

MR. BELLMAN: Well, to start Out with, I'll, we'll go down some of your questions here, and then, I think that'll lead to other things.

I came to Flight Research Center in March of 1950. And I spent 8 years previous to that at the Lewis Center.

BY MR. HALLION:

Q. Engine and Propulsion Labs?

A. Yeah. I was strictly an engine and propulsion man, and not an aerodynamicist.

Although the reason we came out here, is we had a son who had chronic illness and we . . . the desert, so I asked for a transfer out.

And with the understanding that I would kind of do anything they wanted me to do.

Q. Sure.

A. And, so it wasn't -- and they weren't really, didn't need a 100 percent propulsion man, so I did get quite involved in the measurement of drag on airplanes, which is about half propulsion and half aerodynamics. And --

Q. Inlet performance, and things like that?

A. That's right. In other words, you can't measure the drag on an airplane unless you can measure the thrust of the engine.

Q. That's common sense.

A. And so it combines the 2.

1 Q Okay.

2 A And measuring the thrust of a jet engine is a, is a
3 exacting task, let's put it that way.

4 Q Kind of a multi-discipline-type approach.

5 A Right.

6 Well, I kind of fell heir to that, and the, and I
7 eventually kind of headed up any of the groups there that worke
8 on propulsion. And that's kind of why Drake, I teamed up with
9 Drake, I kind of -- I, I, he was, he was the leader and the
10 mind, I think, behind most of these advanced projects, and I
11 was kind of his right-hand man and consultant in regards to
12 propulsion things.

13 Q Was that kind of a . . . arrangement? In other word
14 was he assigned, if you will, the task of advanced planner?

15 A Yeah.

16 Q Okay.

17 A Yeah, he, he did that. I was never, I was always
18 associated to him informally.

19 Q There's another individual, okay. L. Robert Carmen
20 (phonetic). Does that -- I don't think he's out there too long

21 A No. In fact, he came from Lewis.

22 Q Oh, okay. What was his role? He seemed, for a whil ,
23 to be in advanced project's thinking.

24 A Well, he was the same type of person.

25 Actually, at the time they started, he and I were

1 working in the same section at Lewis, and they put in a request
2 for somebody who'd come from Lewis out there, because they did
3 want somebody to work on propulsion, see.

4 Q Okay.

5 A So, in other words, that was really -- when I came
6 out, I was excess baggage, because they'd already had one guy
7 from Lewis who'd come out there.

8 But then, after I was out here -- oh, I don't know,
9 a year or 2, Carmen left, went with Northrup. So --

10 Q I see.

11 A -- then I took over all the . . . drag work.

12 Q Okay.

13 A So Carmen really set up what I, what I eventually
14 did.

15 Q I see. Okay.

16 A -- as far as the propulsion stuff.

17 Q And then left to go into private industry.

18 A Yeah.

19 Q I often wondered what happened to him. Because he
20 seemed to disappear completely from the NACA set-up, and he
21 didn't appear even in things like AIAA registries -- would give
22 you an indication --

23 A I think he's still with Redondo Beach, last I heard.
24 He worked in Florida for a while, on the , what was it there?

25 Q SNARK?

1 A SNARK.

2 Q Yeah. There's, there's a strang group of --

3 A Yeah. And then, then later on, ne came back for a
4 long time. He lived down in the region of Manhattan Beach, or
5 Redondo Beach, or someplace down

6 Q I . . . a while back a project officer on SNARK, and
he remarked that SNARK's reliability was such, that test per-
8 sonnel at the Cape referred to the "SNARK-filled waters of the
9 Caribbean."

10 A Well, I had heard that expression. The "SNARK-
11 infested waters." (Laughing.) Yeah.

12 Q Oh, well.

13 A Oh, well.

14 So, Drake, Drake -- we always called Jake, Jake
15 Drake -- I don't know why he ever got that name?

16 Q Did he come from Langley originally?

17 A We came from Langley. But he came out before me.
18 He was in that first group.

19 Q Okay.

20 A He came out.

21 Q Back in '46.

22 A '46 or '47, something like that.

23 Q Relatively early on.

24 A So I didn't come out till '50.

25 Q In the early days, when you had high-speed flight

1 research station, and then after '64 high-speed flight station
2 really before you got into the formalized Flight Research Centt
3 did you have a formal, if you will, director of research of
4 chief of research? I have not seen that title until Tommy
5 Cole came out to the Center from Langley.

6 A No, we didn't when we first came out.

7 We were really a branch of Langley, see, before we
8 became a center. We were just a branch of Langley.

9 And we answered to this fellow Hartwick Sulay (phone
10 tic) who you nay have talked to.

11 Q Right.

12 A So we used to call him the great white father.

13 (Laughing.)

14 Q The great white father. That's very appropriate.

15 That, that was a question, in fact, that I had listf
16 in there on Sulay. What was his relationship to the Center?
17 Did the Center act in the early years at Langley's bidding, or
18 was **it** always somewhat independent?

19 If for no other reason than the fact there was a
20 great geographical separation?

21 A Well, actually, when I first came here, **it** was
22 strictly at Langley's bidding, because even, even travel reques
23 had to go back through there.

24 Q (Inaudible,)

25 A Yeah.

1 Q That was a very strong formalized arrangement.

2 A Right. Yeah. And sometimes, then, it took us about
3 3 months to get our travel pay because of all the mechanics of
4 getting the paperwork signed for.

5 Q Stamped here, stamped there.

6 A Yeah. Was kind of ridiculous.

7 Q Yeah. In 1948, NACA created the Research FA projec 3
8 panel. And promptly Sulay was formally entitled as research
9 airplane projects leader.

10 A Right.

11 Q Now, what was the relationship of that group to the
12 Flight Research Center? Was that group, you might say, es-
13 pecially set up to control the activities of . . . ?

14 A Yeah. Yeah. I would say it was. I, I wasn't that
15 high up that --

16 Q Okay.

17 A At that time. When I came out here, this panel . .

18 Q Were there any members of the Center out here, that
19 were RAFFPP panel members, members of Research FA projects panel

20 A I don't know. If it was, it would've been Walt
21 Williams.

22 Q That's, yeah -- I have the idea that it's never
23 really reached down into the . . . , except at the William leve

24 A Uh-huh. Yeah, I think so. That was kind of a steer
25 ing committee.

Q. Okay. All right. Would you say -- and I don't want to appear to be putting words in your mouth -- would you say that, in point of fact, they probably didn't have that much direct influence that was -- an overseeing committee, if you will? To incorporate the activities of MURAC into the activities of NACA as a whole? But, basically speaking, MURAC was left on its own, under the direction of Langley?

A. Yeah, I'd say so. Except that the idea was, that was kind of a -- in other words, NASA could not build airplanes

Q. Right.

A. That was NASA -- NACA in those days.

We had to have some kind of source.

Q. Uh-huh.

A. And so that committee would come into play in deciding what airplanes we were to work on, and in setting up these, for these research aircraft through the Air Force.

Q. I see.

A. I remember sitting in on various meetings of this panel, like at aircraft, at Douglas.

Q. Mock-up conferences, and things like that?

A. Well, and even, even before that. When, when they come up with proposals, like in the X-3 airplane.

I remember one big meeting at Douglas where we were really pushing to have that thing powered by rocket engines.

Of course, I was brought in because I was a propulsi-

1 man out here. And trying -- I was trying to show the feasibility
2 that it could be powered by rockets.

3 But Douglas, they, they were fighting against it.
4 And they finally won out. And the reason they were fighting
5 against, they envisioned a prototype fighter out of the whole
6 thing, see.

Q Oh, I see.

8 A See, so they would like the research airplane.

9 Q That's very interesting.

10 A -- to be powered by a jet engine.

11 Q To get conventional-type data, you might say.

12 A So that they could actually -- it would lead them
13 right into a later model, that could become a prototype fighter
14 And, unfortunately, there's 2 things that happened there, is
15 the drag was greater than expected, and the propulsion didn't
16 put out as much as thought.

17 And it was very interesting because --

18 Q The X-3 is . . . airplanes, I might add.

19 A Well --

20 Q In terms of sad stories.

21 A Yeah. And here's -- you can show the sad story in
22 a very simple diagram.

23 Q Okay.

24 A And it's something like this.

25 The drag curve of an airplane kind of looks like

that, I think.

Q. I see.

A. There's a thrust curve, kind of looks like that, see

Q. Okay.

A. And then eventually they cross, and that's the ultimate, see.

Q. Right.

A. Well, what happened was, in this particular airplane the drag was just a little bit higher than they thought.

Q. And so --

A. And the thrust was just a little bit higher than they thought.

And so this crossing point, instead of being way up here in Mach 2. something, or Mach 3, was way down here.

Q. Was way down here, like 1.1 or something.

A. And, no, it got up a little bit higher than that, but not much.

But, anyway, they were about a full Mach number off from what their predictions were. But just by the fact that those 2 curves were parallel --

Q. Uh-huh.

A. -- and that their crossing point was just, just a slight error on both sides, and, and the crossing point moved down very rapidly, see.

Q. Yeah.

1 A SO --

2 Q So that really was unfortunate. And then Westinghoi e
3 had planned the J/6 . . . , but that grew too large, so they
4 put in J34s, and that immediately --

5 A That's right. And, now -- so then they built --
6 they went, there was another, a second one that was started.

7 Q Yeah.

8 A But then they, they decided, by the time they got
9 going on that, they decided, "What's the use," and other things
10 were taking its place, and --

11 Q Some programs --

12 A Programs, yeah. They got -- that old hulk of the
13 second airplane sat around for a long time. They never had
14 engines in, it never got completed.

15 Q I first saw that when I saw an overall photograph
16 of the Center. And there was this strange little dark code
17 vehicle, it seemed cast off to one side, and I suddenly realize ,
18 "My God, that's the second X- 3."

19 A Yeah, right.

20 Q Do you think the conceptions of rocket propulsion
21 for the X-3 were, indeed, feasible, and perhaps would have
22 been a useful way to develop.

23 A Oh, yeah. Because -- I, I always had the contention
24 "Never put an experimental engine in an experimental airplane,
25 see."

Q. Yeah.

A. If you've got, if you've got an experimental aerodynamic configuration, well then, put in enough power, a known power system, that you know is going to do the job, see.

Q. Otherwise you have a strictly paper concept getting into the hardware stage and you can get into all sorts of trouble.

A. That's right. Yeah.

Q. The rocket propulsion for the aircraft -- were you envisioning using, say, 2 XLR 11s -- I thinking of the space that would have been provided by the --

A. That's an area that's very vague in my mind. I'm not sure what we were proposing to put in there.

At that time, there were quite a few rocket engines coming along, and I, I'd have to even make a statement on the plans for that.

Q. Okay.

That seemed typical, though, of the kind of projects that high-speed flight station was thinking of in those days. The Center, if you will, was pretty imaginative in, in dreaming up ways to develop new research airplanes, and modify existing aircraft, and things of this sort.

And it seems -- this is strictly an outsider's impression -- it seems that the Center has lost that since, say, 1960. Is that because programs have become so complex now,

1 that there's little room in them for innovation?

2 A No, I don't think that. I think it's the fact that
3 -- this is a personal opinion --

4 Q Sure.

5 A I think headquarters had become somewhat overbearing
6 and they wanted to control all the programs from headquarters.

7 Q . . . in the old days of the OAST

8 A They, they don't give the field centers a chance to
9 do their own thinking.

10 Q That's a feeling that has been expressed to me by
11 virtually every NACA individual that I have contacted.

12 Would you say that NACA as a whole, research and
13 aeronautical development, functioned better -- and this is, of
14 course, strictly a subjective judgment, naturally, -- than, say
15 NASA.

16 A Yeah.

17 Q Would --

18 A Because in those days, see, they took the, the budge
19 money, they kind of split it up among the centers. And really,
20 the centers had a lot of say in how they used it.

21 Q Pretty much autonomous.

22 A Right. Today, now, is every center has a, a group
23 that is -- a specific group at headquarters. And each at head-
24 quarters, they just -- first of all, they demand umptyump piles
25 of paperwork on everything you think about, or propose. And --

1 Q That acts as an incentive to kill research.

2 A You're darn right **it** was. That's right.

3 Q Somewhat complicating our process.

4 A Uh-huh.

5 Q When you had the origin of the X-15 program -- such
6 things as the X-15 steering committee -- what happened to the
7 research airplane projects panel?

8 I have seen some documentation that indicates that
9 **it** lingered on until about 1958, but then **it** finally dropped
10 out of sight completely.

11 A I don't know. You'd have to ask -- somebody, I
12 think Drake'd probably know.

13 Q Okay.

14 A We'd, you'd do real well, he's got a fantastic
15 memory.

16 Q Okay.

17 A And not only that, is he was, he was involved in
18 some of those administration

19 Q Okay. I'll have to hit him on the next trip out.

20 A Uh-huh.

21 Q In the 1950s, the Center tested a variety of exotic
22 aircraft, if you will. There were the early "X" series, and
23 the rocket-propelled research aircraft.

24 However, there was also testing done on service
25 aircraft --

1 A Yeah.

2 Q -- such as an early F-100A, F-102.

3 Now, the F-100A is interesting, of course, because
4 of its coupled-motion problem, and it's easy to see why that
5 aircraft was placed in a NACA test program, in view of urgency
6 of defense needs, to get that aircraft in service.

7 How about a lot of the other service-type aircraft
8 that were coming into the Center, though, such as F-104, KC-135
9 an F-86 with one or 2 flights -- how did the, what was the
10 rationale behind the Center's testing of these aircraft?

11 A Well, partly, was that we had a bunch of experts.
12 And, and **it** was a kind of reciprocal thing. Like, on the KC-13
13 that only a 90-day program, see. The airplane was there for ve
14 little dead time. And they'd get our stuff on, make our tests,
15 and get off. And the airplane went

16 Q Were those tests directed at improving that particul
17 airplane, so to speak?

18 A Well, that's kind of what I was getting at.

19 Q Yeah.

20 A They wanted our people to become familiar with the
21 current airplanes.

22 Q Okay.

23 A See. So, partly for our own training, and partly,
24 you know, see, here **it** is, *see* what you can find out.

25 Q Okay. Was this a desire on the part of NACA

headquarters or Langley, or a desire on the part of the service or the civilian aircraft?

