NASA CULTURE STUDY

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INTERVIEW WITH

CHRISTOPHER C. KRAFT

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(THIS TRANSCRIPT WAS PREPARED FROM A TAPE RECORDING.)

McCURDY: Let me get the facts straight. You joined NASA in 1945?

KRAFT: Right.

McCURDY: At the Langley Center?

KRAFT: Right.

McCURDY: Some of the major positions that you have held were, you were Founding Member of the Space Task Group?

KRAFT: Yes.

McCURDY: You were the Flight Director for all of the Mercury Missions and the early Gemini Missions, you were Director of Flight Operations until 1969, and Center Director at the Johnson Center from 1972 to 1982. We have your last day on duty as August 6, 1982?

KRAFT: That's right.

McCURDY: And, I'm going to mispronounce this, your birthplace is Febus?

KRAFT: Febus.

McCURDY: Febus, Virginia?

KRAFT: Right.

McCURDY: Were you raised in that town.

KRAFT: Yes, sir.

McCURDY: Could I get the occupation of your parents?

KRAFT: My father was a finance officer with the

Veterans' Administration. My mother was a nurse there.

McCURDY: Was there a VA Hospital?

KRAFT: Yes, sir. I was also the Deputy Director of Johnson Space Center.

McCURDY: Right.

KRAFT: In that interim period that you described.

McCURDY: Right, from '69 to '72?

KRAFT: '70, I believe it was '70 to '72.

McCURDY: Okay. Do you have brothers and sisters?

KRAFT: None.

McCURDY: You went to VPI in Blacksburg and majored in aeronautical engineering. When you entered the University did you have that as a major?

KRAFT: No.

McCURDY: What did you --

KRAFT: mechanical engineering.

McCURDY: mechanical engineering. So you were interested in engineering, but not aeronautical engineering?

KRAFT: Right.

McCURDY: Could you explain briefly why it was that you chose engineering and then aeronautical engineering?

KRAFT: Well, I chose engineering because I was interested in mathematics and things like engines, automobile engines. I wasn't a mechanic, but I was interested in engine design. Didn't know a thing about it, but I got interested in the physics in it. And at the time, it was -- a the time of my career -- my life, we were just coming out of -- why don't we close that door.

McCURDY: Yeah.

KRAFT: We were just coming out of the depression and engineering was a good field to get in.

McCURDY: Uh-huh.

KRAFT: So, I went to Virginia Tech because it was a state school and it was only school in the world that I could afford. It was very inexpensive to go to Virginia Tech and not only because it was a state school, because it was a military school and you only had to wear one piece of clothes and that's all I could afford.

McCURDY: That's right back then.

KRAFT: After I got there, I struggled during my Freshman year as any Freshman does at Virginia Tech, not only because of academics, because of the military system, although the military system didn't bother me any, it still was a chore.

McCURDY: Uh-huh.

KRAFT: I also had, I don't know why I'm telling

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you, you don't need to know all of this, but I also had scarlet fever in my second quarter and I had to repeat it. I was very depressed about staying there.

But, I was also a baseball player and I played baseball my Freshman year and that kept me there. I played baseball from then on, of course, all though Virginia Tech. One of my best accomplishments.

I have a great legend there for being a great hitter and a great baseball player, none of which was true. That legend grew as I became one of their more famous alumni.

McCURDY: Yeah.

KRAFT: However, I did play every year. I got interested in aeronautical engineering because I didn't like the people in the mechanical engineering department. I thought they were a bunch of old people who really didn't know what was going in the world. And, I took an elective in aeronautical engineering and I became fascinated by aerodynamics in the first place, but also by the people that were in the aeronautical engineering department, and there were only two.

And it was -- '43 was the first year they offered a degree in aeronautical engineering. Before that, it was mechanical engineering with an aero option, which is the way it was in most universities. So, that's how I got to be an

aeronautical engineer.

I had no aspirations of being a pilot, or inventing some new airplane or machine. But, I became fascinated by the people who were in that department and I liked what I was studying, so I stayed there.

McCURDY: Did you have to support yourself through college, or were your parents able to help?

