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TAPE #5
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This tape begins with a response to the Smithsonian's request for data on Vladimir's role in the development of the Northrop Flying Wing.

Northrop Aircraft Company was organized late in 1939 with obvious purpose to pursue Flying Wing ideas of Jack Northrop. And it did so from the beginning. But later on, through the 1940 and 1941, Northrop was invited into bidding on the night fighter which they accepted and developed during the war, so-called Black Widow. I was not connected with the Flying Wing concept until late in 1940 and '41.

Originally the Flying Wing was a single engine airplane and most aerodynamics work, in fact all of it almost, was done by Frederick Dallenbach. He even moved to Caltech and worked there to be close to the people who were operating the wind tunnel and he stayed there for several months.

I got into the Flying Wing on the second model which was the twin-engine model. And the idea was that I should design the shafts between the Menasco engines and the propellers. And I did so and took it in hand and had immediate obstacle in that Menasco Company didn't exist anymore. And nobody had drawings of the engines. And nobody knew the weight of the connecting rods and the stiffness of the crankshaft. And the whole thing was complicated by the fact that each engine was different, a twin-engine airplane but each engine was different, both six-cylinder engines, but different types.

So I went to Jack Northrop, unable to design anything rationally, and told him, would he object if I put hydraulic coupling between the engine and the shaft? And he said no, go ahead and do it because it will eliminate the guesswork in designing the shafts. So I did so; designed an aluminum hydraulic coupling which was back-to-back so that thenex thrust was zero. And these couplings were made and installed in a mock-up. The mock-up was run extensively on the grounds of the Northrop factory in Hawthorne. And once when I was there, one mechanic came out and came to me and he said, "What have you done to those engines?"

I said, "I have done nothing to them, only put the hydraulic coupling between the engine and the propeller."

He said, "We have never seen them run so smoothly. They are the smoothest running engines we have ever seen in Menasco type."

And it occured to me then that the coupling not only has eliminated torsional vibrations going to the propeller, but also, it's own torsional vibrations were held in limits by the coupling due to the inertia of the propeller. And this was an unexpected gain. And the airplane flew over Los Angeles quite a lot and also over Lake Muroc, now Edwards Field. And it was 1941, late in 1941. And it was quite successful. And it was really a forrunner of the big Flying Wing which also had multi-engine propulsion.

That was the second one that Northrop built?

That was the second one that he made. Yes, second one. The first one, I was present with the testing at Lake Muroc. I used to go there with others, stay overnight and we camped in tents and in a motel in Lancaster and tested the airplane on the lake. Incidently, the lake then was not a field as it is now. And it was very interesting to contemplate that its roughness, when divided into the dimension across the lake, dried-up lake, was of the same order of magnitude as the Palomar telescope. And that was an interesting discovery, incidently, made on the lake. The roughness of the Palomar telescope being equal to the relative roughness of the Lake Muroc. And this is all I can say about the Flying Wing and my connection with it.

That's it?

That's it.

Now wait a minute. They must want more than that. Where did Northrop get the idea to begin with?

I think Northrop was a very influential man in American aviation and he was influential in one direction which was clear to me. And that particularly, was that he subscribed to the French L'Aeronautique, which was a exclusive magazine in those days, monthly, which had magnificent drawings in perspective of structure of airplanes, particularly from France, also from other countries. And it was a repository of ideas in aviation which was growing at a very rapid rate.

And he was familiar from L'Aeronautique with Bernard Ferbois which designed an all-metal airplane in about 1923 in France. Bernard Ferbois was a poineer in all-metal construction in France. And Rohrbach, connected with Zeppelin Company in Berlin, Staaken, was pioneer of that construction in Germany. Those two men introduced all-metal airplane, those two individual organizations. And Northrop was familiar with it from L'Aeronautique.

It appealed to him because he had advanced ideas of his own and he integrated it in what he had thought of and tried to work on Flying Wing, even at Douglas, but was not given freedom to. And when he was free to organize a company of his own, he devoted it to Flying Wings. And that is his great

merit there. Actually Northrop, by reading L'Acronautique, which was unknown in this country, he was able to introduce ideas from Germany and Especially from France into the United States and apply them here. This was his great contribution, because he was in a position to do so, and had influence to do so.

Was he pretty well stifled in trying to do things at Douglas?

Well, Douglas organized . . . . uh, Northrop was associated beforehand with Boeing and that fell apart for reasons I am not familiar with. And Northrop was free for a while. Then Douglas Company was in some kind of a threat. I do not know what it was. I used to know that, but I forget it. And they organized a different company under name of Northrop with Northrop as the president of it, in case they would lose the Douglas plant in Santa Monica. They could still go to El Segundo and continue under Northrop's name.