A I think a little bit of both.

Q Okay.

A A little bit of both, yeah. I think the Air Force kind of looked to us to see, well, you guys have been testing airplanes for a long time. Is there anything here we should be looking at, or don't know about, and things like that.

Q What was the role of, say, Dee Bieler in all of this

Now, eventually, Dee Bieler becomes deputy of, of the Center. Deputy director. Yet, I'm hard pressed to really categorize his role in Center activities prior to, say, 1961.

He seems to have been administrative assistant, if you will, to Walt Williams. But seems also to have had a, a research planning function.

A Well, he was really the, he was really chief engineer

Q Okay. In other words, if there were technical -- chief engineer, did that mean that if there were technical problems --

A well, let's see, let's put it this way, director of research, or something like that.

I mean, the thing was so small that Walt Williams he had his finger in, everybody had their finger in everything else, practically out there -- all the higher ups.

Q It's not -- to use the word in favor today --

1 "humongous" sort of set-up, if you have, with people and office
2 all over the place --

3 A NO --

4 Q -- that you have now

5 A NO.

6 Q Which brings up another point, Walt Williams --

7 I have the impression, from talking to Walt Williams, that he
8 was a very dynamic driving, sort of personality, -- that was
9 intensely interested in all phases of high-speed flight sta-
10 tion and later, for the little while that he was there after-
11 wards, flight research activities, and he dominated it, if you
12 will, all the programs by being intensely involved in each one,
13 at least in a personal awareness level.

14 How did that contrast, say, with the approach,
15 say, taken by Paul Bickel, at a later date, or things of that
16 sort?

17 A Well, Bickel is a lot easier to get along with,
18 you know, and so --

19 Q How about the style of administration between the
20 2 men? I think we have a visitor --

21 A All right.

22 Q We were talking about Paul Bickel and Walt Will-
23 iams --

24 A Well --

25 A Did Bickel leave people to their own -- so to speak

1 -- perhaps to a greater degree than Walt Williams, in terms of
2 doing projects?

3 A Yeah. He was more reasonable.

4 Q Okay,

5 A Walt sometimes got . . . unreasonable.

6 Q In the few discussions I've had with him, I've no-
7 ticed that he holds opinions very strongly --

8 A Yeah.

9 Q And you have to be very careful on anything that is
10 controversial, to his view, because he can turn around to
11 180 degrees very rapidly.

12 A Yeah, **it was** much pleasanter working for Bickel.
13 Bickel was fine as long as you didn't do anything wrong.

14 Q Yeah, and then a ton of bricks came down your --

15 A That's right. And, . . . they always talked about
16 "gettin' in the Bickel barrel" .

17 A Oh, really? The Bickel Barrel? That's a very inter-
18 esting expression.

19 Q And, so I was getting called on the carpet by Bickel
20 so --

21 A That's a good expression.

22 Q He **was**, he was very shrewd and. --

23 A Bickel had this flying background --

24 Q Uh-huh --

25 A Not as a professional pilot, but as a glider pilot,

. . . pilot, so to speak, flight-test engineer. Walt Williams didn't. Walt Williams was, if you will, your research laboratory engineer.

Q That's right.

A Did this difference reflect in the interests of the two men. Did Bickel, for example, take a much closer interest in flight operations?

Q Yeah.

A . . . so to speak, one of the boys with the pilots?

Q Right, and

A How about the role of the test pilots themselves. How does -- has that changed? It seems to me that nowadays they're very much involved in not simply mission planning, but programs direction, if you will.

Q They always were.

A They always were.

Q Yeah, this is where NACA differed greatly on the flight research center -- differed greatly from the companies. You see, the companies regarded their testpilots as a commodity -- to be bought and sold. They had a program, they'd bring in new test pilots, and the test pilots did exactly what they were told, and went through the motions, and --

Q If they lost --

A If they lost a few test pilots now and then, as they did, there were very few tears sheu. In fact, some of our pilots, they left for the money.

1 A One night, I remember Walt Jones -- everybody told
2 him he says, "you'll get killed" and a year later he did.

3 Q Yeah.

4 A He was remarkable --

5 Q Yeah, he got . . . on the F 89 program, and because
6 that was, and I've heard Scott Crossfield talk about the same
7 thing, you know, that the way the companies treat test pilots.
8 But NASA brought the test pilots in as, really , as
9 one of their engineering team on a given thing, then, as projec
10 engineer on some of the projects I was in, I mean, a few times
11 I've ignored the pilot -- not deliberately -- that was a pretty
12 good way to bring the wrath of Bickel down on you, because he
13 wanted to be sure, and he impressed on the pilots the need
14 for joining with these engineering groups, he'd get after them
15 if they were invited and didn't show up to --

16 A Yeah, they didn't keep their credentials up, so to
17 speak.

18 Q That's right.

19 A I suppose there was a feeling on the part of Bickel that
20 in the last analysis, even in a relatively simple performance
21 examination, or whatever, the pilot, to a degree, lays his life
22 on the line --

23 Q Yeah --

24 A For this reason, the engineer owes it to the pilot
25 to bring him in to his confidence.

1 Q Absolutely.

2 A At the same time, the pilot, if he has any common
3 sense, involves himself closely in that whole engineering re-
4 search process.

5 Q Yeah. When I first came there, a few of the pilots
6 were of the kind of the company type, you know, "Tell us what
7 to do, and show us the stick, and we'll perform" you know, and
8 oh, McKay, was kind of that kind.

9 A How about -- what pilots, this is another subjective
10 question, I think -- but what pilots really impressed you throu h
11 the years, as top-flight individuals, in terms of their abiliti s
12 and their, if you will, research powers, and things like that?

13 Q Well, I don't know -- we did have tremendous, I
14 mean I'd be hard pressed to say but what most of them weren't
15 very exceptional. I mean Walker, of course, was tops. And
16 some of the more recent ones have just been excellent. The
17 last few I've worked with were --

18 A The one on everybody's lips out there now seems to
19 be Einar, Einar Wolfson (phonetic).

20 A Yeah, he's excellent
21 (Simultaneous)

22 A . . .it's Fulton, who's been doing this big stuff
23 -- you couldn't ask for anybody better, you know, and then
24 Tom McMurtry, some of those guys were just intensely interested
25 in what they were doing and you were always delighted when they

1 would come and join your meetings, you know, --

2 Q Everybody benefitted.

3 A Right. So, it got to the point where you had no
4 hesitancy about asking them, and, they -- there were just very
5 very few that you were reluctant to work with.

6 Q Kind of hopping around, -- of all the research air-
7 craft programs in the early years, perhaps the one that was
8 the most disappointing, and the one that NACA had the least
9 involvement with, was the X-2 program, in that the NACA had
10 never meant the aircraft to fly.

11 A That's right.

12 Q Although they had done a tremendous amount of work
13 at Langley on rockets, and firing rocket models, warm-ups, and
14 wind tunnel testing and participating in meetings on instrument
15 tion of the aircraft, and the flight research program . . .
16 and things of this sort. Several things seem to have, if you
17 will, conspired to kill the X-2, the greatest of these being
18 the failure of Curtis Wright to generate a thoroughly reliable
19 rocket engine --

20 A Yeah.

21 Q until a much later date than they had planned,
22 and did NACA eventually, if you will, by say '54, really
23 start to lose interest in that airplane? Scott Crossfield
24 in his book Always Another Dawn , gives the impression that
25 this was the case, but he's concerned strictly from the pilotin

1 aspect, and so I don't know how much of that material he's
2 really close to.

3 A The -- Well, I think we were always intrigued with
4 the program, because I mean we were trying to move the Mach number
5 out, and, up to 3, which of course the airplane finally did
6 when it broke up, went unstable. So, I think we were always
7 shall we say, a little bit jealous, because the Air Force
8 wouldn't let us have more to say about the program. And we
9 really feel that had we been more involved, we might've approached
10 this dangerous area more cautiously.

11 Q I have the impression, and this is basically because
12 most of the documentation I've been reading at this point
13 has been NACA generated documentation.

14 A Sure.

15 Q But, I have the impression that the Air Force in
16 all their programs, with the possible exception of the initial
17 X-1 program, really was basically interested in taking these
18 research airplanes, flying them to maximum performances as
19 rapidly as possible, in what almost seems to have been an attempt
20 to gain favorable publicity for the service.

21 A Oh, yeah. I'm sure that's right.

22 Q In effect, they threw the X-2 away.

23 A Yeah, they did.

24 Q Now, that's just an impression I have.

25 A uh-huh. No, because they -- what they had is, they

had a -- we were with them on the planning, see, and they had laid out a step-wide progression upwards in speed, but due to engine failures and some other mishaps, they got delayed on their program, so they skipped, they starting skipping steps, you know.

Q Oh, that's a critical error, and you get into trouble very rapidly.

A Right . . . they were really, had headed out and going -

Q -- way beyond the extrapolated data.

A Right. See, in other words, if you had, if you go like upwards like in 2/10 of a Mach number, tune increments, then each time you come back and you look at, wiggle the airplane a little bit and then you can start analyzing the curves of the stability of the airplane, and pretty soon you can see when the thing is gonna go unstable.

Q -- you got a definite tendency, a trend . . . the data

A Right, that's right. You can watch the stability margin go down and down and down, see, and before it gets to zero, you stop. But if you take too big of a step you're going

(Simultaneous)

A And that's what happened to the X2, as nearly's I can tell

Q How did the loss of the X 2 affect the Center?

Now, the X 1B had not been planned as an aero-dynamic heating vehicle in its initial stages, but apparently, the Center, unde

1 took to modify the X 1B to get at least some of the data that
2 they had hoped to get in the aero-dynamic heating program with
3 the X 2. Was that basically the only way the X 2 lost . . .
4 at the Center?

5 A I think so. I mean, you know, there was quite a
6 variety of airplanes there --

Q -- the 15 was on the horizon.

8 A Yeah.

9 Q -- it was coming up pretty rapidly.

10 A This is right. So, and then we got, we kind of
11 milked the X 1, we went to the X 1E that didn't . . . the
12 X 1 and that sort of filled in the gap there.

13 Q Were you familiar with some of the proposals to
14 make that aircraft at the very end of its life, into a
15 Mach 3 research airplane by adding things like ventral fins
16 and a new, highly, if you will, highly explosive fuel . . .
17 U data, and

18 A Yeah, I was in on the engine mod part of it.--
19 . . . , I guess we called it --

20 Q -- unsymmetrical . . .

21 (Simultaneous)

22 Q Was that a, if you will, kind of a casual attempt
23 to modify the F plane? Was very serious consideration given
24 to that?

25 A I think that pretty good consideration was given to

1 it. I think it's one of those things that, again, the time
2 caught up with it.

3 Q Were you involved with any of the other programs
4 such as X 4, X 5, . . . , 104 --

5 A I measured drag for the X 5, did quite a bit of work
6 on that, then 92X . . . , 92A, and a little bit on the X 4,
7 just drag work on the airplanes, nothing else.

8 Q . . . company program, were you in on that?

9 A No, that was strictly aerodynamics, and that was
10 Drake. You ought, you need to talk to Drake. He was in that
11 very heavy. The F100 problem. The X 5 was kind of interesting
12 because we were trying to get it to go just a little faster
13 you know, get in, to get well into the drag rise, see, as you a
14 proach Mach 1, see, and, because we -- Joe Walker, he kind
15 of figured out a way -- thing of it is, if you go along fast,
16 and you push it down, that, and to get it into a dive, you
17 know to gain the gravity effect to help your speed increase, in
18 crease in drag pushing it over was so much that you knew . . .
19 he finally figured a way over, that he could prop it over his
20 back and pull it through this way.

21 Q Oh, really --

22 A And use plus G's instead of negative G's. But the
23 airplane was better designed to take it, and that way we
24 get to -- completed the drag curve.

25 Q Yeah, you'd roll and invert it, and then . . . the
vehicle . . .

3 A . . . and pull it through, He did that several
4 times for us. We just got some beautiful end of a drag curve
5 there, that we were hunting for.

6 Q Did the, did the . . . eventually go trans-sonic,
7 like Mach 1.0?

8 A Yeah, that's right. Yeah, we finally put out a
9 drag report on that, showing the whole drag rise. That was
10 kind of interesting, those days, because there just weren't
11 that many airplanes that were (simultaneous)

12 Q That's true.

13 A -- supersonic.

14 Q And that aircraft, of course, although that parti-
15 cular approach to variable sweeping was not adopted on subseque t
16 airplanes, nevertheless, it did give quite a bit of confidence
17 to go ahead with the variable wing sweep approach.

18 A That right. Yeah.

19 Q How did the emergence of NASA in '58 affect the
20 Center? Did you see an immediate attempt on the part of Head-
21 quarters, or the part of Personnel at the Center to orientate
22 the Center attitudes towards a space-related-type research
23 program? Or was the general feeling that the X 15 was heavily
24 enough committed there that this was unnecessary?

25 A I don't think it was necessary. I mean I think
that was -- space came in very gradually out there, you know.

Q How about Dinosaur? When did the Center start talk-

1 ing about so-called round three studies on X 20 Dinosaur type
2 work? Were you involved at all with that?

3 A Yeah, I was on the second round of Dinosaur. I
4 wasn't involved in the first round. In the second round I
5 was one of the Air Force Evaluation Committees when they were
6 trying to decide between Boeing and Martin.

7 Q Was this scientific advisory board sort of stuff?

8 A I don't know who it was --

9 Q -- probably just air research

10 A Yeah, I think so. It was the Air Force proposal
11 evaluation, and we went up to Wright field for awhile and then
12 we went up to Boeing for a week and went on to Martin for a
13 week -- typical manoeuvring for the selection of a contract c.

14 Q Do you think that the X 20 was a feasible vehicle
15 that should have been built. Do you think that perhaps it
16 was pressing the technology a bit too much at that time?
17 What are your feelings?