KRAFT: No. No, my father became ill when I was a freshman and he got a small pension from both the service and his civil service monies. And my mother skimped and saved and paid the small amount of money it took to go to Virginia Tech. Of course, then it was a lot of money to her, but I think it cost me about $3,000 to attend Virginia Tech for four years.

McCURDY: Uh-huh.

KRAFT: Everything.

McCURDY: Fees have gone up considerably since then.

KRAFT: Slightly.

McCURDY: As you know. What values did your parents try to instill in you when you were trying to grow up? Can you answer that question?

KRAFT: Well, they were good Christian people. And my mother was a good North Carolina woman and I think she was my inspiration. My father was not a strong man and

I think she was probably the thing that inspired me more than anything.

But, I think that more than anything else I have to say that I was fortunate as I went to school, from kindergarten -- including kindergarten on, to have a lot of very, I'd say extremely competent teachers, and I think they were more inspiration to me than anything else. Starting in kindergarten I had a woman named Bryant and then I seemed to get real good teachers as I went forward in grade school and when I got to junior high school I had a superb set of teachers.

And when I got at -- I only went through Junior High School at Stevenson, and had to go to Hampton High School which was five miles away. And, the teachers there that I came in contact with were extremely good, particularly in mathematics in both places.

And, I think they were the people that inspired me -- the desire to excel in me. But I was fortunately, I don't know -- you know, you never can explain your genes.

I never had any trouble in school, I was always -- everything came easy to me, particularly math and english and Latin and things like that. I didn't have any trouble. I got along well in almost anything. The only thing I ever had trouble with was French.

McCURDY: (LAUGHTER).

KRAFT: I passed it, but that was the only thing I had trouble with. And in college, after my Freshman year I didn't have any trouble. And my last two years I made nothing but "A's."

McCURDY: Did you pretty much know where you wanted to go when you graduated?

KRAFT: No. No, I had a job with LTV, with Chance Vogt.

McCURDY: With --

KRAFT: Chance Vogt, which is now LTV.

McCURDY: Huh?

KRAFT: Well, I had a job offer from NACA, and I had a job offer from Chance Vogt in Bridgeport, Connecticut. And I went up there in January 1945 because I wanted to get out of small town Febus and small town Hampton. I don't know why I did, it was a mistake.

McCURDY: Uh-huh.

KRAFT: But nevertheless, they wouldn't at that time, it turned out I didn't have my -- funny story, at that time I didn't have my birth certificate with me.

McCURDY: Hum.

KRAFT: And because of the security problems in the war, they couldn't put me to work and I was up there on my own in the hotel for a couple of days and then I transferred to a old place where a lot of carpenters and

elderly people were living during the war. That's all you could get for those kind of jobs. And I kept going there everyday and they would say, "Well, we can't talk to you yet because we don't have your birth certificate."

Well, I had told them where to get it in Richmond and I think they screwed that up. Well, I waited for five days and I would go there everyday and they would say, "Sorry, we can't talk to you yet." And I said, "Well, can't I talk to the guy that interviewed me to get me up here for a job?" And they said, "No, we can't do that yet until you get your birth certificate." And I said, "Okay."

So, I went back to my small room there, wrote them a letter and said I'm on my way back to Virginia. I'm going to probably apply for the job that was offered to me at NACA and if you want to contact me, here's my address. I never heard from them again.

McCURDY: Hum.

KRAFT: Not till this day have I ever heard from them. That's how I went to work for NACA.

McCURDY: (LAUGHTER) Okay. Did you have the sense in going to work for NACA that you were going to work for a government agency?

KRAFT: No. Never felt that. Never even thought about it. My father had worked for the government, of course, all of his life. And so did my mother. Now, she

wasn't a nurse after I was born, but no I never -- I became aware of it after the war when civil servants to this day get kicked in the ass by the Congress and by the President, and all of that sort of thing.

I became very aware of it in that light and in my salary problems in later years. But, initially I didn't have any problems.

As a matter of fact, it was a good thing to do. They had -- the government had reasonable pay. As a matter of fact, the first salary I made was more than my father ever made and it was $2,000 a year. And, they had good retirement. Everybody knew they had good retirement. At that time, it was good retirement. It isn't anymore, but it was then.

McCURDY: What characteristics of the Langley Center stand out in your mind from the first ten to fifteen years? What kind of an organization was it? What was your sense of what its charter or mission was in those days?

