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TAPE #3
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The first question concerns the jet engine. Since it was basically developed in three places at the same time, was everybody working on widely known basic knowledge that already existed?

The idea of jet engine propulsion started very early in the aviation history. The Parisian Aeronautical Exhibit in 1911 had in it already a jet engine airplane designed by (Henri) Coanda who was a Romanian living in Paris. He died only, I think, in the early 70's. He was a venerable pioneer in aviation, throughly unknown outside of Europe but a man who had done a great deal in aircraft progress.

And this airplane was . . . he was then a chief engineer of the Bristol Airplane Company in Bristol. And he designed this airplane and designed the powerplant which had no propeller. It was exhibited and it flew. It was a full-sized airplane. I said it flew: actually it didn't fly but it lifted off the ground and came back again and landed in those fields they had in those days and crashed and was damaged. And they did not reconstruct it and didn't continue.

But the idea of jet propulsion started possibly even further ahead by Loren in France. And he wrote an article about possibility of jet propulsion and that has been probably the earliers known, this was before 1910. And it was about the earliest known thought of jet propulsion. His article is well-known and has been known by all who worked on jet propulsion.

Then there was a period in the early 1900, between 1900 and 1906 there was organized a company in France, Société Anonyme des Turbomoteurs. Now this company was organized by an inventor, Lemale, and by an attorney, (Rene) Armengaud. And Armengaud financed it. He was a patent attorney. And they organized a company and designed a gas turbine which had compressors of the centrifigal type. And these compressors

were designed and built by Brown-Boveri. Now, Brown-Boveri has never done it before. This was the first time they did a centrifugal compressor and it was so successful that they stayed with it ever since and are still building them to this very day. And this has been a basis of Brown-Boveri establishment in gas turbine industry.

And this powerplant was built in Paris and it worked. But its efficiency was only three percent, which was about two percent below the efficiency of the steam locomotive, so it had no future and utilization, and it was abandoned. This was about— it was for several years actually— but it was about 1909 was the time they abandoned it. And the company didn't disappear. The company kept in existance and they made a fortune.

Because at that time the torpedos were driven by steam engines and it was high time to do something better. And there was an effort to make a steam turbine in a torpedo and they took their knowledge and applied it to torpedos and made the first turbine torpedo and made a fortuen on it, because everybody was buying toepedos, every government.

And we had in this country, there was an inventor, Leavitt, and this Leavitt also had a Curtis turbine and it was financed by Briss. And it was the Briss-Leavitt torpedo which was standard in our Navy for many, many years.

But the continuation of gas turbine work that carried on; in 1911 a German, Holzvorth, designed a constant volume gas turbine. Now the constant volume gas turbine in those days had a great deal of attraction because constant volume cycle is nominally always more efficient than constant pressure cycle. That comes from the greater steepness of the constant volume lines or isohorts compared to isobars.

And this turbine was built by Brown-Boveri. They financed it themselves. And they built it, it was run, but it was not successful because its efficiency, nominally high, was actually very low because the losses in the valving were so high that it couldn't make up for the high efficiency of the cycle. But Holzvorth stayed with it and never abandoned it. He kept on working through World War I. Then came the end of World War I and he got associated with Krupp. Now Krupp developed the diesel engine with Diesel himself, and they felt that there was another opportunity to do something similar with gas turbines. And they built a number of Holzvorth's turbines and sold them. Actually they were used in power stations for number of years, for about nine, ten years after world War I.

And subsequently there arose a young man in England, Frank Whittle. And Frank Whittle was in the Royal Air Force where he tried to get the jet engine built under Air Force sponsorship but couldn't get anywhere. This was in the 20's, from 1924 to somewhere around 1930. He was an engineer, he was a very bright man, very well educated. He went to Cambridge and, in fact, that was his qualification.