18 A I don't have much feeling in that area.

19 Q How about the X 15 program? My impression is that
20 when the program started, it was so massive and so large, that
21 it required virtually the services of everybody in the Center
22 to be dedicated toward that one program. The end result of thi
23 was that about 1962 the Center suddenly realized that when the
24 15 program terminated, the Center had no other areas that it
25 was involved with and its existence, if you will, was imperiled

1 A That's right. That's exactly right. In fact, Drake
2 and I, we were at the start of the X 15, we were pretty much
3 against this total involvement, and we were trying to propose
4 some continuing work, like I was -- air breathing propulsion.
5 We wanted to put some ram jets on an F 104, and things like that
6 so that we could keep our finger in some of these fields, see .
7 And --

8 Q That would have been a very interesting program.

9 A I remember, yeah --

10 Q would they have been tip ram jets? Something like that?

11 A Yeah, we were working with Northrup, and they would
12 even have provided us with the ram jets if we could have given
13 them the testing. We worked out some details there, but then,
14 then, I -- Williams wasn't really behind that, and so then he
15 wrote Abe Silverstein, and Abe Silverstein, he wrote a letter
16 that really killed the whole thing. And --

17 Q Silverstein was essentially saying, I presume, "That
18 Lewis's bag, let us handle the ram jet work, you people
19 go fly your airplane."

20 A Well, he didn't even say that. He just said there's
21 no future for ram jets.

22 Q Yeah. Which, is not terribly accurate in any res-
23 pect.

24 A Well, but not only that is, I think that inlets
25 are inlets, whether on a ram jet or a jet engine, see, there's

1 always things to be learned.

2 Q Kelly Johnson, in the early 50's was a strong oppon-
3 ent of the research airplane program. He always argued that th
4 same amount of time and effort that you were putting into a
5 research airplane you could develop a piece of operational
6 hardware. Now, I think his discussion was colored by the fact
7 that he had pretty much an exclusive working relationship with
8 the Air Force, through the skunk works and things of this
9 sort.

10 A Yeah.

11 Q And that if you adopted that kind of approach, where
12 you had guaranteed money coming in, perhaps you could throw
13 money at a problem, and solve it that way.

14 Did Kelly Johnson base, do you know, some of his
15 reluctance on the research airplane program, on the fact that most
16 of those aircraft were not air-breathing airplanes? He used
17 to argue that he was not learning anything from rocket air-
18 planes that he could apply.

19 A I think so. I mean, he has the typical company view
20 point, like the Douglas people had on the X-3, you know.

21 Companies didn't like to get involved in the govern-
22 ment building an airplane that didn't do then to the company
23 much future good.

24 Q Virtually building an airplane, if you will, at cost
25 taking a lot of manpower and time and there's no ~~€~~at productic

1 contract at the end of the rainbow.

2 A That's right. He didn't like that sort of thing.

3 Q Now the Senate in the '60s was heavily committed to
4 X-15. How do programs like, say, the para seta-lifting body
5 program, we call it now, -- . . . Reed was instrumental in the 2,
6 getting the M2 program going.

7 And people like Richard Klein, and Gary Layton, and
8 people like that, were heavily involved in the formation of
9 parased.

10 Were these side shows, if you will, to the X-15?

11 A Oh, yeah. And I think they were kind of encouraged,
12 because I think, again, people were realizing, you know, X-15's
13 ultimate future, and we've got to keep this Center active,

14 So when people come up with bright ideas -- and they
15 also, I think they had the feeling like -- oh, Whitcomb was
16 playing with his parased, you know, wing back there at Langley.

17 And I think they felt, well, here is really the plac
18 to do these sort of things, 'cause we've got the better safety
19 provisions.

20 Q You're not operating in a restricted environment,
21 when people are intimately familiar with flight testing this
22 requirement.

23 A That's right, yeah. And we had good safety reviews,
24 and things like that, with people who were very knowledgeable.

25 Q What was the role of headquarters in all this? My

1 impression is, that on the lifting bodies program, until you
2 start getting into the heavyweight program -- the M2, F2, and
3 HL10, and then the Air Force end of things with X24, SV5P --
4 basically, in the early days of the lightweight lifting body,
5 and in days of parased, and things like tnat, headquarters was
6 not terribly involved.

7 A No, they weren't. Why, the program was, you know,
8 below a certain level, we could do pretty much what we wanted
9 to.

10 Q That's interesting. In other words, they were only
11 concerned, if you will, with highly visible programs?

12 A Yes.

13 Q Is that a tendency --

14 A -- Well, they were concerned with anything that cos
15 more than so much money.

16 Q Yeah. If you had a vehicle cost of less than, say,
17 several hundred thousand dollars, it probably didn't concern
18 them. Would that be a fair statement?

19 A Yeah. Now, we got -- oh, I don't -- during the day
20 when they were kind of exploring the upper atmosphere, we were
21 we had a program there where we were trying to launch a rocket
22 off of a --

23 Q F-104.

24 A F-104.

25 Q Horace Peterson, I think, was the pilot on that.

1 A Yeah. And ~~Was~~ Messing, who worked right under me, he
2 was kind of project engineer for it.

3 Q Messing?

4 A Yeah.

5 Q M-e-s-s-i-n-g?

6 A Wesley Messing. Yeah. I think he's down at -- he
7 transferred.

8 Q That rocket project has some sort of acronym, I can'
9 think of it now.

10 A I was trying to think of it, too, What'd they call
11 it?

12 Q ARC (phonetic) or something like that?

13 A No.

14 Q There were firings undertaken here ---

15 A Right.

16 Q -- over the bombing range, one -- the first round
17 fell short, the second round overshot into Nevada. Then they
18 moved them to Magoo (phonetic) --

19 A Magoo.

20 Q -- and fired one which took a right turn and just
21 missed an island.

22 A Right.

23 Q And that pretty much ended the program.

24 A That ended the program.

25 Q Yeah. Dick Horton was there, and the safety officer

1 looked down and said, "You're not planning to fire any more
2 of those, are you?"

3 (Laughter.)

4 A That's right. And it's too bad, because I think
5 the last one was a defective rocket, and there we could figure
6 out from that, the trail, it must have burned a hole in the
7 side of the case.

8 Q Yeah. You had a burn, a thrust vector that was --

9 A Yeah.

10 Q -- way off.

11 A You couldn't figure out why, how they could get that
12 thrust vector.

13 Q Yeah.

14 A So, the --

15 Q They were basically sled rockets from China Lake,
16 I think.

17 A Yeah. Yeah. And --

18 Q Rings a bell.

19 A Then we got the hole in this one 104 that had this
20 trapeze underneath it, to swing it down. . . .

21 Later on, that, that was the 104 that was lost.

22 Q Zero 11, or something like that, I'm not sure.

23 A Yeah. So --

24 Q We have one of the 104s in the Air and Space Museum
25 that was out here -- 818 -- which was old, I guess, 961 --

1 it was the oldest F104 in existence.

2 A I see.

3 P And we put that into the building before opening
4 it in July. In fact, we have a lot of the old aircraft that've
5 flown. They've got the M2, F3, and things of that sort.

6 A Oh, yeah.

7 Q The X15 number 1, the X1 number 1, --

8 A Yeah.

9 Q -- 0558 number 2.

10 A I remember, I was kind of semi in charge of the 25th
11 anniversary out here --

12 Q Oh, really?

13 A -- and we borrowed the --

14 Q X15?

15 A X15 from you people.

16 Q Yeah. We were walking on eggs around that airplane
17 when we put it in the new building. Some of the systems were
18 still active in it, and, at one point, I guess there was --
19 the tailskid was either hydraulically actuated, or spring
20 actuated, or something -- and one of the workers was moving
21 around the rear of the aircraft, and there was a thunderclap
22 of noise --

23 A (Laughing.)

24 Q -- and the skid extended, and just missed him.

25 And it was very close. And we, everybody really

walked on eggs, we brought in safety inspectors, and purged all the systems, and let off pressure here and there and everywhere

That is --

A Fastastic, that the pressure'd be left.

Q Yeah. After all these years.

Well, we had another interesting thing. We took out the German V-1 to put on exhibit, and we discovered a nitrogen sphere that was pressurized, in the storage crate where this vehicle was stored, and it was still pressurized at 400 psi, even though this thing had been crated up like, at the end of 1945. It was still, still hot.

A uh-huh.

Q So, amazing. We've had other incidences, incidents.

We once were refurbishing a German fighter, and casually checked one of the cannon in the wing, and found a fully chambered round.

A Huh.

Q Live. Which blew everybody's mind.

A Yeah.

Q You have to be very, very careful.

A Well, you heard -- you probably about that time we had this -- Kenny Berger (phonetic) out there, was -- oh, he had a, he used -- he was on one of the 104s crews, you know, and he stepped, pulled the wheels and washed the brake drums --

Q Oh, yeah.

3 A -- periodically, see. And they had this tank, you
4 know, and it was on the floor, and he didn't like bending over
5 that much, so he was going to made himself a stand, to put
6 this thing up on.

7 Q So he went up the scrap yard, and found this old,
8 old rocket -- it was one of the --

9 Q 5-inch aerial rockets?

10 A No. I don't know, wasn't 5-inch.

11 Q A JATO booster, maybe.

12 A Well, what it was, it was one that, you know -- those
13 big tanks they had on the X-15 number 2?

14 Q Oh, yes. Yes.

15 A It, it pushed these away.

16 Q Right.

17 A It put a right-angled thrust on it for separation, see.

18 Q Yeah.

19 A And so then, after --

20 Q Yeah.

21 A And then the tanks came down with a parachute --

22 Q Yeah.

23 A And then afterwards these rockets were discarded,
24 they were one-time only affair.

25 Q So he got one of these things, and had it in a bench
26 vise, and was sawing it in 2 with a hacksaw --

27 Q My God.

(Laughter.)

3 A And all of a sudden the thing takes off, in both
4 directions, because he had sawn through, oh, probably, 90 percent
5 of the way, see.

6 So fortunately for him, because if he'd just, if he'
7 done that . . . , then the fire would have come right out at
8 him.

9 Q Sure.

10 A But as it was, it just went zingo, both directions,
11 see. It was, you know, like one of these devil chasers around.

12 Q Yeah.

13 A Narrowly missed an airplane, and bent a bench, and
14 one, the other half went up through broke some windows in the
15 door and almost went through went through an I-beam, a great
16 big I-beam. And, so --

17 Q Wow foolish, you know. How a person could make an
18 error like that.

19 A Well, you know, you wouldn't -- I mean, the thing of
20 it is, the, that, the nozzle's right-angled, so you can't look
21 into it.

22 And then, it was all blackened, so it just looks like
23 it's empty, see. Looks like it's fired. Well, what happened
24 was, only the igniter had fired. The main charge had never
25 gone off.

Q My God. That's a frightening anecdote. It's incredible.

A And, then, I was on -- I got involved in a, an awful lot of those accidents --

Q Yeah.

A -- starting with the X1.

Q Uh-huh.

A And, I don't know --

Q That's right. You were on most of the safety boards after

A And, I kind of -- well, when I came off from Lewis, I'd been on the -- we'd set up the rocket, back at Lewis, and I was on the safety board there, the special safety board dealing with rockets.

And when I came out here, I kind of got involved. And then I rose just a little enough far enough away from the airplanes, that when they had an accident with the airplane, I didn't have any direct responsibility, so I was a good man to come in --

Q Yeah.

A -- And be on the safety boards, see.

Q That gets in another area.

On the, on the X1 series of accidents, with the tri-crystal phosphate homoleather gaskets, and the X2 accident, which apparently was the same cause --

A Right.

Q At various stages -- for example, in the X13, the

1 so-called cooling accident. I believe the initial cause was
2 laid, at first, was laid to chilling of the nitrogen pressuri-
3 zation system, and fracture under, under loading that wasn't
4 pressurized.

5 A Right. Yeah. They had, they had these 2 coils --

6 Q Yeah. It was a manifold, in effect.

7 A Yeah. Right. The, they'd taken a huge coil of this
8 tubing and put it -- I know don't know, something like 4000
9 pounds of pressure, something like that --

10 Q Yeah.

11 A -- and high pressure nitrogen in it.

12 Q And there're all sorts of right angles and --

13 A And so they thought it was those tubes had gotten
14 brittle from the thing.

15 Q Yeah.

16 A And then when NASA got the X1A, the X1A --

17 Q And that blew.

18 A Well, we -- no, we, before we blew, though, we had
19 taken it out, taken those tube coils out, and had found, made
20 room and moved some stuff around, and put this huge, sausage-
21 like tank in there.

22 Q Yeah.

23 A And then after the thing blew, had dropped to the
24 ground, we examined the wreckage, this sausage-like tank was
25 still intact.

1 Q Yeah.

2 A So we knew **it** wasn't that.

3 Q Very interesting. Yeah.

4 A Yeah.

5 Q Do you think -- that's one of the more interesting
6 detective stories, **if** you will, in aviation technology. Do
7 you think that the true cause of that accident -- of not just
8 the X1A accident, but all that series of accidents -- the true
9 cause literally could not have been detected prior to that point
10 or do you think there --

11 A Oh, I think you could have.

12 Q You could have? People were just hopping at the
13 first -- and to their minds, most logical cause.

14 A No. I think that's kind of criminal on the part of
15 the Air Force.

16 Q Yeah.

17 A The fact that they didn't have adequate accident in-
18 vestigation.

19 Q Who ultimately -- was NASA -- and initiated, basically,
20 the agency that ultimately discovered that tricrystal phosphate
21 business?

22 A Yeah. And I can give you the details, because --

23 Q Fine.

24 A In fact, I got a copy of the report, if you're in-
25 terested in seeing **it**.

1 Q I've seen the accident report.

A Oh, have you.

