of Dornberger or first met him?

RUDOLPH: No. I don't remember that. I guess that in summer of '32, Pietsch just went to the Heereswaffenamt, among all the many other agencies he had tried to convince. I think this was definitely the summer of '32, because we started in summer of '32 and by fall we were building already. It couldn't have been later than August.

NEUFELD: Okay, so somewhere between May and August you finally got -- it probably was later than May because you only started in May when you met Pietsch again at the Arbeitsamt, so it had to be probably somewhere between June and August, 1932. Okay, and you got the contract at that time, by August you got the contract from the Heereswaffenamt, and you --how long was it that you worked with Pietsch? Because in this book I get the impression that it happened very quickly, that Pietsch took the money and then you never heard from him again, but now it seems that it lasted a year or more before he disappeared.

RUDOLPH: I think so. Let me think. In '32, I think, we were still together. In '33, began the difficulties with him, spending the money. And I'd say in about mid-'33, maybe even later, I had to go to the Heereswaffenamt, and then of course I didn't get the money right away either. I had to present to Dornberger and then he in turn presented that to a calculating office. I had to write down in detail what it would take and how long it would take to build finally the aggregat. And I'd say this was then, building and other things, on the order of a year. And then I know I demonstrated it in August of '34.

NEUFELD: And in August '34 when you demonstrated, you had been working alone for a year maybe? Is that--obviously it's hard to remember now exactly when it was. So it was some time, there was maybe a year between the time that you had to go tell the Heereswaffenamt that Pietsch had taken the money and disappeared or whatever. Do you ever know what happened to Pietsch? Did you ever see him again? He just disappeared?

RUDOLPH: No.

NEUFELD: You have no idea what happened to him. He never turned up.

RUDOLPH: No. But Dornberger told me once that Pietsch, after, that Pietsch threatened to sue Dornberger because Dornberger

wrote in that book about Pietsch and me. So Dornberger said, "Go ahead and do it." But of course Pietsch was in no position after he had squandered the money, to do anything.

NEUFELD: So that was probably in the 1950's or something after Dornberger's book came out, that he threatened to sue.

RUDOLPH: Ja.

NEUFELD: Okay, so he was still alive but you have no other knowledge --

RUDOLPH: He was still alive, yes.

NEUFELD: No other knowledge of what he was doing. Okay, so you tried to carry on then for those two years from mid-1932, summer of 1932 to summer of 1934, with him and then without him, building the engine. You were unemployed, so you were living on unemployment insurance?

RUDOLPH: Right.

NEUFELD: Did the SA give any small amount of money out? Did they have pay?

RUDOLPH: Oh no, the SA gave nothing, and from the party,also nothing. What I got was my just claim because I had paid into the unemployment fund the government had established. So I remember, I got seven marks and fifty pfennig per week.

NEUFELD: Which must have been very difficult.

RUDOLPH: It was very, very difficult.

NEUFELD: So that plus of course the money you got for the experiments, you were not using for food or rent or anything like that. The money that you got from Herreswaffenamt was just for experiments, equipment.

RUDOLPH: Yes, just for building the assembly,the aggregat.

NEUFELD: They didn't give you anything for salary or anything like that, for living expenses.

RUDOLPH: No, no. No. No, they were not interested in that side. Of course, it played an important role in the whole affair, but this I could not, for good reasons, consider. They made a contract with Pietsch, and how he lived or from what he lived, that did not interest them. That was strictly a contract, a contract to Pietsch to perform certain tasks.

NEUFELD: All right, Okay, because I'm not entirely clear on just

--obviously at that point the Heereswaffenamt had very little money and it was '32, '33, and they were only giving out contracts and they had set up a small group at the end of '32. Did you know much about that? I know of course it was either November or October 1932, Wernher von Braun went to Kummersdorf, I gather.

RUDOLPH: No, I think he --in '32?

NEUFELD: Yes. He says --see, since you were not there, I'm sure you don't know this, but there's a disagreement in the books, rather small. Some say that von Braun started on the 1st of November '32, some say the 1st of October, '32.

RUDOLPH: That I would not consider significant.

NEUFELD: Yes. It is a small fact. It's just trying to straighten out all the stories. Sometimes the stories disagree very much. So he started there with Riedel and --

RUDOLPH: Riedel wasn't there yet.

NEUFELD: He started a little later?

RUDOLPH: To my memory, he came in spring of '34. So von Braun worked for the Heereswaffenamt before Riedel came. And then, I remember also from talking to Riedel that the Heereswaffenamt, they say, Dornberger gave another contract in probably '32, end of '32 or '33, to Heylandt to perform certain tests, but not burning of engines, but just trying to establish the pressure distribution in the combustion chamber and along the nozzle, by just supplying air pressure, and let the air from the combustion chamber expand through the nozzle, and Riedel told me that he established along the nozzle checkpoints where he measured the pressure, and then could calculate the velocity, the exhaust velocity.

NEUFELD: Right, and expansion ratio of the nozzle and so forth. So that's probably how he came eventually to Kummersdorf, I suppose. First he had worked on a contract of Heylandt.

RUDOLPH: This contract was of course given to Heylandt.

NEUFELD: To the company.

RUDOLPH: To the company. Not to Riedel. Riedel did of course the work.

NEUFELD: I'm glad you told me that story, because it sort of clarifies how he became involved again, because obviously he had stopped for a while having any involvement at all in rockets, Riedel, between '31 and late '32 or '33, so do you know whether

there were any other contracts out? Of course you were not an employee as you said of the Heereswaffenamt until August '34, but before that time, do you know of anything else, have you heard of anything else going on?

RUDOLPH: I don't want to leave out other fellows trying to do some rocket work. That is very greatly in my mind. There was a fellow with the name of Winkler.

NEUFELD: Yes, right.

RUDOLPH: Who, maybe you know more about him, having read about him, than I remember. He wanted to build a rocket --well, I don't really know any more what he wanted to accomplish. I know also a fellow who later became an employee of Peenemünde who was the first one to volunteer to fly in a rocket. His name was Heinisch. Are you aware of him?

NEUFELD: I've heard of the name. I think he was a pilot, right?

RUDOLPH: Of his background I don't know anything.

NEUFELD: Yes, Klaus Riedel was still involved with Nebel for a year, in 1933, I think.

RUDOLPH: Well, as I mentioned in 1932, no, 1931, the Raketenflugplatz, that is Nebel, invited us Heylandt fellows to come and see rockets fly. It didn't work. Not a one flew. But this didn't mean-- "they did not do it"-- before. It was failure, failure, and that, was the theme of the day, not successes. And only through trial and trial and trial, finally did we in Britz and the fellows at Raketenflugplatz, solve the mystery of failures.
NEUFELD: Right.

RUDOLPH: There was nothing theoretical which we could use.

NEUFELD: Yes, it was all empirical basically.

RUDOLPH: All empirical.

NEUFELD: You had to make it up as you went along, you had to test, test, test. So you, let me think of what else I want to know here. All I knew is that there were a few contracts. I'm very glad you told me the story about Heylandt. I know that von Braun was also of course getting money to do his experiments that led to his doctoral dissertation at Berlin in 1934. In Huntsville I've seen a contract dated 1933 between him and Heereswaffenamt, with money to finance his experiments that were in the dissertation. At this point that's all I knew what Heereswaffenamt was doing, at this point, but they had their own little group there at Kummersdorf and von Braun was obviously

--mostly at that time, had been going back and forth, because he had to go to the university, as well as at Kummersdorf.

RUDOLPH: He was back and forth from Berlin to Kummersdorf.

NEUFELD: Yes. Would that continue to be true after 1934, after he finished the dissertation?

RUDOLPH: Oh yes. Oh yes. Oh yes. He spent most of the time in Kummersdorf. The exact issue I couldn't give you, but I knew he was very much interested in the test results. Even before we ran the test, he told me what we did to prepare the test, because here you could see whether his theories worked or did not work.

NEUFELD: Right. He always showed a great talent for trying to understand all the different problems.

RUDOLPH: Marvelous talent.

NEUFELD: Because I know that in the first interview that you made for the Franklin book, that you said that your first impression of von Braun when he was 1931 at Raketenflugplatz was that he was kind of flippant, you know, he was just a rather smart kid.

RUDOLPH: Yes.

NEUFELD: So when did you feel more friendly towards him? When did you have a higher opinion of him?

RUDOLPH: Well, after the demonstration at Kummersdorf.

NEUFELD: 1934.

RUDOLPH: Yes. He was very flippant in 1932. Maybe he didn't even mean to be. I got the impression that he was. But I sure got this impression. And then when I met him again, when I met him again, I must have been --when I went with Pietsch to Kummersdorf to look at a test stand there.

NEUFELD: Which was probably 1933 then.

RUDOLPH: Probably 1933, yes. I had an entirely different impression.

NEUFELD: That he was more professional now, more mature?

RUDOLPH: Yes. He was not a kid any more.

NEUFELD: Did he look older at this time? Of course he was still very young, he was only 20 or 21.

RUDOLPH: He looked older, yes.

NEUFELD: Yes. There are pictures available from the period 1931-32 at Raketenflugplatz. He does look very much like a student, a young student.

RUDOLPH: He did. Now, when I demonstrated my aggregat, he was very professional. And he was sure the thinker, the brain, in the Heereswaffenamt. No doubt about it.

NEUFELD: I don't know if I ever asked you, I don't know if the book really has anything about your impression of Dornberger when you first met him, or your first dealings with him in those contract years.

RUDOLPH: Well, Dornberger was a typical Prussian officer.

NEUFELD: What was good about that? Was there anything that bothered you about that?

RUDOLPH: Oh, he didn't bother me at all. He was outspoken, no beating around the bush. I could convince him that what I wanted to finish the work on the assembly. Not so his colleague (later General Zanssen). And maybe not even Dornberger completely, because he sent, when I now continued to work, I had begun with Pietsch, he sent Zanssen, who was also a captain and a friend of Dornberger, every week to this little workshop I had established in Berlin, to check the work, after the disaster with Pietsch.

NEUFELD: Right.

RUDOLPH: No wonder. And I remember that Zanssen would say, "Mr. Rudolph, do you really think this will work?" He was full of doubts. And I said, "You can be sure it will work." It worked.

NEUFELD: So you had the impression at that time that Zanssen was less open-minded about it?

RUDOLPH: Oh, I wouldn't say he was less open-minded. He was really truly doubtful that what I wanted to do would work. See, at that time Riedel had already been now for some time at Kummersdorf, and von Braun and he ran there their tests, and mostly failures, failures, failures. So no wonder Zanssen was doubtful that I, a little guy, could --

NEUFELD:--experimenting on the side, essentially --

RUDOLPH:-- could be successful. And remember right now that the design of the engines, the injection system was sort of a mixture of von Braun's, Riedel's and Oberth's ideas. I don't remember --

NEUFELD: --you mean, their injection system, not yours.

RUDOLPH: Hm?

NEUFELD: Do you mean their injection system, the von Braun group?

RUDOLPH: Yes, the von Braun group, the von Braun-Riedel group at Kummersdorf had designed a rocket motor, and the injection system in that rocket motor, which I saw later, had ideas of von Braun, of Riedel and of Oberth, mixed and combined.

NEUFELD: You saw that they had basically been an improvement of the Raketenflugplatz designs, probably.

RUDOLPH: Well, I don't really know. Anyway it has its strengths and disadvantages. Those were the order of the day. And then it was of course aluminum and magnesium, and magnesium burns easily.

NEUFELD: They were experimenting with light metal.

RUDOLPH: Yes. So you see, it was not far-fetched when Zanssen had great doubts that I would perform.

NEUFELD: Right. So that --

RUDOLPH: Dornberger? I had to give him my calculations and he in turn gave them to an office that checked it and approved it.

NEUFELD: This is on the contract, you're saying, still.

RUDOLPH: Hm?

NEUFELD: This is in the period when you're still working on contract.

RUDOLPH: Yes. You know, I think that Dornberger was an honest help, straightfoward. And that is it.

NEUFELD: But you describe him as well in the book as not being, in regards to connection with the Luftwaffe, that he was open-minded, he wasn't sort of a narrow Prussian officer that only wanted the army to do or only wanted to do it the old way or something like that.

RUDOLPH: Oh, well, you know, when that contact was established between the German army and the German Luftwaffe, I think it was not Dornberger who did that. I think that was Wernher von Braun.

NEUFELD: Yes. Now, I want to come back to that story, because that's an important story. I first want to get finally the last part here. So when you did the test in August, '34, and you gave the story in the book about how von Braun had been very considerate in terms of accepting the integral of the thrust over time, rather than the exact performance set down in the contract, and that you had fulfilled the contract. Was it immediately after that that Dornberger asked you to come over? Because I gather

there was a few months difference.

RUDOLPH: No, right away. Right away.

NEUFELD: Right away? But I think in the book you say you didn't really start until November or something like that?

RUDOLPH: Well, no, there of course, that was August. So he put a pistol to my head "You either work for us or you don't work at all." And so, I was out of work, so I tried to convince Dornberger the same day to give me another contract, but he didn't. He was insisting that I join the government. So I think I decided right then and there, to do that. Then I had to go through the security checks and so it took until December before I was hired.

NEUFELD: Okay. I'm really interested in why you felt that you did not want to work for the army at that point. Was it that you didn't have the freedom to do what you want?

RUDOLPH: Yes, this is --well, if you work for the government, you are also subject to all kinds of regulations. And I didn't want to be held in, I wanted to be free-wheeling, free-wheeling.

NEUFELD: You'd been living for two years that way.

RUDOLPH: And I liked it.

NEUFELD: Of course obviously this was already some time after the Nazi seizure of power, and the government was in. Obviously you didn't feel any hostility to the government or anything like that?

RUDOLPH: No.

NEUFELD: Or to the army as such.

RUDOLPH: No, no hostility. I only repeated, I didn't want to be subject to bureaucracy and regulations, which naturally go with a big governmental outfit, whatever it might be, whether in Germany or in the USA or elsewhere.

NEUFELD: Right. I know obviously there had been tension between the army and the SA, for example, things like that had nothing to do with the way you felt about these things.

RUDOLPH: Oh no, not at all. Not at all. In fact, I had to even leave the SA-Reserve when I was hired to go with the government.

NEUFELD: Right, they asked you to resign from it. Did you have to resign from the party or were you not a member of the NSDAP?

RUDOLPH: Oh yes, I was a member of the NSDAP. I'd been a member since 1931. And I gave you the reason why I became a member. The general depression rolled over Germany, and I had a colleague in the Heylandt plant who was at the financial end, and he had to--was involved with receiving and contracts and the financial aspects of it, and he predicted very bad times, and he was right. It proved later on that it came that way. So he told me, "Why don't you join the party, the NSDAP? Now we are not safe from the Communists if we don't strengthen the NSDAP. The Communists will take over, and will become the government," and I sure didn't want that. When People said "Heil Moscow" --then I preferred the "Heil Hitler." [At that time I could not foresee the disastrous events caused later by Hitler's government. (A. R. Nov. 17, 1991)]

NEUFELD: You saw Communist party KPD people a lot in Berlin, I suppose, because I know that that was a KPD stronghold.

RUDOLPH: Oh yes. There was street fighting. In certain quarters of Berlin you couldn't even go because it was Communist-controlled.

NEUFELD: Did you stay away from all of that at that time?

RUDOLPH: Oh yes. I was not involved in this fighting. I was happy with my work.

NEUFELD: Right. Okay, now, I'd sort of forgotten about this. Did you remember that in the Klee and Merk book which was published in Munich there's a picture of your motor, your 1934 motor.

RUDOLPH: That's right, that picture, here is the engine here is the fuel tank, the oxygen tank, pressure bottles.

NEUFELD: Okay, let me--since this is on tape, I have to clarify this. The left hand picture, this is Klee and Merk, the English translation, page 14. The left hand picture is of a rocket motor designed --

RUDOLPH: Von Braun and Riedel.

NEUFELD: This is a very early, very small model, I gather. It's hard to know exactly where that comes from. This says that it was ordered by the Heereswaffenamt in 1931. The right hand picture is of your 1934 motor which is the one that you were talking about in August, 1934.

RUDOLPH: Which I demonstrated in August 1934.

NEUFELD: Okay. So the injector design in it was essentially the one that you have made the drawing of?

RUDOLPH: It's exactly like that.

NEUFELD: Now with a cooling jacket. Okay. It says here as well that the combustion chamber was built inside the alcohol tank, so that was additional cooling to put the (crosstalk)

RUDOLPH: --in addition to cooling because when you started to burn the fuel, the fuel level in the tank would sink so it didn't cool any more.

NEUFELD: Okay, right.

RUDOLPH: So maybe it contributed a little bit, but this was the cooling jacket, and through there, the cooling.

NEUFELD: Why was it put inside the tank then?

RUDOLPH: Simply to make it cheaper, less costly, and anyway it was practical to do so. But cost was the main point.

NEUFELD: How did you save money on that? Because I guess I'm not clear. Obviously there are things I don't understand.

RUDOLPH: With the engine outside, you need it of course then a structure to take the thrust of the engine.

NEUFELD: Okay.

RUDOLPH: Then it would be longer. And maybe that would create difficulties in hanging it in the test tank.

NEUFELD: Right.

RUDOLPH: So that's a consideration later on.

NEUFELD: Okay, so that was why then you put it inside the tank for that purpose. I have to stop ...

TAPE 2, SIDE 1

NEUFELD: When we last left off, we'd just talked about this motor that you had built or finished in 1934 on a contract.

RUDOLPH: Right.

NEUFELD: And we talked about your coming into the Heereswaffenamt. And the nature of the motor and so forth. I had one question left over from this question of --about Dornberger asking you to come over to the Heereswaffenamt. Why do you think that he insisted so hard to make you come over as an employee?

RUDOLPH: Well, he wanted to strengthen his group at the

Herreswaffenamt, and there were only problems there and nobody else he could get who was inventive or creative, he wanted to have, and eliminate all the numerous unproductive free-wheeling characters. I was only one of them. There was, as I mentioned before, Winkler and several others. I don't recall their names.

NEUFELD: So you knew that there were other contracts that they had at that time.

RUDOLPH: No, I don't even know whether they had contracts. I only know that these people somehow worked on the rockets. They wanted to go into space.

NEUFELD: Yes. I think, there's a lot of stories but there's not much clear evidence exactly what happened. Some say that the army asked for a monopoly, from Hitler, over the rockets, and then they started forcing other people to stop working, or joining.

RUDOLPH: I don't think it came from Hitler. Hitler probably didn't even know about it. So it was self-interest on the part of Dornberger and his superiors, to create something entirely new.

NEUFELD: And probably he thought that the contracting didn't work as well as having everybody together as employees?