The reason for losing the Douglas plant threat, was unknown to . . . I used to know that, but I forgot it now. There was some real reason that they might lose the factory, a lawsuit or something like that, and it eliminated itself and Northrop was then a parallel organization to Douglas. And it was redundant in a way because it was in competition in a way with Douglas plant in Santa Monica and intention was to close it down eventually. When the war broke out, another plant was a very productive plant and everybody was grateful that it existed. But Douglas Company was always Douglas.

The Turbodyne was to have powered the Flying Wing, wasn't it?

Yes. The Flying Wing had four engines and it was assumed, and eventually it was proposed that the Turbodyne be converted into . . . not the Turbodyne. That the Flying Wing be converted to Turbodyne powerplants, jet powerplants, as driving powerplants for the Flying Wing. There resulted pictures from it, which are in existance today, and they show that that was the intent to do. When that happened I do not know but it never was actually done.

OK, well that's all we know about the Flying Wing?

That's all, yeah. I do not know which designation of the letters belongs to the twin-engine Flying Wing. N-1M apparently and obviously is the single-engine one. But I do not know the designations from then on. There was one single-engined and one two-engined and what followed thereafter, I do not know . . . and the great big one afterwards, yes.

Single-engine one was started right in 1939. That's about the first job which was being done in Northrop organization when I came in, in September 1939. And I do not remember when it flew. It must have been somewhere in the springtime in 1940. And twin-engine was started through the 1940 and flew in either 1940 or early 1941. And with the great big one I had nothing to do at all.

Did you ever talk to anybody who flew the big one?

No, I did not. I did not talk to anybody who flew the big ones. That would be an interesting subject.

OK, I'll type that up and send it to the guy at the National Air and Space Museum. You seem to have become interested in aviation at a very early age.

From the very beginning I had two directions of interest. One was aviation, from the age of about nine years old till the present time. And one was when I was in secondary school in Europe, in turbines, turbomachines.

And I always felt that airplanes must be somehow driven by turbomachines. And nobody seemed to be making any attempts at it, nobody at all anywhere in the world. Although there was one attempt and that was by Coanda, the Romanian scientist who was for awhile the Chief Engineer of the Bristol Airplane Company in Bristol Filton in England. And he did design and build a jet engine airplane in 1911. And it was exhibited in Paris at the Aero Salon. And it did fly but it met with an accident in landing and it was never pursued anymore. But the first jet engine airplane actually was built in 1911.

And that wasn't a model.

No, it was a two-seater, as I remember it, two-seater biplane. And then I was associated with airship company and that was a good opportunity to develop powerplants because we were short of powerplant, particularly in endurance and in power output. This shortness resulted in a great crippling of the airship effort with larger airships. They had to be slow and they had to be of high fuel consumption, and they had to be subject to vibrations and so forth.

So I started developing a steam powerplant for airships and that looked promising in the context of those days. And I did get along quite well with it but we never submitted it to the Navy because my associates were uneasy about what reflection it would be on our names, that we are thinking about things like that. So I did nothing about it. And then later on we— historically parallel to Zeppelin organization— we started designing big flying boats. I also tried to drive the flying boat with steam engines, steam turbines. And that was not promising at all. That had no future whatever and I abandoned it.

And the idea persisted until I came to Douglas. And there was an opportunity, now in association with airplanes, to do it with airplanes in the form of a gas turbine as a jet engine. And that was denied existance also. That was not allowed to exist. Contrarywise, in Germany when a man came forward with that idea, he was accepted right away. And that's the difference between the attitude of the European industry and the American industry. And I am not bashful to stress it and accent it. That's the way it is even now.

You say you got interested in airplanes at an early age. What was it that got you interested in turbines? Had you seen one in operation?

Well, I saw in about 1909 already, I saw an article in a magazine my father used to subscribe, which was the Zvonicek turbine. Zvonicek was, later on, to be my professor. He developed a turbine and built it. Only one was built. And it

was in the central power station of the Chestroraska Colben Works in Praha. And I was there in 1922 visiting, and that turbine still was on line, still was working. And I remembered it and it had a . . . it made on me so much impression that I stayed with it intuitively as a best source of energy for some vehicle that's travel. And that has been a correct intuition. And that still persists to this very day, worldwide today; to use turbines in automobiles, turbines in ships, turbines in airplanes. And, of course, we'll use them in airships.

Could you tell me again about your work on the Apollo gizmo, the J-4 thing skipping across the desert and all that?