3 Q And both the test with the

4 A Well, yeah, I, I devised the test. And some --
5 because I wanted -- in fact, you saw that picture in there.

6 Q Of the detonation.

7 A Of the detonation. Just taken with the flash that
8 detonation. We were out there one night, and I got a cameramar
9 out there, and set up the apparatus, and --

10 Q It was some very low value, like 10 foot-pounds
11 of pressure, something like that.

12 A Oh, no, it was more than that. But anyway --

13 Q Uh-huh.

14 A Oh, well, it was about that. A pound weight droppin
15 for 10 feet, something like that, yeah.

16 And, but -- then we just filled the camera, and
17 opened your lens, and when you opened his lens, then I pulled
18 the trigger, and down it went, and, bang, it goes off like a 45

19 But, anyway, the way that was discovered, was, after
20 the X1A blew up, their, their original thought on the whole
21 thing was a metal failure, see.

22 Q Somewhere in the pressurization system.

23 A No, no, no. In the main tank.

24 Q Okay.

25 A See, we knew it wasn't the pressurization system --

Q Because of the tank.

a. -- because the tank had survived, see. So --

Q And the main lines --

4 A And this was the difference between that and the
previous 3 accidents, see. 'Cause we'd changed those tanks,
6 and we no longer had them.

8 And, but anyway -- then we were suspecting a weld
9 failure in the main tank itself. But, so somebody suggested,
10 "Well, I mean, it doesn't do any, I mean, once the thing ex-
11 ploded, it pretty well destroys the marks. But why don't we
look into the X1B, which is sitting right outside there --

12 Q Yeah.

13 A "And take a look at it." And so we did.

14 Q X-rayed all the welds?

15 A Well, no, no, we didn't get that far. We decided,
16 well, let's examine the tanks.

17 So, there's a door in it. So we got -- we pulled
18 the airplane apart -- you have to break the whole airplane into
19 2 pieces --

20 Q Yeah.

21 VOICE: (Inaudible.)

22 A All right. See you.

23 VOICE: Be back in a minute.

24 A Let me know if the car doesn't start. (Laughing.)

25 But anyway, as soon as we opened the door, and stuck

our head in there, there was a pool of oil in the bottom of
2 the oxygen tank. And the Bell --

Q. Somebody said, "What's that?"

4 A. Yeah. And the Bell people said, "Oh, we wipe that
out all the time."

6 Q. Oh, my God.

A. See.

8 Q. Isn't that incredible?

9 A. Now, that's the incredible thing, see. This is what
10 the Bell tech rep says, you know. "We, well, we've had that
11 **all**, oftentimes, we just wipe it out when we see it."

12 And --

13 Q. You'd never -- yeah.

14 A. SO --

15 Q. Just on, on a straight safety --

16 A. Yeah.

17 Q. -- measure you'd never have oil in the presence of
18 lox, anyway.

19 A. That's right.

20 Q. Strictly speaking.

21 A. So, anyway, we gathered up -- and we got small bottl s
22 of stuff that we collected out of the X1B tank.

23 Q. Yeah.

24 A. And then we decided we were going to have the Air
25 Force laboratory analyze it. And then somebody said,

"Well, those guys over there maybe aren't too sharp. Let's" --
and so we split it in 2. We had enough so that we could make
2 samples.

And so we sent half down to a place in . . . Los
Angeles called the Truesdale Laboratories, you know. And
they said, well, they just sent back a superficial report,
saying, "Well, it's a hydrocarbon, and it shouldn't have no
business being in an oxygen tank," see.

Q. Yeah.

A. That --

Q. They completely missed --

A. Completely missed what we were after, see.

Q. Yeah.

A. Well, they had a pretty sharp chemist, worked with
the Air Force, the rocket base, at that time. And he --

Q. Did an actual breakdown.

A. He did a complete breakdown. And he says, "Well,
it's tri-. . . phosphate." So then -- let's see, I was
assigned the job of checking with where that leather came from.

And I traced it down to the Linde company in Buffalo
Niagara Falls. And I called them up -- and it was just, I
think it was the Lord's providence, because I happened to call
them at lunch hour, and everybody was gone, and so finally the
girl at the telephone desk, she kept referring me, you know,

3 "So and so's gone," and then . . . the next office down the
line, and he's gone, and finally I got down to a guy in the
laboratory.

4 Q Fantastic. Just the person that you wanted.

5 A Just exactly the person that I wanted to talk to.
6 And I, I asked him about this leather, and he says, "Oh, yes,
7 we put carnuba wax in it, and then we have to use tricresal
8 phosphate to --

5 Q (Inaudible.)

10 A As, as a plasticizer, what they called it, see.
11 To make it go in. Well, that was, their . . . hard to say.
12 (Laughing.) And starting the next day, we couldn't get word
13 one out of the Linde company. They wouldn't even talk to us
14 any more.

15 But we knew what we wanted to know.

16 Q Yeah. That's all we needed.

17 A That's all we needed, just that one word. Knowing
18 that they had, they had, that was in the leather, and we knew
19 where it came from.

20 And then we started these little tests, from that
21 point on, . . . the record.

22 Q (Inaudible)

23 A Right. You see, the thing of it is, the Linde com-
24 pany -- and it was a misuse of a stuff -- the Linde company

had used that leather in liquid oxygen valve packings. But, you know, when they make a liquid oxygen valve, you know, the pipe is down here, --

Q Yeah.

A And they put a long stem, and the handle's way up here. And the packing is 'way up here, see.

Q And there's no possible way that it's ever going to --

A Well, see, that, that -- the room temperature always heats up that stem, so by the time it gets to the packing, it's always gaseous oxygen.

Q Yeah.

A And they'd had any trouble with it. But when you put that stuff, and soak it in liquid oxygen, and then you impact it.

Q That's all you need to do.

A Well, as near as we could figure out, see, they had a, a -- it was a double flange, see, and bolts on both sides. This door fit right into the whole in the end of the tank, there was a flange on the inside, and a flange on the outside, and a whole of bolts through. And a leather gasket on both sides.

Well, when they pressurized that tank, evidently, it would shift just enough for those bolts to impact along the edge, and it was some of that liquid that oozed into there.

Q Right to them.

1 A That's what did it.

2 P Yeah. That accounted for the, in every case, the
3 low order explosion, followed by then a heavier detonation.

4 A Well, when the whole tank went. And that was just
5 the plain old --

6 Q The low order was basically ignition.

7 A Right.

8 Q Yeah.

9 A Exactly right

10 Q Yeah.

11 A But, the thing of it is, I mean -- see, the original
12 2 X1, X1 number 1, and X1 number 2 -- they, they didn't have a
13 pump like the later one.

14 Q Right. They had . . . pumps. They had high pressure --

15 A They had high pressure tanks that fed directly into
16 the rocket engine from the tank, see, so they were very limited
17 in their ability to carry oxygen, because they have such heavy
18 tanks.

19 Q Yeah.

20 A And --

21 Q You have these 2 large . . . , and a lot of wasted
22 space.

23 A And then -- but their weight was their big problem.
24 So, in other words, they had no problem with this, because they
25 had no gaskets, because the tanks were welded up solid. And

1 when they came to the X1A, the X1B --

2 Q . . . that's interesting.

3 A -- and X1 number 3 --

4 Q -- gasket problems in those.

5 A -- then those were lighter weight tanks. And they
6 felt they could make them securely with doors in them, and
7 then the doors had this gasket.

8 Q Yeah. That's a different ball of wax, entirely?

9 A And those were the ones that started blowing up.

10 Q What was the solution? Obviously, yank the gasket.
11 But what gasket material did you replace it with?

12 A They welded them up tight.

13 Q Welded them up tight.

14 A X3, I know they, they just took a, they took a
15 torus and cut it in half, and then that just filled over all
16 bolts --

17 Q Okay.

18 A -- and then they just welded the thing in solid.

19 Q Yeah. Okay.

20 A They didn't have any gasket.

21 Q There was no other choice?

22 A Well, gasket materials for cryogenics is very hard
23 to come by.

24 Q I imagine even today that's true.

25 A Yeah.

Q How about the X1A accident, when Walker was getting ready to launch, get the aircraft going -- and I think about 4 minutes before launch, they had a lower explosion.

A Uh-huh.

Q And there was all sorts of talk, back and forth, between chase and the airplane and the tower on the ground and whatnot, and it seemed that everybody and their little brother was on the air at some point.

A Yeah.

Q Talking back and forth about possibly bringing the vehicle back.

A Right.

Q Which seemed to me a noble goal, but one that was completely foolhardy.

A Well, that was the decision that was made.

Q And Ventzol (phonetic) -- Ventzol says, and this is virtually a direct quote, Joe, get rid of the damn thing.

A Yeah.

Q No, Butch, get rid of the damn thing. Butch was the launch pilot.

A Right.

Q And, was Ventzol speaking on his own, or was Ventzo speaking as command authority, so to speak, when he said that

A Oh, he was definitely in authority. He was, he was director of flights, flight director.

1 Q Yeah.

2 So he had the last say?

3 A That's right.

4 Q Yeah. Because the minute they left that thing go,
5 **it** just went down tail first into the --

6 A Oh, yeah. Well, the reasons they really had to drop
7 **it** was, --

8 Q There was so much smoking, I think.

9 A NO.

10 Q They had an increase in oxygen tank pressure on that

11 A Well, and the real -- yeah, they were a little bit
12 concerned about a fire still there. But by that time, it'd
13 gone, it'd gone about a half an hour, or something like that,
14 before they dropped **it**.

15 The reason they had to drop **it** was, the gear had
16 come down on the X1.

17 Q Oh. And they didn't know if **it** had locked down or n t?

18 A Well, and not only that, is they couldn't land a
19 B-29 on, on the X1 gear.

20 Q Obviously, yeah.

21 A See? And, even when they put the 29 gear down, and
22 the X1 gear --

23 Q -- still hung below.

24 A Still hung below.

25 Q Yeah.

1 A And if it was locked down, then the whole thing would
2 just crumple up, and you'd lose both airplanes.

3 Q You'd break both airplanes up.

4 A See. I mean, it would've been very foolhardy to
5 try and do that.

6 Q Completely foolish.

7 A As it was, I mean, we got the information, you know,
8 eventually.

9 Q Yeah.

10 A It's, it's amazing what you can get out of wreckage.

11 Q Speaking as a person who's been involved in accident
12 investigation, I find that, I find that an interesting state-
13 ment. I've heard that before, but never from someone who's
14 actually participated in accident investigation boards.

15 A Uh-huh.

16 Q Is that true of all the accidents that have occurred:

17 A Almost every accident that I've been connected with,
18 and that've been quite a few, we have really been able to sift
19 through the wreckage -- in spite of how finely it's divided --
20 and you can pick up --

21 Let me give you some examples.

22 Q Okay. Fine.

23 A First of all, in the X1A, they went out there after-
24 wards, and the cockpit camera -- you know, looks over the
25 pilot's shoulder to see what the things were reading -- we

1 found, we found the film magazine, see.

2 And --

3 Q That's a vital bit of material right there.

4 A Yeah. And it was kind of interesting, because it
5 was badly damaged --

6 Q But you could still --

7 A And it was interesting because the thing had hit,
8 impact on the side, and the reel had gone this way --

9 Q Yeah.

10 A So all the film that was wound on the reel was
11 broken here and here --

12 Q Right.

13 A See. So you ended up with a whole bunch of pieces
14 of film about that long.

15 Q Yeah.

16 A Well, we sent it down to some outfit in Hollywood
17 that does film work, and they took tweezers, and developed
18 each piece.

19 Q That's incredible.

20 A See. And, you know, film's always numbered along
21 the edge.

22 Q So it was simply the matching the numbers --

23 A And so we matched the numbers and, and where there
24 were between numbers, we were able to put it in, we just laid
25 it out on big pieces of paper, and then you could take

1 microscopes and you can look at each film, and you could read
2 the dials.

3 Q Yeah.

4 A And it could tell, show you what the pressures were
3 see. Well, that showed us what kind of went first, you
6 know.

7 Q Yeah.

8 A Where the pressures started to drop, and things like
9 that. And what was normal sequence, see.

10 Q Yeah.

11 A So, we decided there -- I mean, we could see defi-
12 nitely that the tanks were coming up in pressure, see. And
13 not only that, by that time, the, the high pressure source was
14 dropping, see.

15 Well, that's not the logical time for it to break,
16 after it's lost . . . pressure, see.

17 Q Yeah.

18 A so --

19 Q That pretty much ruled that out right off --

20 A So that kind of ruled that out, the 2 things to-
21 gether, ruled that out, definitely.

22 Q I'm going to turn the tape at this point, it seems
23 to be running low.

24 A All right.

25 Q Okay. We're back in business.

1 Q So it wasn't the high pressure source, obviously.

2 A No, no, it had to be the other end. Then it was
3 logically the tank that was coming up in pressure, see.

4 Q Yeah.

5 A Hello, Kitty.

6 VOICE: Hello.

7 A Gee, everybody's bringing me money today.

8 (Laughter.)

9 VOICE: . . . just in time, you know.

10 A Okay. Well, so -- I'll, I'll **give** you another
11 example. In fact, I'll give you a couple more.

12 The, you know, the 104 that we lost out there --

13 Q Was this Joe Walker?

14 A No. It was Milt Thompson, was the pilot.

15 Q Milt Thompson. Yeah, I don't know the details
16 about --

17 A Okay. Well, he was doing simulated flame-out
18 approaches. You know, it was a time when they'd lost a few
19 104s.

20 Q On dead-stick approaches, and things like that?

21 A On places where they had lost the power on final.
22 So our pilots always had the idea, that there was a better way
23 to bring a 104 in.

24 And that was the time when they were losing some
25 in Germany. I think that was associated with than, I could **be**

1 wrong, but -- anyway, he was, they were, they were trying these
2 techniques, where they were practically bringing them in dead
3 stick.

4 Q Yeah.

5 A So he was making a series of what they call flame-
6 out approaches. And he wouldn't quite touch down, or just
7 barely touch down, and then he'd pull up his flaps and go up
8 to 20,000 feet and come down and do it again, see.

9 And he'd done a couple of these, see. And all of
10 a sudden he started to get a roll that he couldn't control.
11 And we were listening to him on radio up in the control tower
12 up there, and when we realized that he was having trouble --
13 he talked to us quite a while -- and then all of a sudden he
14 says, "It's going."

