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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERVIEW WITH

Gene MATRANGA

by

R. P. Hallion

on Friday, 3 December 1976

at DFRC

(THIS TRANSCRIPT WAS PREPARED FROM A TAPE RECORDING.)

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ANSWER: Arrived here on June 6 1954 and --

QUESTION: Right after the big -- right before the big change?

ANSWER: Riqht before the big change, right. As I said, I spent one day on South Base helping pack all those things in boxes so we could come up here and try to get going.

Most of the Air Force activity at that time was still on South Base -- well, I shouldn't say most -- All the Air Force activity at that time was still on South Base. We were the first tenant to move into what you'd call the permanent base here, and that was on, ~~June 6 -- or~~ June 7.

When I first came here I was assigned to work with Wendy Stillwell, and he was what we call project coordinator for the X-1A. That was a joint program with the Air Force to explore high-speed, high-altitude flight. It was a follow-on to the basic X-1 program, to extend the altitude and speed capabilities above that of the X-1, the original X-1.

QUESTION: Now; '54 would have placed it right after the Yeager's 1953 mach 2.5 flight.

ANSWER: Right. And right in the middle of K ~~D Murray~~ Murray's 93,000-foot altitude flight.

QUESTION: 93,000.

Were you involved in the planning of those

altitude flights?

ANSWER: No, I was involved in the data reduction program --

QUESTION: Data reduction.

ANSWER: -- but not in the planning.

QUESTION: Okay,

What role did NACA at that point play with the Air Force in the X-1 progran? Before, it had been fairly close, but I gather by that time --

ANSWER: Well, the Air Force performed the operational function and we --

QUESTION: Okay.

ANSWER: -- performed the research function.

QUESTION: Okay.

ANSWER: It was our instrumentation that was in the airplane, and we analyzed all the data. We published. the data.

QUESTION: There were several reports, there were RMs --

ANSWER: Right.

QUESTION: -- came out at that time --

ANSWER: Right.

QUESTION: -- on. the X-IA program.

The X-IA then left here, I would gather at about the end of '54, perhaps -- Yes, it would nave to he the fall

of '54 to go back I believe to Langley for some instrumentation work for a proposed -- I believe it was high-temperature research program. And then it was lost when — shortly after it came back here in August of '55.

ANSWER: That's right, because it came back here as a total NASA-operated program when it came back.

QUESTION: Right.

ANSWER: It was also equipped with an ejection seat. That was one of the changes that was made to it. during all Yeager's and Kip Murray's record-breaking flying they didn't have an ejection seat, and I recall Yeager making the comment on his mach 2.5 flight --

OUESTION: On the landing,

ANSWER: If he'd have had one, he'd have used it.

QUESTION: Right, he wouldn't have been in the airplane.

ANSWER: That's right.

QUESTION: I came across that transcript. It was a great quote.

ANSWER: For your interest, I have the folders on both those record-breaking flights --

QUESTION: Good.

ANSWER: -- with the pilot debrief --

QUESTION: I would he very much --

ANSWER: -- including that statement of his that —

QUESTION: Great. I'd be interested in seeing those.

ANSWER: That I do have.

QUESTION: After the X-1A was lost, NACA was fairly upset about that, and started looking toward the X-1B program for the same sort of research, instrumenting the B in a limited way, and then the loss of the X-2 encouraged Hubert Drake and L. Robert Carmen to consider at one point actually modifying the X-1E as a potential mach 3 research airplane. They came up with some little study on that.

How did the Center take the loss of the two?

Was the Center by 1956 really interested in the X-2, or did they recognize that essentially it was a program that was so frought with problems that it probably it would not be a success not matter what happened?

AMSKER: I think we were interested in the X-2. I think the specter that lay behind the X-2 program was that it had slipped so far, however, that the X-15 was going to get so much more information Into the higher-speed regimes, that anything we did on the X-2 was going to be eclipsed by the much more spectacular information from the X-15.

It was living in the shadow of the X-15 in the mid-'50s already. We knew that there would be an X-15 in '54, and its usefulness was very questionable.

You have to also realize that at that tine F-104s were flying, and one of our decisions on the X-IE was that we could probably fly the X-IE two or three times a month, whereas Kelly was flying his F-104s two or three times a day into the same flight regimes, so it really didn't make sense for us to be applying those kind of resources to that kind of information.

QUESTION: That brings up another point.

In the 1950s the Center tested a lot of military aircraft.

ANSWER: That's right.

QUESTION: Not so much, I don't think, for the -- this is one thing Frank confirmed -- not so much apparently for the service-test aspects, as much as using them as research vehicles.

For example, the F-100 in ~~extra~~ inertia coupling studies.

ANSWER: And I went from the X-1A to the F-100.

QUESTION: Okay; fine.

Anything --

ANSWER: I'm Mr. F-100, really,

QUESTION: Great.

ANSWER: So, you've found the right guy.

QUESTION: Beautiful. Fire away.

ANSWER: The X-1, as you say, went away in the midsummer of '54, and the F-100 arrived midsummer of '54, so

that was the natural transition for me.

We instrumented the airplane and started flying in what must have been, what must have been late August. I don't remember the exact first flight date for us for research flights. Rut of course on our fourth flight, Scott Crossfield wound up with a flameout, made his historic --

QUESTION: ~~Dipstick~~ Deadstick landing -- and the hangar wall.

ANSWER: -- first ~~dipstick~~ deadstick landing of the airplane and, of course, in Scott's usual spectacular way he put the thing through the hangar wall.

And that was --

QUESTION: That's a rather famous anecdote.

ANSWER: Very, very famous anecdote.

Other people were breaking the thermal barrier and he was the first to break ~~the~~ the aluminum barrier

QUESTION: Break the hangar wall.

(Laughter.)

ANSWER: Shortly thereafter, and it only took us something on the order of six weeks to repair the airplane, we were back in the air again. In that six weeks' tine period the Air Force had lost, if I recall correctly, three airplanes.

QUESTION: Exactly right, yes.

ANSWER: Two at Eglin and one elsewhere, and I don't recall where.

QUESTION: George Walch, right up here at --

ANSWER: Was it George? Okay.

George's incident I know about in great detail, because that certainly was close to some of the things --

QUESTION: Mohave, I think,

ANSWER: No, it was between --

QUESTION: (Inaudible.)

ANSWER: -- Rosamond and Lancaster, right near Avenue D and Sierra Highway.

QUESTION: That's been a bad area. That's the exact same area where Kincheloe went down.

ANSWER: Well, Kincheloe was a little bit further east. But., yes, it's the sane area. It's about the end of the runway, is kind of what it boils down to.

QUESTION: oh.

ANSWER: If you follow the runway straight on west, that would put you pretty much into that area.