There was an article written in the Harpers (magazine) in the 50's by Lanceloy Whyte. Lancelot Whyte was a British banker

and he financed Whittle in the 30's. And Lancelot Whyte had no idea that Whittle was taling something sensible but he was very impressed by him, personally. And he was debating with himself. In fact, he says that he did not even sleep. He was worried that to give it up, he might do a great damage. And yet he was worried to take it on, that he might destroy himself because the project was so big, to him, in money. And he finally decided to go ahead. And his decision— this was the note in the article in the Harpers— what made him decide to go ahead? And that happened early in the morning. He couldn't sleep again. He would get up during darkness still, and walk the streets. And it dawned on him that Whittle made an impression on him, that he is capable of doing it. And he was not only an inventor but he was also capable of carrying the invention out. And Lancelot Whyte realized what a rare combination this is. Most inventors are not capable of carrying it through. And those who carry something through are not capable of inventing. But here was a man who could do both. And he immediately gave him money and went ahead.

And they organized a company, Power Jets Limited. Power Jets Ltd. was first financed by Lancelot Whyte. Later on, government, when the war came, government boutht into it and Whittle built a gas turbine, which was built actually, mostly by Thomson-Houston Company in Rugby in England. They built a compressor and the turbine. And Whittle built the combustors and they put it together and it worked. This was in . . . the first flight was in 1941, in June 1941.

And up to that time, there was another individual, that was Leisholm in Sweden. Leisholm was associated initially with Youngstrom brothers. And then Youngstrom brothers passed away and he organized a company which was called Axiabar Milo in Stockholm. And this company had number of patents on gas turbine, propulsion by jet, jet engine. And his solution was more realistic than Whittle's. Whittle used a centrifugal compressor which was limited in through flow amount, whereas axial compressor was not limited. Therefore Leisholm had a much more clear concept of it, but he never built it. And he is today forgotten because he never built it.

Then Whittle was financed later on in addition by government and he was able to build it and in 1941, it was finished and flown actually in Meteor, Gloster Meteor, in Gloster, England.

I got started in gas turbines very gradually. The publicity of gas turbines was all throughout, negative. Number of books were published by Lippincott in this country, and by others elsewhere. And everybody who had association with gas turbines was very much in negative attitude, that it will never come through because the metals were not available, temperatures required were too high, compressors were not available and therefore, the whole thing was sort of dismal. And I also steered away from it for that reason.

But when we encountered in airship design, designing large airships beginning with MC-38 and we went up to MC-72 in sizes,

several in-between; we had a problem, what to drive it with? And in MC-38 we actually planned to propel the ship by pursuit ship engines, V-12 of Curtiss, which was absolutely unacceptable but it had to be done because there was nothing else. And this created a pressure to do something about power. Now we get that pressure in aviation almost since the first day. But in airships it was even more pronounced than in airplanes. And I became interested to do so with steam turbines and I proposed steam turbines for metalclad airships. And I did quite a bit of work on it. But my group, the people I was with then, Metalclad Airship Corporation, were so pessimistic and skeptical about it that we never even proposed it to the Navy for fear of losing face. And I determined that it was feasible. It could be done using condensers in the helium chambers to convert heat into lift actually. And the turbines would be externally located as was customary in those days. And the possibility was real to do it very well.

And that, later on, was translated into possibility of driving big flying boats with steam turbines. And we were designing very big flying boats alongside with airships because we were not sure that we would ever get financing for airships. So we were falling back on flying boats just to bridge over the period. But when it came to flying boats, I found by analysis, that steam propulsion in flying boats had no attraction whatever. It was too heavy and relatively too complicated and I abandoned it.

When I came to Douglas I was pursued by the same thought, that we are short of power. We were always deficient in power for airplanes. And at Douglas, later on in 1935 and 36, we designed the B-19 bomber, the biggest airplane at that time. And it was driven by engines that were actually much too small for the airplane. But there was nothing else available. And it was a testimony that there is some new source of power needed. And gradually from steam, I came to gas turbine. And in 1935 I was ready to show it to Douglas. And I did and the acceptance was zero. The doubt was great and I actually hurt myself very much in esteem at Douglas because they thought instinctively, what's wrong with him?

Did you give them plans for a jet engine?