15 And that was the end of the conversation, see. And
16 then a few minutes later the Air Force tower reported smoke
17 over in the bombing range, and no sign of a parachute.

18 Q And everybody immediately skips a beat.

19 A And everybody, boy, the gloom was there, was so
20 thick you could cut it with a knife, cause Milt Thompson was a,
21 he was one of our better pilots, too, he was a good one.

22 But, about half an hour later, here comes Thompson
23 walking in. He had hitchhiked home. (Laughing.)

24 Q Incredible. Absolutely incredible.

25 A Yeah. He had parachuted down. And nobody had --

1 how the tower had missed him -- I guess they'd been so concen-
2 trating on the airplane going in, that they didn't see his
3 parachute.

4 Q That's incredible.

5 A He landed near a road. And the truck comes along,
6 and he grabs his parachute up in his arms, and hops aboard,
7 and they bring him home.

8 Q That's an incredible anecdote. I didn't know that.
9 That's a funny story. That'd make a good one for the book.

10 A Yeah. So, anyway, it was really kind of a surprise
11 to see him walking in the front door.

12 Q What was the cause of that?

13 A Well, now then, see, there's on the 104, there *is* a
14 flap motor on either side.

15 Q Okay.

16 A But they want these flaps to be absolutely synchro-
17 nized. So, there's, there's a flexible cable that starts out
18 of the one flap -- there's a separate motor, keep in mind, there's
19 a separate motor on either flap.

20 And there's a flexible cable that goes down part way
21 then there's a control box, then the flexible cable goes around
22 to the other side, see.

23 Q Uh-huh.

24 A And this control box tells the mechanism what the
25 positions of the flaps are, you know. So when they're all the

1 down, it shuts the motors off automatically, and, and reverses
2 them so they're ready to come back up, and so on and so forth.

3 The pilot's got a switch to put them down, or take
4 them up.

5 And so -- that airplane hit the ground probably
6 going about Mach 1, straight down, see

7 Q And rolling all the way.

8 A And rolling all the way, boring -- it was a whole.

9 When you stood in the pit, you couldn't see out the
10 top, you know. It was that big of a pit. And not only that,
11 the engine, which is normally probably as long as this room
12 is wide, would stand about this high, and all crumped together

13 And, and yet, we, we got guys with shovels and
14 diggers out there, and we pulled out the control box, see.

15 And from the -- and also, and also we dug out the
16 screw mechanism, the jacks, on both sides. And -- when they
17 make an impact, then you can tell exactly what position they
18 impacted at.

19 Q See exactly where they were.

20 A Exactly where they were, see. And not only that,
21 in this control box *is*, the impact fortunately was longitudina
22 to the shaft.

23 Q Right.

24 A And there was a whole bunch of cams and each cam
25 had a washer between them, and each cam left a perfect

impression --

2 Q On that washer?

A On that washer. The washers were keyed, so you
4 could just, you could just read the whole story of when, of
6 when --

Q It was almost like an accident tape recorder.

A Right. It was, see.

8 Q Flight recorder, yeah.

9 A You could tell that. And so from that we deduced
10 that the one flexible shaft had failed, see?

11 Q Yeah.

12 So you had asymmetric flap operation.

1 A So you had asymmetric flap operation. Not only that
14 is, the -- what it was, is, one motor, one breaker was out, so
15 one motor wasn't running. And so the only side that was working
16 was the side away from the control box.

17 The control box says the flaps are up, see. Even
18 though there's one flap was down. So every time the, the
19 pilot went to do anything, this flap went down further. And
20 he couldn't bring it back up, because he had to have that
21 control box in the right position for it to reverse the motor.
22 See?

23 Q Yeah. Isn't that strange.

24 Thompson was very, very fortunate in that

25 A Yeah. He, he was a good pilot, though. We knew

1 when to get out.

2 Q Yeah.

3 A And, see, he didn't bother with anything. He said,
4 "Well, I think I have to bail out," you know. When he realized
5 it was -- he'd gotten to the point where if you went any faster
6 in a, in a turn, in a roll, that he couldn't slow down or it'd
7 roll more. So he had to keep his speed up.

8 And when he got to the point, just where he realized
9 he was not going to be able to hold that airplane any more,
10 keep it **from** rolling --

11 Q Without going to a much higher Mach number --

12 A -- and he, he did, bailed out. Very sensible.
13 He was that kind of a pilot, though.

14 Q Were you ever involved in the X-5 accident investi-
15 gation, when the Air Force lost their X-5?

16 A Ah, no, but I knew about it.

17 Q Yeah. That seems to me to be a very strange acci-
18 dent. NACA, Joe Walker had already demonstrated that the air-
19 craft had terrible spin characteristics, and I've never been
20 able to determine -- and the Air Force seems to have conven-
21 iently misplaced, et cetera, the accident report on that air-
22 craft -- it's difficult to determine whether Raymond Thompson,
23 the pilot, entered that spin inadvertently or deliberately.

24 It's a --

25 A Yeah, I don't know. That's not the part I was too

1 concerned with, how he got into it.

2 The fact it, they knew -- I mean, the procedure for
3 getting out of it, was to sweep the wings forward.

4 Q Yeah.

5 A And, evidently, the force -- he got into it hard
6 enough, that the forces were such that he --

Q The . . . vectors would not bring it forward.

8 A Mould not bring it forward. He was attempting to
5 crank it forward by hand, and I think -- as near as we can
10 figure out, he got so involved in this mechanical process --

11 Q He lost track of his altitude.

12 A -- he lost track of his altitude.

13 Q Yeah.

14 A Because he could have bailed out at any time there.

15 Q There was a high -- yeah, it was fairly high when
16 it started, like 20 thou.

17 A Yeah. That's right. He had a lot of room. He had
18 a lot of room to maneuver --

19 Q Yeah.

20 A -- and plenty of time to get out. And the only
21 thing is, they could figure out, he just, he was, you know,
22 trying to be a hero and save the airplane.

23 Q There was a, there's an Air Force, an old Air Force
24 general that . . . meet with now and then, Ben Kelsey, who was
25 sort of prominent as a test pilot in the 1930s and early 40s,

1 even earlier than that, actually, in the '20s, the late '20s.

2 And he said that as a test pilot, there's a moment
3 whenever you have your first aircraft incident, no matter how
4 serious it is, where the temptation to stay with the airplane
5 and try and bring it back, is irresistible.

6 A Yeah.

7 Q And if you survive that first incident, if you
8 either force yourself to get out, or you crash and you survive
9 from that point on you don't have any difficulty whatsoever in
10 getting out of the airplane when things start to go on you.

11 I suppose it's just a matter of, of learning that
12 little rule, building up a little --

13 A Well, that's what -- something that -- if you read
14 the, the story of the Lindberg, that was one thing that he had
15 no hesitancy about.

16 Q NO.

17 A He, he climbed over the side and bailed out, you
18 know.

19 Q Yeah. The Spirit of St. Louis, his book he wrote in
20 '54, is the classic pilot . . . , there's no question about it

21 A That's right.

22 Q It's a tremendous book.

23 A Yeah.

24 Q And you can't, you know, you get a slightly different
25 image of Lindberg from the popular press of, you know, Lucky

Lindy --

A No. No, he was very cool and calculating.

Q Indeed so. Indeed so.

A Right.

Q His -- if you read about flying the "Spirit of St. Louis" right after it was built, he has a little test program on it. He makes a little control pulses, he evaluates it in turns, he evaluates it in unaccelerated and accelerated flight. It's really quite --

A And when you read his planning of going across the ocean, very meticulous, and he always figured out, well, what can one man do, and how can he do it in the simplest possible way.

Q Yeah. What are your limitations --

A Right.

Q And what are your expectations.

A No, he was --

Q He would have made a model test pilot --

A Yeah.

Q -- had he gone into flight testing before . . . no question.

Q How about the B-70 accident? Walker nit the 70 wit the 104 --

A Yeah.

Q -- that seems such a strange accident. Was it caus

1 do you think, by position error? In other words, **it** was very
2 hard to maintain position along the leading edge of that delta?

3 A Yeah.

4 Q Simply -- and the tail of the aircraft was so far
5 back and so high --

6 A Well, yeah. That's right.

7 Q **It** simply --

8 A Yeah. Actually, **it** happened to be that **I** was the
9 NASA man on the investigation of that. In fact, we were the
10 group that went out there and found the critical piece, the
11 piece of the tail of the 104, and showing the marks --

12 Q The leading edge imprint.

13 A -- of the tip of the B70 on **it**. Which is a really
14 classic.

15 Q Do you have a copy of that B70 accident report?

16 A Yeah.

17 Q I've been unable to find one. . . .

18 A Yeah, I've got one.

19 **It** was kind of sensitive, so they kind of kept **it**
20 under wraps. But **I** see no reason for --

21 Q How did NASA view the conclusions of that report?
22 Obviously, as a member of the board, you must have been happy
23 with **it**.

24 A Well, **I** think that --

25 Q **I** didn't know that NASA had had that input, impact

1 on it. In fact, I didn't know that NASA had a member on the
2 board.

3 A Yeah. Yeah, I was it.

4 Q The, the old flight test people have always seemed
5 to take what I think is a highly defensive attitude. They feel
6 that Joseph Parton (phonetic), on the B70 program, was, if you
7 will -- and this is probably too strong a term -- if you will,
8 a scapegoat for the whole affair, in terms of the Air Force
9 activity.

10 It seems to me that, that the flight was ill-conceived 3.

11 A It was. And not only that, is -- you see, the
12 weather entered into a problem.

13 Q Yeah. You look at the photograph of those aircraft
14 in formation, you just wince.

15 A Yeah.

16 Q You know, you realize the danger --

17 A See, opposite Joe, on the other side, was this Navy
18 pilot --

19 Q In F4, from Maqoo.

20 A Right. But, now, see, the Navy pilots -- he was
21 used to formation flying of that type.

22 Joe Walker, he's an excellent pilot -- but, you know
23 our pilots -- well, even when they're flying chase, you know --

24 Q There's a healthy separation.

25 A Well, not even that, even when there isn't, they,

1 they're in and they're out, see.

2 They'll come in a little bit something, and then move
3 out. And you've got that relative motion, you know, you know,
4 you are staying in a position a long time. And that's the
5 problem.

6 Q Yeah.

7 A If you're traveling in a --

8 Q You may have a long term position --

9 A -- if you're traveling on a freeway, you know --

10 Q -- be very close.

11 A If you're traveling on a freeway, you pass a car, you
12 feel personally safe to move over for him, because you know he's
13 not going to speed up that much in a given length of time, see.

14 On the other hand, if you sit out in a car for quite
15 a while, and he's off in your rear corner, see --

16 Q Yeah. You get a little nervous.

17 A Then you get a little nervous about moving over in
18 front of him. You don't know whether he's edged up on you, or
19 dropped back a little bit, see.

20 And I think this was the situation with Joe Walker.
21 And we, we looked at all the pictures. And originally they were
22 going to go from near Mohave out towards Barstow (phonetic) in
23 one low sweep, and back, and they'd be through.

24 Q Yeah.

25 A Well, there were bad clouds over in that area. So

1 then they went up to the north. But then they were restricted
2 by the Navy range up there. So they had a much shorter path.

3 So they went around and around and around, 3 or 4
4 times, see. And every time they'd get into a turn, everybody'd
5 get out of position, see. They aren't in a straightaway.

6 Q Oh, yeah.

7 A And --

8 Q You'd think somebody at some point would've realize

9 A Yeah. And not only that, is, the sweep of the B70
10 was such, that when the tail, the tip of the wing and the tail
11 were all forward together, Joe Walker was still 20 feet away.

12 Q And there seemed to be perfect clearance, you know.
13 Here's that leading edge, and he's right here --

14 A Right.

15 Q -- and there it is.

16 A See, unless you have just moved into that position,
17 see.

18 Q Yeah.

19 A You won't realize. And the thing of it is, is, once
20 that, once those 2 pieces of metal come in contact, the tip of
21 the one thing, there's nothing Joe could do. You can't bend
22 out, because the wing's got to go up. You can't go down, becau
23 the tip of the tail's got to go up, see.

24 And the thing of it is, the instant he'd comes up
25 just a little bit, his lift increases enough that, zingo.

1 Q Immediate roll.

2 A Immediate roll. It rolled him right in.

3 P Yeah.

4 A Absolutely impossible to get out.

5 Q How about a rapid power reduction? Any improvement
6 there?

7 A That would be the only way.

8 Q Yeah.

9 A Or acceleration. One or the other. To go forward
10 or out.

11 But, it's, it's almost impossible once, once you mak
12 contact, you're gone.

13 Q Well, it's just microseconds.

14 A Right.

15 Q From that point.

16 A See. And --

17 Q Were you in the tower at the time, the control room?

18 A No, I wasn't out there at all.

19 Q That must have struck the Center as absolutely in-
20 credible, the way that Walker'd gone down.

21 A Yeah. Yeah. And --

22 Q Did that have a demoralizing effect on the Center,
23 would you say, in terms of the pilots' office, and things of
24 this sort?

25 A Oh, I don't know.

Q There were a series of accidents that occurred in a relatively short sequence. You have Walker, and then, within a year you have the loss of the X15 number 3, and you have Bruce Peterson having a very bad smash-up in the --

A Yeah.

Q -- F2

A I don't think so.

P Okay.

A I don't think so, really. The greatest blow to the Center was Walker, of course. And -- because they kind of look on him to take Renzel's (phonetic) place. And he was, he was a good pilot.

Q Yeah.

A And it was very unfortunate that thing happened. But --

Q Aside from that, it was simply an incident that people preferred to put in the past, . . . towards somebody else?

A Yeah. Well, Peterson -- he wasn't as good a pilot as the rest of them. He was, he was a little bit below standard. He was not bad.

Q Just . . . in that kind of vehicle, you can get in trouble.

A That's right. Any of those vehicles you could.