RUDOLPH: Yes, I think that was a form of his striving for himself. German research was to be concentrated in the government, independent of contractors, easily supervised, easily evaluated. You didn't have all the administrative work in dealing with the contractor and the frictions going along with it. That was all eliminated. So it became very effective. That was the goal of Dornberger.

NEUFELD: So you think that Dornberger had that -- I know from my working on this already that that was Dornberger's idea later on and that everyone came to agree with that philosophy of the big government laboratory, the big government installation to do these things. But you think that he thought that right from the beginning, that was his idea right from the beginning.

RUDOLPH: Yes.

NEUFELD: Do you have any knowledge of why he had that philosophy from the beginning? Was it problems of contractors? Was it the way army ordnance or Heereswaffenamt worked or?

RUDOLPH: Well, the army ordnance had of course its own arsenals. So Kummersdorf-Schiessplatz was one of these arsenals, where they fired rockets and did research, measuring of performance, but they were always dependent on a contractor who built the equipment, and the proving grounds,for instance the artillery rocket proving grounds Kummersdorf-Schiessplatz could only judge

the results, but not do any improvements themselves. That was always up to the contractor. And here was, as I mentioned, the long way of negotiations between government and contractor and the frictions which crept in, Dornberger believed were unnecessary obstacles and, therefore not wanted.

NEUFELD: So as you were able to observe at that time, there was a philosophy in army ordnance before this that when artillery or rifles or other equipment, that they had to buy it from a contractor and just test it. They didn't have, as far as you knew, a lot of in-house development of other kinds of weapons at that time.

RUDOLPH: I think that was it.

NEUFELD: So that the proving grounds like Kummersdorf were generally before this time testing weapons that were built on contract by armaments manufacturers and those kinds of people.

RUDOLPH: Yes.

NEUFELD: Okay. Dornberger seems to have early on concluded that he wanted to build up the team inside the army weapons department.

RUDOLPH: Right.

NEUFELD: That's more efficient and less conflict with contractors. Dr. Reisig says that Dornberger's concept was "Alles unter einem Dach"-- everything under one roof.

RUDOLPH: Right.

NEUFELD: Do you know when Dornberger might have said that, when the phrase came?

RUDOLPH: I have the impression that he had this idea right from the beginning. At the time he hired me, it was a strong indication already that his thinking was in that direction. That of course became very significant when Peenemünde was established.

NEUFELD: Right, so in building that new center, that was Dornberger's conception of how to build it, to build a big facility where most of the things are done inside the facility.

RUDOLPH: Now, the first contact between the army and the Luftwaffe was not done by Dornberger. Dornberger was at that time, as was routine, as I believe an officer at the artillery proving ground or something like that, in Saxony, and so Wernher von Braun was free-wheeling, and so we would discuss in our little corner in the Versuchsstelle West as it was called, our

corner, how small our place was, and if we wanted to build bigger rockets, then we could not do that in proving ground Kummersdorf any more, but had to find a better place, especially for test-flying them. We needed a range, distance, for that, and so von Braun and I would kick that around every so often. And one day he came back when he had visited his parents. He told me he had talked to his mother and his mother had suggested Peenemünde as a perfect place to establish such an undertaking.

NEUFELD: Right. Yes, the story is, I guess that's been repeated many times, but you remember this happening immediately after Christmas holidays, or do you even recall, I think von Braun says, it was at Christmas holidays that he saw his parents or something of the sort.

RUDOLPH: It could have been, but I don't remember the exact time.

NEUFELD: There are two stories, one, that he visited his mother's relatives in Anklam or up in that area, and another that he visited his parents, but at any rate, Okay, there's that all important story about the Luftwaffe and their involvement that comes in 1935, I guess. And you in this book here mention that, the way you remember it is that he went to the Luftwaffe or the air ministry, or the two of you went to the air ministry, while Dornberger was away. The problem is that von Braun's version is different. Maybe both are partly right. Von Braun in an article in the fifties wrote that the contact was started by Major von Richthofen in January, '35, that he came to Kummersdorf or something, so it started on his side.

RUDOLPH: Who?

NEUFELD: Major von Richthofen. He was a nephew or something of the Red Baron...

RUDOLPH: -- yes, yes.

NEUFELD: And he was head of the technical office of the Luftwaffe or something.

RUDOLPH: I'm not aware of that. But what I definitely know is that von Braun said, "Let's go and see the Reichsluftfahrtministerium, somebody in there," and we got there and we were received by a Ministerialrat or Ministerialdirektor, high official. Bäumker I think was his name. And von Braun in his usual manner made an excellent presentation to him. And before he even finished, Bäumker said, "Von Braun, I give you five million of Luftwaffe money so you can start the ball rolling." Then Von Braun started the ball rolling.

NEUFELD: And you were there. You were sitting in that room when he said that, so as far as you know, that was the first time that

large amounts of money from the Luftwaffe were mentioned. Because again that's unclear, and it's an important memory, because sometimes the records say that Richthofen suggested the money, something of the sort. But it's obvious that there are conflicting memories on this. You were there and you remember that, you remember that very distinctly?

RUDOLPH: Very distinctly.

NEUFELD: You also -- I guess you also describe the fact that you were both enthusiastic about the Luftwaffe at that point.

RUDOLPH: Very much so. Look, where else could you have gone in Germany and made a speech for half an hour, let's say, and got approval. That was new, entirely new, fantastic, unbureaucratic, fast moving, decisive, overwhelming. So no wonder von Braun and I were enthusiastic about Luftwaffe.

NEUFELD: Yes. That enthusiasm really started when you went to this meeting, is that right?

RUDOLPH: When I went to?

NEUFELD: When you went to this meeting at the air ministry. That's when you really became enthusiastic about the Luftwaffe, at this time, not before that time.

RUDOLPH: No, not before.

NEUFELD: Of course it scarcely existed at that time, did it. It was an office on paper almost setting up an organization, recreating an air force, I guess. There was no air force under the Treaty of Versailles.

RUDOLPH: No, no. No.

NEUFELD: Did you feel aggravated at all by army bureaucratic red tape and things like that?

RUDOLPH: Yes, I sure did. I sure did. And that happened after we moved to Peenemünde. And there we had first as a commanding general a fellow with the name of Schneider, and he was sure a bureaucrat.

NEUFELD: When was that, approximately?

RUDOLPH: That was in 1937, maybe, the beginning of 1938. He was of the old-fashioned type, old-fashioned army type. He did not believe in all these fancy ideas von Braun and I had. He said, "That will never be coming about, your fancy ideas. You risk government money." In fact, he accused me of wasting the government money, that I should be put, well, not in jail, but I

should be forbidden to do such a thing, the things I did. I ordered materials of all kinds, sheets of copper, sheets of aluminum and other materials I knew we would need if we would make fast progress. If we always waited until the design was ready, and then looked at a parts list and then ordered, and then before the material came in maybe would go by maybe half a year. That would mean we'd lose time. So I anticipated the probable demands and ordered that material before. Of course I could not always be right. You see, I was half the time right and half the time wrong. So half of the material, you could say, was not needed. But I provided in this way progress in a shorter time.

NEUFELD: So it wasn't around the very early days of Kummersdorf that you were really bothered by army bureaucracy?

RUDOLPH: Oh, ja, I was already bothered at that time in Kummersdorf. Example, when we needed and Dornberger had bought, let me call it a sheet metal building, a building built from sheet metal, which was bare inside when I came to Kummersdorf and which now had to be equipped with machinery, and I ordered the machinery through the ordnance office. No problems. But you had to have three offers or three selections and then pick one of them, the cheapest one, of course, and when I had to equip this one shop, we needed material, and here again a slow process of buying. If we had for instance too many pencils and you were allowed only five instead of ten, then five were taken. And repair material, we had to buy, no, not to buy, to order through the buying office of the artillery proving ground.

NEUFELD: Right.

RUDOLPH: And so you see, I needed half an inch bolts, of some length, then you would write out a requirement, which was well established, and then send somebody to the store room of the proving ground and get them there. Now, this took mostly half a day if not more. I was wondering why it took so long. I needed these bolts in half an hour, not half a day. So I found out that there was a big book, maybe ten centimeters thick, and on page 1 was listed about half inch bolts. Now, when the page was full, it would say "go to page so and so," so maybe page 50 was the next one, and then on page 50 if it was full, "go to page 75" and so on, and before they found out whether they had them in store or not, it took already an endless time, and then maybe there were not any more there. So then you waited, because they had to order them, and that took time because of the three bids they had to have for purchasing them. Then when the stuff finally came and had to be sorted and put into the bins already, there was endless time gone. It was frustrating, and very bureaucratic, inefficient. So I changed that system for our little proving ground. I installed a card system, where there was not a big book any more, but for these say half-inch bolts, one card, for three-quarter inch bolts, another card, and so on, and then we

had a very efficient girl from one of the villages nearby. She was really sharp and she was very very thorough, so she would write in beautiful handwriting "three-quarter inch bolts, so many" and every time bolts were taken out of the bins in the shop she would get notified and took them off, so there was a card in her file and card in the shop where the stuff was stored. And since it was only a few steps, it was easy to bring up to date all the time. And then every year, there came a general from the Heereswaffenamt, and checked whether this bookkeeping with the big book in the proving ground was being kept orderly. So he was also of the old-fashioned type and sticking to these books. And when he came to our little proving ground Versuchsstelle West and saw my new file, he almost fell out of his shoes. I don't remember any more exactly how it all happened but anyway he complained bitterly to Dornberger that I had introduced this new-fangled stuff and he didn't like it and wanted it removed and going back to the old thick books and all the difficulties being associated with them. I told Dornberger, I won't do it, I stick to the new stuff, and what will you say, Dornberger. He said, "You are right, go ahead," and he straightened that all out with that "Feind No. 1," ["enemy No. 1"] we called this guy, the inspector general from the Heereswaffenamt.

NEUFELD: Do you know who it was any more?

RUDOLPH: No, I don't remember his name any more. But the whole thing is significant. After I left Kummersdorf and went to Peenemünde, we were faced of course with the same issue. A card index or a book. And I started right away, with a card index, and then I learned later that this general had no objections, quite contrary, he introduced in all the arsenals of the Heereswaffenamt my card index system.

NEUFELD: Really. I guess that shows that management was one of the things that you were good at from the beginning.

RUDOLPH: I think this is really my strong side, managing. I thought I was a top notch designer, and even in engineering school, I came out on top of all the designs of my colleagues, and so I fancied myself a top notch designer. But I never could carry this out although I wanted it, because designers you could find by the dozens, but if you needed somebody who saw a system and all the involvements, as I just illustrated in these little examples, hardly anybody thought of it. So this way I got into management, when I didn't really wanted it. I wanted to be an engineer. But I was very happy to become a managing engineer or an engineering manager.

NEUFELD: Right.

RUDOLPH: Out of necessity.

NEUFELD: Yes. There are some things I want to come back to, but I want to follow that line because it's something I wanted to ask, namely, it's not clear from what exists in this book and elsewhere what exactly you were doing after you did the motor on contract and then came over to Heereswaffenamt. Obviously at the beginning I guess there were so few people, you were doing a little of everything. Rocket engine design or were you involved in administration?

RUDOLPH: Where are we now?

NEUFELD: Okay, 1935, end of '34 that you came --late '34 you came to Kummersdorf, and in that period, '34, '35, '36, '37, say before you go to Peenemünde, where you were involved in all kinds of things.

RUDOLPH: I was involved in designing. I was involved in running the operations. Not in running the tests. I did run some tests too, but mainly this was Riedel. He wanted to keep that in his control. And then I was involved in organizing the operations at the proving ground, and then very soon after von Braun took me to the Luftfahrtministerium to Bäumker, of course we had to think now of Peenemünde. And so I started already thinking about how we would equip Peenemünde, and so I sat down and ordered machinery.

NEUFELD: That was 1936?

RUDOLPH: About that time. Then I sat down with a fellow with the name of Müller, Johannes Müller. He was, by request of Wernher von Braun, loaned by the Heeresbauamt, the office of building of the army, was loaned to us, to von Braun, let's say, and so we made little sketches and then he would make bigger ones out of it, and then drawings, so that was the basis for laying out the development plan of Peenemünde or Peenemünde East.

NEUFELD: Right, not Peenemünde West, the Luftwaffe.

RUDOLPH: Because in the course of time, because of this General Schneider being such a stumbling stone, he created all kinds of problems for the air force. The air force of course was --let me tell you a little joke. There was the saying in Germany, and I think as I told Franklin too, the Kaiser's Navy, the Prussian Army, and Hitler's Luftwaffe.

NEUFELD: And there's truth to that, too.

RUDOLPH: Yes. Of course the Luftwaffe was really free of bureaucracy. And therefore, this General Schneider was a thorn in their side, and that finally led to his dismissal. He was a strange fellow. He would call me and tell me, "Rudolph, you ought to be put in jail. You're wasting the government's money, the Steuergelder."

NEUFELD: He was in the army ordnance Heereswaffenamt in Berlin? Is that where he was?

RUDOLPH: He was really a general of the Pioneers. I think he was.

NEUFELD: Yes, the corps of engineers.

RUDOLPH: The corps of engineers. So he was familiar with building bridges. So that was his line. But he was old fashioned, good grief, was he old fashioned! I mentioned before, he did not believe what we had in mind would ever work. He thought it was all fantasterie.

NEUFELD: So his role was then, he was auditing the books or looking at the system of administration every year?

RUDOLPH: He was not only doing that. He was also involved in hiring of people. We were now on the Baltic Sea, in an entirely non-industrial area. Now, how could we get people to this non-industrial area if we did not offer them better pay?

NEUFELD: Right.

RUDOLPH: But he was against that. He was against that. He wanted it in the old army way and of course this didn't get us anywhere. So Dornberger could establish that we got better pay, and then we advertised in the newspapers for the new location without naming the name, of course, it was all secret.

NEUFELD: Right.

RUDOLPH: And so we got people. But he had a book, a book like the book where the bolts were listed in, that he had from every person a photo and a sketchy description of the person.

NEUFELD: So he was trying to keep track of hiring of personnel but he was making it difficult.

RUDOLPH: He kept track of personnel. He kept track of everything, he tried to, with more or less success. But was a stumbling block, a hindrance.

NEUFELD: As far as you remember, his job was not within the army weapons office then. He must have worked for some other organization.

RUDOLPH: He was sent from this other army office, outfit, army outfit, to Peenemünde, for what reason I don't know. I was always surprised and amazed that a guy like him was put in such a charge, not only for the army side but also for the air force side. This was all under the one hat, Schneider.

NEUFELD: Okay, so the central office or whatever which coordinated --

RUDOLPH: --administration --

NEUFELD: --the construction contract was given to --as has been said many times --was given to the Luftwaffe, the actual buildings at Peenemünde.

RUDOLPH: Yes.

NEUFELD: Because you liked those much better or you liked their way of doing things much better.

RUDOLPH: A difference like day and night. When I ordered this machinery, let me think for a moment, at that time then Peenemünde was established and there was still the army and air force together under Schneider. I got to know, and how this came about I don't know any more, but I got to know the Beschaffungsamt of the air force.

NEUFELD: How would you translate that, acquisition?

RUDOLPH: Acquisition or --

NEUFELD: -- purchasing office?

RUDOLPH: Purchasing office, acquisition office, which was huge. And when I went there and showed them the catalogues, I wanted the machine tools to select from, and I had done already quite a bit, I was advised, "All this stuff, really, they are not too good, we buy only the first class stuff, nothing else." So I was quite surprised again by the Luftwaffe, and they did that beautifully, marvelously, fast, without bureaucracy. I would write out a requirement and send it. I don't know whether it went through Dornberger's office or not. I'm not sure, I never found out. Then it got in their hands, and there appeared everything perfect. Also for the cranes, the huge cranes we needed. They had the most marvelous attitude. If I wondered whether I should have only one crane hook or two, they'd say, "Take two, you might need it." See?

NEUFELD: These are cranes used for construction or for the test stands?

RUDOLPH: For the building of the rockets, V -2.

NEUFELD: Okay, inside the buildings, Okay.

RUDOLPH: Inside the buildings.

NEUFELD: Okay. So the Luftwaffe constructed Peenemünde, at least

up to '39 or so, I think it was, but they were under for a while this joint office that Schneider was at. And Schneider gave the Luftwaffe problems as well with his bureaucracy?

RUDOLPH: I think so. I didn't of course experience that, but I can very well imagine, that he got all upset about him with his wanting to know everything, when he didn't understand a darned thing about it. I didn't experience it however myself. So he had a bunch of bureaucrats who reported directly to him, and there was one, he wanted me to bring my bicycle personally to him for his inspection, and I declined to do that. I sent a helper to present the bicycle to him. That was another bit of bureaucracy. And he complained bitterly about me. Schneider in this case did not agree with him, because he saw that I was busy and didn't have time to spend an hour or two to present a darned bicycle.

NEUFELD: Right.

RUDOLPH: Then later on he told Dornberger,as Dornberger told me himself that he said that Rudolph was the only guy who worked hard on the special "playing". Now, what he considered playing was also work. He didn't understand a darned thing about it. What I did, he saw the results, so on the one hand he acknowledged that I was working hard establishing the machinery, not the buildings, the machinery and so on. On the other hand however he also blamed me for wasting the taxpayers' money by having too much material. I admit, half of it was probably useful and half of it not. But in order to save time, it was worth even spending that money.

NEUFELD: Right. It would have slowed everything down if you'd followed strict red tape procedure for everything. So, I know both you and von Braun and I presume many others, there weren't many others, but, were more enthusiastic about the Luftwaffe than the army in those days.

RUDOLPH: Yes.

NEUFELD: Did you at any time say or think, I wish the whole organization could go over to the Luftwaffe?

RUDOLPH: No. No, because I knew that Dornberger, who was not Lufwaffe but army, was also the type who was thinking along the lines of Luftwaffe.

NEUFELD: So did Dornberger protect you a lot from bureaucratic interference?

RUDOLPH: Yes, he did. And he of course also saw that Schneider was impossible, and therefore also worked towards his transfer.

NEUFELD: Okay. I had meant to ask you about Zanssen, just because

you had mentioned him without my jogging your memory, that he had been the one who had come to you and looked into your contract work before. Was Zanssen there with Dornberger or involved with Dornberger all through that period of time?

RUDOLPH: No, but as I mentioned before, the two were friends. How their friendship was established, I don't know. Dornberger would always see that Zanssen was involved in the work which was done. And Zanssen was a very critical observer. Much more critical than Dornberger. So at Peenemünde, after Schneider left, Zanssen --

NEUFELD:-- came --

RUDOLPH: --was put in charge, but only of the army side. The air force was separated. Very bad.

NEUFELD: The organizations were split about when? Was that '37, '38?

RUDOLPH: '37, '38, I don't remember any more. It was certainly '38.

NEUFELD: So Zanssen by and large was not involved in Kummersdorf. You saw him occasionally? Did he work there?