No. I presented only analytical study of it, that it can be done. And I argued with them after all, that the propeller is also a jet. It's a very slow-velocity jet, but it's a jet. And I couldn't convince anybody. Nobody would believe that this is feasible. And there was an occasion in 1935, the Douglas engineering in Santa Monica was visited by Mr. Mead who was a Vice President of Engineering of Pratt & Whitney, and Mr. Chatfield, he was a Chief of Research. And the Chief Engineer called me in and he said these gentlemen, he introduced me to them and I used to know about Mead already and Chatfield also, and he introduced me to them. He said, "Why don't you put it out on blackboard and explain it." So I did and they shrugged their shoulders. They said, "We don't know, but give us your papers and we will take them with us and have our consultants evaluate it and we will let you know."

In about three months time, a letter arrived from Pratt & Whitney signed by Mr. Hobbs who was a chief engineer, stating that their consultants at MIT had come to conclusion that this cannot be useful, cannot work. And therefore they have no further interest in it.

So that was the tempo of things going on there while in England, the engine was already being designed by Whittle at that time, in 1935, 36 and thereafter. In Germany, Heinkel was doing similar work under direction of Hans von Ohain. And Ohain later on came to United States, after the World War II, and has been at the Air Force Laboratories at Wright Field. In fact, he retired last year, only.

Well, the progress was at standstill. I made an assembly of about 87 slides which I still have and I gave a number of talks across the country here, to Chamber of Commerce and to Kiwanas and all kinds of people, hoping to find somebody who would be interested. Nobody was.

Were your ideas the same as Whittles?

I did not really know what Whittle had. I only knew that he had something. I did know what Leisholm had. And I had, with Leisholm, correspondence actually. And I was ready to work with him and I did very much the same thing as Leisholm did but it was different in many respects.

Then, during this time, in 1939, I was approached indriectly by Northrop to come into his new company. So I went to visit him at his invitation and we talked what he wanted to do. And he was interested in magnesium aircraft construction which I was doing some work on at Douglas. And he said, would I come with him and continue it? I said, "Jack, I will come if you would see your way to sometime in the future—I did not know that things were moving so fast in Europe— sometime in the future you would consider developing a jet engine."

He said, "What's that?"

And I explained it to him and he said, "Well maybe, sometime in the future."

I said, "Well, that's good enough for me." And I said, I'll come with you."

And I left Douglas and went to Northrop in November 1939. And about first of December, he came to me. He said, "Why don't you come to my house and give that talk you spoke about?" So I did come. I spent an evening there I lived on Pacific Palisades and he lived in . . . I don't know where he lived. He lived somewhere in Inglewood. And he had about 40 people present there. He invited people. And I gave the talk. It lasted about three and a half hours because I explored the thermodynamics of it and explored the metals and fuels, documented by pictures of what was available. And it made a very good impression on him. And he came to me after the talk. He says, "When do we begin?"

When was this and who were the other people he had invited?

In 1939. In December, about December 15, thereabouts. Well, these people were people from the organization already. He had a group of about 20 people in the Northrop Aircraft

Company, some of his friends, von Karman was there also, and some people who might be interested in taking part in it, whatever it might be. And I said, "Why don't we begin January second?" And we did.

It's a credit to him that his corporation paid for this. They paid for it from corporate money and we worked, we got a group together and selected some people and started working on, first on thermodynamic principles, cycles, then on actual design and compressors. And we started gradually and by about 1940, about midyear, we were way deep in it already. In 1941 I already had about two big reports, each of them about two and a half, three inches thick; drawings and everything ready to go.

How many people were working on it then?

I had about 20 people, took together, all of us. And at that time, it was February, I think, 1941, (Vladimir later changed this date to March, 1940) Northrop and I took a trip to Washington. And I had an artist, from the drawings we had, he made a beautiful, almost full-sized drawing of the Turbodyne. We gave it the name Turbodyne. He made a drawing which was a perspective cross-section, three quarter cut, so they could see what's inside; what's actually going on there. And it was done in color, very creditable work. And I took it to Washington with Northrop.