See, whereas Thompson, I don't think, would ever have gotten into trouble with it, Peterson did. See, Thompson, he

1 had just had --

2 Q A margin of superiority.

3 A Yeah. He, he was a true test pilot. You know, he
4 survived as a crop duster. (Laughing.)

5 Q It's interesting.

6 A NOW --

7 Q Peterson strikes me more as a good service pilot --

8 A Yeah.

9 Q -- as well as a good test pilot.

10 A yeah, he is. Yeah.

11 Thompson, though, I think -- on, the mud lake acci-
12 dent, I was involved in that, see. And Thompson showed me a lot
13 of things.

14 Q This was where Mackay landed --

15 A Right.

16 Q And broke up the vehicle and --

17 A Yeah.

18 Q And was very badly injured.

19 A Yeah. So -- but here, again, it was a, a -- well,
20 in actually, in these investigations, like in the B70, and the
21 X1 mud lake accident, see --

22 Q Uh-huh.

23 A -- you always give the shadow of a doubt to the
24 pilot, see.

25 Q Yeah.

A I think in both of those cases, you could criticize the pilot more than what was actually done in the final report, *see*. But if there's a shadow of a doubt, you --

4 Q He's the one who's in the cockpit, and he's the one
5 that knows the situation . . . step at a time, so to speak.

6 A That's right. You don't say, "Well, he shouldn't
7 have used his judgment."

8 Q It's like faulting somebody, like you often have in
9 courtroom procedures, that the . . . crime months after inci-
10 dent, where everybody is cool and calm and collected in the
11 middle of a nice, quiet, sedate courtroom, to start rationalizi-
12 well, what might have been. Rather than in the situation at
13 the actual time.

14 A That's exactly right. So we don't -- I mean, of
15 course, you can say, "Well, Walker shouldn't have been that
16 close."

17 And they tried to work up all these theories that
18 there s a, a --

19 Q Leading edge

20 A Yeah. But I don't think this is really the basic
21 cause. I think the basic cause is that he got too close, *see*.

22 Q Yeah. Well, when you found that scratch mark --

23 A We know, we know he hit.

24 Q Yeah. That's it.

25 A We know, we know he hit, *see*. The question is, why

1 was he in that close then, see?

2 Q Yeah. That knocks a hole

3 A And, and I think that the reason he was in that close,
4 he got just a little bit careless.

5 Q Yeah.

6 A But he got careless at a critical instant, when it
7 was a fatal --

8 Q Uh-huh.

9 A -- event.

10 Q It proves that in aeronautics, unfortunately, there
11 are, is always that time when there's no room for an error at
12 all.

13 A That's right. Yeah.

14 Q One error can cost you. And that's apparently the
15 only error he ever made.

16 A Yeah.

17 Q But that was enough.

18 A That's right, see. Somebody like Crossfield, he made
19 a bunch of errors, and walked away from them. Seemed liked one
20 time he --

21 Q They hang a wall and set up with the 100?

22 A Yeah.

23 Q And things of that sort.

24 A And that was kind of stupidity, you know. And then
25 one time he came in with -- which was it --

1 Q The F107?

2 A No, **it was** that Navy -- the Skystreak, what is that --

3 Q D5581.

4 A Yeah. D582

5 Q 2. Okay.

6 A The Skyrocket. Okay, He came in with one of those
7 with a piece of joshua tree hanging in on underneath --

8 Q Oh, my God.

9 A On the landing gear.

10 Q That's incredible.

11 A He -- on the foul lake bed.

12 Q He just scraped in.

13 A Yeah. Just, just, just hit the edge of the lake
14 bed.

15 Q Yeah.

16 A Just hit, barely.

17 Q Yeah.

18 A And --

19 Q Another 20 feet either way, and that's the end of th
20 airplane.

21 A Yeah. Then there was another one that Neil Armstron --
22 X1, X15 -- one of his flights in the X15, you know, he -- they
23 would come in from, you know, way up by Mud Lake, some place
24 like that. And they had this new stability system aboard, you
25 know.

Q This was the x15 number 3, I guess.

2 A Yeah. And he was, he was -- or course, he was the
3 lead pilot on that whole thing, all the way from Boy,
4 he was really having a ball, you know, going through all the
5 maneuvers and adjustments and things like that. And he didn't
6 pay attention to where he was, see.

7 And suddenly he looked down, and here it was, down h
8 mezuzzah (phonetic).

9 Q Yeah. And the coastline coming up fast.

10 A Yeah, you know. I, I was watching the flight that
11 day, you know. All of a sudden, all the trucks out in the lake
12 they'd pick up and they'd head south, you know. (Laughing.)

13 And he'd, he'd got it turned around and came in,
14 and made a straight-in approach on the south lake bed, and --

15 Q Apparently, in the meantime, bombing the deuce out o
16 L.A. in terms of sonic booms.

17 A Oh, I think so.

18 P Yeah.

19 A I think so.

20 So, anyway -- that -- they all have their points.

21 Q It's probably the magnitude of the error, actually,
22 you know.

23 A Fortunately, most of them walk away from it, you know.

24 Q And it's just somebody's terribly back luck when it
25 doesn't, when it doesn't turn out that way.

1 A Yeah.

2 Q Were you, were you involved in the, in the program
3 such as the X15 program in the '60s -- were you involved in
4 A2, X15A2, things of that sort? Was your specialty basically
5 propulsion?

6 A Yeah.

7 Q Did you ever get involved in the air-breathing work
8 on the YF12?

9 A No. YF12, you ought to talk to Bill Schweikhart
10 (phonetic) if you haven't.

11 Q Bill Schweikart, okay.

12 A He was my assistant for many years, and he took over
13 my job when I left. And he was specially assigned, and early
14 in the game, he went down and worked for the YF12 people for
15 a long time. So, he knows Calley Johnson (phonetic) very well,
16 and all those guys.

17 Q Okay.

18 That seems to be one of the more well-known programs
19 People know about it, I should say, but they don't know much
20 about it.

21 A Yeah.

22 Q Of course, there's probably not much that can be
23 even now told about that --

24 A Uh-huh.

25 Q -- program.

Are there any areas, looking through Center history, are there any areas that you think are particularly significant that I should bring out? Or that I should investigate? Things that you feel that -- areas where the Center made real contributions, areas, perhaps, where the Center could have made contributions, problems, or, or, relationships with other NASA center with industry, things of that sort?

A Oh, I don't know. It's hard to say.

When we got through with the X15, I often wondered what it really accomplished, sometimes. Making newspapers.

Q It certainly had great publicity value.

A Yeah.

Q It was our answer to Sputnik, so to speak.

A Yeah.

Q At that critical time.

A It did good in that respect.

Lifting body program was kind of our own baby -- that was Dale Reed's And I thought that was well-conceived and, and eventually, very beneficial program. To show that the queer shapes could fly. And to get things into manned --

Q You could indeed take something that didn't look like an airplane, and fly it.

A That's right, you know. And it did have -- and in our modifications -- and I think these were very carefully done programs, I think this was primarily due to Bickel's

astuteness -- that they approached these things very gradually.

2 Q Did you ever hear the story that, about the building
3 of the lightweight lifting body, that there was a center --
4 well, there was a section of the hangar out there, that was
5 marked off as the "Wright's Bicycle Shop."

6 Somebody actually put up a sign reading "Wright's
7 Bicycle Shop."

8 A Yeah. I remember that.

9 Q And it basically indicated Bickel's philosophy of
10 not, not having the Center's role in getting this program going
11 too well know.

12 Now, Ralph Jackson tells a story that at some point
13 there was some Congressional testimony going on. And perhaps
14 it was Thomas Paine -- I think it was Paine -- was testifying,
15 and there was an Air Force individual testifying opposite him.

16 And the Air Force individual kept referring to the
17 new research airplane NASA's flying at Edwards. The new research
18 airplane NASA's flying at Edwards.

19 And Paine turned to his aide, and said, "What's this
20 new airplane?" And the aide said, "Beat's me."

21 And they finally called up Bickel, and found out that it
22 was the lightweight lifting body.

23 A Oh.

24 Q It seems like -- I don't know if that story is just
25 a great anecdote, that probably has no basis in fact, or whether

it indeed it is a true story. But it seems to me that Bickel was a master, if you will, at working quietly and getting things done.

And I wonder if that's a true assessment?

A I think so. And it was a low-budget affair. It was built over here at el Mirage (phonetic) in some old glider hangars that were -- even the roof was so leaky they had to have plastic over where they were working, so the rain didn't come in the few times it rained over there.

And -- like, one of the aircraft companies -- I think it was Northrup, later on, who built from the later lifting bodies -- they looked at that first one and said, "You know, we couldn't even turn out the drawings for what you bought that thing for."

Q I believe it.

A And --

Q And, if you will, that was kind of a, a NASA skunk-works approach.

A That's right. Yeah. But it was mostly a matter of, we only had so much money, and we wanted to get involved in this field, and we felt that there was a significant flight test area there, you know.

After all, if they're going to use these lifting bodies in space, somebody'd better examine the, the Mach 1-down characteristics.

1 Q Right. It's great to re-enter at Mach 25, but if
2 the crew has to jump out of thing at Mach 1 --

3 A Right.

4 Q -- that doesn't say much whether it's useful.

5 Do you, were you ever involved in any of the decisio 3
6 in the direction of, say, going . . . with shuttle at the Cente
7 or the Center activity in that sort of endeavor?

8 A NO.

9 Q You basically stayed with propulsion all the way
10 through.

11 A Right. Until I quit. Yeah. Then, eventually, I
12 took on a couple of special projects. Like doing the X15 at
13 times when we weren't doing any propulsion hardly at all.

14 Then I got off the sidetrack of this lunar landing
15 research vehicle.

16 Q Oh. LLTV, LLRV.

17 A LLRV, yeah.

18 Q Okay. That's very interesting.

19 A And I --

20 Q One more point, before I forget it.

21 These 2 areas, I would like to discuss those -- the
22 training vehicle, the research vehicle LLRV, and also, were you
23 involved with the X15 proposals to put a ramjet in the vehicle?

24 A Yeah, a little bit. Not too much.

25 Q Okay. What about the lunar landing training vehicle

1 A That was a --

2 Q How did that program originate?

3 A All right.

4 Q This -- I'm very happy you mentioned that.

5 A Yeah. Well, I got to be manager of the program.

6 Q Oh, really?

7 A The -- Wes Messing, he was working for me.

8 Q M-e-s-s-i-n-g.

9 A Right.

10 F Okay.

11 A And he kind of started it out. When they first came
12 out, they were talking about some training props to land on the
13 moon, you know.

14 And there were different schemes, you know. Some
15 guys were --

16 Q Langley had the big old --

17 A Well, they hadn't had it yet, but they were talking
18 about things like that. And there were people about -- even
19 about our place, about things going up and down the hangar, see

20 And we always envisioned a pre-flight vehicle, see.

21 Q Basically --

22 A And --

23 -- reflecting the flight testing philosophy at the
24 Center.

25 A Right. Yeah.

1 So we -- we had various schemes. We were talking
2 about something similar to what we finally came up with. And
3 then one day Bell walked into the place, this Ken Levin (phonetic)
4 from Bell --

5 Q Levin?

6 A Yeah. L-e-v-i-n. He was their project engineer on
7 it.

8 Q Bell project engineer. That was Bell aerosystems.

9 A Right. And he had -- they had put together a pro-
10 posal, see, and somehow Hart heard that we were vaguely inter-
11 ested, so he came out.

12 And then we gave them a study contract. Really, what
13 we wanted to do was, we wanted to pay them for the study they
14 had mostly done, so we gave them -- I don't know -- \$50,000
15 study contract, or something like that -- it wasn't too great.

16 And then we got headquarters -- we really got approval
17 from Houston, cause they were in the space, you know. We kind of
18 convinced Houston. By that time Walt Williams had gone to
19 Houston, and, of course, he was enthusiastic over the idea.

20 And, of course, we were kind of bucking Langley at
21 that time, see. And some of the people down at Houston didn't
22 think it was such a good idea.

23 But, I think it was borne out. Because, later on,
24 the Astronauts -- they felt that that was very valuable training

25 Q Very useful.

A Very valuable training in that machine.

It's always good. You know, if you can cream yourself --

A Yeah.

Q You've got -- psychologically, you're in a better situation than in a pure simulator.

Q Because in a simulator you can say, "Oh, well, it was a bad day." And go back and punch it in and try it again.

A Right.

Q No second guessing in a

A And with this vehicle, they guys really got confidence, and said, "Okay, I can land this thing on the moon," you know.

Q Who had the bright idea of mixing the jet engine with the rocket propulsion.

A I don't know whether we came up with that, or Bell came up with it, I think we both had the same idea.

I remember, early in the days, we were drawing from sketches out there the jet engines of various types, trying to

Q We all had this idea of the 5/6, you know. One-sixt that would move --

Q Yeah.

A -- and 5/6 that --

Q How, easily, to accomplish that?

1 A And not Yeah.

2 Q What -- now, what was the jet engine that was ultimately used for that, a JD5, I don't think so?

3
4 A No, a TF34.

5 Q A TF34? Gee, that's very interesting.

6 A Uh-huh.

7 P TF34 was, itself, an experimental engine, basically,
8 at that time.

9 A That's right. In fact, you know, the interesting
10 thing was, that General Electric at Lynn (phonetic) -- they --

11 Q TF34? That is interesting.

12 A They --

13 Q Certainly interesting.

14 A They put the fan part. You know, the basic part was
15 this JD5.

16 Q Yeah.

17 A The fan part was experimental hardware. And they --
18 their first engine -- to deliver on schedule, they had to make
19 the first fan from some used parts they had in their scrap bin.

20 Q That's incredible.

21 A See, they'd run this test through the Air Force, and
22 the Air Force hadn't really bought the engine. And so the part!
23 had been -- You know, after the testing, then, they'd run quite
24 a few hours -- and they set these parts on the side.

25 And later on they came back and put the first engine

1 parts together out of these used fan parts. And it turned out to be
2 that was the best engine of the 3.

3 Q Of the lot. Very interesting.

4 (Laughing.)

5 A We bought 3 engines, and we did the whole program on
6 one engine.

7 Q What was the cost of that program? Could you give
8 a cost figure?

9 A Yeah. I think it was \$3-1/2 million, was the contract
10 to Bell.

11 Q Now, this was just for the RVs, not the training
12 vehicles?

13 A That's right. Later on --

14 Q Just for the LLRVs.

15 A Right. Well, later on -- the next contract I think
16 was \$8 million from Houston, but you'd have to check on that.