QUESTION: Did that immediately change the character of the NACA program?

ANSWER: You bet. It immediately changed the character, because --

QUESTION: Okay. What had the program been before, and now what did the program shift to?

ANSWER: The program was fundamentally a stability and control and a Loads program.

QUESTION: Okay.

ANSWER: And it then became a roll coupling program.

QUESTION: Okay.

ANSWER: Hewitt Phillips in the mid-1940s, late-1943s; '46 and '47, had come up with a theory for roll coupling. The inertia distribution of airplanes in that time period was such that --

QUESTION: (Inaudible.)

ANSWER: -- they would not couple. But he had the theory that said if you get this combination of inertia distribution the airplane will couple.

So., yes, we found they would couple, and several of our people went back to Langley, and -- in conjunction with Phillips -- did some analog simulations, our first analog simulation, to see whether the airplane responded as Phillips' theory said it would, and really not to very many people's surprise the analog simulation showed it would.

And we went out and had a series of flights that -- probably three months' in duration -- we were finished by Christmastime -- showed how quickly we could do things in those days -- we had wrapped the story up and published a report on it, on the F-100 roll coupling.

QUESTION: Now, the X-3 experienced the same

thing in one of Joe Walker's flights.

ANSWER: Joe Walker.

QUESTION: Joe Walker, right.

And --

ANSWER: With the same inertial distribution.

QUESTION: With -- exactly.

Was that -- The X-3 program was one of these kind of serendipitous programs in which the engines never came through for the airplanes. They never got mach 2 out of it.

When it was flying, because of the awareness of Phillips' work and because of the awareness of the F-100 program, did the people here realize that the X-3 would encounter a sort of instability, and therefore --

ANSWER: We were concerned with three airplanes --

QUESTION: Okay.

ANSWER: -- in terms of coupling. We were concerned with the X-3, because it was, indeed, arranged that way.

We were also concerned with the F-102, because --

QUESTION: 102. I didn't know that.

ANSWER: -- we had just received an F-102 in the same time period. In fact the F-102 arrived here a little bit before the F-100, and there was a great deal of internal competition between the F-100 and the F-102 program to see

who could get the best information first. And F-100 was from our standpoint a better operational airplane, so --

QUESTION: Was this one of the area-ruled 102s — I gather --

ANSWER: No, we got a YF-102 --

QUESTION: No, YF — Okay.

ANSWER: -- which was not the area-ruled, and then we did get an area-ruled F-102, subsequent --

QUESTION: Okay.

ANSWER: — to that, but we had one of the original YF, which was not area-ruled.

QUESTION: Okay.

Now, on the X-3, was Walker -- as I recall it was on a research flight when he initiated very rapid roll, and he got something like 18 or 19 degrees nose-up pitch and like 13 or 18 degrees of yaw, and he recovered and decided to make a similar roll, and the second one was even wilder than the first.

What happened as a result of him coining back with his aircraft having, in effect, gone berserk, you might say? What happened when **he** landed after that flight?

ANSWER: I don't remember the details of that.

QUESTION: Hmmmm.

ANSWER: I don't remember the details of that.

QUESTION: I was just wondering if this caused

everybody to sit down and have. a reevaluation of things or what-not.

ANSWER: No, I don't recall -- It obviously didn't affect people here. I think we probably would have had the response that -- Yes, that's probably right. I guess maybe. we should have expected that sort of thing. But it did not create a storm here the way the initial F-100 experience did.

I think the response must have been just because of the absence of a great deal of attention that -- Yes, I guess we should have known enough to expect that.

QUESTION: Would it also possibly be because the F-100 was obviously at a time when national security was paramount a new major production program and you could just see the idea of second lieutentants spreading themselves all over runways with this thing.

ANSWER: Sure, sure, sure.

Recognize, the F-100 had a -- had a -- had two problems, really.

QUESTION: Okay.

ANSWER: One was its inertia distribution. The other was moving from the prototype, YF-100, to the production model, F-100A, tail area had been reduced, in order to reduce drag, and that is really what precipitated George Welch's accident.

So one was a rnl! coupling problem; the other was a directional stability problem.

QUESTION: How about some of the other programs here. A tremendous program that is not apparently too much available aside from the published reports, but in terms of private support, things of that sort, a tremendous program was run on the B-47, on a load program in the early last 50 program. Were you involved with that at all?

ANSWER: I was not involved with that. Bill Andrews was one of the key research engineers on that. He came up from Langley, and Bill's still here.

QUESTION: Ah, good.

ANSWER: So Bill would be the man to ask the question on on the B-47 prograin.

QUESTION: How about the 104? 104 was received about 1955.

ANSWER: '55.

QUESTION: We have it now in our museum.

ANSWER: Right.

QUESTION! · ˇ 818.

ANSWER: Right.

QUESTION: And that apparently was also used in a coupled motion study program.

ANSWER: Right.

QUESTION: In fact ---

ANSWER: Again, we were concerned with roll coupling on that airplane, and we were concerned with pitch-up on that airplane, because of the T-tail.

QUESTION: Okay. Can you elaborate on that in any great detail. Did Lockheed —

ANSWER: Yes, I can elaborate.

QUESTION: -- interface .with you?

ANSWER: Lockheed interfaced with us very closely. Bert McMaster, who was one of Kelly Johnson's stability and control engineers, was up here two or three times a week to interface with us the flight data.

Our engineer, Tom Finch, who again is still here --

QUESTION: Okay.

ANSWER: -- was down at Lockheed two or three times a week working simulation problems, and at one stage of the game we had the only instrumented F-104 in the world.

Lockheed, as you know, lost a lot of the early airplanes, and they lost all their instrumented airplanes.

QUESTION: My word.

ANSWER: So at one time we had the only instrumented airplane in the country.

So, yes, we worked very closely with the Air Force, both local AFFTC people, and Flight Dynamics Lab people to look at the roll coupling problem, to look at potential pitch-up problem in the airplane, and I hnte to use the word

"pitch-up" because with the stick shaker and stick kicker system was designed it wouldn't allow you to get into the pitch-up (inaudible).

QUESTION: On the ioss of those F-104, this brings to mind an immediate question: Why? Was it because NACA ran their program so well, so conservatively, moving up incrementally and studying problems and what not, that the NACA approach had such built-in conservatism and --

ANSWER: I think that's absolutely the reason.

QUESTION -- persistency that you wouldn't lose an airplane, whereas a contractor would just ran a program through.

ANSWER: Right.

QUESTION: Okay.