We flew. It took us 24 hours to fly across the continent in those days. And we came there, we went to the (Navy) Bureau of Aeronautics, to the Powerplant Section. And there was a man there, Mr. Friedner. Mr. Friedner was an elderly gentleman, he was civilian engineer, and he was for jet propulsion. And he was the nucleus in the Navy. The officers didn't care. There were two officers, Commanders, Ricobata and Spangler. And we talked to them, showed them the picture. They were not impressed at all. And Ricobata then in parting, he said, "God damn you, Pavlecka, don't you know that the decks of our carriers are wooden and they'll burn? Put a gear case on it and bring it back, we'll look at it."

So I knew I had to make it a turboprop in order to get a contract. I did so and still didn't get a contract. Until 1941. In 1941 England was in a bad way. Things were really uncertain and they asked officially, a delegation be sent to England to make a list of what they need, for deliver, and in return they said, we'll give you what we have. And what they had was radar and jet engine, among other things.

And one of the members of this mission was General Arnold who was then the Chief of the Air Corps. And I was in the Air Corps (offices) in about November 1941 (later corrected to 1940). And I came there and Northrop arranged it and I went alone. And I came and I was welcomed in the lobby by Colonel (E.R.) Page.

Where did you go?

To Dayton, Ohio, to Wright Field. And the head of the Powerplant Division at Wright Field was Colonel Page who was an absolute autocrat, feared man. He was feared by everybody. And I went to the lobby early in the morning, about eight

o'clock to the Powerplant Livision and comes out Colonel Page and welcomes me, very affable, very charming manner. And I thought, now I am getting somewhere. And that's the last time I ever saw Colonel Page. He never stayed to listen to anything and introduced me instead to Major (Donald J.) Keirn. Major Keirn was his assistant, apparently, and he got together about five people, civilian engineers and himself, the only officer.

And we went into a conference room and I had two thick briefcases of documents. And I started talking at the blackboard and on the table. And nobody believed anything. They read some thermodynamics books; see, we were very badly prepared in fluid dynamics and thermodynamics when the war came. We were ignorent in this country in those two sciences. In Germany the fluid dynamics and thermodynamics were in a high state of development. And here, even Caltech didn't teach thermodynamics, which is amazing in retrospect, how primitive we were when we went into World War II. And I couldn't but comment that he wrote an equation (on the blackboard) from memory for me. I said, "That equation is not correct, this is so and this is that way." And I shouldn't have done it because that antagonized them even more. But I couldn't do anything.

Well, came the noontime and when I used to go to Division before, as a guest of an officer, I was always taken with him to the officer's mess. This time nobody took we so I had to go to cafeteria. And I came back at about 12:30 and we continued and at four o'clock we disbanded. I convinced nobody. Nobody was at all even saying that maybe this is possible. Everybody said this is nonsense, it is impossible. And I went back to the hotel and I lived on Alka-Seltzer the rest of the day. That was my experience with the Air Corps.

Had they seen the Whittle engine yet?

No. The Whittle engine appeared in 1941. And that was when General Arnold and Major Keirn were in England to see what the British need.

Then when did you visit the Air Corps in Washington?

In 1940.

Did they ever apologise?

No.

And they were taken . . . they were not told where they are going. They were taken by an automobile. This is what I heard from first-hand information. They were taken by automobile, they went to Gloster, and taken to Gloster to the airfield where Gloster Aircraft was. And there was the small airplane, two engines, two pods on it, and monoplane. Pilot sitting in it already. And they disembarked from the cars, walked to the airplane and General Arnold is reputed to have said, "Where are the propellers?"

And he was told, "General, there are no propellers."

"What was this?"

And they said, "This is a jet engine, designed by Whittle, by Power Jets."

And pilot was given a signal to start. He electrically started the jet engines, took off and flew, came back, landed,

took off again. General Arnold said, "Nobody must know about this. All drawings go in my briefcase and nobody touch my briefcase. You, Keirn, you fly back to United States right now and pick up B-17. Fly back and take two of these engines back to General Electric." That was our beginning in jet engines.

Arnold was not informed that we have struggled already almost two years to get something going like that in this country. And I come back to this later on. I have some harsh words to be said about this, and they must be said. And Major Keirn, who didn't believe a thing, went to the United States, brought two I-40's with him to General Electric. And General Electric in Schanectady said, "We don't want it. Take it out. We don't want anything to do with it."