RUDOLPH: He was also involved in Kummersdorf, and Dornberger of course too. But since Dornberger was now at a certain time at the assignment as artillery officer in Saxony, Zanssen took over. But somehow von Braun managed to go around Zanssen, to the Luftfahrtministerium. He should have asked Zanssen. He didn't. He just went to it.

NEUFELD: So Zanssen was actually then the military commander --so he was there almost the whole time.

RUDOLPH: And so when Schneider was fired, Zanssen was established in Peennemünde as the commander, but for the army side only.

NEUFELD: I want to get back to that. There's another question, and this was one that Frank Winter raised. There was also a Major von Horstig.

RUDOLPH: Oh ja.

NEUFELD: Who seems to be involved in the early years and then disappeared.

RUDOLPH: In the very early years. In fact, I think even before I knew Dornberger, I knew Horstig. And Horstig was also a "von".

NEUFELD: Von Horstig.

RUDOLPH: Von Horstig, Ritter von Horstig, and Wernher von Braun was a von.

RUDOLPH: Yes, and so I think he helped von Braun getting established. Von Horstig was his protector.

NEUFELD: Really, so he played a significant role--he was Dornberger's superior officer in the early years, is that right?

RUDOLPH: Yes.

NEUFELD: And of course Becker was above them.

RUDOLPH: One interesting story about Becker and Dornberger and von Braun. When we were at the little proving ground Versuchsstelle West, Kummersdorf Schiessplatz, one day Becker was announced to come to visit us, and it was in the Prussian army, the youngest most new fellow talked first, and the most senior last, so the little guy was not influenced by what the big guy was saying. Good method. So since I was the most junior, I had to talk first, and I told Becker how we would build at that time the building of the A-3, that was going on in Kummersdorf, which were later on launched at the Oie Greifswalder Oie, an island in the Baltic Sea. So I told him about that and showed him the tools and what further on we would be doing, and what was also probably necessary for the next bigger rocket. He listened. He had no questions. And then Riedel made his presentation, and Riedel talked of course about the A-4, the next big step, from 1500 kilogram thrust to 25,000 kilogram thrust, and Becker also had no questions. And up came von Braun, and von Braun didn't even bother to talk about A-3 or A-4. He talked about going to the moon, and so for an hour or so a most interesting back and forth went on. Becker didn't get angry, because this lousy civilian talked about space and he was an officer and professor and doctor engineer, professor at the technical university, Technische Hochschule Charlottenburg. And so most interesting, this discussion, von Braun trying to convince Becker that it was possible to fly to the moon, based on Oberth's ideas. And Becker, who had written together with a fellow with the name of Cranz, another doctor engineer, a book about ballistics which meant artillery flights, shooting, and so he argued against von Braun, that von Braun would not be able to harness, to put it in simple terms, the energy necessary to fly to the moon or to the Planetenräume. So finally I guess they didn't discuss it any further. But Becker then approved the work of the A-4.

TAPE 2, SIDE 2

NEUFELD: So this meeting with Becker was probably 1936, would you say at Kummersdorf?

RUDOLPH: Let me think for a moment. No, I think it was in '35.

NEUFELD: As early as that?

RUDOLPH: I'm not sure of it, but in '36 we were already involved in planning Peenemünde, so it must have been '35.

NEUFELD: The reason why I'm guessing it's '36 is that the actual plan for the A-4 was drawn up, according to Dornberger, in March '36. Now of course maybe the idea was already out there.

RUDOLPH: Yes.

NEUFELD: The actual sort of planning has been dated anyway March, '36. So was it after that time? Or was the idea already being--

RUDOLPH: I think it was before this was put in writing or in drawing. It was to my mind before.

NEUFELD: Because I guess there was also at some point Fritsch, commander-in-chief, is supposed to have come to Kummersdorf in 1936 and looked at the plans or talked to them or something.

RUDOLPH: I don't remember Fritsch. I don't remember at all now. I was always involved with the building of the rockets, with getting material, with getting the necessary personnel for the workshops, to keep the stores filled and the test stand operational. So in the big philosophical or conceptual questions I could not get involved.

NEUFELD: You were sort of really out of design by and large.

RUDOLPH: I was not in design any more.

NEUFELD: So in some ways, it sounds like your position was almost chief manager, chief administrator of the civilian employees, as opposed to the military officers.

RUDOLPH: Yes.

NEUFELD: You had sort of risen into the position of being the central management person? The organizer?

RUDOLPH: Yes.

NEUFELD: Supply person in terms of ordering materials and machines and so forth.

RUDOLPH: Yes, so I was manager, really the manager.

NEUFELD: You reported directly to von Braun as your next immediate superior at that time? And von Braun was more involved --we're talking the Kummersdorf era 1935-36-37, into '37. He was sort of the one who coordinated everything at the top, design.

RUDOLPH: Yes.

NEUFELD: The management or supply or organizational things, so he would have his hands in everything to some extent?

RUDOLPH: Yes. He relied on me very heavily in organizing or managing, in everyday things, also the future things to come. For instance, when this architect engineer from the Heeresbauamt, the building office of the army, came, we would sit together and discuss it, and he would have the final say. He would maybe not agree on some points with my thinking, and put his own stamp on it. But all in all he left me a very free hand, very free. I can in fact not think of any instance where he told me point-blank, "You change that."

NEUFELD: Because he agreed with the way you were doing things, he thought you were doing it right.

RUDOLPH: Yes.

NEUFELD: In the organizational structure at that time, do you think that, were you on roughly the same level as any other persons, or were you more or less his second in command and everybody, if there was an organizational chart, and there is no chart for that period.

RUDOLPH: I would say, it was von Braun, and under von Braun there were Riedel and myself. That was in brief terms, it.

NEUFELD: This is Walter Riedel, right.

RUDOLPH: Yes.

NEUFELD: Walter Riedel I or Papa Riedel. So he was primarily involved in design of A-3, A-2 and A-4?

RUDOLPH: The A-3 had been designed, as far as they could think of building it, and I was in charge of having it built. So Riedel designed it, Rudolph built it, von Braun listened to the two of us, and if we had any disagreements, he would resolve them.

NEUFELD: So as far as the testing of the motor or A-3 was concerned, and the construction of that, by and large you were responsible for supplying the test stands with materials, keeping them going, and he was responsible for the actual testing of the motor?

RUDOLPH: It was not that sharply divided, so I did some tests too, not as often as Riedel, but I would run them too.

NEUFELD: Thiel did not come at that point?

RUDOLPH: No, Thiel was not in existence. Well, he was in existence, but not with regard to the development of the A-4 motor.

NEUFELD: He came in '37?

RUDOLPH: No, he came earlier. I remember that von Braun introduced us, Thiel and myself, and Thiel I don't exactly know any more. You see, there had been an accident before I got to Kummersdorf, and there was an engineer by the name of Wahmke -- and he operated with hydrogen peroxide and I forget now what else, and there was a terrific explosion, and the test stand was destroyed, Wahmke and I think another fellow died. Now, this was, you might say, the parallel to what von Braun did.

NEUFELD: I think there's something about Wahmke on this page. It mentions him here on this page from the Klee and Merk book, something about Wahmke was killed and two others were killed or something of the sort. That was 1934 I guess. Do you want me to read it?

RUDOLPH: I can read it. A little about Wahmke but this is in essence it. I don't think so, this was an Heylandt engine which was tested.

NEUFELD: This is, we're referring here to Klee and Merk, I think it's page 13, right. 12 in the English edition.

RUDOLPH: I think Wahmke designed his own motor. And then Thiel I think was hired not by Dornberger but Thiel belonged to another branch of the ordnance research department. I try to remember the name of that person over him. He was not a general but in an equivalent position to a general. He was a Ministerialdirigent.

NEUFELD: Even at that time.

RUDOLPH: Even at that time, so he was above a Ministerialrat Schuhmacher I think was his name, or Schumann. And he reported of course I think directly to Becker.

NEUFELD: Okay.

RUDOLPH: And he had placed Thiel in a position in the ordnance department research with experimenting at Kummersdorf, and so therefore von Braun introduced us. But then when we moved to Peenemünde, Dornberger made a wise decision. He decided that Thiel should continue the development of the rocket engine, and that was his only, only, only purpose--to make that darned engine work.

NEUFELD: To build up to the 25 ton thrust A-4 motor.

RUDOLPH: Right. And von Braun was overflowing with ideas. He had so many ideas, he hardly finished one, he came out with another one and on top of that another one and another one. So Dornberger would say, "You have too many ideas. I don't need that many. I want this one and that one and that one, so stick to it, fellow." And he was hard to control, Wernher von Braun.

NEUFELD: Did that change later or was he always--?

RUDOLPH: I think he had always some difficulty with him, only not as much as in the beginning, to keep him on a single track. And since he knew that, he gave Thiel the order, "You develop the engine and not von Braun."

NEUFELD: Yes.

RUDOLPH: And not von Braun.

NEUFELD: Because in fact I've found a number of documents, even in the United States, that date from the Thiel era and Kummersdorf, so he stayed with his own group, but I wasn't quite sure when the division was made, between you know--Riedel therefore had been heavily involved in engine testing and engine design before that, before the rest of you went to Peenemünde in 1937, and then it was all Thiel after that time essentially or mostly Thiel and his group. Okay. I wanted to backtrack with one or two questions, because there are always things that interest me that I don't want to lose before we move on. One was that Frank asked me why was von Horstig dismissed, why did he leave the rocket development business? Do you remember when or anything about it?

RUDOLPH: I don't remember at all. He might have reached retirement age.

NEUFELD: Was he that old at that time?

RUDOLPH: Well, I can't really tell you. I met him only very briefly.

NEUFELD: When you met him was he in his fifties, sixties?

RUDOLPH: I can't tell you.

NEUFELD: But he wasn't a young man?

RUDOLPH: He was not a young man. No. Since he was the superior of Dornberger who was in his thirties in 1935, maybe 30, I don't really know, he was certainly in his forties. I guess -- poor guess.

NEUFELD: Okay. He just disappeared as far as you were concerned,

you didn't see much of him.

RUDOLPH: I didn't experience him any more.

NEUFELD: Was he a presence at all in Kummersdorf in the early days when you came?

RUDOLPH: No.

NEUFELD: He wasn't really there.

RUDOLPH: I think I met him in the ordnance department.

NEUFELD: Back in '32, '33, somewhere in there?

RUDOLPH: '34, '35 time.

NEUFELD: But he was based in Berlin.

RUDOLPH: Yes.

NEUFELD: At Heereswaffenamt headquarters, offices.

RUDOLPH: I don't remember ever seeing him at Kummersdorf.

NEUFELD: Okay.

RUDOLPH: He might have come with General Becker on that occasion, more likely.

NEUFELD: Because from all the books that have been written about this, he plays a significant role in the early period and then he just sort of disappears, and we're not clear on what happened to him, whether he retired, was transferred, or what happened. Another thing that came out, a very interesting comment you made about the aristocratic advantage that von Braun had. There were two or three different questions that come out of that. One is, do you think that von Braun's aristocratic origins as a Freiherr, in some ways he really was from the Junkertum, in Silesia and so forth, that helped him with many officers or just von Horstig in particular?

RUDOLPH: No, I think it helped him with many others.

NEUFELD: I'm really interested in that because that was my guess. I have actually said that to people, that this must have helped, knowing German history and the role of the Prussian aristocracy in the army. Von Braun was so young then, incredibly young.

RUDOLPH: Incredibly young, yes, but since he was an aristocrat, and his father was minister of agriculture in the government --

NEUFELD: Yes, Papen and Schleicher governments --

RUDOLPH: So that helped too, to my mind.

NEUFELD: Yes, so that he had the kind of social position to overcome being so young and inexperienced. That helped him.

RUDOLPH: And then he had the knack for a winning personality, a really winning personality.

NEUFELD: Very charming.

RUDOLPH: He was not arrogant or stuck-up, but --well, as an average fellow, he behaved as an average fellow, and therefore he was very much liked. And then he had also a fantastic talent to present complicated interrelationships in very simple terms. That was really fantastic, he did that, really fantastic.

NEUFELD: A talent which of course he also used in writing popular things about space flight. He would explain well what he was doing.

RUDOLPH: See, when he and I were not married and we were living at Kummersdorf proving ground, he was living in a casino apartment room and I too. Now, when our work day was over, we would sit together in the casino.

NEUFELD: Which is the officers' club?

RUDOLPH: The officers' club, right, and we would talk rapidly, talk rapidly, rapidly, rapidly, and so we would sit until midnight or mostly into the morning hours and von Braun would spin his thoughts, his fantastic thoughts of going to the moon, going to Mars, going into it the All.

NEUFELD: Into space.

RUDOLPH: Into space. And I would work with logarithm table and slide rule. He developed his formulas. And we were so fascinated by it that we suddenly noticed, good grief, it is 4 o'clock in the morning! We have to go to bed. Now, of course, we were dead tired in the morning, and von Braun was not a one who woke up easily in the morning. He had a hell of a time getting up. So was I. So we harmonized beautifully. We didn't fall into bed, and didn't fall out of bed in the morning, so we were usually late going to Versuchsstelle West. But these fellows all knew we had worked half the night, and so no complaints, not a single word.

NEUFELD: Again that sort of shows the fact that Zanssen and Dornberger and others were openminded enough to say "let them work the way they want to work."

RUDOLPH: Right. But this guy Schneider, he wanted to be there at 7 o'clock or 8 o'clock in the morning, and 5 o'clock, close the door, lock it, go home. A striking difference.

NEUFELD: Yes. Punktlichkeit. He wanted it to be precise. So when you stayed up late, this was --I think your wife said you got married in '35. So this was mostly before that time that you could do that.

RUDOLPH: Yes, entirely before that time.

NEUFELD: What was the date of your marriage?

RUDOLPH: It was the 3rd of October '35.

NEUFELD: That's exactly seven years before the first successful launch, which was also the 3rd of October.

RUDOLPH: Amazingly short time, what a short time that was.

NEUFELD: That was a short time.

RUDOLPH: From practically nothing. Now, von Braun's ideas he published in 1954, or '55, in Colliers Magazine .

NEUFELD: Even before that though he wrote a German book called DAS MARSPROJEKT. About '52, something like that.

RUDOLPH: Yes, I've heard of that, but I have not read it. Or only partially. But this is what we talked about in this officers' club at all hours, what he had published in Colliers Magazine.

NEUFELD: So basically, those ideas you had about the form of a Mars expedition, the calculations for the trajectory, propulsion, weight, those kinds of things, those were all done in the thirties.

RUDOLPH: Right.

NEUFELD: That would have been basically then in the year between late '34 when you came to late '35 when you got married and moved with your wife to a house or apartment around Kummersdorf?

RUDOLPH: '35, not in '34. We didn't start that early, because I was too new, and only during the course of the year, '35, we became close friends.

NEUFELD: Related to that, so although he was obviously a Freiherr on paper, he had absolutely no pretensions, in his friendship with you or anyone else, he never carried the title very consciously.

RUDOLPH: No.

NEUFELD: He didn't even use the title, did he?

RUDOLPH: No. At some points Riedel would call him Braun. Never von Braun. And Riedel had of course the practical experience from Heylandt and von Braun didn't have any usable practical experience except the Reinickendorf Raketenflugplatz, which was not very much. And so Riedel felt most superior to von Braun.

NEUFELD: Too much so?

RUDOLPH: Too much so. He let von Braun feel that. And that, I didn't find it right, because I recognized of course the brilliance of von Braun. And Riedel sort of didn't get used to it, and so Riedel, unfortunately he would always strive to be the deputy of von Braun even in Peenemünde.

NEUFELD: And how did that work in terms of conflicts between--I mean, did that --von Braun, did he handle that quite well?

RUDOLPH: Yes, I think he handled it quite well. And he would even say, "Now, look at Arthur, see, he works with doctor engineers, and he's not an Akademischer himself but he works with doctor engineers and Diplom-Ingenieurs, and he has not the slightest hesitation to do so. And you, Walter, for heaven's sake, you fight everyone who has an academic title." So did Riedel, unfortunately. As I say, he was a top notch designer, fantastic designer, but he did not overcome that barrier that he felt inferior to academicians. And that was his big, big, big mistake. You could not even address him with that. He would get wrath in response, cursing.

NEUFELD: You could not address him how, that made him angry?

RUDOLPH: Say, "Riedel, be reasonable. This guy knows so much we don't know, we can learn from him and use it to your own advantage, our and your advantage and in furthering the role of the team." You could not talk to him.

NEUFELD: So he had difficulties later? This is getting us way off the chronology, but he had difficulties later on as a result of it, conflicts?

RUDOLPH: Sure. He resisted the hiring of Diplom-Ingenieurs, doctor engineers, for heaven's sake --

NEUFELD: --even worse.

RUDOLPH: Even worse. While I didn't hesitate to do so. I acknowledged their capabilities, their advantages they had because of education, going to Technische Hochschulen or

universities, which I unfortunately did not have, but I recognized the difference and hired them. And Walter Riedel, he did not and did not, and von Braun urged him to do so. To repeat, he said, "Look at Arthur, he does so, why don't you?" No. No.

NEUFELD: Would that mean that at some point later on he was pushed to the side a little bit?

RUDOLPH: Well, he was, in fact he was taken off his position, and Riedel III took his place.

NEUFELD: The other Walter Riedel.

RUDOLPH: Yes, the other Walter Riedel.

NEUFELD: So here we're talking when, 1941, '42, somewhere in there?

RUDOLPH: Yes. '41, '42, that time.

NEUFELD: You know so much, I'm fascinated. We're still struggling to get out of the mid-1930's on the chronology. We're still in Kummersdorf almost. I'm trying to think--you know, I had another question from that era that I never asked. ...That was, you came not long before the launching of the A-2's, Max and Moritz, right?

RUDOLPH: Yes.

NEUFELD: Did you go to Borkum and participate in that?

RUDOLPH: Yes.

NEUFELD: You really didn't have time to have much of an involvement in that development.

RUDOLPH: I was hardly involved in it. I only had to see to the transport of the liquid oxygen by a truck went there in time, so I rode a truck from Berlin to Kummersdorf and Borkum, and across the channel, and got it unloaded and available. And then of course I saw the two go off very well the two A-2s.

NEUFELD: I never looked up Borkum on the map. Is it East Frisia?

RUDOLPH: In the so-called Ostfriesland. It is the most westerly on the border of Holland.

NEUFELD: Right on the border of Holland almost. But I guess the rockets didn't matter that you were near the border, for secrecy reasons.

RUDOLPH: We fired them straight up anyway, no trajectory.

NEUFELD: Right. And that motor that was in the A-2 was a motor that derived from von Braun and Riedel and Oberth I assume, in the A-2.

RUDOLPH: In the A-1 and the A-2. And then in the A-3 too, was Riedel and von Braun designs.