ANSWER: George Welch's accident is a pretty good example of that. We went back and looked at the records ~~wreckage~~ on George's accident, and that accident was very predictable. The data from the flight two days earlier showed he was at neutral directional stability. But the way that Rockwell -- and it's a typical company flight-test operation -- the way they operated was the data was gathered here at Edwards, it was shipped down to North American at Los Angeles airport, the data was analyzed and reduced, and then it was -- determination was made, "Well, what did we learn?"

Well, in the meantime, two, three, four flights had been flown subsequent to that, and it was insidious --

QUESTION: You're saying it all right there.

ANSWER: -- in this particular case because in order to get the speed he had to perform the maneuver in a dive, so that while his spoed was remaining essentially constant, the dynamic pressure on the airplane was --

QUESTION: Chanqing markedly.

ANSWER: -- was increasing, And that, of course, affects the period of the airpiane.

QUESTION: Sure.

ANSWER: The oscillation of the airplane.

So, as far as he was concerned, the airplane was stable. It was apparently stable. But the stability was due to the fact that he was increasing dynamic pressure, and not due to the fact that he had inherent stability.

QUESTION: In other words --

ANSWER: So, again --

QUESTION: Okay.

ANSWER: -- after looking at the records, it was very obvious.

QUESTION: In managing a flight, then, at that time. a contractor would say, "Make flight A, send the data out for reduction," and by the time you got the data back, you might have made flight F.

ANSWER: Right.

QUESTION: Are contractor programs still run that way, or are they managed more tightly, would you say? Is there a constant attempt to -- I -- Perhaps it's a function of cost. The most cost involved in the program, perhaps, is a delay, then.

ANSWER: I think it's an inherent difference between a research program and a development program.

A development program has hard milestone dates to meet, and they have to fly in order to get all those milestones in, in order to meet the very critical deadline.

That affects production schedules and a variety of other things. In the research environment we can be a lot more relaxed about it, and if we see something that looks strange., we can soy, "Hey, stop."

And we can stop, and we can reanalyze. A development program normally does not have that luxury.

QUESTION: Okay.

ANSWER: So there's a -- And I don't mean to knock the contractor operation --

QUESTION: Sure.

ANSWER: -- at all.

QUESTION: It's just a different philosophy.

ANSWER: It's an entirely different environment.

QUESTION: Okay.

ANSWER: So the environment is really what makes the differ-cnce. They really can't afford the luxury of the way that we normally do business.

QUESTION: Okay.

How about the other service programs run here in the '50s. There was a little program very briefly run on the F-107. In fact, I think it used a ~~five~~ side stick controller.

ANSWER: I was involved in that program, also.

QUESTION: Was that directly in support of the X-15, or was that kind of serendipitous?

ANSWER: The ~~sign-on~~ side-arm program in that was -- it was a target of opportunity, if you wish, The thing we were really concerned with on that airplane was the stability augmentation system. That was an airplane that had a very sophisticated ~~sass~~ SAS system.

QUESTION: That I hadn't known.

ANSWER: The F-100 had a very simple yaw damper in its initial application, pitch damper was added to the F-100C, but the -- ~~sass~~ SAS system in the F-107 was really the forerunner of what you might call modern fly-by-wire stability augmentation.

It also had a very sophisticated inlet system. It was the prototype for the B-70 inlet system.

QUESTION: That's a good thing. Except you

simply had the inlet down below the aircraft rather than above. On the 107 you had it above.

ANSWER: We had it above.

QUESTION: It was a bifurcated inlet, was it not?

ANSWER: It was a split inlet, two dimensional.

QUESTION: NACA flew at least one aircraft, at least one F-107.

ANSWER: We flew two of them.

QUESTION: You flew two, but one was lost in an accident, I believe, or some -- not a major accident, but it was a runway accident, or something like that.

ANSWER: Yes, I'll tell you about that one.

QUESTION: Okay.

ANSWER: We put the sidearm controller --

QUESTION: Okay.

ANSWER: -- from the X-15 in the airplane.

It was a target of opportunity. It was an airplane that was here, and that was available. We had completed the ~~SAS~~ EAS work on the machine. So we put the sidearm controller work in the airplane.

Scott Crossfield was asked to evaluate the sidearm controller. Stan ~~Parcanic~~ Antchak and I sat down -- Stan was one of our pilots, and had flown the airplane a number of times -- We sat down and we briefed him in the handbook with the limitations on the airplane, and Scott

climbed in the air-plane to go check it out.

He allowed the airplane to accelerate to too high a speed on the ground. The airplane was -- had a difficulty. It was an inherent design defect in the airplane in terms of the fact that the brakes and wheels were inadequate for the size and weight of the airplane, and the brakes caught on fire before he ever took off.

QUESTION: One of those things.

ANSWER: He realized it. He heard the tires blow and he aborted the takeoff heading that way on the lake.bed. He normally operated right off the lake bed.

Arid the airplane sustained some fairly significant fire damage before the fire could be put out, and it was never flown again.

QUESTION; Was Crossfield at that time a North American test pilot?

ANSWER: He was a North American pilot.

QUESTION: Okay.

ANSWER: That is correct.

QUESTION: What SAS lessons were learned from the system, from the aircraft?

ANSWER: I think we learned we needed to hnve solid-state technology instead of vacuum-tube technology.

QUESTION: Ah, that was a vacuum-tube-technology aircraft.

ANSWER: Vacuum-tube technology.

QUESTION: Okay.

ANSWER: In fact, there was significant difference between how the number 1 airplane was put together and how the number 3 airplane was put together. Those were the two that we operated, and --

QUESTION: Did the number 3 have solid-state?

ANSWER: It was not solid state, but it was --

QUESTION: On the way.

ANSWER: It was on the way, and it was significantly better.

QUESTION: Hmmm.

ANSWER: It was significantly better.

QUESTION: Significantly better meaning less complex, more reliable?

ANSWER: More reliable.

QUESTION: More reliable.

ANSWER: Not necessarily less complex. The functions were all the same. It's really the hardware that was used.

QUESTION: Okay.

ANSWER: Connectors, potted connectors in the number 1 airplane were a major source of --

QUESTION: Powered connecters?

ANSWER: Power --

QUESTION: Power. Sorry.

ANSWER: Potted.

QUESTION: Potted.

ANSWER: Potted. You use a potting compound.

QUESTION: Oh.

ANSWER: So that the wires went into the back of the connector and then you put a potting connection, a soft, pliable RTV type of material to pack in, to hold the Wires in the proper location.

And that really didn't work out very well. On the number 3 airplane they went to a different type of connector, and it reduced the maintenance headaches significantly, probably by an order of magnitude.

QUESTION: When you --

ANSWER: So packaging was -- was --

QUESTION: Okay.

ANSWER: -- was a major factor in increased reliability (inaudible).