They were under a misapprehension that because General Electric was building turbines, they could build jet engines. That's not so. Because steam turbine is a thermal machine which has got a large pressure drop, with very small interim. Gas turbine is a machine which has a very small pressure drop with a large interim. Just around, just the reverse. But to them it didn't occur. Make a turbine, make a turbine, no matter what it is. And General Electric was forced to do it. They were pushed into it.

And we were given, in June I think it was, sometime then in 1941, we were given a contract on a compressor. That compressor was for a gas turbine, a turboprop of about 10,000 horsepower. That's what they were planning. The compressor took about 35,000 horsepower to drive, at about 12,000 rpm. And I objected to it. I said, "Who is going to drive it, where? You must think of driving this. You cannot have a compressor alone. We won't be able to test it without having something to drive it. So let's build a gas turbine and the whole thing." And I did not win, at all. And they gave us a contract on a compressor and the rest of it was to be at standstill.

We, at least, had something. We had money coming out from the government. And we got busy with it. And, at the same time, the literature on compressor design did not exist. There was nothing. There was a book, translated by Professor Marx, the latest handbook. And Professor Marx translated a book by Keller on axial fans. But axial fan is a different machine from axial compressor. And we had no theory, nothing to go by.

At that time, attached himself to me, a young man by name of Fred Dallenbach. A very intelligent man, he had no formal education except high school because it was Depression and his father had no money. He had to go and earn money right away. He was not educated formally. But he educated himself informally. He was a first-class scientist. Which is a horrible thing that our country has done to have man like that, to deny him education, who was actually born to it and they denied him education. And I worked with him and we worked together very smoothly for number of years and he contributed greatly to the Turbodyne.

And we decided, well, we have no way to go except by our own way. Let's design a compressor, let's build our own theory. And we did so. We built a theory of axial compressors which later on, after the war, was shown to be correct by the British. We had Professor Horgrum come from England. We discussed it with him and gave him our report. And he agreed that we did soundly. We did the same thing as they did in England, independently. And at this time we just were going in the dark by our own.

And we designed a small compressor, which was driven about 18,000 rpm by a high frequency motor, up near Atlantic Blvd, in A.O. Smith Company which got an inventor who made these motors. We brought it up there and we tested it there. And the compressor was computed to have about 93 percent efficiency, which nobody believed could be done. And von Karman argued with us that it cannot be done. We tested it within a fraction of a percent at 93 percent. So we proved that our compressor theory was sound. It worked. And we started basing the compressor on that foundation.

And at the same time, there developed problems in Northrop Aircraft. Northrop had a small group of people, very close-knit cabal of people, who constantly were agreeing with him and giving him information about what's going where. And this cabal has grown into a kind of a subversive mafia in Northrop Company. And it became so bad that somewhere in 1945 or 46, Northrop couldn't handle it himself and walked out one noontime and never came back, left the company just flat. And the new management reorganized, fired everybody who they can suspect and put some health in the company. But this was very similar to what has happened to Ford Motor Company with Bennett in the late 30's. The same thing happened there.

Well, the conditions at Northrop were getting very bad. And there was—I developed the heliarc welding at the same time—and there was a lot of strange things happening at Northrop which nobody who was related to something was aware of, and yet suspected it's going on. It was a kind of a secret organization, it was, just in the beginning. Later on, it got so bad, I hear, I wasn't there then, that something drastic had to happen. And at this time, we were working on the compressor, and we started building it. And in 1942, at the end of the year, I left Northrop because I couldn't take it anymore. I couldn't take the atmosphere. And Dallenbach left shortly thereafter, with me. We abandoned the whole project personally because Dallenbach's health was failing and I was disturbed about the whole thing. I was uneasy and never had any cooperation from the Navy.

We had a man who I have to praise to high levels. That was Professor Durand. Professor Durand was of Leland Stanford University. He was in his eighties already. And he was given the job, in the government, to monitor powerplant developments, because he was essentially an originator of a propeller theory. And so he was related to powerplants. He came to me several times in Northrop and I unfolded everything I had, discussed it

with him. He was deeply interested and very, very cooperative with us, very supporting. And I have high respect for him for that reason. He was the only man who believed in jet propulsion.