KRAFT: Well unquestionably -- well anybody that had anything with aeronautical engineering even in school, I mean in the University, was aware of NACA activities. In particular the NACA technical reports and knew that NACA was the prime research -- aeronautical research organization in the United States and probably the world.

Everything that had ever been done in aeronautics

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came out of NACA. If it hadn't been done there, it hadn't been done. So, I knew that about NACA before I went there.

Recognizing also that I lived only eight miles from where NACA started. I was born and raised there and I was well aware of the connotation of the "NACA nut" that was given them in the local area.

McCURDY: The NACA --

KRAFT: The "NACA nuts" they called them.

McCURDY: I never heard of that.

KRAFT: A lot of stuff written in the newspaper about that recently as a matter of fact. Brain busters they were called. NACA people were called brain busters. So, I was aware of that kind of connotation of those people out there, but that didn't bother me any.

As a matter of fact, I fit in very well with them. And now what kind of organization was NACA? It was a very conservative, very limiting organization in scope in certain areas. And people were very naive when it came to what the real world of airplanes was all about. Now that sounds strange.

They knew every aspect of what makes an airplane fly. They knew how to perform miracles in making airplanes perform better when they had failings. And you have to recognize that I was in flight test.

McCURDY: Uh-huh.

KRAFT: Airplane flight test, not in the wind tunnel flight research and that's a very different world than wind tunnel work. I was more attuned to the real world of airplanes than the rest of the Center was.

But nevertheless, I was embroiled in the type of management that existed in NACA. It did not acquaint you with the world of organization, or management, or politics involved in management, or deal with the problems of managing people. That was not a goal of the NACA.

The goal of the NACA was to provide the best aeronautical research that could be provided in all fields, whether it be in low-speed aerodynamics, or high aerodynamics, or gas dynamics, or structures, or guidance and control. Well, you name it, they had the experts and they were superb. But, they did not provide, nor should they have --

McCURDY: Uh-huh.

KRAFT: I'm not saying that they should have. I'm not criticizing them by the way, I'm just describing them.

McCURDY: Yeah.

KRAFT: As a matter of fact, I don't intend -- I don't want to criticize because there was another side of the coin. I mean, they did not provide that kind of training.

On the other side, their training of an individual as an engineer, as a technician, as a scientist was absolutely outstanding and is one of the biggest missing links in NASA today, in that they taught you every aspect of what you were involved with as an aeronautical research engineer which is what I was.

Now, what does that mean? Well, I had to do every part of the job. I had to write its requirements, I had to provide its instrumentation. If anything had to be built, I had to design it and I had to take it through the shops and assure that it was built properly. And I interfaced with the people in the shops.

I had to see it was properly installed in the airplane. I had to deal with the safety of the airplane. I had to deal with the mechanic of the airplane, the crew chief. I had to write the flight test. I had to assure that it was not going to destroy the vehicle I was playing with.

I had to interface with the pilots. I had to tell them what I wanted done. I had to reduce the data by hand. If there was any calculation to be done, I had to do it myself. If it was a hand computer, I did that; and eventually an electronic computer, I had to do that myself. And then I had to write the report. And then I had to defend it in a court of review.

And if there was any interface with the outside world in that airplane's build, in the way that airplane was built, or the way it flew, or the improvements that needed to be made, I was the interface with the outside world, with the people that built that airplane.

And there is no other place in history where that kind of training could be achieved. And as a result, when I got NASA, when we started the Space Task Group and I became a manager of people as well as a manager of contracts and a manager of -- and a doer as opposed to a thinker, there was nobody in the United States that could snow me. Nobody.

I don't care how good he was or how much smarter he was than I was, the training I had at NACA prepared me for dealing with that kind of situation. And believe me they all try to snow you.

So I say that the change in character of NACA into NASA, the NASA unwittingly, unknowingly let that part of NACA wither up and die. But that was a very, very significant aspect of NACA.

And that's you'll find that in -- one other thing that happened that would -- I'm a very, very strong believer in this. One other thing happened as time passed in NACA and that was a lot of great engineers and scientists recognized that about NACA, that virtue that I just described, and came and spent time at NACA with the express

purpose of learning and leaving. And in the '50's and '60's, even into the '70's, you will find NACA sprinkle like salt and pepper over the entire aerospace industry.