QUESTION: When the X-15 program started coining along, how did your function then change? Did you get involved with X-15 --

ANSWER: I went from the F-100 and the F-100 continued through a variety of things. We did the initial roll coupling work, we looked at the effect of ~~slacks~~ slats. That airplane had five segmented ~~slacks~~ slats on each wing. And we

mechanically constrained the slats to look at pitch-up, to get some idea of what the advantage of a leading edge did for you.

Then we took the airplane to Nelles AFB, our instrumented airplane, and had the Nelles people fly it in a normal training operation for a matter of six weeks.

QUESTION: Now this was an F-100A, hut it was modified with the additional fin area.

ANSWER: It was an F-100A.

That is correct.

QUESTION: Ultimately.

ANSWER: It had additional fin area, and it had additional wingtip extensions.

QUESTION: Right. A ~~footage tie~~ foot or two, something like that.

ANSWER: Right, those were added to the airplane. And we got a variety of operational data on the F-100 airplane., which, again, was reported. From there then X-15 loomed big on the horizon, and we were concerned about low ~~lift-right~~ drag landing. So I proceeded then to run a series of investigations on the F-104 to simulate X-15 landing characteristics. Neil Armstrong was the project pilot, and --

QUESTION: What year ria~this, about '58?

ANSWER: I don't really remember. Let's go back

and see what I've got to show in terms of -- in terms of references on some of this stuff.

QUESTION: That's a handy little door stopper.

ANSWER: We wrote NASA-TMX-31. It was published in 1959, so the data had to be done.

QUESTION: Okay, so the landing set -- the F-104 landinq set for 1958.

ANSWER: Right.

QUESTION: Okay?

Was this also done on the same 104 that had the reaction controls installed in the linkage. After the X-1B program?

ANSWER: I think so.

QUESTION: Fell apart.

ANSWER: The number was -- Well, we did it in two airplanes. We had two F-104s, 961 and 734? I don't know. The last numbers were "3-4."

We used both airplanes.

QUESTION: Okay.

ANSWER: And we intermixed the really low L/D ~~LORD~~ Landing work was done on 961.

QUESTION: 961 did the low L/D ~~LORD~~ work.

ANSWER: That did the lower ~~lover~~ Lower D work.

QUESTION: That's the one we have at the museum.

ANSWER: That is the one you have in the museum.

QUESTION: Yes.

ANSWER: That was the original -- That's number, airplane number 9, I think --

QUESTION: Right. YF-104A.

ANSWER: Right.

And we did all the low ~~LORD~~ L/D work, the lowest ~~LORD~~ L/D work on that airplane.

The other airplane had a -- had a glove on the wing, a Fiberglas glove on the wing, to look at boundary layer transition, and we didn't want to take the airplane to flight the extreme conditions for fear that we'd shed that Fiberglas glove.

QUESTION: ~~You had~~ You'd have a problem.

ANSWER: Arid have other problems. right.

So that one went to lift drag ratios, ~~pull 03~~ below 3. That's the only work that we'd ever done here at left drag rations of less than 3.

QUESTION: Where does the F-5D, the Douglas F-5D fit into the research program out here.

ANSWER: That cane after F-15. We were concerned with Dyna-Soar then.

QUESTION: And were you involved directly in that?

ANSWER: Yes, that was --

The F5-Bs --

QUESTION: I got a gold nine.

ANSWER: The F-5Ds *came* here as -- I was very fortunate in my years.

Hey, I got to work on all the --

QUESTION: The funny airplanes.

ANSWER: The fun airplanes. Really.

And the F-5Ds came here ultimately to look at another military configuration. We were concerned more with the general handling qualities of stability and control. But again, it was a target of opportunity. We found that the -- F5D we had completed the basic program on that, and Dyna-Soar loomed on the horizon as a follow on to x-15.

And the F-5D was just exactly right in terms of wing loading, in terms of lift-to-drag ratio, to simulate the sorts of things that Dyna-Soar would do.

QUESTION: Was it brought to the center specifically for Dyna-Soar --

ANSWER: No.

QUESTION: -- work?

ANSWER: No. It :%!as again a target *of* opportunity.

QUESTION: What was the original reason --

ANSWER: The original reason was to look at stability of control and handling qualities.

QUESTION: Okay.

ANSWER: And we completed that work very quickly. It was a six-month-or-so type program where we documented the basic behavior of the airplane, and then this, as I say, loomed as a much more important thing to do.

QUESTION: How did the pilots like the F-5D.

ANSWER: Very rice. It was a nice-flying airplane.

QUESTION: Apparently it was — Well, it was much like the 106 was a bigger brother to the 102, and started actually as a 102B in the old days.

ANSWER: Right.

QUESTION: It was a follow-on to the old F-4D, the (~~Inaudible~~) Skyray.

ANSWER: That is correct.

QUESTION: And yet it had none of the vices of the F-4D had, although the F-4D was a good airplane.

ANSWER: It also had 5-75 ~~inlets~~ engines, which --

QUESTION: Right, so --

ANSWER: made it a much more, much more powerful engine.

It was a well-behaved airplane, very well-behaved airplane.

QUESTION: When did the -- Now one F-5D went up to Ames, and was fitted with a ~~five~~ Ogee wing.

ANSWER: ~~Five~~ Ogee wing, and was run in the wind

tunnel, right.

QUESTION: Okay.

Was that the number 1 or the number ??

ANSWER: I don't remember.

QUESTION: Okay; no problem.

ANSWER: I don't remember.

QUESTION: That could be checked out.

ANSWER: I don't remember. I don't remember serial numbers of the airplane. Ames had one and we had one and I really don't have any idea what the disposition of the other three airplanes were. I think there were built five.

QUESTION: I told them -- Ralph Jackson's office -- going through some old photos of the lifting body program and I came across a very interesting photo. It showed the M-2, F-2, apparently in one of its initial glide flights, and way over in one corner of the picture was an F-5D.

ANSWER: F-5D -- was used as chase airplane.

Used it as a chase airplane quite a bit, BES quite a bit, because, again, it could get slow enough. It had a low wing loading, contrasted to something like the F-104, that couldn't slow down. The F-104 had to make its approaches at fairly high speed. The F-5D --

QUESTION: And you had to separate at a steep angle.

ANSWER: Yes, the F-5D could get the steep angle, but it didn't have to have the high speed.

QUESTION: Well, so --

ANSWER: It was a very versatile airplane. And we used it not only to do lower ~~fever~~ lower D landing and approach work, but also to simulate the abort maneuver for the Dyna-Soar.

QUESTION: I would like to get into that. I think I'll turn the tape at this point.

QUESTION: Okay. We were talking about the abort maneuver for the Dyna-Soar and the F-5D uses a --

ANSWER: Right.

QUESTION: -- simulation vehicle for that.