That Apollo incident was in about 1967, at Rocketdyne. I was at Rocketdyne. I was in stress analysis group. I was given a job there, stress analysis of turbines and compressors and pumps and so forth. And I established a very high level of performance there, very high quality. I was doing better work than the rest of them because the rest of them were not so well prepared for it and they didn't have the interest which I had.

So I was given a job to please look into this, what makes it fail? And it was the turbine end of the shaft of axial hydrogen pump of F-1, so-called F-1 powerplant. And the pump was J-2. And I was told that the thing has not as yet reached full speed and that things are getting very aggravated and that they are under high pressure how to make it go to full speed. It was brought to me by the head of the Stress Analysis Department whom I know very well. Uh, I think his name was Harris. And so I considered what goes on there and got the forces and got the stresses and everything together, worked it out, and of course, discovered that this cannot stay together. Because it was a curvic coupling which, in fact, would have done the task of transmitting torque but it was cut up so much by bolt holes that not much remained from it.

What did you call that?

Curvic. That's a Grecian patented name of a facial spine coupling. It was amazing to me that somebody would have passed drawings like this into shop, where actually what remained of the curvic coupling was inadequate at first sight. When you proved it numerically, it was really a dismal thing. But having done this, I also have proposed, how could it be cured? And that was cured by eliminating curvic coupling altogether, and have the torque be taken through by bolts which would be body-fitted. And I did not think much of it except when he came for my work, I said I have a proposal that could be done here. He took it with him and came back in a while. He says, "Work on this right away." So I worked on it.

The grapevine had it around in the curvic division. There was a special division of curvic couplings. And in the curvic division, they learned that I am eliminating their curvic coupling. And there was a storm right away. And some people descended on me, what in the world am I doing? Do you know what am I doing, and so forth.

I said, "I am doing—well, I don't know what it has to do with you—but I am doing something which could work and ought to work."

And I was—managment as well as myself—were plagued for days and days by interrupted visit all the time, by somebody from the curvic division. And it was denigrated. It was no good, what I was doing, and so forth. And finally the pressure rose. It was about Monday and I was asked to work overtime as long as I can. So I work overtime and I put in shop, drawings of the bolts. And the shop drawings are put into manufacture on Tuesday morning and they were supposed to be done Wednesday.

It was done but each bolt cost $180 which was quite a lot of money in those days also. And the bolts were put on Friday on the turbine and on the shaft. And the turbine, for the first time, reached full speed. Up till that time it never did reach that full speed. Always tore off before and jumped into the wilderness into Suzanna mountains and started forest fires and all kinds of adventures were happening there.

Well, this went on the jet engine which actually went on the Apollo. Later on I learned that the deadline was Friday that week, because the NASA telegraphed Rocketdyne, unless it's fixed by Friday they are withdrawing it to Huntsville and giving it to von Braun to do. So it wasn't done and Rocketdyne retained their reputation.

Then later on, there was a big conference of all kinds of consultants, among them Ben Hartog, who was and still is, although up in years, still a top-notch consultant in this country. And they all agreed that that was the best solution. And that's the way it went into production and went to the moon.

Was it in the engine that lifted the Lander off the moon?

It was in the engine which landed. It's the second stage of Apollo. And the second stage of Apollo turbines and pumps are the same which lifted vehicle away from moon to go back to earth. So it was a very important item because if it had failed, those people would have stayed there.

How long had they been working on it at Rocketdyne?

I don't know how long it has been worked on. But this situation with the curvic coupling lasted for weeks and was not reaching any solution because they tested and tested and they did nothing else. And that, of course, repeated the failures only.

You have more on the flying wing? OK, let's record that for them too.

The flying wing concept has been initiated by Captain Dunn in England in 1911. He must have worked on it sooner than that because, 1911 he actually flew it. And it was a biplane of long aspect ratio and no tail. Just wings, twisted wings. And it maintained equilibrium. He flew it himself from England to France. And it was quite a sensation of the day as a stable airplane, self stable, not requiring any tail. And it had a great promise but the British didn't pursue it any further until in the 1930's.

Lippisch in Germany designed and built a flying wing monoplane which he flew quite extensively. And the monoplane was just a single-seater, small airplane and no tail, just a flying wing. It was not backswept like Dunn was. Dunn actually was swept back. It had a high aspect ratio but Lippisch had a small aspect ratio. And trailing edge, as I remember, was straight while the leading edge was V-formed in plan view.

And then next man who worked on flying wing was Northrop. Northrop was the third one to build a flying wing.

The third one, yah.

End of tape #5.