Leaders at all levels from top management, to research, to designer, to all aspects of engineering and research. And there was a -- you were encouraged -- I shouldn't say that.

You were not discouraged from a free interchange between the industry and the NACA. It was not uncommon for NACA people to go into industry. It was not uncommon for industry to come into NACA. And that also was another very strong character of the early days of NASA.

Also, because the leaders of NASA were NACA trained people they were -- if good managers, if good managers and some of them were not of course. And, you know, good managers are as hard to find as good thinkers and maybe sometimes harder because it is a harder job.

People don't like to deal with people. But you will find that NACA background was one of the strongest building blocks of that person's character and that person's ability to do the job. And there again is the reason that NASA is beginning to be a very different organization today than it was in the '70's and in particular the '60's, because the people today who are now in management in NASA do not have an NACA background.

McCURDY: When NASA was formed our of NACA in part, did you just acquire the people who had this training, or did the practice continue through the first few years? Did you have the same kind of practices then as --

KRAFT: No, no, no, no. Well, we expected that kind of training and we did try to carry it out in the Space Task Group, but unfortunately we were a part of the dismantlement of that virtue that I described because we were faced with an entirely different kind of set of goals and an entirely different environment.

We now had to build something. We now had to fly something that we built. We now had to interface with the contractual arrangements to get that done. We had to build an organization. We had to make things happen that we had not ever been associated with before.

So we were, all of us particularly in the early days of the Space Task Group, were faced with having to do not one job but ten everyday. We didn't have enough people to do what we were trying to do. We had to write specifications. We had to develop an RFP. We had to develop an organization to carry it out. We had to do detailed testing of hardware, all of which we had experience with, but had not had to manage either from a budgetary sense, a contractual sense, from an interface with other people that had to do it on your direction, etc., etc.

And that was an entirely new world for us to live in. And a lot of NACA people failed at that; a lot of NACA people did not. But it was a very different environment and therefore trying to maintain we did, many of us, and particularly myself and Max Faget to name two, did everything we could as we built our manpower up, our organizations up to provide that kind of cradle to grave teaching of how you do things, but it was very tough to do because of the demands of what we were attempting to do.

Now there still is a Langley Field and there still is a Lewis Laboratory in Cleveland, and there still is an Ames Laboratory, but they have also changed -- totally changed because they got enamored with this world of contracts.

And they do everything contractually these days. They've gotten so they don't have the same demands on their people that was there 40 years ago, 50 years ago because the world has changed -- the world of NASA has changed.NASA is a contract world. Are you a contractor? McCURDY: Yeah.

KRAFT: They do everything by contract.

McCURDY: They don't do histories in-house.

KRAFT: They don't do anything in-house anymore. They're trying to manage this world instead of doing this world. Now, I have to admit that I'm a very opinionated person on that subject, but I think it is, and I can't

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stress it too strongly, the missing fiber of NACA is no longer in NASA -- at any Center. Now, you wouldn't expect it to be particularly true at the Johnson Space Center, or at the Marshall Space Flight Center because they are development centers.

McCURDY: Uh-huh.

KRAFT: But even here we try. I tried when I was here and so did Gilruth, to embody that kind of character to our people. It's difficult to do in a development center, but we still tried.

The other aspect of it is the budgetary limitations of carrying it out are not provided. In order to get people to do the kind of thing, Gilruth would advocate -- you've got to have hands on capability and having hands on capability costs you maybe 10 percent of the budget you're spending. Maybe 5 percent.

And what I mean by that is, you know, if a guy is going to tell somebody how to build an APU, an auxiliary power unit that's going in a space craft, you can't do that by learning on paper.

You need an APU of your own. You need to build one. You need to work on one. You need to take it apart. You need to test it. You need to understand its idiosyncracies and its faults and it's virtues. And unless you have hands on hardware that doesn't happen.

So it's hard to provide in the budgetary limitations that NASA has. Nevertheless it is one of the things that ought to be done. By the way, I did something about six months that bears on this subject.

You know, being a retiree now and looking at NASA from the outside for five years and I've become very unhappy with what I see. And I say, well okay, Kraft, you're so goddamned smart what would you do if you had NASA to run, what would you try to do?