ANSWER: Right.

QUESTION: What was the procedure on a flight like that? How was -- What -- What flight maneuver did the aircraft --

ANSWER: The flight maneuver was basically to reach a very high speed, essentially on the deck -- We did all the work over the north lake bed here. The pilot then would pull up, for 4 9'5, and go vertical, and -- Again, the report would tell you all the pertinent information in terms of the altitude.

But he would then simulate the abort, peel over, and then make a lower ~~lever~~ lower D landing to the north lake bed.

QUESTION: Was it a power-off landing?

ANSWER: It was -- Yes, it was a power-off landing. Or a simulated power-off landing.

If you'd reduce power --

QUESTION: Was Neil Armstrong the pilot in that?

ANSWER: Neil Armstrong was the project pilot, and one of the copilots who was following the Dyna-Soar program was also Bill Dana.

QUESTION: Bill Dana. A-ha.

ANSWER: So you can talk to Bill about that.

QUESTION: Very good,

ANSWER: He did a great deal of work with the F-5D. He probably --

QUESTION: Okay.

ANSWER: -- flew the F-5D here more than anyone else.

QUESTION: Very good. I'll have to get hold of --

ANSWER: Bill also had a lot to do with the F-107. Bill came here originally as an engineer.

QUESTION: I hadn't known that. I thought Dana was pretty much a 60s-type figure. That's interesting.

ANSWER: He, he came in the ~~first~~ late '50s. He came in the late '50s and was assigned to work with me on the F-107, and took the F-107 from me, if you wish, as I went on to the lower ~~lever~~ Lower D landing work.

QUESTION: Very good.

ANSWER: And then moved into our pilot's group.

QUESTION: That's an interesting --

ANSWER: Neil Armstrong, by the way, came here as an engineer, also.

QUESTION: From Lewis.

ANSWER: Right.

QUESTION: Yes.

ANSWER: Worked for six months or so as an

engineer and then moved into the pilot group.

QUESTION: John ~~Yancey~~ Mackie, the same thing.

ANSWER: Right.

QUESTION: That was rather characteristic of the way that they wanted to look at somebody in an engineering capacity to find out if he was a competent engineer, to give him the feel for the engineering side of the problem, and then, having looked at him for four, six months or what have you, then begin to work him into the research activity.

QUESTION: I gather that those have set a heavy standard in many, many areas, and it's character, if you will, over time has changed. For example, the heavy involvement now with a completely center -- Houston and the shuttle -- but some things remain the same, and that's one of them.

The -- Unlike, say, the Air Force Flight Test Center, or the Naval Air Test Center at Patuxent River, the pilots that cone on board here are regarded almost as engineers first and pilots second.

ANSWER: It's a mix. It's a mix.

QUESTION: Okay.

ANSWER: It is a requirement that all our pilots have an engineering degree.

QUESTION: Sure.

ANSWER: That is a requirement. But it's a combination.

QUESTION: Have you found any particular background is desirable? I'm not thinking in terms of, say, military jot backaround, not something like that, but among the sciences, do yc! find that people with an engineering or ti:chnology-type degree are superior, perhaps, to those having a pure science degree like a physics degree or something like that?

ANSWER: The engineers are -- tend to he a little more practical, less theoreticai --

QUESTION: I would have --

ANSWER: -- more practical, more pragmatic.

QUESTION: Yes.

ANSWER: -- and willing to accept something as a fact even though the theory can't prove it. A little more --

QUESTION: I would have expected that. That's the tendency in engineering in general, but, you know, I couldn't have -- I wouldn't have concluded it without checking it.

ANSWER: Yes.

Just a general comment, too. As far as I'm concerned, Neil Armstrong is the finest engineering test pilot I've ever worked with.

QUESTION: I see.

ANSWER: Neil was an outstanding engineer. He not only could go up and do the maneuvers that you wanted him to do, but he could come back and tell you exactly what happened, and why. Was thinking all the time.

And that guy got into trouble once, on the X-15, if you haven't heard the Story.

QUESTION: No, I haven't.

ANSWER: He went whizzing overhead at about mach 6, and was describing a ~~(inaudible)~~ phugoid oscillation in the airplane. He was following angle of attack. And because he was describing this thing on the microphone, we couldn't talk to him. He was blocking out our communications.

QUESTION: Oh, my God.

ANSWER: And saying, "Hey, Neil, turn."

QUESTION: Yes.

ANSWER: And he finally realized over Pasadena where he was, and he --

QUESTION: Which is way the hell off.

ANSWER: -- he turned, and boomed the hell out of Los Angeles. And made a straight-in landing to the south lake bed, and I think *he* touched something like 50 feet inside the perimeter of the lake bed, so here's a case where that good engineering test pilot almost got himself in a lot of trouble being fascinated by an

engineering problem.

QUESTION: That's very interesting. That communications problem cropped up two or three times before.

ANSWER: Communications is without a doubt the worst problem we have in operating airplanes. We can't talk to it. At the critical moment, you can't talk to it.

QUESTION: Okay.

Any other notable incidents at that time?

ANSWER: It's really a weak link in terms of --

QUESTION: What could be done to improve that? Is there anything that can be done?

ANSWER: I don't know. I really don't know.

QUESTION: I was thinking that there were two drops -- that the X-1 and the D-558-2 number 2, one in the NACA program with the X-1 number 2 and a guy named Robert Champine, before your time.

ANSWER: Right.

QUESTION: And then --

ANSWER: (Inaudible.)

QUESTION: And then the other one was Bill Bridgman and the Douglas contractor program on the Skyrocket, and I think this occurred about '51, also. And, in both cases, because people were talking and the (inaudible) had the button depressed, they were not able to radio that

they were not going through with the drop. They were dropping vertically -- literally dropping at vertical.

And fortunately that's the only two of that magnitude, but this points up another one. So communications still --

ANSWER: Communications was a problem and as a result of a variety of those things we exercise fairly good -- I think we exercise fairly good discipline, if you wish, in the use of the radio.

QUESTION: Do you try -- Do you have pilots limit their --

ANSWER: If we ultimately --

QUESTION: -- transmission time, so that somebody can break in?

ANSWER: Right. And we ultimately went to the idea that the space program utilized, of a single communicator, as a result of that sort of thing.

QUESTION: Did they --

ANSWER: When we operated in the '50s, everybody had a microphone in his hand and could interrupt. X-15 we changed that. We said, "Hey, there will be one communicator, because there are just too many people on the air."

QUESTION: And that was then adopted over into the space program --

ANSWER: And that was --

QUESTION: And they -- that adopted -- as a result of the experience he --

ANSWER: As a result of the X-15 program.

QUESTION: Excellent.