NEUFELD: That was basically then an evolutionary development of what they had done. Now, I know from your diagram regarding the motor that came out of your contract and so forth, that had sort of a history going back to Valier, that you say it was used in the rocket aircraft experiments.

RUDOLPH: Yes. When we, in 1934, no, 1935, von Braun had good contacts with Heinkel, the aircraft designer and owner of an aircraft factory, and I remember flying with him in his plane to Rostock where the company was located, and there maybe, I don't remember exactly any more, he made an agreement that Heinkel would send several of his employees, engineers and workmen, to Kummersdorf, so we could build an engine to prove that an airplane could be driven by a rocket engine. And Heinkel provided it for us. I remember the name of Künzel, and the other one I don't remember, but he was also an aristocrat from so and so. ...Also a fellow by the name of Haukohl who also went later on to USA and he's still living in Huntsville, and another one who is living in Hamburg. He got in touch with me last year and wanted to see me, and I want to see him too but we never got around to doing it.

NEUFELD: Right. These are all people who worked for Heinkel?

RUDOLPH: Worked for Heinkel, but were sent to Kummersdorf, and we used these fellows to design the engine. Künzel or the other fellow, the aristocrat, used my design and made it so that it could be variable thrust.

NEUFELD: What was the thrust of that engine, do you remember?

RUDOLPH: I think it was 100 or 200 kilogram. I don't remember any more.

NEUFELD: Was that the engine that was installed in the Heinkel 1, 2?

RUDOLPH: 176.

NEUFELD: Maybe I'm not clear on this. There was the 112, which was the propeller aircraft that had the rocket assist. That's what I've seen. I even saw it in a movie the other night. And then there was the 176 was a rocket-only plane?

RUDOLPH: No, it had a propeller. So Warsitz was the flight

captain, the pilot. He used the propeller to start it. When he was at the necessary level, he would ignite the rocket engine, and throttle it, it had variable thrust, and make his test runs--what was the proving ground of the Luftwaffe?

NEUFELD: These were before Peenemünde West, some of them anyway.

RUDOLPH: No, the flights themselves took place while we were already in Peenemünde. It must have been in '37.

NEUFELD: Early for Peenemünde.

RUDOLPH: And the captain was Warsitz.

NEUFELD: So you never flew a rocket aircraft with no other engine in it.

RUDOLPH: No.

NEUFELD: Okay. And this design then was the one that you had worked on before, that was incorporated into the aircraft. There was also another Luftwaffe-army joint project and that was the Starthilfe, assisted takeoff.

RUDOLPH: The Starthilfe was being built in Peenemünde in my workshops.

NEUFELD: That was all post-move that project existed.

RUDOLPH: Yes, started about in '37, we could say post-'37, because in '37 we got to Peenemünde, before we really got it in operation it was '38. And then Dornberger ordered me in '37, darn it, to build the pilot production plant.

NEUFELD: Right. That's a very important story that I want to explore in a lot of depth with you, so let me hold onto the pilot production story. I'm trying to see what the questions are that I haven't covered here, to make sure that we've covered everything that I want to cover.

RUDOLPH: Who is Winter?

NEUFELD: He's an historian at the Air and Space Museum.

RUDOLPH: A colleague of yours.

NEUFELD: Yes, he's a colleague of mine at the Air and Space. He's written a good book on the early rocket societies. Your involvement in A-3 was to assist in the design somewhat?

RUDOLPH: No, not in the design, in the construction.

NEUFELD: So the design was done under Riedel and you were involved in putting it together in '36 and '37.

RUDOLPH: Yes.

NEUFELD: And just in the construction workshops at Kummersdorf, it was put together.

RUDOLPH: Yes. Right.

NEUFELD: So as far as the engine design itself goes, you were not involved in A-3 engine design. I know one of the biggest problems was guidance, the whole story of your involvement with Kreiselgeraete.

RUDOLPH: Yes. Let me tell you a story there. So one day von Braun said, "Let's go see Firma Kreiselgeraete and von Boykow." So we went in his car. The door could not be closed. You had to either pull it with a string or hold it by hand. So we drove to Kreiselgeraete and there we met a very distinguished looking fellow with a cane, sehr gepflegter Herr, and von Braun and he started discussing the stabilization of the rocket A-3, and I still remember, Boykow, that was the name of the gentleman, put his pencil drawing figures over here and discussing things I didn't understand, and I am not sure whether von Braun understood either, but one thing was clear, von Braun wanted a stable platform in his next rocket which would insure that the thing flew at least straight up, and if possible on a trajectory. Well, Boykow of course had built huge, huge gyros, big as this room here, to stabilize the Geschützplatformen of Schiffen.

NEUFELD: The turrets of battleships and warships.

RUDOLPH: Yes. And we saw them in his plant, huge, huge gyros, not what we wanted. From these huge things, make them very very small, smaller than you can imagine. And of course Boykow realized what he was confronted with, and told von Braun he would do his best. By the way, he was also a theater performer, an artist.

NEUFELD: Really? I never heard that.

RUDOLPH: Well, ja.

NEUFELD: So he had a dramatic style, did he? (crosstalk)

RUDOLPH:... He was most unusual, but likeable. Likeable. Not at all elegant.

NEUFELD: I heard he was an Austrian?

RUDOLPH: He was an Austrian.

NEUFELD: But he had been in the Habsburg navy or something, the Austrian navy?

RUDOLPH: That could very well be. I don't know that.

NEUFELD: I've seen that written. I don't know much more about him.

RUDOLPH: Well, he was known in Berlin and had his company. And when we got to flying the A-3's for the first time, we had four of them, all four started all right, so the engine performed fine, but after a few seconds, say 20 to 30, fell into the Ostsee. So something was wrong with the stabilization. And there was a fellow by the name of Dr. Ing. Schröder. He was also on the staff of von Braun, and he was an aerodynamicist, and when I got from this first firing of the Oie and the first two or even three failed, I came back to Peenemünde. Schröder was waiting there and he told me right away, "All were failures." I said, "Yes, how do you know that?" Well, he claimed that he had calculated that before, he knew that, from his theoretical considerations, and really it was so. And we went to a model of the A-3, and there was in there a model of the stabilized platform. I said, "How come they all failed?" And he said, "Well, they failed because the stabilization did not work. Now, if you think back, if you want to stabilize a projectile out of a gun, you give it a twist, a turn. Because if you fire it without a twist it won't--"

NEUFELD: --won't spin--

RUDOLPH: It will not spin. It will not be stable, not follow that trajectory. So the feeling was, we need only that gyro, to keep it from --

NEUFELD: Tipping over?

RUDOLPH: No, what is this way of the movement?

NEUFELD: Pitch?

RUDOLPH: Pitch and yaw. To help that you have to prevent turning, didn't even enter the mind of von Boykow because if you want to stabilize, you give it a twist. So normally a bullet or a projectile would be stable and you don't have to give it a twist, so that was the feeling interpreted for the rocket. You don't need to stabilize it because if you give it a twist, that is only necessary in a projectile, not in a rocket. I don't know whether I make myself clear.

NEUFELD: Yes, I was distracted because the tape is almost out, but certainly you have to be concerned with three axis stabilization now, try to hold it in all three axes.

RUDOLPH: We concluded, what is missing is the third stabilization, the stabilization to prevent it from turning, because the darned thing will turn.

NEUFELD: Will pitch into the wind, from its aerodynamics.

RUDOLPH: Will pitch it into the wind, and so therefore, a third gyro was introduced that prevented the turning, and then since we had painted the body black and white, we could see in the photos how the darned thing turned. So this came out a few days later and proved that the thinking of Schröder and myself at that time was correct, and so the third gyro was introduced.

TAPE 3, SIDE 1

NEUFELD: Okay. Now, regarding what you were just saying about the A-3 platform, you had only a roll gyro and a yaw gyro, no pitch gyro? Or were there more than --

RUDOLPH: A pitch gyro and a yaw gyro but no roll gyro.

NEUFELD: And the problem came from the roll.

RUDOLPH: Yes.

NEUFELD: That began as soon as --

RUDOLPH: --the rocket started rolling, turned on its axis, and so the platform was toppled, and the rocket would start going into the drink.

NEUFELD: So the gyro, the yaw and pitch gyros, they tumbled over?

RUDOLPH: Yes, they tumbled over.

NEUFELD: They were unable to handle the roll moment.

RUDOLPH: Couldn't handle it at all. They were not designed for it. Now, later on of course the system was very very much simplified. I don't remember the details because I was not involved in the design.

NEUFELD: Yes. I did try to talk to Dr. Reisig about it some, but there's so much that I don't understand. I think that in some ways is most challenging to me as a non-engineer, trying to understand the guidance system evolution.

RUDOLPH: If you want a real expert in that, that is a Dr. Mueller.

NEUFELD: He was there throughout?

RUDOLPH: At Kreiselgeraete.

NEUFELD: And then he came over to Peenemünde at some point. What's his first name, do you know?

RUDOLPH: Fritz. He got involved in the A-5, in the redesign of the stable platform. They also got Siemens into that.

NEUFELD: I've heard about that, and I talked to Dr. Reisig about it, but he wasn't entirely clear himself on just who was involved when.

RUDOLPH: It is difficult to re-establish. Mueller I think is your best source. Even so, his opinion and mine might differ. I realize, I talked to him about the A-3 and A-5 and he had a different opinion about it.

NEUFELD: What did you disagree on?

RUDOLPH: I think we had a different opinion about what was the A-3 and what was the A-5. In his opinion, the rocket which flew first on Peenemünde was A-5, but I think it was for sure A-3.

NEUFELD: I agree.

RUDOLPH: And the A-5 was the improved A-3, the improved A-3 with respect to steering, because the engine was all right, there was nothing wrong with that.

NEUFELD: Right, you were right. I mean, there's no doubt that that's the case. The A-5 did not fly until '38, '39. I guess the question really is, sorting out, you know, how many gyros each system had and who was involved in building them and when and sort of the design features of that. As you recall, the Kreiselgeraete system that went into A-3 had two gyros. It did not compensate for roll.

RUDOLPH: Correct.

NEUFELD: And the aerodynamic forces in the fins were not sufficient either to correct for rolling.

RUDOLPH: No.

NEUFELD: And you then went to Kreiselgeraete and said you wanted a three gyro system for A-5. When did you decide to build A-5, only after the A-3 failure?

RUDOLPH: After the partial success only of the A-3. See, I got only marginally involved in that because Dornberger had already re-assigned me to the Versuchsserienwerk.

NEUFELD: Yes. Okay. And again, I want to keep the Versuchsserienwerk for one story, because that's probably going to be the main thing you want to talk about after 1937-38. Siemens came into the guidance when, immediately at that time, when you started talking about A-5?

RUDOLPH: I don't remember.

NEUFELD: And they were to design a separate system?

RUDOLPH: They were to design independent of Kreiselgeraete the other system. The details, sorry, I don't know.

NEUFELD: Right, it was not your department, your job. It seems to me from what I've been looking at, we talked before about the role of concentrating it in a government laboratory. You think it was in the guidance that corporate contractors played the largest role?

RUDOLPH: Right.

NEUFELD: At Peenemünde. That was the only place or virtually the only place for contractors? Obviously you always needed contractors for components and things.

RUDOLPH: Oh, sure. I think there we didn't have the capacity to do that at Peenemünde. That was entirely out of our knowledge, our experience, so we had to rely on contractors to do the whole darned work. Forschung.

NEUFELD: Yes, research.

RUDOLPH: Research and the concept establishment etc. etc.

NEUFELD: And were there any other companies that played a more significant role in those days? I've heard about the turbopump with Klein, Schanzlin and Becker.

RUDOLPH: All right, glad you mentioned it, sure. This was also quite a task. Up to the A-4 we had pressure-fed propellants to the combustion chamber. Now, these of course meant weight, weight of the tanks, and that we could not afford in the A-4, so we used a turbopump to drive the propellants from a very low pressure in the tanks into high pressure, 10 atmospheres in the A-4, into the combustion chamber, and there we hired Klein, Schanzlin and Becker to do this development. There were of course others who had been building pumps for transferring liquid oxygen. Heylandt had a pump. But I don't know the details. And so we selected, Papa Riedel selected Klein, Schanzlin and Becker, and they did marvelously, really marvelously.

NEUFELD: There's a document photographed in the Klee and Merk

book which shows then as early as 1935 Klein, Schanzlin and Becker being involved, so that's about the time that you began. I think this document is November, 1935, so is it that time that you began looking around, or somewhere in that time span that you began looking at turbopumps?

RUDOLPH: Yes. Yes. I think not earlier.

NEUFELD: And you did not use turbopumps in A-5 or anything, that was all pressurization.

RUDOLPH: It was.

NEUFELD: This is an important point again, if we wanted to pin down when you began thinking about A-4, when the idea began, so that you were already at Kummersdorf in 1935, saying, "We need to have a turbopump developed for larger missiles, larger vehicles."

RUDOLPH: Yes, for the next size, the next generation, turbopumps.

NEUFELD: Did you have a specific idea at that time about the size of the engine and the size of the turbopump you needed?

RUDOLPH: Maybe quite arbitrarily, the next generation, that is A-4, should have a thrust of 25,000 kilograms, 25 metric tons. And then the next one would have 100,000 kilograms, ten tons.

NEUFELD: 100 tons.

RUDOLPH: 100 tons. That established that, at that time, just as some guidance, milestones.

NEUFELD: Milestones, Okay, so in effect before you even had a vehicle design or specific purpose, you said that's a logical goal for engine size, thrust development, and so in effect, if I understand you correctly, you sort of specified the engine size, and then developed a thrust, and then developed a vehicle after the fact to fit around that size of engine.

RUDOLPH: Correct. Very well put.

NEUFELD: Okay. And then at that point of course that's where Dornberger comes in in his book and says that in '36 he specified that he wanted a projectile to go twice the Paris gun range, something like.

RUDOLPH: Twice the --

NEUFELD:--regular Paris gun, right, and that was in '36. That was only when you started to get specific about what the A-4 would look like.

RUDOLPH: Yes.that's for sure right. Then before we were still fooling around with the small stuff, and only in late '35, crystallized the ideas about engine size and then of course, as sort of an afterthought, range.

NEUFELD: Right. You could calculate what kind of range you were going to get, once you knew both the propellants, specific impulse, and the mass ratio of the vehicle, so you'd have a good idea, approximate idea of what the mass ratio is, you know more or less how big a payload you could get, how far. And that crystallized right at the end of '35, or last couple of months, or first couple of months of '36, somewhere in there?

RUDOLPH: More so in '36.

NEUFELD: So the engine idea was late '35, the concept?

RUDOLPH: No, it was a test.

NEUFELD: Okay, to go back to what I was saying then, beyond those examples of the guidance contractors and then turbopump contractors, were there any other companies that played a big role in those days, in the thirties, in the actual development of the vehicles, as opposed to supplying components or equipment?

RUDOLPH: These were the outstanding contributors.

NEUFELD: As much as possible you tried to do other things in-house.

RUDOLPH: Yes. Yes.

NEUFELD: Okay. That's more or less what I assumed, but I wanted to make sure that that was right, that my guess on that was correct. Okay, we're getting close to the time when we can finally begin to talk about Peenemünde and the Versuchsserienwerk. I'm trying to think of anything else. One standard question that Frank Winter wants me to ask everyone, because he's writing this Goddard book or he will be in the future, is whether you had any -- actually for the purposes of the record, you should repeat the story that you told me at dinner, at lunch, about you first heard of Goddard on this cigarette card, right. Would you just like to briefly summarize that story again?

RUDOLPH: In the late twenties, probably, I was a heavy smoker. And so one day I opened a pack of cigarettes by a German company, and out fell a little picture, maybe two by four inches or so, and in the corner of it was the picture of Goddard, and in the bigger part was his test stand or launching platform. This was most interesting, and this even enthused me more to try to get into the rocket field than it had before, and I was at that time

still going to school.

NEUFELD: Right. So you were in engineering school at that point, and that was before you knew Valier or before Heylandt.

RUDOLPH: Correct.

NEUFELD: So it had to be 1928 or '29.

RUDOLPH: Right.

NEUFELD: And you knew something about Goddard. That's an interesting fact in itself. But as far as Goddard's influence if any was concerned, did you ever use any Goddard patents, have any knowledge of what he was doing?

RUDOLPH: I sure didn't. It could be that von Braun knew about it, at the Heereswaffenamt. But I don't know.

NEUFELD: You don't know of any examples in your personal experience anyway.

RUDOLPH: No.

NEUFELD: Okay. He likes to get that out of the way as a standard question, and I have one more standard question from him. He likes to know about whether other people at Peenemünde or Kummersdorf had been involved in the Verein für Raumschiffahrt at all or whether you even know that, other than von Braun and Klaus Riedel, Hans Hueter, Kurt Heinisch, Heinrich Gruenow. Those people he knew were in the VFR.

RUDOLPH: And Willy Ley was a member of the society.

NEUFELD: But of course he was not at Peenemünde or Kummersdorf, so as far as you know, of course, you didn't have much to do with it so there's no reason why you should know much.

RUDOLPH: I had nothing to do with the society.

NEUFELD: And there was of course a small group that was involved in the Gesellschaft für Weltraumforschung, a small space flight group that existed around Peenemünde somewhere.

RUDOLPH: Not at Peenemünde, to my knowledge. It could have been the group around Winkler.

NEUFELD: This was actually a group that existed in the Third Reich era in the late thirties apparently, but you never heard of it?

RUDOLPH: No.

NEUFELD: Okay. I think Hans Kaiser and even earlier on Krafft Ehricke had been. That was before Krafft Ehricke ever came to Peenemünde though. But you never heard of it. Okay, well, that gets this story out of the way, that gets his questions out of the way. Okay, so now we get to 1937. You moved to Peenemünde right at the very beginning of the move, in 1937?

RUDOLPH: We moved in May, '37 to Peenemünde, on the 17th of May. And then of course we could not go into the plant itself, so we were housed in hotels in the resort town of Zinnowitz. And while my colleagues were in their free hours sunning themselves on the beach, I sat in my hotel room and gave thoughts, consideration, to how to run this new big plant, big compared to little Kummersdorf, and so I worked all the paperwork and the forms which were needed to operate a plant, and when I later on showed von Braun what I had in mind, he was enthused about it, and approved right away without asking any questions. And even when I left, after we left Peenemünde, or at the time we had to leave Peenemünde because it was bombed, these methods I had introduced in '37 were still in operation.

NEUFELD: So at this time, was there a clear plan? I'm not quite sure whether you're talking about the equipment of the buildings, the location of test stands and buildings, or are you talking about the organization?

RUDOLPH: I'm talking about the organization.

NEUFELD: In a sense what the chart would look like, what the lines of authority and the organizational groups would be.