And I said, now you have to live with the constraints that NASA is living under. You have to live with the politics that they have to deal with everyday, and you've got to live with all the things that prohibit people from doing what they think is right, but because of this situation they can't.

Or because the damn thing is cast in concrete. It's already been done. There's nothing you can do to undo it. You've got to live with the fact that it's a bad set of management you have got on the space station, etc.

Now, if you're so damn smart, how would you go about fixing it? And I tried to write down all the things that I would do and one of the strongest things that came out of what I tried to write was to try to go back to this NACA type of thinking within NASA.

McCURDY: Did you --

KRAFT: But, it costs. I mean, it's going to cost money.

McCURDY: I've had people tell me that in the first few years of NASA, that for example the von Braun group retained some of its hands on capability.

KRAFT: Yes.

McCURDY: They built the first Saturn as I understand it?

KRAFT: Yes. But look, von Braun and Marshall Space Flight Center bear no relationship to NASA.

McCURDY: Hum.

KRAFT: They didn't have an NACA background. They had a German background. Man, that is like night and day.

McCURDY: Isn't it the same kind of hands on capability?

KRAFT: Yes, it is. But they're attitudes are different. They believe in covert operations. That's what they had to do in Germany to get their job done and that's what happens at Marshall Space Flight Center today. That's what caused the Challenger accident.

It's a very different atmosphere. You dare not quote me here, but I'll give you a statement which Bob Gilruth and I were having lunch at Langley Field about 1959 sometime and at that time -- I've got this in my speech, not

what I'm going to say here, but I refer to that situation.

The Germans were at Huntsville, Alabama. And, the Germans wanted to do their own space program. They didn't want any part of NASA. And when NASA was formed they were asked to become a part of NASA and they refused.

McCURDY: Hum.

KRAFT: Because they wanted to go it on their own. They wanted to do their own thing. They wanted to have their own space program. And when it became obvious that that wasn't going to happen, and the Army was told to stop working on the ICBM and to go to small rockets, then the people at the Alabama Missile Agency saw the handwriting on the wall -- the Germans did and they decided then they would become a part of NASA.

I'll tell you what Dr. Gilruth said about that. He said, in the discussion at lunch one day when we were talking about von Braun and him coming into the agency and into NASA and becoming a part of our space flight team, he said, "Well, you know von Braun, he doesn't give a shit what flag he fights for." That states it as simply as you can state it.

McCURDY: That's interesting.

KRAFT: Now, von Braun and his rocketeers from Germany get an awful lot of credit in the press and in the history for the backbone of the space program, and if you

want my opinion of that, it's bull shit. (LAUGHTER).

McCURDY: Of course, from our point of view, what we're looking at is reliability. He never lost a rocket on which he had a person. You know, they used to say they had 99.9 percent reliability. But, you folks had the same thing in Mercury and Gemini as well.

KRAFT: But that's a different -- see, that's because you don't know.

McCURDY: You mean you don't know what --

KRAFT: Look, the --

McCURDY: What didn't happen you mean?

KRAFT: No, no. The Red Stone and the Jupiter which was a derivative of the Red Stone was the world's simplest rocket and was reliable because they didn't modify it, they didn't change it, and they didn't go -- they stayed with advancements in the state of the art.

McCURDY: Uh-huh.

KRAFT: And, it would carry a projectile from Point A to Point B with half-assed accuracy, but it work every time. On the other hand, the Atlas was a metal balloon because it was built to carry a very big atomic bomb that weighed a great deal.

McCURDY: Yeah.

KRAFT: And, it had to have high performance. And so, when you built the Atlas, it had to be built on the

edge of the state of the art in structures, in electronics, in rocketry, in guidance, you name it.

Whereas, hell the Red Stone and Jupiter had a cam follower for Christ sake as a pitch control device. It had a small motor which was geared down which had a cam and a follower, and that was what pitched the damn vehicle over.

Whereas the Atlas had a gyro and all kinds of electronics interpretation and acceleration control, and etc., etc., etc. So the Red Stone was a very simple machine.