And the atmosphere at Northrop was also poisoned by the attitude of the government. Our Navy Bureau of Aeronautics, Powerplant Section, was infiltrated, at that time, with people who openly were sympathizers with Nazi Germany. I did not know it at the time. It haduated itself gradually. And these people were literally sabotaging effort in the Navy to get something of value into Navy use. I know their names. I will not repeat them now but these people did tremendous damage.

Example of it is here. Frank Whittle came to us in 1942, a visit. He came from Washington. He was in United States and he was told we are working on gas turbine. So he came. And I met him. He was very taciturn, very nervious, extremely nervious. He wanted to go, right away, back. Northrop wanted to put him for a week in a cottage on the Lake Arrowhead. He refused, refused even to see anything in California, just want to go back to Washington, back to England.

And Whittle listened to what we had been doing. He contributed very little in comment. But he did say, "You have our reports from England, don't you?"

I said, "No, we don't have any reports."

He was then a squadron leader and he said, "You are lying." He told me, "You are lying to me. We gave these reports to your Navy to give it to people like you so that you can build on what we have already done. And you mean to tell me you don't have them?"

I said, "No, Commander, we don't have them."

He went right away to telephone and called Major Heeden in Washington. "Heedon, what's going on? These people should have these reports and they don't have them. What has happened?"

I don't know what the explanation was. But he wanted to leave right away. He didn't want anything to do, anymore, here.

He said, "This is incredible that you work on it and you don't know what we have done and it is being kept away from you by the Navy."

That was a part of the sabotage.

Did you ever get them?

We never got the reports. Even afterwards. Never got them. Never. And there was an effort in the Navy, especially by Ricobata, to get rid of me, to get me out, because I had an accent and as much of an American as I was, I was born somewhere else. And to have a man in charge of this, which suddenly became such a big issue, who had an accent, that was untenable to him. And there was an effort to get rid of me. I sensed it, and I accommodated them, and I went out.

And I was immediately approached by Lockheed. Lockheed also was developing jet engine, way behind us, in time as well as in development. And that's another story. But Ricobata later on became Vice Admiral. And I can't see what makes decisions to make people like that high officers in the

Navy. What's behind it? What motivates it? The man was incompetent. The man was unresponding. He was un-understanding. And this was nothing but bitterness, great bitterness. And I have an example.

At that same time—I learned about this later on—there was, at the same time the mission went to England in 1941, a similar mission went to France. And a member of that mission was the President of the Fairchild engine corporation, Fairchild aircraft engine. And he was taken, with others, to the aircraft industry in France. And at Hispano-Suiza engine company they discovered a new engine, which actually was an existing engine but with a new supercharger, which was built by Planiel-Chilovsky. This supercharger had advanced features in it. It was very efficient. And it was very good characteristic, flight characteristic. And de Planiel and Chilovsky, the originators of it were there also. And the President of Fairchild company tried to get them to come to United States and work at Fairchild. Planiel did. Chilofsky did not. Chilovsky was a Polish jet. And Planiel came to United States and he was given a job at Fairchild and he thought he would be allowed to continue with superchargers. Instead he just had an office. They created a corporation for him called Stratus Corporation. And he was allowed to do nothing. And he owned fifty percent of the corporation. Fifty percent was owned by Fairchild. And until his death, and I met him in New York after the war, until his death he was not allowed to do a thing in Fairchild. And he died of broken heart actually.

And now, his partner, Chilovsky, in France—this is important to bring forth—he was of Jewish religion and yet in spite of that, in spite of war, he raised money in France for a gas turbine development. And he has created Societè Turbomeca which still exists to this day as a powerful French company. And Chilovsky was given money, was given permission, was given encouragement; immigrant from Poland and Jew on top of it, which in France, was quite a handicap. And he started in Tarnber and started a factory and started developing gas turbines. Then came, later on, a signal that Germans are going to occupy all France. So he loaded all his equipment, machine tools, and shipped it on a freight train to Switzerland, to Geneva, and put it on a sidetrack in Geneva. And there it stayed for the rest of the war. Until after the war, he routed it back, this time to border, reconstituted his company and continued. It is now a big industry, there are several factories now.