17 P \$8 million? I'll check on that.

18 A Uh-huh.

19 Q Roughly 8 million from JSC --

20 A Yeah.

21 Q -- for the training vehicles.

22 A Right.

23 P Okay.

24 A And I'm sure that was . . . later on.

25 Q This is probably a "which came first, chicken or the

1 egg," but, type of question, but, in the early '50s, the
2 British had developed an Avro test bed for --

3 A Oh, yeah, I remember that.

4 Q For an engine. I guess it was Norenda (phonetic)
5 or something like that. Avon. Rolls Royce-Avon.

6 Was the --

7 A Flying bedstead, they called it.

8 Q Flying bedstead, exactly.

9 A Right.

10 Q Was the lander influenced by that type of philosophy
11 or was it simply, simply coincidental, if you will. People
12 realized that the lander would have to have a structure and a
13 shape basically like that?

14 A Well, no. And, really, the -- what designed the
15 lander was, we had to get a swiveling engine in there --

16 Q Uh-huh.

17 A -- so that . . . remained vertical.

18 Q Yeah.

19 A See. To take out 5/6 of the weight.

20 Q Yeah.

21 A And --

22 Q I never thought of that, but, of course, if the
23 vehicle changed in pitch, and roll, and -- then the engine did
24 have to remain vertical.

25 A See, the engine always has to remain vertical and

1 and they have to --

2 Q. So it was gimbeled?

3 A. Right.

4 Q. That's something that didn't cross my mind, but, of
5 course, it's true.

6 A. Otherwise, you could do the whole thing with a heli-
7 copter.

8 Q. Of course.

9 A. See.

10 Q. Yeah.

11 A. In fact, when I first went to Bell, we did some
12 experiments. I got up -- my helicopter ride, I think, we went
13 up in the helicopter one day -- Levin and myself and the test
14 pilot -- and we, we did some rapid descents in --

15 Q. A 1/6, if you will, sort of descent.

16 A. Well, and -- then I remember, we had a stopwatch, and
17 I was taking some things, and we plotted a couple of curves,
18 and we decided, this was ridiculous, you know.

19 You aren't going to get anywhere near, you can't
20 drive a helicopter down the way that this landing's going to co
21 in.

22 Q. NO.

23 A. And so I was -- we . . . some very crude tests of,
24 we convinced ourselves -- see, this was, this was the part that
25 Houston --

1 Q Uh-huh.

2 A You know, you can train these guys with helicopters
3 and things like that, just as well --

4 Q Houston seems to have always shown a lack of appre-
5 ciation, if you will, for the, for the necessity of flight
6 test research.

7 And it makes me wonder, at times, if Houston isn't
8 afflicted with the same sort of thinking as the Soviet space
9 program, where they envisioned the Astronaut -- Cosmonaut, in
10 Soviet terms -- as pretty much a passenger in their vehicle to
11 do their bidding from the ground, rather than as a test pilot
12 in command, if you will?

13 A Yeah. Well --

14 Q You wonder.

15 A We've always had the attitude that the test pilot --

16 Q Yeah.

17 A -- really had to know the whole story, he had to be
18 in it from the beginning, follow it through, had to be his baby
19 So that he knew everything intimately when it came to flying.

20 Q Yeah.

21 A Anything that was new.

22 And, see, Walker was our first test pilot on that.

23 Q Uh-huh.

24 A And, gee, we worked hand in hand, he even went to
25 meetings at Bell with us, and down to Langley, and around.

1 Q Who else flew the aircraft at the Center? There was
2 an Army pilot, I think. Jack Kluba (phonetic) who may have had
3 some sort --

4 A Yeah. And then there was a fellow that took over --
5 what, oh -- I've been away from there just about long enough
6 I am forgetting people.

7 Q Would it be Don Malik?

8 A Yeah. That was it. Don Malik.

9 Q Don Malik. He came from Langley.

10 A Right, He was an excellent test pilot, too.

11 Q He's certainly going strong now in the

12 A Yeah.

13 Q Houston got the training vehicles, and promptly
14 crashed, I guess, 3 of them.

15 A Right, Mostly out of foolishness.

16 -- Was it running them out of fuel, basically?

17 A Well, and -- again, attempting to fly when the wind
18 conditions were adverse.

19 Q Yeah. What sort of parameters had been set up on
20 wind, as --

21 A Well, we, we had it pretty low. I think we had, it
22 had to be below 10 knots. We liked it below 5 knots -- to the
23 point that we even had our little anemometer station, we set
24 it up down where we were doing the testing work, you know.

25 Q Very interest ng.

A And we didn't have, we didn't have that tight of a schedule to meet. And --

Q What sort of differences existed between the research vehicles and the training vehicles? I suppose the research vehicles were more concerned in instrumenting and studying aircraft motion, whereas basically the training vehicles were basically simulating the landing environment.

A And we were, we were interested -- we had a lot of instrumentation on there, and we were interested in the possibilities to control, and the general stability of the system, you know, and the computer systems. It had to be an extensive computer system to maintain, first of all -- something had, had to have a . . . on there to sense and hold that jet engine vertically no matter how the pilot turned the other vehicle. Which was a little tricky.

Q Yeah.

A And --

Q Did the Bell company do most of the detailed design? Or was Flight Research Center --

A No.

Q -- actively involved?

A We were actively involved, but they did most, they did the detailed design, they did a good job, too.

Q Yeah, apparently. You know, I never heard any complaints about the operation of Flight Research Center -- worked

1 beautifully .

2 A Uh-huh.

3 Q Did the training vehicles have a LEM-type cockpit
4 display? Or did -- was that felt to be unnecessary? Basicall
5 you were simply trying to get pilot --

6 R It was --

7 P -- pilot's feeling here --

8 A Right.

9 Q There wasn't time to go beyond that.

10 A And -- originally we didn't even have a cockpit over
11 it, see. Later on they put one over it. Enclosed it.

12 Q Yeah.

13 A We didn't, we didn't both with that. Mostly --
14 wieght was very critical when we first started on that program.

15 Q Sure.

16 A The -- there was a gap in engines. The TF34 gave
17 us most thrust we'd get out of a small engine. And if we had
18 to have any more thrust than that, it meant going to an engine
19 about 3 times the size.

20 Q Yeah. A J57 or something --

21 A Something like that. Something horrendous.

22 Q Yeah.

23 A See. And then that, that just magnified the whole
24 project, see.

25 Q Yeah. You take yourself from a thrust weight cycle

1 A Yeah. Right.

2 And we had to stick with that engine. That was our,
3 our white hope.

4 Q Yeah. That's interesting.

5 A And, in fact, the specs was, that the weight of the
6 vehicle shall not be -- let's see, the thrust -- it would be
determined by the thrust of the engine. Unlike the Air Force -

8 Q Uh-huh.

9 A -- we didn't, you know, we didn't buy the engine,
10 and, and then go to another company company and buy the air-
11 frame, see.

12 Q Yeah.

12 A We bought the whole thing as a package.

14 Q Uh-huh.

15 A And then we had to say that the thing had to take
16 off at a certain time, and it had to have a thrust of 105 perce
17 of the weight of the airplane, see.

18 Q Okay.

19 A It was that, that, was that close, though.

20 Q Those were tight design specs.

21 A And there were -- we realized that it was a difficul
22 thing. And there were days that we'd go down there -- if it
23 warmed up a little too much we couldn't make it -- we generally
24 started about 3:00 in the morning, getting ready for a flight,
25 hoping to take off just at dawn.

Then, even though -- even then, some days that the thing would sit there, run at full thrust for a minute or 2 minutes, and then enough weight would burn off and it would take off. (Laughing.)

Q . . . would lift off.

Some of the early rocket experiments, in the '30s, when you'd have a rocket sitting in the stand there --

1 A Yeah.

Q -- burning away propellant, until finally it just
10 started to stagger off.

11 A Right. Yeah. So -- but -- it just worked, and then
12 Armstrong and Leese (phonetic) had nothing but kind words to
13 say about its use.

14 Q I interviewed him once before the 15 program . . .
15 We're going to have to . . . get on some of these other things.

16 A Uh-huh.

17 Q Had he flown it here? Or had he flown it just at
18 Houston?

19 A I think he just flew it at Houston.

20 Q Yeah. That's my impression. I don't recall seeing
21 his name come up, in terms of flying it here.

22 A So, then -- see, I left that program after the 25
23 flights. I think they flew 200 flights out here. After the 25 --
24 after it was built, together, working, and after 25 flights,
25 then I turned to -- my assistant was Matrainga (phonetic).

1 Q Gene Matrainga, right.

2 A Yeah. Great guy. And he, he took it over and
3 finished up the job.

4 Q Did Gene Matrainga basically succeed you in the --

5 A Well, I was kind of off on the side, see. They were
6 very anxious, about that time they were anxious to get back int
7 some more propulsion work, see.

8 So I left that job and went back and picked up my
9 old propulsion group now that the X15 was past. And we started
10 in on the --

11 Q B70, perhaps?

12 A No, it was the inlet of the airplane built in Dallas
13 by Fort Worth.

14 P The F-8? The Crusader?

15 A No, no. The one, the variable sweep wing job.

16 Q Oh, the F111.

17 A F111, yeah.

18 Q Oh, yes.

19 A Yeah, we did --

20 Q . . . work and all that.

21 A Yeah. They were having a lot of inlet trouble with
22 that.

23 Q Yeah.

24 A And we --

25 Q This was about '67 --

1 A We got involved in dynamic instrumentation. The

2 Q The Center. That's interesting.

3 A The miniature -- and studying, studying the flow
4 patterns right before the engine, and we found out a lot about
5 that.

6 Q The engine face.

7 A Yeah.

8 Q The F-111 had some severe design problems when the
9 initial F-111A model flown -- the one in the old days would have
10 been an XF-111, I suppose.

11 And the inlets were a major cause of a lot of the
12 problems there.

13 A Yeah.

14 Q Now, this all comes out when the aircraft first gets
15 into its flight test program -- and I think the aircraft makes
16 its first flight about '64.

17 Now, was your involvement in that program -- was this
18 a NASA research program just to develop generalized inlet data,
19 or was this a program --

20 A No. It was --

21 Q -- for fixing the airplane.

22 A It was -- we were given one of the early airplanes,
23 with the idea that we might help out. There -- the Air Force
24 was in deep trouble.

25 Q This was 771, I think.

1 A Yeah. Uh-huh.

2 Q Yeah. The aircraft --

3 A And that was number 6 airplane.

4 Q Yeah.

5 A And later on we got 778 --

6 P Yeah.

7 A 13, was number 13, I guess.

8 Q Which later became a TACT airplane, I guess.

9 A Right. See, then, really, that was the superwing
10 improvement --- SWIP.

11 Q SWIP.

12 A SWIP. Yeah. okay.

13 Number 13 airplane was the one kind of inbetween.

14 And then starting with 14, was the later model. So we had those

15 2 airplanes, number 6. We worked mostly on number 6.

16 Q That program seems to have been a program that had
17 a lack of good control, in terms of overall direction.

18 A Yeah.

19 Q Langley had warned them on some wind tunnel studies,
20 and the results were ignored. And the aircraft designer was
21 fixed, and then it was flying, and the next thing you knew,
22 everybody knew, they'd get up around 1.1 Mach, and start having
23 compressor stalls and everything else.

24 A Right. And --

25 Q High angle of attack, I think they had all sorts of

1 | compressor stall problems.

2 | A Well, just before, you know -- let's see, what was
3 | it, a 107 airplane --

4 | Q F-107 with the bifurcated 2-dimensional inlet --

5 | A Over, over the pilot.

6 | Q Over the pilot, yeah.

7 | A We were going -- see, this was before the X15 --

8 | Q Yeah.

9 | A -- and we were going out there, we were interested
10 | in doing some dynamic inlet -- I was particularly interested
11 | in, in doing some dynamic work, see.

12 | Q That would have been the airplane for it, too.

13 | A And we had, we had some proposals. One from Douglas
14 | on dynamic instrumentation on inlets.

15 | 'Cause we were, we were getting concerned, now, the
16 | airplanes were getting faster. They were, they were starting -
17 | 104 went into this twin duct instability, and we were involved
18 | in that, see. And we put some things on that.

19 | But we realized we weren't measuring pressures fast
20 | enough. So we started that. Then Crossfield came out and creat
21 | the airplane for us.

22 | Q That took care of the 107 problem.

23 | A That took care of the 107 problem.

24 | And so that problem was dropped. Well, then, after
25 | the X15, I'd always had this, we'd had this hankering out there

1 And when we got into this stall problem, you know, the Air Force
2 was getting this stall problem on the, on 111s, then we decided
3 "Well, okay, now here's our opportunity to get on an airplane."

4 So we devised some rakes, they were, they were really
5 fantastic. And we got some of these little tiny quarter-inch
6 diameter transducers, and buried in them rakes, so they,
7 from the --

8 Q Very interesting.

9 A -- time they picked up the pressure, till the time
10 we were actually turning into a electrical circuit, was only
11 about 1-1/2 inches, see.

12 Q You're getting at virtually an immediate direct read

13 A Right. I think we were, we did a good job of that.
14 Because our rakes worked very thick.

15 Q The ultimate fix on the airplanes was a so-called
16 triple-plow inlet.

17 A Yeah.

18 Q And I think that was ultimately only applied -- there
19 were modifications made to the inlets in all the aircraft, but
20 triple-plow, in its full-blown glory, if you will, was only
21 applied to the last 96 airplanes, the F-111F.

22 A They moved the whole inlets out just a little bit, they
23 They gave more space.

24 Q Yeah. That's true. They got them out of the bound-
25 dary layer problem.

A Right.

Q And things like that.