ANSWER: Walt Williams.

QUESTION: That's a good --

ANSWER: Walt Williams was the director here --

QUESTION: -- contribution.

ANSWER: -- during all that formulation stage --

QUESTION: Yes.

ANSWER: -- and he took it with him into the Mercury program.

QUESTION: There was one -- When Walker was in the X-1A and they had the in-flight explosion, and they were making up their minds and dropping it, I looked over the transcript, and I was amazed at the number of people who were coming on the air. You'd have some Air Force sergeant on a truck out here on the lake bed and he'd be on the air.

ANSWER: Yes.

QUESTION: Everybody'd he on the air.

ANSWER: Yes.

QUESTION: And --

ANSWER: That was before the days of -- And

that is one of the events that obviously influenced the whole thing, because there was a great deal of consternation and confusion in our control room on who had the authority to say, "Hey, go ahead and drop that thing."

There were people up there that were very excited over the fact that the temperature of the ~~locks~~ Lox in the airplane was far higher than we wanted it to be, and yet nobody would stand up and take the responsibility of saying, "Get rid of that bomb."

QUESTION: I think the person that finally did it was Joe ~~Vessel~~ Vensel --

ANSWER: Joe ~~Vessel.~~ Vensel

QUESTION: -- who said something like, "Stan, drop the damn thing," and that's virtually an exact quote.

ANSWER: And I think that that would -- that would have been exactly what Joe would have told him. "Stan, drop the damn thing."

QUESTION: Joe Vessel. What was he -- I had made plans to interview Vessel when I came out here, contact him, and well, you know whnt happened on that.

What was he like to work with? What kind of an individual was he? What sort of irpact did he have on the center? That's an easy question, isn't it?

ANSWER: Joe was apparently a very mild-mannered fellow. He was very quiet. He very rarely raised hi5

voice. Just a prince of a guy. But he was decisive. He really was decisive. He had the interests of his pilots very much at heart.

He was an interesting character because he was hard of hearing, and he --

QUESTION: What was his open-cockpit biplane days, when he ~~(inaudible)~~ was a test pilot -

ANSWER: Right, right, at Lewis. And it was a funny thing. When the meetings got boring, he'd just turn his hearing aid down and go to sleep.

QUESTION: That's very interesting.

ANSWER: (Laughter.)

QUESTION: That's very interesting.

ANSWER: But Joe was a fine guy, and he really -- really concerned about the safety of his pilots, all the time.

QUESTION: Did he stick to -- in this framework -- did he stick to operations, or did he ever get out and -- into the research and say, "I think in our next research airplane we should have something like this," and make those kind of decisions?

ANSWER: He was concerned from the piloting equipment standpoint, yes, indeed. He made inputs into the ~~X-20~~ X-15 program, for instance, in terms of fighting very hard for things that he felt the pilots needed in order to do

their job better, not only from a flying standpoint, but from a research standpoint, yes. He was very active in that realm. (Inaudible.) Very concerned about making sure that the pilots had adequate protection for the higher altitude environment --

QUESTION: That's great.

ANSWER: -- when some people would have been willing to cut corners.

QUESTION: Scott Crossfield did a little ~~(inaudible)~~ pressure suit work with -- Did he and Vetsel work together on that?

ANSWER: I think all the pilots worked very closely in that area. In fact, our piloting group has always been a very tight-knit organization.

QUESTION: That's another trend, then, you see as continuing from ~~(inaudible)~~ NACA.

ANSWER: Oh, you bet. In fact, it's rather interesting to hear the observations of your people like John Matthews, our lawyer, who has come in. He says, "It's a very distinct pecking order in the Center, here, and Operations, Flight Operations, is the top of the pecking order."

QUESTION: Ah. That's what you --

ANSWER: They control the philosophy of the Center operation. Pilot safety is the paramount concern of operating our airplane.

QUESTION: From a human standpoint --

ANSWER: It really *is*.

QUESTION: -- would it he an overstatement to say that the Center was, in effect, build around the pilots? Or built at least around the Operations Center?

ANSWER: That's a very true statement.

QUESTION: okay.

ANSWER: That's a very true statement.

And I guess one of the things that really upset us as outsiders looking in in the space program is *we* look and see how many times the astronauts cane to the rescue and took over when the automatic systems did not perform their function.

QUESTION: Apollo 13 being a good example.

ANSWER: And the space people, at least the space management people, seem to be reluctant to utilize that capability. The astronauts, by contract with our pilots here, don't have nearly the say in their own destiny.

QUESTION: It's -- I always see it as kind of like a pyramid. You have a regular pyramid at the Center, where the pilots' concerns are very much at the pinnacle, and then in the *space* program, although apparently our astronauts have a hit mere control over their destiny than the cosmonauts do in the Soviet Union.

ANSWER: Right, they're much more active.

QUESTION: Right.

Nevertheless, in our space program it's an inverted pyramid where you have this overwhelming diffusion of power and authority and the astronaut is stuck somewhere in the middle of the whole organization, the middle level --

ANSWER: Right.

QUESTION: -- for this whole arrangement.

The 15 took so much time in terms of research -- or the F -- X-15, rather -- took so much time in terms of research, development, and need for manpower, but during the first half of the '60s, really, it seems that there were not too many other programs going on here, like you had seen in the '50s, say, with 102s, 100s.

ANSWER: There were not as many, but there were still some.

QUESTION: Okay.

ANSWER: We created the lunar landing research program --

QUESTION: Right.

ANSWER: -- which --

QUESTION: Were you involved in that?

ANSWER: I was involved in thnt.

QUESTION: By the way.

ANSWER: We created the lifting body program --

QUESTION: Right.

ANSWER: -- and the para-glider program.

All of those things were -- were done with whatever manpower was avilable.

QUESTION: Did it reflect -- All those seem to reflect the growing shift that occurred after '58 and the creation of NASA.

ANSWER: The space side.

QUESTION: Toward the space side of the agency,

ANSWER: That's right.

QUESTION: Yes.

ANSWER: And places like here were trying to find a role, trying to play a part in the space activity.

Jake Drake, again, was one of the major driving forces at that time.

QUESTION: Was it a -- almost a desperation trying to find a role in the space --

ANSWER: No, no.

QUESTION: Okay.

ANSWER: Trying to utilize our capabilities to look at things where we felt we had a competence. It wasn't a --

QUESTION: I see.

ANSWER: -- desperation at all.

QUESTION: I was wondering in the sense of

Center's survival. "Oh, my God, if we don't get on the space program, they might shut the Center down."

ANSWER: There was a measure of that, but I don't think it was a -- It was a subliminal thing, rather than a very overt thing. I think we saw that there was indeed a great trend. Some of the other centers, Lewis, for instance, almost got out of the air-breathing propulsion business entirely at that time, to devote to rocket motors and space propulsion sort of concerns.