And here, I was an immigrant to this country. I was a citizen and I try to do big things for this country and I was denied the opportunity. He was not. And I don't forget this. This is very important to be aware of. And Planiel died. He was given the same treatment I was given. And he died without creating anything anymore. And I have heard this against our corporations very, very much, against our military-industrial complex. That's a lot on how they work.

Yet when the war ended, many people were brought from Germany, outright Nazis were brought from Germany and put into Wright Field in Dayton, Ohio, for about two years and

after that they were free to get jobs in the industry. And one of them was Franz. Franz used to be an engineer at Junkers. And he also worked on gas turbines when Junkers developed the jet engine later on in the war. And Germans got into production of jet engines much faster than we did. They had much more skill in it. They really did it on a tremendous incentive. Well, Franz was given a job, Vice President of Engineering of Lycoming.

And he was, in about 1956 or thereabouts, at a gas turbine congress in Washington. And I went to it. And there was an exhibit there also, a number of firsm active in it already. And I walked, early morning before people would come, to see the exhibit. And I walked upstairs. And as I walk upstairs, I'm confronted with a billboard of a gas turbine cross-section in simplified lines. And I stopped right on the stairs. I said, "Where did I see this before? I've seen this before somewhere." And then it dawned on me. My heavens, that's mine. I did it on Turbodyne. This is what the original Turbodyne was composed of. And the feature was, that in the original Turbodyne, I had an axial compressor and centrifigal compressor at the end, at the high-pressure end, to get high pressure for the cycle. And Navy was against it. The Navy pushed and pushed and finally I had to abandon it because it wouldn't work. Here it worked. But the German did it who was brought from Nazi Germany, given opportunity to do it while an American citizen was denied the opportunity to do it years ago.

And again another snag which I never forget and I always am aware when I deal with American corporations, how they operate.

At Northrop did they continue with the Turbodyne after you left?

After I left, Northrop continued and finished the Turbodyne, belatedly, after the war. They finished it late in 1945. And I was invited by them to come over and see it, which I did. It was in a concrete house, like a cathedral, and 10,000 horsepower gas turbine—I have pictures of it from them—running two contra-rotating propellers. And it worked. It was somewhat behind the times in those days. Progress was very fast. And it was bought then by General Electric because Northrop was given an opportunity to either abandon the airplanes, concentrating on engines. They needed blank in tape
Flying Wing later on, shortly afterwards, was cancelled, and we had nothing. Our plans were sold to General Electric. That's why General Electric got the name, Turbodyne.

General Electric later on sold the name to Worthington Company. They started a gas turbine company in St. Cloud in Minnesota in Minneapolis which was developing a first-class organization. And then they became discouraged and sold it to Brown-Boveri. Brown-Boveri didn't buy the name. It's under their name now. And Turbodyne name still is in ownership of Worthington-Studebaker now. And Brown-Boveri now is building steam turbines also in that factory, gas turbines, and is enlarging it. It's having very good success with it.

Did the United States then, ever develop a jet engine?

First jet, uh, the Navy gave a contract, under forced conditions, to Westinghouse. Westinghouse developed a jet engine which was very clumsy, very simplistic. It was 1944, sometime then. And that jet engine never succeeded. I don't think it was ever in an airplane actually. But it was abandoned later on. Westinghouse gave it up, but continued in industrial turbines from that. And the only jet engine was the I-40 which was brought from England, Whittle engine, and was made by General Electric in Schanectady. And later on, General Electric transferred all light gas turbine work into Lynn, Massachusetts. And the I*40's, I do not know when they stopped making them but the first one was sometime around 1943 or sometime then, was the first one.

Was the final Northrop engine much different than the one you began?

It was about the same efficiency. You see, the Turbodyne in 1945 was already obsolete because it took too long a time to get it. Too long a time wasted in waiting, in procrastinating. You cannot do it in powerplants. You have to move fast in powerplants because progress is very fast. We see it right now.

And Douglas could have gotten in at the very beginning.

Oh, Douglas could have done it. Douglas could have been a prime, principle engine maker, and on the West Coast, which the government wanted. Somebody on the East Coast, somebody on the West Coast.