RUDOLPH: Yes.

NEUFELD: When you went there was already a detailed building plan, I guess, by other people?

RUDOLPH: Yes.

NEUFELD: About where the test stands would be, where the headquarters buildings would be.

RUDOLPH: I was of course concerned with locating the fabrication laboratories or workshops and Riedel and von Braun were concerned about where to locate the test stands. Von Braun of course also with Dornberger on how to get the wind tunnel established.

NEUFELD: Right.

RUDOLPH: And then there was a material testing laboratory under Dr. Maeder. ...And so I was concerned with receiving the material, storing the material, the purchasing department to replenish or get the material at all, the issue of it, in an

orderly way, and an improved card index system, and then the workshops with hundreds of machine tools, some quite advanced, based on ideas from von Braun. He thought we could cast the engines, simply cast the engines, and then of course work the cast body into a final combustion chamber.

NEUFELD: As opposed to welding.

RUDOLPH: Not weld at all.

NEUFELD: Yes, no welds, sort of cast as one piece.

RUDOLPH: And therefore he had even a deputy who was a casting expert, Fachmann. And I had there a fabrication building or Einzelteilbau-Werkstatt, single piece workshop. I called it EW, Einzelbau-Werkstatt. Or single piece workshop. You could also say Entwicklungswerkstatt. And then there were the components or parts built, and then there was next to it a Zusammenbauwerkstatt.

NEUFELD: Construction?

RUDOLPH: Assembly. Assembly was done, and it was a very high building, with very high hook height of the crane, and this was all done, this assembly, vertically, not horizontally. Now, in this workshop we tried new building methods, of course not new machining methods. It was all old-fashioned machining. But we had hundreds of machine tools. And this was now '38. And in 1937 we fired the first four A-3's on the Oie.

NEUFELD: Right. And you tell in this book the story about Dornberger coming to you with the idea for the Versuchsserienwerk.

RUDOLPH: You want to talk now about it or you still have other questions?

NEUFELD: Yes, I still have questions about what you said before. You were involved in building the construction workshops and, as you called it, the single part workshops and the machine shops for the construction of the vehicles.

RUDOLPH: I established also one workshop what you call in USA the "Skunk Works." And there, there was a master sheet metal worker who probably could not even make a drawing, but understand a drawing, and then had so much imagination that within half an hour or so he would form out of sheet metal what you would tell him verbally, without sketch, without drawing. And that of course was for Versuche.

NEUFELD: Experiments or tests.

RUDOLPH: Experiments, most important. If another fellow came in and had a bright idea, he would know how to make it without a drawing, without a sketch, and he did that marvelously.

NEUFELD: So you and other people had to find many many talented workers.

RUDOLPH: Oh yes.

NEUFELD: Skilled workers, skilled metal workers.

RUDOLPH: Yes. He was one who had come from the aircraft industry and did marvelously.

NEUFELD: So who was involved in hiring this much larger work force of skilled workers?

RUDOLPH: I did mostly. Not exclusively but mostly. Then I also established an Oberflächenschutz laboratory, where--

NEUFELD: -- surface protection?

RUDOLPH: Surface protection. And there we had huge basins for surface treatment. We used the process called Eloxieren, which was by submersing the tanks into big basins with a chemical solution, and using electric current, I don't know the details any more.

NEUFELD: Was this electrolytic?

RUDOLPH: Electrolytic treatment, so we got a hard surface which could withstand the chemical influences of the later propellants.

NEUFELD: Right, in the tanks and also in the combustion chambers.

RUDOLPH: In the tanks and in the pipelines. Not in the combustion chamber. The combustion chamber was made out of steel, the tanks were all out of aluminum, an aluminum alloy, Hydronalium.

NEUFELD: Hydronalium, I've seen the name before, is an aluminum alloy with aluminum and what?

RUDOLPH: It was sea water resistant.

NEUFELD: Right, because you were dropping rockets in the water too. But Hydronalium is an aluminum alloy with do you know what other components it had or was it aluminum exclusively? I never did get the name of the process you said, the hardening process, the surface protection, the German name of it.

RUDOLPH: Electro, I have to think myself now, between the English and the German. Eloxieren. ...

NEUFELD: That's the name of the electrolytic hardening process. And so, did you line out, this was in '37 finalized, you were buying machinery. You were hiring skilled metal workers.

RUDOLPH: Machinists.

NEUFELD: And machinists of various kinds.

RUDOLPH: And employees for purchasing, and also engineers for what we called Arbeitsvorbereitung. I might call it in a free interpretation, people tops in engineering.

NEUFELD: Preparation for fabrication.

RUDOLPH: Right.

NEUFELD: Just to link up with things that you said before, you were doing this with --you were having to deal with Schneider in Berlin in his office, or was Schneider there?

RUDOLPH: He was in Peenemünde.

NEUFELD: And you had to go through him as a sort of base commander for both east and west even in '37.

RUDOLPH: Yes.

NEUFELD: To do much of this hiring and buying materials, and that's when you had the problems you described a lot earlier with the bureaucracy and trying to get, and attracting people to Pommern, which is where you were, right.

RUDOLPH: Right.

NEUFELD: To the middle of nowhere, in some ways. You acquired those people through Berlin mostly? The machinists and bureau personnel and all these kinds of people?

RUDOLPH: Because there were these advertisements, of course, the idea, send their applications to Berlin because of reasons of secrecy.

NEUFELD: Right.

RUDOLPH: I could not address it to Peenemünde.

NEUFELD: Did the advertisements even say "army" on them, or did they not even identify --?

RUDOLPH: I don't remember. I don't think it said that.

NEUFELD: Yes. That's the kind of people they wanted, so "send

your name to this post office box" or something. So you were organizing all those different aspects in terms of setting up the laboratories. One question that came to mind is, when you were developing this fabrication building, this high building with cranes and so forth, I gather from some book or other that you constructed that already with even bigger vehicles in mind, even bigger than A-4.

RUDOLPH: A-10.

NEUFELD: You had the A-10 as a rough concept.

RUDOLPH: Not even a drawing. Only a thought.

NEUFELD: The A-10 would be the vehicle that, at a lower stage, would accommodate the 100 ton thrust engine.

RUDOLPH: Right.

NEUFELD: So you had a rough idea of how big it was and you drew up the height of the building and cranes and everything on that basis. Obviously you didn't want to build something that was immediately obsolete, I guess. Did that also reflect a confidence that you were going to keep getting the kind of money coming in and support coming in that you could really expand? You were confident at that time that you were going to be able to go on to bigger --

RUDOLPH: -- yes. Yes. Of course this impressed Dornberger and von Braun, especially Dornberger, that I had been using so much foresight in the whole concept of establishing Peenemünde East, and he asked me to do Peenemünde South, the Versuchssertenwerk.

NEUFELD: One question that comes out of that, in old article that Krafft Ehricke wrote and maybe one or two other places, I haven't seen any documents on this yet, it's asserted that there was a very ambitious plan laid out, I don't know when, for a rocket city of 30,000 people, big experimental centers, scientific centers, sort of a long range vision of what Peenemünde should become in the future. Do you know anything about that idea?

RUDOLPH: No.

NEUFELD: Do you know if it's even true?

RUDOLPH: I don't know. I haven't the slightest idea. But that doesn't mean that there weren't some such thoughts. Of course, I was on the managerial end running the whole shops, but not in developing brand new far-reaching ideas.

NEUFELD: So that could well have been, but that was somebody else's job. You had very heavy day to day responsibilities in

terms of management and so forth and organization.

RUDOLPH: I could say, my main task was works manager, exclusive of the test area. Dornberger wanted me to have the test area too, but von Braun for some reason didn't want that, and I had some difficulty with von Braun at that time anyway. You see, I mentioned before that von Braun was bubbling over with ideas. Even Dornberger had to say, "No, Godammit, stick to this, this, this! Those and others." Now, because of this quality of Wernher von Braun, he would run with different ideas in the workshops, in my workshops, where I was the manager, and tell the fellow at the machine here, "Stop that and do now so and so." And so there was friction between von Braun and me. I say, "You ruin my whole operation here, why don't you tell me?"

NEUFELD: Right.

RUDOLPH: But he thought that I would cut him off from the connection to the workshop, which was not my idea, I only wanted it in an orderly way. And so we got, like that.

NEUFELD: What time, year was that?

RUDOLPH: That was in '38.

NEUFELD: So this was, I know I keep putting you off as far as Versuchsserienwerk is concerned, I have so many questions. This was during the time when you were sort of involved in both Versuchsserienwerk and also in Entwicklungswerk, which in both, you had sort of hands in both sides. Did that continue later on at Versuchsserienwerk, that von Braun would get in your way?

RUDOLPH: Oh, when I got now it must have been mid-38 when I got definitely separated from von Braun, when Dornberger told me, "Forget the Entwicklungswerk, the work for von Braun, you concentrate now solely on the Versuchsserienwerk, in brief, Werk Sud."

NEUFELD: So the friction period was basically in '37 before the whole Dornberger's idea came up and then in that first half of '38 when you were doing both.

RUDOLPH: Yes.

NEUFELD: That's when the two of you came into conflict over his changing the way you wanted to organize things or how jobs were done.

RUDOLPH: Ja, he would come into the workshop and change things around. Of course that brought my whole system in disorder. And he could have as easily asked me to change that. But he wanted to be free-wheeling with the thoughts pouring out of his mind and

change it right away.

NEUFELD: Did that have any role in Dornberger saying, you concentrate only on this, and taking you out from under von Braun?

RUDOLPH: Dornberger was not even aware of that.

NEUFELD: He wasn't even aware of the conflict.

RUDOLPH: No. This was not a real big conflict. We had our own little frictions.

NEUFELD: It didn't in that sense hurt your friendship in any significant way?

RUDOLPH: No, not at all.

Neufeld; Not at all, so this is just day to day conflict, and then became, then you were separated from Entwicklungswerk, and that was not important any more. You weren't directly involved with his management or anything of the sort.

RUDOLPH: That's right. Now, this of course created a big problem for von Braun, and he realized only afterwards what bigger problem it was, after Dornberger put me out from under him. Then we had two fellows, two very bright fellows. The name of the one fellow was Martin and the other Walther. Martin and Walther.

NEUFELD: Those are the last names?

RUDOLPH: The last names. ...These two were friends. In fact, I hired Walther on recommendation of Martin, and Martin was running the workshops for me.

NEUFELD: This was still in Entwicklungswerk.

RUDOLPH: In Entwicklungswerk. And Walter I asked to do the Arbeitsvorbereitung and the purchasing department. Now, the purchasing department was under a fellow I had hired from the aircraft industry. Very soon I noticed that he made a lot of mistakes, and so I called him on the carpet, and told him if he couldn't do better I would have to fire him. Well, I didn't fire him but I put Walther in charge on top of him, and Walther, he did a marvelous job, really marvelous. How he as an engineer handled the purchasing was really astounding, and this of course was what I needed.

NEUFELD: So these were the people--I'm sorry, go ahead.

RUDOLPH: Especially in light of General Schneider always criticizing the purchasing.

NEUFELD: Okay. Were these the people who were left in charge then of these things after you had separated --

RUDOLPH: --yes, yes --

NEUFELD: From Entwicklungswerk.

RUDOLPH: Yes.

NEUFELD: And they did a good job for von Braun in taking over things that you had really been doing before.

RUDOLPH: This of course created now frictions between the two, Walther and Martin, and von Braun complained to me and said he would never agree again to me being separated from him because it brought him a lot of headaches and he had to be the peacemaker between the two.

NEUFELD: Who had to be the peacemaker, von Braun?

RUDOLPH: Von Braun.

NEUFELD: Von Braun had to be the peacemaker between these two.

RUDOLPH: And before that it was running smoothly without having him giving it even a thought.

NEUFELD: Okay. I had one more question that came out of your discussion of your role in setting up the organizational plan. You see that as something that you were most responsible for, the organizational plan of Peenemünde at the beginning.

RUDOLPH: Yes.

NEUFELD: And the question comes from a comparison with Dr. Reisig. Dr. Reisig in his articles and in his interview with me said, maybe you were talking about two different things, that von Braun was crucial in his concept of the division of the laboratories, what the different specializations of the laboratories would be, and of course you talked about the organizational structure. So can you reconcile those two comments? Was von Braun responsible for a different part of the organizational plan than you, or was there interaction?

RUDOLPH: There we have never any difficulties with establishing the organization as such. So for instance, there was Papa Riedel for design. For the technical design office. Then there was Dr. Schröder for the aerodynamics. But he was later on, he was not replaced but there was another office established for some reason which did his work, so Schröder was sort of left out in the cold, but not fired. And there was of course now Dr. Steinhoff in BSM. That meant Bordgeraete, on board equipment, steering. And BSM,

measuring.

NEUFELD: Yes, Messtechnik.

RUDOLPH: Messtechnik. There Reisig played a major role. And there was of course the Windkanal, which was kept sort of independent, on insistence of Dornberger, from von Braun.

NEUFELD: And that was of course Dr. Hermann's wind tunnel.

RUDOLPH: Dr. Hermann. And then there was Dr. Mader and his Materialuntersuchung.

NEUFELD: Material testing.

RUDOLPH: Material testing.

NEUFELD: Okay. So the aerodynamic group under Schröder was different or separate from the wind tunnel group.

RUDOLPH: Yes. Oh yes.

NEUFELD: The Schröder, group, as you say, of course Schröder was more or less pushed to the side because they weren't satisfied with him?

RUDOLPH: There was friction between von Braun and Schröder. Von Braun would say, "If I listen to Schröder, nothing would work. He has in every thought already in the back of his mind the thought that it won't work. I need a fellow who says, it will work, even though my theoretical findings say it won't." You see the difference? In other words, we have to overcome the difficulties and even the doubts by action, by positive action, not by resignation. Therefore the friction came up between von Braun and Schröder. There was a fellow by the name of Steuding in his place. But this I don't know too well any more, all these involvements, because I was already busy at the Werk Süd. I wasn't in close contact with Werk Ost any more.

TAPE 3, SIDE 2

RUDOLPH: We were I think talking about the organization and my function in it, and the whole problem, what were the different elements of this organization. For instance, how we worked with Dr. Hermann, and then with the material laboratory, with Maeder or with Papa Riedel in design and with Steinhoff in electronics parts. So he dealt with these fellows very intensively, while I only saw the results of this comparative, the problems of the East Laboratories, let me call them, where they decided on how to go about the electronics or the aerodynamics or whatever, and then put in a design for me or my laboratories or workshops to translate it into hardware.

NEUFELD: So before you were transferred to the Versuchsserienwerk full time, would you say that you held a position approximately equal to these other people, if there had been a chart, I know there may well be somewhere, but you had the same level --

RUDOLPH: --yes --

NEUFELD:--sort of directly subordinate to von Braun, as Fertigung and so --

RUDOLPH: --Steinhoff, Riedel --

NEUFELD: Or any of those people. Do you remember what your title was at that point in time?

RUDOLPH: Betriebsleiter. Or Betriebsdirektor.

NEUFELD: Okay.

RUDOLPH: Operations manager.

NEUFELD: Okay. I had one or two questions about those people, then we'll go on to Versuchsserienwerk. One was, let's see --so when you were talking about Schröder and aerodynamics, was he an aerodynamic theorist? He wasn't in control theory or guidance theory or something like that, was he?

RUDOLPH: I don't know that. He was a theoretician.

NEUFELD: And this was separate from the experimental wind tunnel under Hermann, Okay, and Hermann's wind tunnel was not directly under von Braun? Or on the chart it was, but Dornberger wanted it protected?

RUDOLPH: I don't remember that. On the chart it might have been. Dornberger gave Hermann special stature, almost equal with von Braun, as he did with Thiel, still in Kummersdorf.

NEUFELD: Right. That's true, I just remembered that.

RUDOLPH: Then later Thiel came to Peenemünde and then was under von Braun, for practical reasons.

NEUFELD: Right.

RUDOLPH: But Dornberger always saw to it that the ever bubbling ideas from von Braun did not mess up things, because of that.

NEUFELD: So in that sense, from the organization chart that I saw regarding Thiel in some ways, at least the 1942 chart that I saw in the Wernher von Braun papers at Huntsville, Thiel almost had a higher position than some of those other directors. He was, that

was 1942, but he had a special position almost. He was directly under von Braun but he also commanded two or three separate laboratories to himself.

RUDOLPH: He would pretty well have to -- ...the testing complex.

NEUFELD: Of course as it gets bigger it gets more and more complicated because you have a very big organization, thousands and thousands of people by the middle of the war. The other question I had was regarding Steinhoff. I gather he didn't come until 1939 or something like that. You can, I don't know whether you agree with the comment that I've seen, that because of the problems with guidance in effect you had to start building a guidance laboratory as well because you were still not very satisfied with what you were getting.

RUDOLPH: That's right.

NEUFELD: With Kreiselgeraete and Siemens. So that's true as far as you know.

RUDOLPH: That's true. So he established a laboratory, and I know there was Dr. Hoelzer who still lives in Huntsville and Dr. Friedrich. Dr. Friedrich was a close friend of mine later on. They invited me to see their laboratory, and so Dr. Friedrich and Dr. Hoelzer demonstrated a platform, the so-called stable platform where they had all these gyros and other instruments on, and now they give the stable platform a jolt and see how the gyros reacted, to find out the steering problems.

NEUFELD: Right, so those were Steinhoff subordinates at the time. On personality questions, Steinhoff, what was your impression of him as a personality, how he was to work for?

RUDOLPH: Well, I think he was liked by all his fellows very much. I liked him too as a friend. But he had one darned disadvantage. He would make changes until the last split second. So I remember, for instance, when the V- 2 was quite ready to fire, there comes Steinhoff running with a black box, new, under his arm, clambering up the ladder, opening the door, taking the old out and putting the new in, and says, "Now you go."

NEUFELD: Last possible second.

RUDOLPH: I suppose you would say. That is, for a "skunk works," quite all right, but not for a rocket you just want to fire. Because you don't know what you introduced. No documentation, no nothing.

NEUFELD: Right.

RUDOLPH: This was Steinhoff.

NEUFELD: I asked the question, I wanted to get your own reaction first, because Dr. Reisig said that he had personal conflicts with Steinhoff, so that they did not get along. He did not like Steinhoff or did not necessarily agree that he was a good person to run that lab. I wonder if that's just their personal conflict.

RUDOLPH: It could be, but you see, from what I just said, you can see that possibly for this very reason, Reisig got in confict with him or vice versa. Because it was disorderly, downright disorderly. It might be a bright idea, even a splendid idea, but the way it was introduced, by last moment thinking, last split second moment thinking, things were confused. You didn't know any more what was going on.

NEUFELD: Right. But as far as you knew, other people's comments about him, they felt he was a competent people, that he was theoretically and so forth--

RUDOLPH: Oh yes, he was definitely competent.