3 would it be fair to say, basically, that the inlet
4 problem was solved by . . . ? Would that be a, be a fair assessment,
5 ment, or would that be a little bit too --

6 A I think that'd be too great.

7 Q A little bit too great. Okay.

8 A I don't think we need to take that much credit.

9 Q Okay.

10 A I think, though, we contributed.

11 Q Yeah. Was Flight Dynamics Lab involved in all that?

12 A And -- yeah. With dynamic distortion. They were
13 if doing some of the work, and I think we turned out some pretty
14 good flight data in this area.

15 And we --

16 Q Was a team effort.

17 A We, we consult -- we were on a very friendly basis
18 with both the Air Force and with the General Dynamics people
19 down there.

20 Q That's interesting.

21 A And --

22 Q When did you finally leave the Center? What year?

23 A Oh, about 2 years ago.

24 Q My word. So you really did keep up there, right
25 until the advent of the advanced projects going on now.

1 A Yeah. They, they were starting on the shuttle stuff
2 and talking about that.

3 I was in, for the last year, I was kind of off again
4 on a side tangent, partly. On this high MAT program (phonetic)

5 Q Yeah. Which looks like it's about 2 years away.

6 A Up until the time they were about ready to place the
7 contract, and then I quit. Yeah.

8 Q Once again, from a propulsion standpoint?

9 A Well, no. That wasn't really, that was just was
10 because I was kind of available.

11 Q Yeah. The Center seems to have a rare talent for
12 taking people who have time on their hands, if you will, and
13 putting them then in various programs here that are underway.

14 A Yeah. You know, for something like that, when you're
15 trying to get things to, for a head -- I think some of the older
16 people do an excellent job --

17 Q Uh-huh.

18 A -- of working out a new contract.

19 Q They have the experience, and they know generally,
20 if you will, the program problems that can show up, and so they
21 know how to work around them.

22 A That's right. Like with Bell, on that contract there -

23 Q On the landing vehicle.

24 A -- on the landing vehicles. I had an excellent
25 procurement man work with me. In fact, he did on high MAT, too

And, boy, you get *a* good engineering or *a* good procurement man, and they can get what the government wants.

3 Q Uh-huh.

A So, I know with Bell, there's one engineer at Bell, this guy Levin, he was, he was top-notch. And most of the other guys were a bunch of crooks. (Laughter.) Except for the president of the company.

8 Q Giesel (phonetic)?

9 A Yeah. He was excellent, you know. The one, one
10 time I realized that, you know, they were just pulling, trying
11 pull the wool over my eyes --

12 Q My boss . . . Bell employees who likes to . . . that
13 very situation.

14 A And so I got to the point I wouldn't hesitate, I'd
15 pick up the phone and call Giesel.

16 Q Yeah. And see what gives.

17 A I always get straightened out. Get ahold of him.

18 Q Bell certainly doesn't operate now anything like it
19 did in the '50s.

20 A Yeah.

21 Q Or especially in the '40s.

22 A But, you know, they would -- oh, I don't know --
23 we tried very hard to work with them. I mean, I wanted to be
24 a good guy, you know. Maybe this sounds altruistic, but --

25 Q NO.

1 A And with their chief engineer, Levin, he and I got
2 along swell. You know, in fact, he would tell me confidentially
3 he says, "You know, you're on the right track, you know."

4 Q Keep going on this track.

5 A "Keep going on this track," you know. And he says,
6 you know, "Sounds like, sounds like you're trying to" -- he'd,
7 he'd tell me frankly, he says, "Sounds like you're trying to
8 bend over backwards to be nice to us, and we aren't being very
9 good to you."

10 Q Yeah.

11 A And -- but as a result, they probably lost a couple
12 of hundred thousand dollars that they could have picked up from
13 the government real easy.

14 Q Yeah.

15 A Because they tried to keep forcing us into an overru
16 see, and I just, we just told them, I said, "We've 2 vehicles
17 here. We're going to -- when the money runs out, the program
18 stops. Period. And it did. And they had to ship the second
19 one out in a bushelbasket.

20 A Yeah.

21 A And --

22 Q We found the same thing in opening up the Air Museum
23 We'd go to all types of design firms, and, invariably, you could
24 come across some pretty nice people in them, yet, on the whole,
25 they knew that you had a deadline to meet, and they weren't

1 above making any request, and running any contract up, simply
2 to put you off.

3 A Yeah.

4 Q And you'd get a quality product, but you'd pay
5 through the nose, and a bit more --

6 A That's right.

7 Q -- to get it done. It's discouraging.

8 A Yeah, it is. Because, well -- the thing of it is
9 now, since it's different from the Air Force. I mean, I guess
10 some of the Air Force guys, you know -- they're out to get
11 the companies, the companies are out to get them, and it's
12 just a battle, see.

13 Q Yeah.

14 A Well, I had --

15 Q It's practically a skirmish right from the start.

16 A Yeah, and I envision -- and I know that this one, one
17 guy -- and, actually, later on, they put in a program manager
18 that I could work with.

19 Q Yeah.

20 A But between the chief engineer, and the first pro-
21 gram manager -- he was no good, they fired him.

22 Because, here again, I complained to the company
23 about him. And I know you -- the poor guy was just a fall guy
24 because he was just doing what he was told.

25 Q He was fired, probably more because his weaknesses

1 had been discovered. They were actually trying to clean up
2 the organization.

3 A Yeah, that's right. Well, you know, he would,
4 he would, I would sit down at a desk with him, and he'd pull
5 out sheets, and he'd look at them, and he wouldn't let **me** see
6 them,

7 Well, I had written in the contract that I was
8 supposed to be able to see all their product reports.

9 Q Yeah.

10 A And I demanded **to** see them, see.

11 Q Yeah.

12 A And when I, when he wouldn't let me see them --

13 Q **He** just lacked the tact to **do** that on the side.

14 A That's right. Nothing burns you up quite more than
15 things like that. Oh, well.

16 Q . . . supposedly running an open, and all of a
17 sudden you see it's not.

18 A Yeah. And I, but --

19 Well, that's kind of --

20 Q Well, I think that's --

21 A Let's look --

22 Q I think, perhaps, we've touched everything, I don't
23 know. What do you think?

24 A I think so.

25 Let me tell you about one thing that's kind of

1 interesting --

2 Q Okay.

3 A -- an X15 accident.

4 Q Okay.

5 A I don't know.

6 Q This involves Mike Loves (phonetic)? Not Mike
7 Loves, but Mike Adams?

8 A Mike Adams got killed.

9 You know, when they -- when that thing first hap-
10 pened, it -- we had an electrical device on there, that was --
11 there was a little motor that ran a probe out on the wing. Ar
12 that was causing an electrical disturbance.

13 And we found out later that it was -- and, here ags a,
14 it was, it was NASA's fault -- from the fact that it was not,
15 the device wasn't adequately tested out in an altitude chamber
16 see.

17 And it turned out that they -- even though it'd
18 only a 110 volt motor, it started generating 3- or 400 volts
19 internally --

20 Q Yeah.

21 A -- and under high-altitude conditions, it was
22 arcing, you know, arcing about that much.

23 Q Yeah.

24 A And -- which just upset the computer system on
25 board to no end. So when we were --

1 Q I can imagine.

2 A So when we were investigating, you know, we, we
3 strongly suspecting that maybe the -- it, not only did it upset
4 the computer system, but it upset, but it might have upset the
5 pilot's instruments, see.

6 Q Uh-huh.

7 A And that the poor pilot was kind of led astray.

8 And so the one vital piece of information we felt
9 we had to have, was the cockpit camera.

10 Well, we had the canopy over the patch crew, and
11 we had the camera -- but you know, the airplane broke up at
12 about 50,000 feet --

13 Q Yeah.

14 A -- and scattered itself over many miles -- in fact,
15 the main, one of the wings wasn't found till a year later.

16 Q That was over the . . . wasn't it, in that area

17 . . . --

18 A Yeah. Right.

19 Q . . . basin.

20 A So we'd been in the investigation quite a little
21 while, and we realized the vitalness of this. It was the
22 16 millimeter film cartridges, you know, like you used in the
23 World War II gun cameras.

24 And it was one of those things. Some guys --

25 And it was an interesting thing, because we had a

1 map, and we could plot where all the pieces were found, see.
2 And it was very apparent, that how far a piece traveled depen-
3 ded upon its mass, compared to area.

4 Q . . . know the area basically where it could fall.

5 A And we figured -- that's one of the . . . , that
6 it probably fell in an area that we had not really looked at
7 too much.

8 So, on, I guess -- and, then we had also the X15
9 crew and a lot of other who had been working on that, see, the
10 had nothing to do with that crash of the airplane, for a while
11 till they could get recycled into other jobs.

12 So, about two weeks after the accident happened,
13 a couple of guys came up to me, and they wanted to go up, and
14 they have -- a couple of guys are motorcycle buffs, and I says
15 "Well, I don't want you tramping around up there with motor-
16 cycles. But if you want to go up and look, we'll organize it.

17 I think it was Vic Horton that was in charge. And
18 we mapped out a mile square -- and that's a lot of territory
19 to look --

20 Q That it is. . . inch by inch.

21 A Inch by inch.

22 And I think we had, I don't know, I think we had
23 something like 15 or 16 guys, see.

24 So Vic got them all up there. And we, they kind
25 of figured out where the area was that we wanted to look. And

1 then we, they lined them all up, and they were going to march
2 down this way for nearly a mile, shift over, and march back,
3 see. So they tried to cover that whole area in there in a
4 couple of days.

5 On the very first pass they found the thing.

6 Q That's incredible.

7 A Absolutely incredible.

8 Q Yeah. Isn't that, isn't that fantastic.

9 A And --

10 Q So it's based on the predicted ballistic process --

11 A Right.

12 Q (Inaudible.)

13 A It wasn't, it wasn't very, it wasn't that scientific
14 you know. But, you know, we could see the airplane landed
15 here, the canopy here, and the . . . landed here. And these
16 are, these are much lighter, much more aerodynamic than that,
17 and so on and so forth.

18 And we'd get, kind of, you know, just by rule in the
19 thumb, well, anything that light, is going to have to be back
20 in this area.

21 And then we sent the film to Boston to be developed
22 by these guys --

23 Q . . . came out okay.

24 A Oh, perfect.

1 Q The last frame must have showed the canopy separa-
2 ting? Or at least shown light entering the cockpit.

3 A Yeah. But -- and not only that, it showed that the
4 pilot systems were absolutely perfect. And it showed the sun-
5 light around.

6 Q . . . simulating everything.

7 A Yeah. And so, in other words, it, it just shows
8 that the pilot was obviously disoriented.

9 Q Was that a function of the fact that he had shown
10 unusual susceptibility to vertigo?

11 A Well, we think so. They, that airplane was a great
12 one for giving a guy vertigo, because they head up, even, the
13 pilot can see absolutely nothing, other than blue sky.

14 Q There's no external horizon.

15 A There's no external . . . visible for the entire
16 assent of the airplane.

17 Q Yeah.

18 A And it's not till he bend over at the top that he
19 can get a horizon again. And they say that's just terrible
20 on people who are prone to vertigo.

21 Q It should be instruments only.

22 A And -- but the fact remains, that there were, there
23 were not only the instruments working properly, but the sun-
24 light would flash by, see. The airplane was obviously turning
25 slowly in a horizontal attitude, you know. . . .

1 If the pilot couldn't recognize that, then the
2 . . . was in trouble.

3 Q. He was really incapacitated.

4 A. He was really, truly incapacitated. In fact, the --
5 up until that time we got that film back, the Air Force general --
6 who was it?

7 Q. Not Grant?

8 A. No. Anyway, he'd been . . . antagonistic with us.

9 Q. . . . incapacitated theory?

10 A. Well, yeah, yea. And the fact that, you know, he
11 kind of had the attitude, " Well, you guys killed my pilot,"
12 you know. And he, he came over and looked at that film, and
13 he didn't say a word. He just got up.

14 And I was, I was the one that showed it to him.

15 Q. What . . . ?

16 A. And he, he looked at that film. . . . And never
17 heard any more out of him.

18 Q. Yeah.

19 A. But, we hadn't had that film, see, there -- we would
20 have been always that cloud. And our poor engineer --

21 Q. Always has been sort of a strained relationship with
22 the Air Force --

23 A. Yeah.

24 Q. On future projects.

25 A. That's right, you know. That, you know, us, us

1 dumb stupids, we put this piece -- well, I admit, we should hav
2 tested that, altitude tested that piece of apparatus.

3 Q Did that have anything to do with saturating the
4 system on the -- so that the control system broke the aircraft
5 up, then, on re-entry.

6 A NO.

7 Q No. You don't think so? I had heard that, one or
8 2 places.

9 A That airplane was destined to break up, anyway.

10 Q Yeah. It was Mach 5 at, what, 120,000 feet, and it
11 was going down?

12 A Well, it was coming in backwards.

13 Q Oh, my God. Yeah.

14 A Tail first. You know, then, as soon as the air got
15 thick enough, and then, then it just --

16 Q Executed some gigantic high G.

17 A Right.

18 Q Control reversal in direction.

19 A Right.

20 Q That was, I think, the saddest of the accidents, in
21 that he knew he was in trouble -- he didn't know exactly what,
22 I don't think -- and the people on the ground were simply unabl
23 to help him. In fact, they were incredulous --

24 A That's right.

25 Q -- at what was going on,

1 A Right. And really, I think, here again, it's just a
2 case of putting a fellow on a job that he's, was physically
3 unsuited for, see.

4 Q Yeah. Well, the text on him in the Manned Orbiting
5 Laboratory program, according to the X15 accident report, had
6 shown such unusual susceptibility to vertigo, that it was almost
7 if you will, almost criminal neglect.

8 A I, I, I, I have always felt that way.

9 Q I read those results, and it blew my mind --

10 A That they ignored, that they would ignore a symptom
11 like this.

12 Q Yeah. He, he showed such a disorientation tendency,
13 that it makes you wonder if he was suitable for a flying and
14 piloting command on any vehicle.

15 A Yeah. Particularly --

16 Q Yeah. A high-performance program.

17 A A very, very demanding

18 Q I think we've just about come to the end of this
19 tape as well, as a matter of fact.

20 A All right. Well, maybe we've

21 * * *

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