We felt there was a balance, but we didn't want to put all our eggs in the aeronautics side of the house.

QUESTION: Sure.

ANSWER: And it was a matter of trying to strike a balance.

QUESTION: How did the Center -- and I don't know if you'll wish to go off the record or something -- How did the Center get involved in the ~~riot call~~ YF-12 program? Did that start very early on when Lockheed was doing their work?

ANSWER: Again, I was involved (inaudible).

QUESTION: Anything you can add there that you feel you can add would be appreciated.

ANSWER: Okay, let me tell you about the ~~LORD~~ YAD LLRV program, first --

QUESTION: Okay.

ANSWER: Carrying this thing through chronologically.

QUESTION: Okay, fine.

ANSWER: ~~LORD~~ Lleu — Bell came to us in late fall of what must have been '62 or '63 -- I don't remember if I can go back -- hut they made a proposal to us that we should look into terminal favored lunar landing, but a gimbeled engine into a flying machine.

Bell had been operating a number of VTOL machines, X-14 (inaudible) in the test vehicle, and they came up with a proposal for the gimbeled engine.

We let a study contract to them to do a preliminary design and we went down to sell it to Houston, We found a fairly good reception ~~for~~ from Walt Williams. (Inaudible) ~~were~~ Max Faget was very much opposed to it.

QUESTION: Ah, that's interesting.

ANSWER: Langley was still —

QUESTION: Why?

ANSWER: Their bridge structure.

QUESTION: And ~~Frissay~~ Faget supported the bridge.

ANSWER: Max ~~(inaudible)~~ Faget supported the bridge structure. They invested $5 million in the bridge --

QUESTION: Which proved really only ~~you're~~ unthinkable ~~talking~~ on of crash ~~(inaudible)~~ studies.

ANSWER: -- and we said, "We can do it for $2 million."

So it left some of those people with egg on their face saying, "Hey, it cost twice as much to do a job that wasn't that good."

We contracted with Bell to build the vehicles, and Bob ~~Siemens~~ Seamans was the guy that really sprung the money for that. The Houston people really were not particulary enamored with it, but ~~Siemens~~ Seamans at the headquarters level did approve.

We built it. Bell ran into some problems with cost. We said, "Hey, we're going to put a ceiling on it, spend the money. When you're through, deliver all the components out here, we will finish assembling it, we will check it out ourselves, and we will go fly. Which is exactly what we did.

QUESTION: Were they built at Bell Aero Systems in Buffalo?

ANSWER: In Buffalo.

And we flew the machines. We made, I guess, 199 flights, or something in that neighborhood, demonstrated it, we checked out ~~Zero Batty~~ Joe Algranti, who is the chief pilot: down at Houston, and Bud ~~Reen,~~ Rheem his assistant, and delivered the vehicles down there in the spring of 1967.

One of the very colorful people here at the time who participated in that program in a very active way was Jack ~~Hoover~~ Klwever. I don't know whether that means anything. Jack was an army officer assigned to work with us in the piloting office.

QUESTION: Right. Now I recall. He was about the only mach 2-rated Army pilot in the world, I think.

ANSWER: Right. Right,

Jack was a very colorful individual. He had a very sixth sense --

QUESTION: Is he still around,

ANSWER: -- for flying VTOL machines.

I understand he is still in the Army. I understand he has a star now. He was a major here at the time. And the last that I knew of Jack he was the commander of the Dugway Proving Grounds, up at Dugway, Utah.

QUESTION: Ah. Hmmm.

That's an odd place for an aviator to wind up.

ANSWER: He had some sons who followed him into the helicopter world, and one of them was killed in Vietnam when he was in Vietnam.

Jack was very involved in that, and I think he made some very innovative contributions to the VTOL world,

working on the first attitude control on a VTOL machine.

QUESTION: On the ~~LORB~~. LLRV

ANSWER: On the ~~LORB~~. LLRV

Some of our brethren around around the world in the VTOL field were very skeptical that that would be successful, and now it's being used in all VTOL machines.

We've done some very innovative things, we've done some very unique things, because we didn't know any better.

QUESTION: What happened? What happened -- How come Houston started losing those aircraft and they got 'em away from there. Was it that they weren't running the programs ~~(inaudible)~~ well they've been run out here?

For one thing --

ANSWER: I attribute it to the press to make a schedule.

QUESTION: Oh, okay.

ANSWER: There's a lot of controversy, and I'm sure they have -- There are two sides to every coin. Our observation of the figures says, for instance, we never operated in more than a 10-knot wind. We felt that was really the --

QUESTION: The maximum?

ANSWER: -- the maximum that we could safely fly in and be assured that we would have adequate control

and what have you.

Houston --

QUESTION: That's almost true for the (inaudible).

ANSWER: I realize that.

And it was attitude control power that was the limiting factor. The Houston people felt they had to up that to 15 knots in order to get in the number of flights that they felt necessary to adequately train the astronauts.

The first two accidents were really attributable to wind. In the first case the wind was high, and attitude rocket fuel was used at a much higher rate that was anticipated. He ran out of control fuel.

QUESTION: There you go.

ANSWER: In the second instance --

QUESTION: (Inaudible.)

ANSWER: -- again, the winds were higher than predicted, there was a very large shear in the wind, so that while the winds on the ground were blowing at close to 15 knots, gusts as high as 60 knots were experienced a couple hundred feet in the air, and it tipped the airplane over. It, tipped the machine over. (~~Inaudible~~ Young Algranati) very barely got out with life.

QUESTION: Yes.

ANSWER: In the third instance -- and they lost

three of them -- In tho third instance it was a power failure. Again, a difference in philosophy. We used a way of bringing the emergency power on the line. ~~They~~ Bell ~~did~~ recommended in the LLTVs that a different power switching scheme was used, and that power switching scheme cost them that vehicle.

QUESTION: So you had the one lunar landing research vehicle here, and then you had three --

ANSWER: We had two.

QUESTION: You had two.

ANSWER: We had two vehicles here. We flew the number 1 machine through the fall of '66 and then we assembled the second machine and flew it to demonstrate that it was just like the first machine. We delivered the first machine to Houston in January of '67 and the second machine in February of '67. So they got the two LLRVs and they independently bought three LLTVs.

QUESTION: Of the five of those, three were lost, the one --

ANSWER: One LLRV was lost, two LLTVs were lost. There is the one LLRV, number 2, here, and there's one TV at Houston.

QUESTION: Okay. Fine. Great

That's a good summary on that program.

ANSWER: Right.

QUESTION: Good.