NEUFELD: Because Reisig did not necesarily feel that way, but I got the strong feeling that that came from a personal clash that they had.

RUDOLPH: I don't even know that.

NEUFELD: Okay, finally after many delays I can get to something that I always considered very important. As I wrote you, this story about Dornberger coming up with the idea for the production plant, when he talked to you in Oie, fascinated me. It tells you something also very important about Dornberger's concept of Peenemünde and so on.

RUDOLPH: We were at the Oie and firing this four A-3's, and one day there was a fog and there was Dr. Hermann and Dr. so and so, I forgot his name for the moment, and we were talking about the A-4, the future, how to construct that. And of course now you had here a sort of free-flying piece of equipment, how to control them in flight, and therefore it was very essential to have these wind tunnel experiments. And they wanted to know how exact my people could construct such a surface, whether it would be plus, minus one inch or plus, minus a quarter inch or plus, minus an eighth or a sixteenth or so. And I said, "Well, I can do whatever you want, but it will of course involve time and cost, and time is always like cost." So we kicked that around most interestingly without big arguments but just discussing it, and so one day when we wanted to go back to Peenemünde, because we had no other A-3 to fire for the moment, we could not go back because there was a storm, and the storm had driven water out of the harbor on the Oie and so we were sitting there forced to stay.

NEUFELD: Excuse me, was this after all the firings had been tried

or in the middle?

RUDOLPH: I think it was in the middle. I'm not sure any more whether it was that we had fired all. I think it was in the middle. And so one day von Braun and Dornberger and I were sitting together discussing things like I had discussed with Hermann and his deputy, and there springs Dornberger on me out of the blue sky, "I want to build a Versuchsserienwerk, a production plant for the V-2 and the coming big rocket, and you will do that." I say, "Dornberger, for heaven's sake, I'm a development man, I'm not a production man, and you leave this up to industry, don't bother us fellows in development with your new ideas." And von Braun was of course saying the same thing, even harsher than I did.

NEUFELD: Actually you feel it was rather tense? Actually I know, not in the long run, but it was tense, there was an argument?

RUDOLPH: There was an argument, there was a strong argument. I was so opposed to it. And I liked what I did for von Braun. Why now in a new area much too soon, to my mind, and even in an area which was sort of strange to me, even though challenging. And therefore my point, let industry do that, and not here in Peenemünde, not in Peenemünde. So I had two big arguments, not to do it at all, and if so, not in Peenemünde, let industry do it.

NEUFELD: What do you think his motivation was for wanting to do it in-house? Again this is part of building a big complicated complex rather than contracting out.

RUDOLPH: He wanted it all under one roof. Alles unter einem Dach. Not only the development but also the production, at least the pilot production. It was a pilot production, a Versuchsproduktion.

NEUFELD: Okay.

RUDOLPH: Because it is one of the most difficult tasks from development to go into production. Look at American industry. They always go into production with a lot of unsolved problems, even today, in the United States where, after forty years on it, they should know better, yes?

NEUFELD: Right.

RUDOLPH: And Dornberger had great foresight. He knew if he gave that, after the development was halfways finished, to industry, it wouldn't work. And therefore he insisted on doing at least a pilot production, you see, 300 a month in Peenemünde, right next to the development. That was apparently his thinking. So the way, in hindsight-- a really, really good thought.

NEUFELD: So you consider in retrospect that he was right and you were wrong in that original argument. So that's what the meaning of Versuchsserien was. That was clear at that time. Was that what he argued, that first you would produce a preliminary production run and then maybe expand that to other places?

RUDOLPH: Yes.

NEUFELD: Keeping the plant at Peenemünde and adding other factories or something at later times.

RUDOLPH: Later and on site of Peenemünde, and he thought about the feedback from the experience in this pilot production into development, so the shortcomings could be corrected right away.

NEUFELD: Okay.

RUDOLPH: Without much delay because of the distance, the factories away from the Entwicklungswerk, the development works.

NEUFELD: So from his standpoint, it wasn't so much that he was completely opposed to giving an aircraft corporation or someone like that the production. Was it that or was it just that he felt you first had to have this test series?

RUDOLPH: He was convinced that he thought he had to have it under one roof. This again was essential.

NEUFELD: I didn't try last time to get an answer to this question, which was, that phrase "Alles unter einem Dach," do you ever remember him saying it, as such? It may be very hard to pin down now, who said it first and when.

RUDOLPH: I don't know whether he ever said it in these words, but whatever he did mean that.

NEUFELD: And he was the overriding architect of that concept, would you say, of pushing you in that direction --

RUDOLPH:--yes--

NEUFELD: --of having everything together.

RUDOLPH: Not only me. In the first place, pushing von Braun in that direction.

NEUFELD: And at the time when you both argued very heavily against this, you felt that it was clear that some corporate contractor would be the way to go, if you were going to make a large number of missiles, then you really felt that only they could handle that, that was their job?

RUDOLPH: Yes. I was of the opinion that if we took on this additional task, that would be a tremendous burden on Peenemünde, on the Entwicklungswerk. It would in a way, I felt, hamper the Entwicklung, development. But I have to admit that as a philosophy or as a concept, Dornberger was right, and that it proved itself later on, in the course of the time between, well, let's say, '39 to '45, what happened during that time.

NEUFELD: I'm trying to feel out here attitudes to the proper role of the government and companies in the society. It was merely a matter on his part of feeling that was the best way to go to do that job? Or did he feel in general a government military laboratory was a better places to do things than the private companies? You know, is there any way to figure that out even, what his motivations were, how he felt about those issues?

RUDOLPH: I only can repeat what I said before, that he was of the opinion that if he had it all in his hands, it would lead sooner to success than if he had the production off in a different place.

NEUFELD: Okay. So you fought very hard against that idea and he said, "Well, that's just the way it's going to be done," so he put his foot down.

RUDOLPH: He ordered me to do it. But he said at the same moment, "Now, since you are a lousy civilian, and by the way not an academician, but a small engineer, you will have of course to have a military boss on top of you." And I didn't like that either.

NEUFELD: Right. It sounds rather harsh, in the way that you, at that time.

RUDOLPH: He didn't say "lousy civilian," in just this way, but I felt being insulted like that. So he insults me, at the same time wanted me to do it. I really had to do it, because who else knew about von Braun and his fellows, and I was one of them who knew from experience, they were not about to do it.

NEUFELD: Right, certainly they were much less able than you to deal with that issue.

RUDOLPH: So in a way I felt honored and in a way I felt insulted. And so I got I suppose a Ministerialrat, Schubert, and he had already been in retirement, but Dornberger managed to get him out of retirement and on top of the establishment of Peenemünde South. And I have to say I enjoyed working for him.

NEUFELD: At the time when you were put under Schubert, he was 70 years old, somewhere in there?

RUDOLPH: He was in the early sixties, I think.

NEUFELD: But he had retired anyway.

RUDOLPH: And he had the rank of a general.

NEUFELD: In the bureaucracy, but he was a civilian. He was a civilian army employee.

RUDOLPH: No, no, he was what we called Beamter.

NEUFELD: Yes, that's what I meant, he was a career civil servant.

RUDOLPH: No, he was not a civil servant. I was a civil servant. Schubert was not. Schubert was an in-between, between military and civil servant, and that is I think something peculiar to the Prussian army. He had the rank of a general.

NEUFELD: Did he have the uniform of a general?

RUDOLPH: Yes.

NEUFELD: He could wear the uniform of a general.

RUDOLPH: Yes, he wore the uniform of a general.

NEUFELD: But in the sense of being in between, he had not followed a traditional officer career, in the sense that he wasn't promoted through command positions, he was appointed through administrative positions with equivalent ranks?

RUDOLPH: Yes, because he was an engineer, he was a Diplom-Ingenieur. So he had the academic background to lead, from the book. The book says if you are an academician you are better qualified to lead than if you are a small time engineer.

NEUFELD: Which isn't always true, obviously.

RUDOLPH: Not so. And so, this was a special Prussian something between the military, not really military but halfway military, and not a civilian employee or civil servant, but that's something special.

NEUFELD: This may not be worth so much time, but did he serve as a regular officer at some point much earlier in his career?

RUDOLPH: No. No.

NEUFELD: Okay, that's what I thought, he didn't ever serve in that sense.

RUDOLPH: He was in a position where in the First World War he was

even sent to Turky when there was the Battle of Gallipoli, and the British and the Australians tried to capture that fortification. He told about that most interestingly. He also said that he got butter, but his butter had green streaks, and this was because the Turks were not too clean in making the butter. There was some cow dung in between. Whether that was really true, I don't know.

NEUFELD: So you were put under Schubert. Schubert sat in Berlin, right.

RUDOLPH: He had his office in Berlin.

NEUFELD: As a subdivision, I gather, of Wa Pruf 11. I know the name changed. Looking at just a few documents I know the designation kept changing over time.

RUDOLPH: Yes. Dornberger was once Wa Pruf 11, and he was Wa Pruf 13, and then he was something else again. To this interconnection, he didn't even bother with.

NEUFELD: Yes, it's just a name on a --because I gather that originally what you were called was something like Wa Pruf 11 Gruppe VI or something like that, Roman VI, whatever. So that was Schubert's office, right. He had his office in Berlin. He was sort of the leader of that section. And you were the manager, the leader, in Peenemünde.

RUDOLPH: I was his extended arm.

NEUFELD: But in fact you were the one most responsible for the work.

RUDOLPH: Now, he was, as I say, I liked him immensely, immensely. In fact, I liked him better than Dornberger. So in building all this new production facility, that meant a tremendous effort, and it meant also, if I wanted it to be effective, that there would have to be a new railroad system being built, new transportation with high speed electric trains, not a steam engine train. It meant there had to be a harbor, and a call for a new power plant that was being built at the Peenemünde. That's two examples. There had to be of course what is today in everybody's mouth, a Kläranlage.

NEUFELD: A sanitary establishment.

RUDOLPH: A sanitary establishment, with all the --

NEUFELD: --water treatment--

RUDOLPH: Water treatment.

NEUFELD: A water treatment plant or something.

RUDOLPH: So he had a few fellows who did that, very well, and as I say, he had experience, terrific. He told me he had built plants during the First World War which were supposed to be camouflaged, so he said, "We built these factories, munition factories. Then we put dirt over their roofs, and then we had to of course have heat inside, and because we had the heat inside, the flowers bloomed on top of it, and the birds sang." That was the expression of Schubert.

NEUFELD: What was the expression?

RUDOLPH: His expression, the snow melted, there were the flowers blooming and the birds were singing in the flowers, in the trees, bushes, on top of the plant. So nothing of camouflage. You would never know there was something underneath which was unusual.

NEUFELD: Of course that was mostly for smaller buildings, right, because the main assembly plant and things that you had to build --

RUDOLPH: This he gave me as an example, and for me, it showed that he had a tremendous experience, and that showed up everywhere, when I dealt with him. So once a week he came to Peenemünde, and then I showed him what I had planned. And because of course there was, we expected, that the old plant and the new one would be air raided, we decided to build three plants, three factories, not only one, for these 300 V-2's or A-4's per month which were going to be produced. Now, how big should these factories be? And he didn't interfere with me about the size. He provided three electrical supply lines, for reasons of air raid security, and three other supplies and three so and so and three so and so. And for the size now, I was faced with the problem, what will the future A-4 look like? So we had to be building the combustion chambers, the tanks, the structure, and all the valves and what else goes with it? Even if we had supplies from a contractor like Klein, Schanzlin and Becker, we would have to do something to assemble it. The main problem I was plagued with was, do we weld or do we rivet? Now, the airplanes at that time were still riveted. So I told a fellow who worked for me in the development works, I took him later to my fabrication works and said, "Lay it out for riveting. If we can weld, then we probably need as much space as if we have to rivet, but if we have to rivet, then the thought about welding is for no good. So assume riveting." He came up with a size of 200 by 300 meters. Wow!

NEUFELD: That's a big building.

RUDOLPH: So, 60,000 square meters. Or six hundred thousand square feet. Now, I knew that the Willow Run plant near Chicago [actually Detroit] had one million square feet.

NEUFELD: Willow Run, I thought that was a Ford plant?

RUDOLPH: Maybe Ford ran it, but it was an aircraft plant, and I remember it had one million square feet.

NEUFELD: Yes, it sounds familiar but it sounds to me like a Ford auto plant but I'd have to look that up. Okay, so you knew that that existed as one million square feet, so it was gigantic.

RUDOLPH: Now, when I presented that to Schubert, "Rudolph, have you made it one number bigger than you think is needed?" Imagine! Imagine!

NEUFELD: He meant a factor of ten?

RUDOLPH: Oh no, he meant, have you done the minimum which is required, or if you have thought it should be say 100,000 square feet, have you made it 200,000? That is the expression, one number bigger. And Dornberger would say, "Make it smaller, make it smaller, it costs too much, it costs too much, much too big, much too big." And Schubert would say, "Dornberger, you have said A, now you have to say B. Be consistent."

NEUFELD: In other words, "you want this big plant, you want to produce in-house, you'd better build something big enough."

RUDOLPH: Yes. See, this is what I liked in Schubert. He would protect me against Dornberger, who would always try to cut back. So I appreciated that very much. So this was for instance one instance when we were faced with a big issue with Dornberger, and he didn't want it that big, but Schubert insisted we make it that big. That was only one-third of what we thought we would need.

NEUFELD: So each building would have been 60,000 square meters and Schubert basically backed you up on the 60,000.

RUDOLPH: Yes. And then I needed for it a maintenance building. If you have such a big fabrication building, you need a lot of supporting activity, to sustain that production, and therefore I decided, or had decided a building which was 200,000 square feet which had for instance a woodworking shop to build all the bins and so on for the fabrication building. And not only that, in there were welding shops and a lot of machine shops to support the whole factory. And in the basement, there were the air raid shelters and the rooms for the workers, wash rooms and the bins for the clothing and for washing and so on, and also storage for the fabrication which went up a etage higher.

NEUFELD: One floor higher.

RUDOLPH: One floor higher. And on the ground floor there was also a railroad track, at the end of the building. This was the

building, here was the railroad track, and then came here, the work floor, and beneath there even with the railroad track was all this side here, two and a half, three feet high, the storage rooms and the facilities for the workers.

NEUFELD: Not two and a half, three feet, you probably mean two and a half, three meters, right?

RUDOLPH: Meters.

NEUFELD: Right, because 2 1/2 feet is only about this high.

RUDOLPH: That always happens. I mix up dollars and marks and feet and meters.

NEUFELD: You've worked in both systems, and to keep them straight is difficult. So you had an underground floor.

RUDOLPH: Right.

NEUFELD: Which was rooms for storage, lockers for workers.

RUDOLPH: Right.

NEUFELD: Those kinds of facilities.

RUDOLPH: Yes.

NEUFELD: And you had the ground floor, which was --

RUDOLPH: The fabrication floor.

NEUFELD: Workshops. And then you would have an assembly area on?

RUDOLPH: Same floor. And there now --

NEUFELD: I was assuming there was yet another floor above that.

RUDOLPH: No, no.

NEUFELD: Okay, I now understand. The two levels are sort of below ground and ground level.

RUDOLPH: Right. I know that on this floor on top of the facilities for storage, the workers and so on, there was the real fabrication and assembly floor, fabrication and assembly. So in the side buildings there were the machining facilities and then in the higher building there were the big presses, I forget how many thousand pounds, the presses, about four. They were something which was unusual.

NEUFELD: Very large.

RUDOLPH: Very large, very high pressure.

NEUFELD: Steam hammers, would you call them?

RUDOLPH: No hammers, hydraulic presses.

NEUFELD: Hydraulic presses, Okay.

RUDOLPH: They were of course needed to form the parts of the engines.

NEUFELD: Are you talking nozzle, combustion chamber?

RUDOLPH: Yes, nozzles and combustion chambers and the bottom or top, they had 18 injection pots, sitting on top. These all had to be formed.

NEUFELD: Right, and you had the injector.

RUDOLPH: The injection systems had to be machined, so I needed quite a lot of machine tools, and the combustion chamber was to be welded, so I had to have welding equipment of all kinds. At that time, the development works had developed also a system to weld the outer shell of the A-4, so instead of riveting, welding. And so that gave us a sort of a leeway in size. We could use the size very effectively and not be hampered by limits of size. So I had of course a lot of machine tools. And in order to have a smooth running machine tool delivery, I developed, I think I took a week or two on it, just to lay down the system of ordering and delivering machine tools. And assigned for each machine tool already a place in this huge area, and give it a number, and then, I wrote a requirement order, and in this requirement order came the number of the place in the factory building, and I insisted on it that this would be repeated in the contract the air force now let to industry, and the industry had to provide within a certain time photos, weight, floor space requirements and foundation requirements, so we could in advance establish the proper reconstructed supporting of the machines. And this worked beautifully. There was no haggling where this machine should go. It was previously determined.

NEUFELD: Was that difficult? Again, you have that problem, you're trying to set up a manufacturing plant for something that's still a paper concept, almost.

RUDOLPH: Yes, but certain things were very clear. For instance, the machining of these injection equipment, of these 18 tops was very clear, so I could make the determination to put these machines in a side building. Now, what was more difficult of course was to determine the height of the crane hooks, and if there should also be an A-10 assembled or fabricated, and that was what Dornberger wanted, should we not only do the A-4 but the

A-10? And there was nothing on paper for it. Just in the heads of people.

NEUFELD: Was the A-10 conceived of as a one stage missile or as a first stage of a two stage?

RUDOLPH: I assumed it would be a one stage missile.

NEUFELD: Okay.

RUDOLPH: That would simplify the thinking. Otherwise it would become too involved and almost insolvable. So I think the crane height was 20 meters at least if not 30, so you can imagine what a tremendous building that was.

NEUFELD: The height of the final building was 20, 30 meters?

RUDOLPH: 30 to 40 meters.

NEUFELD: 30 to 40 meters which is something in the neighborhood of 100 to 140 feet, something like that, in height. ...

RUDOLPH: Then of course the area was forested, and when this area was cut out, and I came to see it, I almost fell out of my shoes, and said, "For gosh sakes, what have you done? That's too big, too big, too big."

NEUFELD: When did you say that and when did you determine--

RUDOLPH: --the first cleared area where the building was to be erected.

NEUFELD: When?

RUDOLPH: I really got a shock when I saw that.

NEUFELD: Do you know what the date was roughly when you saw that and felt that way?

RUDOLPH: Let's see, I did the design or had the design done in '38. It was in early '39. Early '39.

NEUFELD: So early '39 day laborers were already clearing the forest from that area.

RUDOLPH: Ja. So I really got a shock. And now I felt as if I had been standing in the snow and making that little snowball and it began to roll and I could catch that ball any time I wanted to, but suddenly this snowball was an avalanche. A tremendous avalanche. And I got really scared.