They could have had it very early, too.

They could have had it . . . well, we could have had it about the same time as Whittle because Whittle was doing it in secrecy. Nobody knew what's going on. Nobody. The Germans made a jet engine also in Heinkel. But German jet engine should not be counted, that Ohain engine, as a credible engine because it was good only for one flight. In other words, it lasted only one flight. By the time it came down, it had to be renewed because it was burned or would have been burnt through anyhow. And then BMW and Junkers got into it and they designed very creditable jet engines, both of them, Junkers as well as BMW. That was during the war and I do not exactly know at what time. But not only that, they built factories for these engines. They did not use old factories. Not at all. They built new factories for it. And that was impressive, tremendously impressive. The German performance really has not been fully appreciated as yet by historians. It's far more substantial and a great effort than even England put out. England didn't have a fet factory as yet in 1945. They just had a division in Rugby. But Germans had two factories already. Germans really got hold of it with a tremendous élan and really made something out of it.

Your turboprop engine was originally suggested by the Navy. When did you then develop it?

We develop originally only jet engine. And we came to the Navy with the jet engine. But at their prodding, we did put a

gearcase on it and made it a turboprop. And that was already in 1940. In 1940 we did so already. So we worked the jet engine only up till. . . uh, less than a year. And after that, it was all a turboprop and it was driving propellers only. And that was the prupose of it. The turboprop was finished in, I think it was about late '45. That was the Turbodyne turboprop but the jet engine Turbodyne never was built, actually.

How was the turboprop engine different from your original jet design?

It was a jet engine which had a lot more turbine so that it could drive propellers instead of giving energy to the jet. It could be converted into a jet engine, yes. But it was never done.

Did they ever use it?

No. No, they never used the turboprop. In the Navy, later on—I do not know exactly the year again, but I think it was 1947—I was back at Douglas Aircraft. And I was approached by assistant Chief Engineer, "Could you help us?" in El Segundo. He said somebody talked too much and sold the Navy on a turboprop engine in a dive bomber. And now we don't want to do it. And he said we must have some kind of a proposal which is due a week from now and it has been in existance for three months but last week they thought of it. And make a proposal which would not embarrass Douglas but which would be rejected.

So I went to El Segundo and met Heinemann. I used to know Heinemann before, and talked to him and he told me what the problem was. So I got busy with it. And I realized that they committed themselves to too much. They committed themselves to performance analysis and design also. And I had seven days to do it. So I said, "Could Dallenbach come and help me?" So they agreed. Dallenbach works at Douglas Aircraft also with me. So he came over.

And we two worked on it and we provided a design which was using gas turbine driving through a shaft; on outrigger was a gearbox and propellers. And we made a fifteen-foot-long layout. And I worked Saturday, overtime, free of charge. But I got hell for it because overtime was not allowed. And anyway, we didn't do it in seven days, we took nine days for it. And Dallenbach helped with the design and analysis also. And we made analysis up to 40,000 feet altitude and provided a whole report of curves and text and a big layout. And it went to Washington ten days later.

And they were so pleased with it, they accepted it. And Douglas said, "Well, what to do now?"

Navy said, "Well, how much do you need for you to do it?

Douglas said, "We don't want to do it." Even then, Douglas didn't want to do powerplants. So they said, "Why don't you take it and pay us for it and give it to somebody else?"

So Douglas put down a price on it, $75,000, of which Dallenbach and I didn't see a penny. And they gave the contract to Allison, and put Allison in the gas turbine business. And that was the T-38 and T-40 turboprop which were on the Electra, and still are running on the Electra.

Was that based on the Turbodyne design?

No. It was axial, yes. In that respect it was similar. But it had no centrifugal compressor. It was a straight jet engine driving a turbine.

An original design?

Original design, yeah, that's right. And we worked it out and that got Allison in business. And Allison got one and a half million dollars right away. And they they produced a machine and it was so bad, they had to redesign it. And before the first machine could come into operation, was about fifteen million dollars. And finally, they stayed in it, they still make it today. Today it's used as a turbine for pumping gas in gas pipelines.

End of tape #3.