ANSWER: We ther went to the general aviation world. LLRVs had ended. I was asked to take over the general aviation world. We bought the twin Commanche. That's down in the hangar. The idea was to make an analysis of the predictability of aerodynamic characteristics .for general aviation class aircraft.

We bought. the airplane. We put it in the full-scale tunnel back at Langley -- and Chester Wolowicz ~~Long was here~~ then went through an analytical process to predict the derivatives that we had.

QUESTION: Flight derivatives.

ANSWER: We had the measurements in the full-scale tunnel at Langley, and Chester predicted the derivatives analytically. Made that comparison.

QUESTION: What year was this? About '68.

ANSWER: '67.

QUESTION: '67.

You did not make the aircraft a variable-stability airplane, did you? That was the Jet Star.

ANSWER: The Jet Star was a variable stability.

QUESTION: Okay.

ANSWER: At that stage in the game, in the late

summer of '67 Paul Bikle and Joe Weil approached me and said, "We have been invited by the Air Force to participate in the category 2 test for the SR-71. We need somebody to go in there at a fairly high Level to represent NASA, to gain an exposure to the airplane, find out what kind of operational experience they've had, find out what sort of technical experience they've had, and, in essence, provide a channel for us into that experience.

"It's ~~(inaudible)~~ unique experience, they're doing it fairly regularly, we want to open the door to that technology compared to the B-70, compared to the X-15."

And I was picked to be the guy. Would I be interested? They speculated —

QUESTION: And he's hardly there.

ANSWER: They speculated that it would probably be a three- to six-month exposure. Maybe no potential for anything beyond that. But they recognized the special access properties of the system, and, again, recognizing we might never be able to publish any of the information that we acquired, but at least it would be background experience that we could then apply to the D-70 data that we were getting and deal with that data maybe with more confidence.

No, I didn't jump at it. I told them I really

wasn't interested. I said, "Hey, the general aviation world looks to me to be a longer term, much more interesting field. I think I can do a *lot* more in terms of creativity *over* the long haul." And I really wasn't interested.

QUESTION: Has that changed?

ANSWER: They said, "Go back and think about it over the weekend."

It was a Friday afternoon. "And come back and chat with us Monday morning."

And I came back and chatted with them Monday morning, and Bickel said, "Look, go do it. I'm asking you to yo do it. I'm not telling you, but I'm asking you to go do it. If it doesn't pan out, we'll put you back in general aviation, and you can go do the general aviation thing," but said, "I think your experience in the high-speed world is really more useful to us than the low-speed world."

And that's how I got involved. I went over -- I *bias* given the choice *of* --

QUESTION: *Was* that being conducted at this base?

ANSWER: Yes, here at Edwards.

I became a part of the **Air** Force team as a consultant. I was assigned a responsibility for looking

at longitudinal stability on the airplane, and was working in the office as an Air Force employee for all practical purposes.

QUESTION: Now this is the SR FR-71.

ANSWER: ~~(Inaudible)~~ SR-71.

QUESTION: Okay, ~~(inaudible)~~ the YF-12's by this time I think were in storage.

ANSWER: ~~Any~~ At that time (inaudible).

QUESTION: Okay. Great.

ANSWER: I was asked to look the picture over and see if we could be of use to them to look at other areas, and I picked a total of about six people from here in the Center -- all senior, experienced people -- to go over and work with us. Broad spectrum, provide assistance.

The Air Force had, oh, three civil servants, I guess it was, and about six military people working the whole stability and control area, or the whole airplane area. And they were really short of technical capability.

So I think we all got out of that very well, and got a very good exposure to what the concerns were. At that stage of the game the Air Force was in a position of wanting to reinstrument the category 2 ~~civilian patrol~~ stability and control airplane, and we volunteered to put a NASA data system in the airplane.

Ben Bellus was running the store at the time, and Ben said, "No, we want to do it with the Lockheed instrumentation. We recognize it's not as good as yours, but we don't want to change the system at this stage of the game, but, yes, we do have two YF-12s sitting in the barn over here. If you want to use them, you're welcome to use them."

QUESTION: And are those the two that NASA's still using?

ANSWER: "Let's sit down and decide how we put this program together:"

And Major Sam ~~Arsini~~ Ursini, who was, in essence the custodian for those airplanes here on the base, Air Defense Command, got together, and we proposed a joint program. Very novel in its arrangement, because NASA was going to pay the dollar.

Normally in our arrangements with the Air Force we provided the people and the Air Force provided the money.

QUESTION: Like lifting body and so forth.

ANSWER: Like X-15, maybe --

QUESTION: Okay (inaudible).

ANSWER: -- is a better example.

B-70 is a better example.

QUESTION: Okay.

ANSWER: Air Force really put in the better share of the dollars in each of them by orders of magnitude.

The F-12 NASA put in the dollars. The Air Force put in no money at all. They did provide us with some 110 Air Defense Command people to maintain the airplane, to run the supply system, and we provided the technical expertise.

We instrumented the two airplanes and we intermixed the research program with the Air Defense Command program to continue the development of tactics for this kind of info.

QUESTION: Now that major -- His name was Sam Racini?

ANSWER: Ursini. U-r-s-i-n-i.

QUESTION: Okay.

ANSWER: ~~Bob~~ Fox Stephens had been the commander of the test force, the SR-71 ~~echo~~ joint test force when we ~~(inaudible)~~ made the agreement,

QUESTION: That was his nickname, right? It was Robert Stephens.

ANSWER: Robert Stephens. Full colonel.

And shortly thereafter Colonel Joe Rogers, who was their defense commander, was placed in command of the test force.

QUESTION: Okay.

ANSWER: So Rogers was really our senior boss, But Sam was really the salesman.

Joe was placed as the test force commander.

QUESTION: Okay.

ANSWER: And I was his deputy in this NASA–Air Force arrangement. And we got the YF-12 ~~(inaudible)~~ off the ground.

We flew for the first time in December of 1969. The airplane had been down for 23 months. We started to work on it in September --

QUESTION: Of '68.

ANSWER: '69.

QUESTION: Oh, yes, of course. December '69.

ANSWER: In three months we took the airplanes out of storage, updated then, added our instrumentation. The program progressed until what must have been June of 1971 and Lieutenant Colonel Jack Layton had replaced Rogers as the test force commander.

QUESTION: Okay.

ANSWER: And Layton got fire indication after coming hack from a mission. He could not get a confirmation of that fire; flew around the landing pattern for almost 15 minutes --

QUESTION: Ton!: a long time for a fire indication.

ANSWER: -- before he was convinced that he

really hail a fire, and at that stage of the game he was concerned about bringing an airplane down close to the runway for fear that the wing might fall off.

So he and the crew member elected to eject.

QUESTION: Now.

(End of recording.)