NEUFELD: You were constructing one of the largest factory

by two people that there was a contact with Himmler through Stegmaier.

RUDOLPH: Through Stegmaier?

NEUFELD: Yes.

RUDOLPH: Stegmaier, that was the name of that major I was talking about before.

NEUFELD: Really?

RUDOLPH: Ja. Incompetent.

NEUFELD: Was Stegmaier, who had been head of Entwicklungswerk, because in one chart of '42 it shows, Zanssen is commander, then you have Stegmaier in Entwicklungswerk, Okay, Leiter, Entwicklungswerk, I think at that time he was a lieutenant colonel but it doesn't really matter.

RUDOLPH: No, he never, to my mind he never got higher than major.

NEUFELD: Because on this organization chart it shows him as lieutenant colonel. So Stegmaier was the person that you were always fighting with, that you really disagreed with. Okay, that's a very important piece of information.

RUDOLPH: I was not always fighting with him, but when we had contact, it was fighting. This was not happening every day, because I did not really report with him. I only needed the support of his office in hiring personnel.

NEUFELD: Okay, that's really important, that we finally figured out who that is. Stegmaier is obviously a person many people disliked, from what I've been able to tell. Do you share the opinion of Dr. Reisig that he was thought of as an SS person, that he had strong connections to the SS, or would you know?

RUDOLPH: No, I don't know. I don't know. I only know I disliked him intensely.

NEUFELD: Because he has two reputations, from what I've heard from Reisig and from reading and so forth. Reisig said that he thought and some other people thought that Stegmaier was an SS spy, although he was an army officer. He also had been known as kind of a party fanatic or something of that sort. This was at least a claim that was made, and that some people didn't like him. Now, he must have been doing something right for somebody or somebody must have liked him, because he held his position for a while, but he was obviously disliked by more than you.

RUDOLPH: Let me say the following --because there was no other

buildings in the world at that point.

RUDOLPH: Ja. And as a sidelight, General Zanssen who had been in touch with the development works, he was a friend of mine. Even during wartime he would manage to get me a piece of chocolate for my birthday. He would never miss to see me on my birthday and congratulate me, and he was a supporter of mine. He had not the slightest doubt that what I did was correct, because he knew me long enough. He met me out of the usual what I did, but it worked, and when he had to go to the Eastern Front as a division commander, his deputy, no, not his deputy, his successor, he was a major, and he would say to me what I did was much too big. He reminded me of Schneider who had been a blocker, and he was the same type. He was always afraid that something would be too big. And he was now in charge ...

TAPE 4, SIDE 1

RUDOLPH: I mentioned this major who was now in charge.

NEUFELD: Are you sure it wasn't a major general?

RUDOLPH: No, no, it was a major, the major, not a higher rank, and he was now supposed to support von Braun and his technical people in furthering the development of the V-2, A-4, and to my mind, he was a stumbler. He had no grasp of what was needed and what was going on. And so he would accuse me of making everything too big, and employing a lot of people in constructing these big buildings, and equipping them. And when Zanssen came back from the Eastern Front, he came right away rushing to me, and he congratulated me on the big buildings. He said, "I saw such buildings, not one but more than one, in Russia in the big forests, as the German army advanced. They were equipped with the foundations and only waited for the arrival of the machinery to be put on and start operating." And the Germans advanced in the early months of '41 -- too fast, so they could not do that. But he said that was the last chance to beat the Russians. A later attempt would for sure have failed. But then it failed too, with the help of Americans.

NEUFELD: Okay, now in order to get this story really straightened out, all I've known so far about Zanssen, because I talked to his daughters whom I met here about this, was that he had been made base commander at Peenemünde, what you'd call the military commander of Peenemünde, after Schneider was gone and after these two halves separated, which was about when, at the beginning of '38? Something like that.

RUDOLPH: Ja.

NEUFELD: Somewhere in there anyway. And I thought he had been base commander all the way through to 1943, when of course he was

pushed out, and everyone says that Himmler was behind him being pushed out in May, '43. At least that's what I've heard so far. Was he then away in the Russian front in between that time some time? He had been absent from Peenemünde for some time?

RUDOLPH: Yes. Yes. This major that I mentioned was now taking over the military side of supporting von Braun and cohorts.

NEUFELD: But this was in the middle of that period. It had have been obviously after June '41.

RUDOLPH: Oh ja.

NEUFELD: Because that's the invasion of the USSR. And it would have had to have been before you left Peenemünde at the end of August, 1943, so it had to be somewhere in that period, you remember Zanssen being gone.

RUDOLPH: Right.

NEUFELD: To Russia. And a substitute or a representative, a Vertreter I assume was put in his place, right? Or you had to deal with somebody in his office who represented him?

RUDOLPH: I had really very little contact with this major. He was mainly concerned with supporting von Braun and his development team. Now, one day Dornberger in Berlin asked me how many people there would be needed to operate the Versuchsserienwerk. And so I told my staff to come up with a number, including everybody, even the floor sweeper, and I came up with 5000, 5000. And Dornberger asked the development people also how many more people they would use, need, to complete the development, and they came up with 50. 50. When I saw this figure, I almost fell out of my shoes. I right away knew that would by far not be enough. And I knew they had difficulty completing the development, because when I asked for the drawings or parts lists for the production in the Versuchsserienwerk, I couldn't get them. They had done nothing in that respect. So they needed more people to take care of that, to support me in production. But nothing doing. And then, we flew to Berlin to present our plans to Dornberger, and I showed him my plan, supported by maybe papers that thick, and he accepted my figure, and he also accepted the 50, and I was wondering why he said nothing, because shortly after that, he realized, or maybe it was even before that, that he needed a separate staff to convert the development papers into production papers, and so he got from Speer, the Minister Speer, a fellow with the name of Stahlknecht who had been quite experienced in the production of airplanes, and he started out to pull all this development material, specifications and whatever, together, and we had a meeting with Dornberger, that is von Braun and his staff, I, myself, and Stahlknecht, and Stahlknecht was complaining bitterly, very bitterly about the state in which these

development papers were in. He said, "If I have here a drawing set, it is changed in the next half an hour," because the development was not completed. And so now these guys asked for only 50 people more, when there was a tremendous amount of work in front of them.

NEUFELD: So the 50 people was --

RUDOLPH: --so I think that this major, I can't recall his name, was putting this number 50 down, because he had no concept of what big a task it was in front of him, but he would try anything to get people away from my work. And the building construction department of --not the air force, but there was a Baugruppe Schlempp--he would pull away from me so I could not do my work in time. But I was still ahead of him, even so. I disliked him intensely because he was just a little guy, no manager, no concept of what was needed.

NEUFELD: He was sitting in the base commander's office. That is, he was in the central office, which of course was above both the Entwicklungswerk or Werk Ost and the Versuchsserienwerk or Werk Süd.

RUDOLPH: No, he was not on top of the Versuchsserienwerk. That was Schubert.

NEUFELD: No, I just meant that on the chart --

RUDOLPH:--no, not even on the chart.

NEUFELD: On the organization chart, you were completely separate from Werk Ost.

RUDOLPH: Completely separate.

NEUFELD: Right. But you did report through to the base commander, did you not?

RUDOLPH: No, no. I only needed the base commander when things like having a safe transported from my old office to the new office, in the production plant.

NEUFELD: So you did not even then, on the organizational chart, you did not even come under Zanssen?

RUDOLPH: No. No.

NEUFELD: You were directly linked, your next superior was Berlin.

RUDOLPH: Right.

NEUFELD: And Schubert was in Berlin and had his own office inside

the Heereswaffenamt.

RUDOLPH: Right.

NEUFELD: Was your direct superior, no base commander to deal with in between you and them, Okay.

RUDOLPH: Only in a supporting role, I had to deal with the base commander.

NEUFELD: Yes, clearly you would have to have relations and work together.

RUDOLPH: Yes, on hiring personnel, no use of setting up a parallel personnel office if they could do it in addition.

NEUFELD: Okay. So that's new. I didn't know that. A few questions that came out of what you were saying. One was, in your description of the building, you talked about the high, to use American terminology, high bay areas. This was essentially a rectangular building, right, 200 by 300?

RUDOLPH: Yes.

NEUFELD: Just a straight flat-roofed building?

RUDOLPH: No, it had a sawtooth roof, but these sawtooth, sawteeth were designed by a mathematician and designer who designed the planetarium domes. Very thin, very strong. And that was of advantage when the bombing raid occurred. In these buildings, in the development works, Werk Ost I had used wooden blocks for floors. That was usual at that time, so if a work piece fell or a tool it would not be damaged but rather the wooden block would be damaged. Now, in these new buildings which were all out of steel and concrete, a steel skeleton and then the concrete put around it, for reasons of saving steel, because it was always in short supply, we suffered of course under these conditions. So when the air raid came, they set the wooden floor on fire and destroyed everything that was inside.

NEUFELD: In the Entwicklungswerk.

RUDOLPH: Ja, so the laboratories or workshops there could not be used any more, and in the production plant, when the bombs penetrated the thin concrete roofs, the ignition system went off and the bombs exploded, but in this tremendous empty area of air, did hardly any damage. Maybe a splinter or two would hurt a few machine tools but not significantly. And there were only two floors, work floors, damaged to an extent that they were falling down partly. So these were all conditions which could have been easily repaired, if not a decision would have been made to evacuate the final production to somewhere else.

NEUFELD: Right, and your facilities were taken over by the Entwicklungswerk.

RUDOLPH: Right.

NEUFELD: After you went to Mittelwerk.

RUDOLPH: Yes.

NEUFELD: They took over your buildings because they survived.

RUDOLPH: Yes. And they could now work in this sub-floor three feet high.

NEUFELD: Three meters.

RUDOLPH: Three meters, that's right.

NEUFELD: Did they use the second floor, the upper ground floor level?

RUDOLPH: I don't know. I don't know. I only know they worked under the protective concrete floor, and did quite well. Now, there was of course the machinery I had ordered, which I needed for the underground plant, but this machinery was, because of the damage which was done to Peenemünde East, also in demand by the development works. So I had to go back to Peenemünde and deal with Rees, who was my successor, to get enough machinery for the underground production.

NEUFELD: Eberhard Rees.

RUDOLPH: Eberhard Rees. We came to an agreement. The big presses, I got. Most of the machinery, I got. And so we could move underground. Now, still there were no complete drawing sets and no complete specifications, no parts list, so I had to go back to Stahlknecht who had the task to fix up, let's say, the development material, paper, and so on, and convert them into production drawings. I remember he complained bitterly that every time he thought he had it completed, these development fellows changed, so conditions were floating, nothing firm.

NEUFELD: As far as, I wanted to backtrack to earlier periods but let's do this first, this Stahlknecht. Stahlknect came, as I understand, mid-'42, something like that, early '42, middle of '42? Somewhere in there?

RUDOLPH: I couldn't, I don't recall when he came. I only recall --

NEUFELD: I know he's there in the middle of '42.

RUDOLPH: I only recall that every day, every day groups of people came swarming over the Entwicklungswerk people and and also over me and my people, wanting to know, to know, to know. And it was so bad that I couldn't even work any more. I had only to show these guys around or assign somebody else to show them around, so their questions got answered. And they all came from the armaments ministry, Speer, in anticipation of establishing production somewhere else, because in Peenemünde we were laid out for 300 a month, and the Speer ministry asked for 900, even 1800 a month.

NEUFELD: Yes, the numbers kept growing.

RUDOLPH: Growing, yes.

NEUFELD: Out of all control sometimes. That was in '43.

RUDOLPH: That was in '43.

NEUFELD: Yes, Degenkolb and Saur kept asking for bigger and bigger numbers on paper.

RUDOLPH: And where was I now, I am lost?

NEUFELD: You are talking about Stahlknecht and all the problems with the --

RUDOLPH: So I had to ask Stahlknecht and one of his fellows whom I knew personally, "Please, for heaven's sake, give me at least a parts list." So that was the situation after the raid.

NEUFELD: It still wasn't very clarified at that point, the parts list, and the production drawings were still not clarified.

RUDOLPH: Oh no, not at all. Not at all. They took another year in the underground plant before it was straightened out.

NEUFELD: Where did the fault lie for that? Obviously this in some ways really became a problem for you all, because of course you were in the middle, the development works were also in the middle of their serious problems, trying to get such a difficult, such a revolutionary thing as the A-4 to work.

RUDOLPH: It was too new, and they needed much more time. And then by decree, a command decision, it was ordered that the darned thing would go in production, in whatever situation it was in. Well, fine, but if you don't have the necesssary supporting stuff, like drawings, specs, part lists, you still cannot do it, even if it is a command decision. And that caused big problems. These guys, not Speer, but he had a fellow with the name of Saur.

NEUFELD: Yes, I know who that is.

RUDOLPH: I think he was a nut. A nut.

NEUFELD: Completely out of control in terms of demands?

RUDOLPH: Oh, he demanded these figures, he demanded not 900 but 1800. That was in a meeting where he told a fellow, "900? Forget it. 1800." Well, you cannot just double a demand which had been established for months before, and everything was concentrating on that, and it would have been better to leave this figure at 900 than to try to get a higher one. And in such a meeting, a fellow from industry who got now involved, very big, Saur fired him on the spot because he said, "It cannot be done." The guy was honest, so he got fired. So what do you think the others said?

NEUFELD: Yes, they didn't say anything.

RUDOLPH: Saur caused, oh, he caused a lot of confusion.

NEUFELD: Okay. Do you think that the development works had any responsibility for the disorganized state of the drawings and the parts list in '42?

RUDOLPH: Yes. You see, when I was in a meeting with von Braun and Stahlknecht and Dornberger, and Stahlknecht complained bitterly about not getting the material, the papers together, I remember that Thiel stood up and said he would quit, he would go to a university and be a teacher instead of struggling with the development of the A-4.

NEUFELD: Do you have any recollection --?

RUDOLPH: That serious was the situation, and only in the winning ways and soothingly talking to Thiel did Dornberger change Thiel's mind and not carry out what he thought. It took a lot of talking by Dornberger and by von Braun.

NEUFELD: Do you remember what time that was?

RUDOLPH: That was before the air raid.

NEUFELD: Not long before?

RUDOLPH: No, not long before. I figure it must have been in June, May or June of '43.

NEUFELD: Dornberger says in his book that there was also a big confrontation, argument, just on the very day of the air raid. Of course they didn't know it was going to happen, but on that very day, the 17th of August, there had been a violent argument in a meeting over production and Thiel got very mad. Maybe this happened more than once.

RUDOLPH: Oh, that happened more than once. It happened very often. Even von Braun said it could not be done.

NEUFELD: That the putting it into production now, that is '42, '43, was crazy.

RUDOLPH: Years would be needed. Thiel meant that years would be needed to ever get the development of the engine completed, not to talk about the other complications and the complicated equipment of the A4 (V2).

NEUFELD: Thiel wanted to move to a more simplified engine, I gather, because I've seen discussions, even a photograph of a much simpler engine.

RUDOLPH: Oh, ja. That was his ultimate goal because this was a darned complicated engine, most complicated, with 18 --

NEUFELD: --injectors --

RUDOLPH:--injection pots sitting up there, with all the valves, and the precision required. You see, you had steel and then aluminum piping, so these had to be carefully connected, all the stresses and strains had to be taken out to be tight, and if you were not careful, if you tightend not enough, then it would leak, and leaks meant explosion. So you tightened it enough but not too much, because if you tightened it too much, the aluminum would flow, and again you would have leaks. So from that example alone, you can see how darned difficult it was to assemble that Triebwerk, that it was the ofen --

NEUFELD: --yes, the combustion chamber --

RUDOLPH: --with the 18 tops on top --

NEUFELD: -- 18 pipes going into it --

RUDOLPH: --18 pipes going into it, and then in addition you had the fuel pipes. A complicated machinery, good grief.

NEUFELD: The aluminum steel connection, was that where the liquid oxygen pipes met the injector head?

RUDOLPH: Right.

NEUFELD: So you had to have a weld. That's what you were talking about when you were talking about --

RUDOLPH: -- this was not welded, It's a pressure seal.

NEUFELD: Okay, pressure seal.

RUDOLPH: Because a rubber seal wouldn't help, it would be too hard under the temperature of liquid oxygen, so the aluminum joining the steel by pressure would make the seal, and if it was done right, it worked. But it was difficult.

NEUFELD: And the problem was of course, you didn't have to do it once, you had to do it 18 times every single engine.

RUDOLPH: Right. Now, imagine building 900, and then this guy is doubling to 1800.

NEUFELD: Yes, crazy.

RUDOLPH: He had no idea what was involved, and because of that, of course, he thought the same about the jet fighters which were developed in Germany.

NEUFELD: Messerschmidt 262 and so forth.

RUDOLPH: Yes. The development worked beautifully, but by ever changing the programs, he brought more confusion, and confusion is what killed it, killed or delayed the V-2 development and also the fighter development, and many other programs, until in the end it was impossible for a little Germany with limited resources and limited manpower, even so, French and Polish and Russians worked on it, impossible. You have a limit. Above that you couldn't go.

NEUFELD: Fundamentally you were at war, but you had too many big opponents, industrial capacity wasn't large enough. Okay, I had wanted to get, before we run out of time here, a picture of the size of the operation as you went along. You started in '38 on this. You started with just a handful of people, three or four assistants.

RUDOLPH: Right, and then at that time, when the bombing occurred, we were about ready to get the assembly line in operation in this first big building, that was being built, the other two were not being built, because of lack of resources, lack of cement, lack of steel and so on.

NEUFELD: So you had about 500 people at the end, but you didn't really have your work force.

RUDOLPH: No.

NEUFELD: You had workers to actually start assembly?

RUDOLPH: I had of course some, and also got some from the Werk Ost. In fact, the Werk Ost moved into one of my buildings, and that was the maintenance building, and continued in vertical assembly. The A-4 was vertically assembled like the A-3 and A-5,

in the same fashion. And that could be done in this maintenance building where also the woodworking shop was operating very nicely, but they brought their own people with them. But when I demanded now for the horizontal assembly, which was planned, in the big fabrication building, I got nothing. See, therefore Stahlknecht and his activities were so very, very much needed. But he did not succeed either.

NEUFELD: So at that point they needed the people just to try to straighten out the production drawings and all of those things before anybody would give you the people to actually build.

RUDOLPH: Yes. The design was not ready. You know, this was the first time that such a big machinery, it was really a flying laboratory, was being built.

NEUFELD: Right.

RUDOLPH: It was not like an airplane where you had years of experience already. It was the first time such thing had been done. And therefore, there were of course tests run and it worked, but then there was no documentation how it had been done, like in the Steinhoff fashion, who came in the last second with a new black box with no documentation. Without supporting papers. And that is the way it is today or was at that time and still is today. If you make a new piece, you need new documentation or updating old documentation, not just do it and then don't know--what did I do? See? Nobody knew. And there were many people in development who pushed the development in a certain direction. For instance, making a change in an equipment which worked, which did not need any further improvement, because it worked for a minute, and that was the flight time.

NEUFELD: The time when the missile was operational.

RUDOLPH: Was operating for five hours. And they still wanted to improve that. I knew of some cases, I cannot recall them right now, even during the time of the production in the Mittelwerk, I had to tell them, "Stop it, God damn, stop it! This is good enough. Concentrate on the things that don't work."

NEUFELD: So in between those two figures, five at the beginning, 500 at the end, can you give a sense of how fast it scaled up? You had a couple of hundred at the beginning of the war?

RUDOLPH: You know that Dornberger got this so-called Versuchskommando Nord.

NEUFELD: Yes, right.

RUDOLPH: So when these fellows came, I had asked 5000. I realized it was too soon. I could have put them to work anyway. But I did

maybe get 50, and 4,500 got in the development works which only had asked for 50, but now, they swallowed the major amount of the newcomers, and still, now we had of course to educate all these fellows. They did not make useful work right from the beginning. That meant an educational process, and that burdened the development engineers, educating the new guys. I had maybe 50, maybe 100 out of this 5000. And then came another swallow, and I got out of them maybe 100 or so. And then of course from the development works I got by and by also, so my guess is, about 500.

NEUFELD: At the end, right. So when did you first get VKN people? Was that right at the beginning of the war, after Poland, that you first got military people from Versuchskommando Nord?

RUDOLPH: No, it was much later. Now, let me see, let me see. When was that? I think it was in summer '43. Now, the first successful flight was on October 3, '42. And that of course supported to Dornberger, and so he could get these VKN people, summer of '43, maybe later.

NEUFELD: Yes, because I guess the books disagree. Some say that the VKN existed as early as late '39, others say different.

RUDOLPH: No, no, no, nothing whatsoever.

NEUFELD: Because it's often attributed that it was Dornberger's connection to von Brauchitsch, and that was crucial. Von Brauchitsch of course was removed as commander-in-chief of the army at the end of '41.

RUDOLPH: Yes, but at that time there was no VKN, I'm sure of that, absolutely sure of it.

NEUFELD: And you think --

RUDOLPH: --the VKN came only after I had made up the list needing 5000 people.

NEUFELD: When do you think you determined the figure 5000? Maybe I asked this question, I've just forgotten.

RUDOLPH: Let me think a moment.

NEUFELD: And it's a strain, so many dates.

RUDOLPH: I think it was by the end of '42.

NEUFELD: That's when you had drawn up your list of workers that you would need to operate.

RUDOLPH: I had a deputy who was a production man, a real

production man. He had a tremendous experience from industry in producing, for instance, beds for military and other military equipment, and I gave him the task to figure out how many we needed, and he came up within a week or so with 5000. And I did not criticize anything. I saw his list and it sounded Okay to me. I even commended him and his good work. Now, see, Dornberger wanted me to remove that guy, because he was a small track engineer. And in these VKN people I got the 50 or 100, out of the 5000. There was a Diplom-Ingenier Donaubauer, like the river Donau and Bauer, so Donaubauer, and what a strange guy. He always came to me, asking how we should do that and do that. And I told him, "Don't bother me, think about it and find out a solution yourself." But he never did. He always wanted me help him. And for this reason I resisted when Dornberger wanted me to make that guy my deputy, to fire or remove my trusted experienced deputy.

NEUFELD: Which was who, your trusted deputy?

RUDOLPH: He was the one who made this list.

NEUFELD: What was his name, do you remember?

RUDOLPH: His name was Broszat. ...

NEUFELD: I remember the name. There were a few other detailed questions that came out of what you said. The construction, the clearing of the land, the construction of the facility, that had still been before the war a Luftwaffe responsibility, because they had been the construction organization earlier on?

RUDOLPH: I have to think for a moment. I think so. No, it could not have been before the war. It must have been during the war. And that was taken over later on by the Organisation Todt, and then by Baugruppe Schlemp.

NEUFELD: This is crucial if Speer's role is to be figured out. It's said, again, and these insertions are not very pinned down well, that he took over the construction management, 1939 or 1940.

RUDOLPH: From who?

NEUFELD: From Luftwaffe or something, that Todt, of course he was officially part of Organisation Todt at that time, he was under Todt.

RUDOLPH: I think he was the deputy of Todt. And Todt had of course the big organization that built the west wall, that built all the new projects like Peenemünde and so on.

NEUFELD: The Autobahn.

RUDOLPH: And the synthetic gasoline plants and so on.

NEUFELD: So at some point Organisation Todt came in and the Baugruppe Schlempp, was that under Organisation Todt? Or was that something altogether different?

RUDOLPH: I'm not sure myself. Anyway, when Speer was now in charge, the Baugruppe Schlempp appeared.

NEUFELD: Schlempp was the name of a person?

RUDOLPH: Right. He was an associate of Speer, and by the way, Speer, and there was a whole bunch who came from the Rhineland, who had been party members, and clung together and formed a sort of a clique.

NEUFELD: In the Speer ministry.

RUDOLPH: And established so their influence throughout Germany. And they were now opposed by Himmler, who wanted to get his hand and grab the whole Peenemünde outfit, and he finally did.

NEUFELD: Yes, in a way, although never directly as a, he never directly controlled Peenemünde Ost but he was the over -- was sort of the over-person, over all of the different areas, I guess, huh?

RUDOLPH: Who?

NEUFELD: Kammler, under Himmler, was the person over the whole thing.

RUDOLPH: Himmler was in the sky.

NEUFELD: I understand. What I'm saying is that Peenemünde Ost was never directly SS.

RUDOLPH: No.

NEUFELD: But it was indirectly controlled by Kammler and Himmler. Himmler first appeared as a factor in 1943, right?

RUDOLPH: Yes.

NEUFELD: Earlier, some time in the spring of '43?

RUDOLPH: I'm not aware of that. I know only that in 1943, he really became very influential.

NEUFELD: You know nothing about the story of earlier -- we know that he came in April to Peenemünde and again in June, something like that. And there's a story which has been sort of confirmed

guy who could fill that position. See, he had quite some experience in the missile field. The development in the Entwicklungswerk, in the development of the V-2, even if he was not competent to do so, he had at least in the minds of a lot of people the status of being knowledgeable. And to take another one in his position could have been a big wash. So there was this question mark.

NEUFELD: Whether he could easily be replaced, even though he caused questions about problems. Okay.

TAPE 4, SIDE 2

NEUFELD: So you were just saying something about Colonel Zanssen, later General Zanssen.

RUDOLPH: I think General Zanssen was removed unjustly or demoted unjustly. I think very highly of him.

NEUFELD: I just heard a story about that from his daughters. One of the things that they heard of or said they knew or heard later. One is of course, books assert that Zanssen was removed because the SS declared him unreliable politically. Or you know, that he was somehow a suspicious character or something. Do you know anything about the charges that were made against him at the time, that seem unjust?

RUDOLPH: No. I only heard that he was removed, and I was shocked when I heard that, because I think he was highly comeptent as a manager. He had a good knowledge of engineering, understanding. He saw through things when people wanted to cheat him. He noticed that, and said it bluntly, and for this reason was disliked by many. But he had the right attitude, to my mind, by opening the cases where people were trying to cheat him and telling big beautiful stories, where he knew it couldn't be that way. It could not be that good. While Stegmaier would make it even more beautiful and fool Dornberger.

NEUFELD: So he had a good eye for --when Stegmaier or other people were not being entirely honest --

RUDOLPH: --right --

NEUFELD: --with what was really happening. You know nothing then about the background, why he was removed?

RUDOLPH: No.

NEUFELD: At all, because his daughters tell me that he later said that there were disagreements between him and Dornberger at that time.

RUDOLPH: I doubt that. I doubt it. I don't think there were disagreements between Dornberger and Zanssen, but the pressure on Dornberger might be from the SS, so high that he could not protect Zanssen any more. I'm sure that Dornberger would do anything to protect Zanssen. They were real buddies.

NEUFELD: Very close friends, huh. This is a very hard story to verify. They say that later on Zanssen said there were disagreements between him and Dornberger over the SS role, you know, that Dornberger felt that it was Okay to have a bigger SS role. But that's very hard to verify, and one of the problems I have with it is that Dornberger was an army man, and obviously there were problems. The SS was a rival in some ways to the army.

RUDOLPH: Yes, the SS was a rival. Now, I don't say that everything that the SS did was bad. For instance, the SS had in Poland I think research on jet engines for the jet fighters. And I remember that they moved this equipment to the Mittelwerk to protect it. So they did good things. Of course, they played insofar a bad role then that Himmler tried to have everything, everything subject to his thinking, his ideas.

NEUFELD: And they had a massive concentration camp system that they used.

RUDOLPH: Undoubtedly.

NEUFELD: Okay, now, I had a question about the labor force and the construction and so forth. I gather from this book that you had nothing much to do with the prisoners of war, the Trassenheide camp.

RUDOLPH: Nothing.

NEUFELD: They were employed by whom, the construction groups?

RUDOLPH: Ja, I think so. I am not sure at all. I had nothing to do with prisoners. Pardon me, I have to correct that. Once Dornberger chewed me out because at this woodworking plant, there was a tremendous pile of scrap wood lying there, not orderly stacked up, and Dornberger chewed me out because of that, and he sent in an order around the shop, the scrap wood has to be stacked orderly. And I said, "Dornberger, this is of secondary importance. First you want the work done, and if the scrap wood is piled not orderly, that is of secondary importance. But if you want to have it stabled orderly then give me some more help." And he got me prisoners, Russian prisoners, and one day they arrived there. Then after a few days I went there and looked what they did, and this is now interesting. So it was just lunch time and there was a big barrel full of soup, and of course the thin stuff was on top and the heavy stuff, the thick stuff on the bottom. So each one of the prisoners, maybe 15 of them, dropped one ladle

full of thin stuff, they ate then, and then they got a little thick, then more thick, and so finally the stuff was gone, all eaten up. And then this guy who did the ladling, he started now working again, and he took a 2 x 4, only it wasn't really a 2 x 4, it was much thinner, and he put it on his shoulder and then he walked this way.

NEUFELD: Very short steps, very short uncertain steps, Okay. ...Indicating what, that he was very weak?

RUDOLPH: Very slow. He was not weak. These guys were well fed. There was not probably much meat in that barrel, but still they were well fed and looked healthy. And I addressed this fellow. He spoke German fluently. And I said, "Now, you got fed and I think you don't have to complain about the food." And I think he said, no, he didn't complain about the food. I said, "I think you should walk faster." He said, "But I won't walk faster." He said, "If you Germans think you win the war," and this was at a time when on the eastern front the German armies captured 300,000 one day and the next week another 300,000 Russians, and he said, "If you think you Germans have win the war, you are dead wrong. You will lose it. We Communists will win it." Imagine, at that time, he was so convinced that the Communists would win. And they won.

NEUFELD: So the prisoner of war camp, the labor camp, was totally developed for construction, clearing?

RUDOLPH: Well, Trassenheide, I don't even think that Trassenheide was a prisoner of war camp. There was a labor camp there.

NEUFELD: A labor camp.

RUDOLPH: And these were volunteers who were there, and the Russians I was talking about were not in that camp. They were in a separate camp.

NEUFELD: But all of this was outside your organization.

RUDOLPH: Yes.

NEUFELD: This was somebody else's -- it doesn't seem they played much of a role at Entwicklungswerk either.

RUDOLPH: No.

NEUFELD: So they must have been construction mostly.

RUDOLPH: Yes, I think so. I think so. If they were Häftlinge or prisoners out of a concentration camp, then they were probably employed by construction, and certainly not in my plants.

NEUFELD: But in building the plants there, in clearing the

spaces, putting up the buildings?

RUDOLPH: Ja, that could very well be.

NEUFELD: You didn't have any direct control over that.

RUDOLPH: None at all.

NEUFELD: You handed over the plans to somebody.

RUDOLPH: to Baugruppe Schlempp of the Speer Ministry. No, I didn't even see the concentration camp prisoners. I didn't see any people in striped suits in Peenemünde. But I was told later on, even by visitors who came to visit me here in Hamburg, after I moved from the USA to Germany, that they knew they were there and they saw them, and I did not see them. Now, I did not walk every day through the whole area where the construction was going on. I went maybe there once every week. Then I didn't see any.

NEUFELD: Your office was where, was it separate?

RUDOLPH: My office was first of course in Werk Ost, then in the buildings of the Baugruppe Schlempp and then in a separate barracks especially built for my staff.

NEUFELD: That was again south, was that south of where the factory buildings or production facility was going?

RUDOLPH: No, that was just south of the development laboratories.

NEUFELD: Just south.

RUDOLPH: And then after the big buildings in south were being built, there was also a big administrative building, and I moved into that, and that was about four weeks before the raid.

NEUFELD: So that was just finished and then --the administration building was in the neighborhood of the factory buildings which were built?

RUDOLPH: Yes.

NEUFELD: Okay. We have to stop pretty soon, so let me just think of what important questions are left. One, probably small point, as far as the production line was concerned, this was not a conveyor or assembly line kind of production, this was stationary horizontal construction, right?

RUDOLPH: Yes.

NEUFELD: Sort of like aircraft.

RUDOLPH: Right. There were ideas of having an assembly line, where first, midsections were put on carriages, then the engine attached, and then the forward part and so on. But it was not ready. Another four weeks and it would have been, so that we would really be able to start that, if we had the parts.

NEUFELD: Are you talking about some kind of moving conveyor?

RUDOLPH: You could call it a conveyor, because there were tracks in which the carriages rolled.

NEUFELD: Okay, so they would mount it on some kind of car..

RUDOLPH: Yes.

NEUFELD: And the car would be rolled or pulled.

RUDOLPH: Right, it would be rolled, in a certain track. Say, for example every twenty minutes.

NEUFELD: Okay, so that was a kind of simple assembly line, sort of like an auto factory, although obviously can't go very fast because it's much more complicated than a car.

RUDOLPH: Much more complicated.

NEUFELD: But it was a kind of assembly line thing where it would be moved up at regular intervals from station to station, and you would feed in the parts from various part shops that existed along --

RUDOLPH: There were these part shops, and then you had subassembly lines, for instance where the engine was assembled, the engine or the Triebwerk, a subassembly line, so you would have a little carriage and on that you put the combustion chamber. Then you got all the pipes, and when that was completed, and there was an important part, the steam generator --

NEUFELD: --right, for turning the turbopumps.

RUDOLPH: For the turbopumps, to get the Triebstoffe out of the tanks, and that was then transported to the main line and attached,

NEUFELD: Right, so you would have an engine subassembly, a complete propulsion system really.

RUDOLPH: Right.

NEUFELD: Including all of the hydrogen peroxide, the steam generator and everything. You'd have that subassembly. You'd have a tail subassembly or something.

RUDOLPH: Right.

NEUFELD: Tanks.

RUDOLPH: And then the forward Geraeteraum was a subassembly.

NEUFELD: Instrument section. Now, I know that earlier points, Luftschiffbau Zeppelin had been involved in building tanks. Were you going to import those, bring those tanks in from Friedrichshafen?

RUDOLPH: We got them from Friedrichshafen. We did not produce any of the tanks in Mittelwerk and of course none in Peenemünde. Since this was well established,at Friedrichshafen, it worked there very well after tremendous difficulties in the beginning. These people did so well that there was no real need to change that. I don't remember whether the Luftschiffbau Zeppelin was the only factory for tank production, probably not. The development fellows, in anticipation of production, had by order of Dornberger to establish three producers, for each main component of the A4 (V2), the tanks, the combustion chambers, the turbopumps, and so on.

NEUFELD: And what time did they start talking about adding on other factories? I know first it was going to be Luftschiffbau Zeppelin for final assembly, in addition to the Versuchsserienwerk. That was a Speer idea, right.

RUDOLPH: See, before the air raid on Peenemünde, of course Speer and Dornberger and others worried about an air raid and so the idea was to establish Luftschiffbau Zeppelin as an additional assembly plant and also Raxwerke near Wiener Neustadt in Austria and so there would be three assembly plants, Peenemünde, Luftschiffbau Zeppelin, and Raxwerke. But at about this same time or shortly before Peenemünde was bombed, also Luftschiffbau Zeppelin was bombed or at least badly damaged by deep flying attacks. And the same happened at Wiener Neustadt. The details I don't know.

NEUFELD: Yes, I know of those raids. In fact, they were not because they knew anything about the connection to A-4, but the Allies saw them as aircraft production facilities and so they launched air raids against them for that reason. That idea came up in '42 or '43, of having these extra factories added on. When you went from three large buildings on the original plant to only building one, were you still holding to the 300 a month?

RUDOLPH: Yes.

NEUFELD: In one building?

RUDOLPH: Well, let me put it--

NEUFELD: -- as a hope, as a goal?

RUDOLPH: As a goal, ja. 300 were demanded out of Peenemünde out of three buildings. Now, two were cancelled because of lack of steel and concrete, so we had to be satisfied with one. Now, let's see what can be done in one. You see, since we now went from riveting ideas to welding, with welding machines, spot welding worked very well so that saved a lot of space, so maybe in one building we could not make 300 but 200, and since these figures were floating anyway, from 900 to 1800 or 2000 a month, so this was in fact wide open. The top figure however was not so wide open. This silly guy Saur demanded 2000.

NEUFELD: Yes, and that's about as high as it went. But you at the time, just before the air raid came and made of all this change, you thought that you might get 200 or something like that out of it. That was what you felt was a realistic figure at that time? Two or three hundred?

RUDOLPH: Ja, if we were in production. The bottleneck of course was the so-called Rudermaschine, the small motor that moved the carbon vaneswhich were exposed to the exhaust stream. If we made 900 missiles underground, that meant 3,600 Rudermaschinen. That's quite a demand. Now, this darned thing was full of problems, full of problems. Unbelievable. And it was a continued headache, and it would have stopped the production of the V-2 if the war end hadn't stopped it.

NEUFELD: Okay. Now, I don't want to hold you much longer, so I just want to see if there's anything else, or anything else you want to say about the Versuchsserienwerk period that --

RUDOLPH: I can't think in the moment of anything else.

NEUFELD: Because it may be a long time before I ever get an opportunity to follow this up. I'm sure other questions will occur to me later on, and perhaps I can write a letter if something comes up.

RUDOLPH: If you write me a letter, and leave space so I can write my answers in.

NEUFELD: That makes a lot of sense. It saves effort on your part. Well, thank you very much. It was enormously helpful in straightening out the story.

RUDOLPH: I wanted to do it today because now my machinery worked remembering, and maybe tomorrow it wouldn't.

NEUFELD: You'd have a bad day for memory. No, your memory seems very good. Thank you.