Now, how about the Saturn vehicle however? And without Bob Gilruth, the goddam thing would never have made flight. And without good old American engineering the engines would of never worked, and the structure would have failed, and the IU was built by IBM, etc., etc., etc.

So, you know, the fact that the Germans built reliable hardware is not true. I mean, go back and look at the goddam V-2. How many of those worked? And when they came over to this country how many V-2's worked? And let me tell you something, the first goddam Red Stone that we had on the pad, shut itself down on the pad.

McCURDY: Uh-huh.

KRAFT: And the German rocketeer who was their chief goddamn launch guy wanted to shoot it down with a rifle.

McCURDY: Shoot it?

KRAFT: Yeah, because he wanted to de-pressurize the tanks and he couldn't think of any better way to do it, so he wanted to go out and shoot it with a 30/30 rifle and put a hole in the goddam thing.

McCURDY: That would have been interesting.

KRAFT: Or the second one we flew shut down early and kicked the goddam monkey in the ass with 17 G because it fired off our escape rocket --

McCURDY: Yeah.

KRAFT: -- when we didn't want it fly -- to do it. Or the next one that didn't work either. So don't tell me about Red Stones and Jupiters.

McCURDY: Okay.

KRAFT: And German reliability because it ain't true. It was good old American engineers out of NACA --

McCURDY: Uh-huh.

KRAFT: -- that made those damn things work and fly well.

McCURDY: What was the attitude toward risks among the NACA people? I mean, you had worked with test pilots. You knew they took risks. Or what was the attitude toward failure for a young engineer? Were you allowed to fail?

KRAFT: Well you didn't learn except by failure.

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Now, you didn't set out to kill people and you didn't ever fly a machine in a flight regime where you didn't have a reasonably good understanding of what the flight characteristics were going to be, or the environment that you were going to fly in.

But, and this is a very callous statement, we out of the flight test business were acquainted with death. And we chose astronauts as test pilots very deliberately, and that deliberance was that these men were used to putting their lives on the line every time they flew.

That was a characteristic we had to have because anybody that gets on the end of a flaming rocket and doesn't recognize the risks and dangers associated with it, does not understand the problem.

Now, so we were well aware of the risks we were talking. On the other hand, and I emphasize this very, very carefully, we would never fly a manned vehicle if we knew something was wrong with it until we fixed it. That isn't to say that there weren't some unknown unknowns. That isn't to say that we didn't recognize the risks involved in the operation every damn time we went to the pad. And I think that recognition of risk is what made us as good as we were.

We did have a fear of it, but we had fear through respect, not fear through management.

McCURDY: Do you think the agency lost any of

that as it moved into the Shuttle era and beyond.

KRAFT: Sure it did. I mean, how could you have the Challenger atmosphere and environment without having lost that?

McCURDY: You mentioned fear through respect versus fear through management.

KRAFT: Yeah. What I'm saying is that we had a respect for the hardware, the machine, and the people we were dealing with. And, we did not try to scare our people to death by managing them to death, or by management fear. We believed in loyalty down and loyalty up in our management.

McCURDY: Could you explain a little bit more about what you mean by management fear? You mean fear of being managed, or are you trying to --

KRAFT: No, fear that if the management didn't like what we were doing, or what we were saying, or the way we were carrying out that we were going to get our ass chewed up one side and down the other, and that we were a bunch of dumb asses and that wasn't the right way to do it.

And, that's the way Mr. Beggs managed NASA. I didn't say that was wrong, right, or indifferent, I just didn't like it. And there are all kinds of ways to manage. He was from the Harvard School of Management. He believed in Machiavellian management, and he did not believe in

management by respect.

See, the other thing that we developed as a management criteria in the organization that I managed, and I don't know how I came about it. I wasn't taught any management precepts.

So, I don't know how I and my staff of good people came up with this kind of management, but we believed in telling it like it was. We believed if you made a mistake you explained why you did what you did and gained experience and knowledge and know how, and not making that mistake again. But others learned from your mistakes.

And after every simulation -- you will go out there today and find that they have a de-briefing. And you go to every position and every man says what he did, why he did it, and the mistakes he thinks he made and then the guy that's in charge tells him the other mistakes he made and it's spread in front of everybody. Everybody including the guy who ran the damn thing.

McCURDY: Uh-huh.

KRAFT: He ends up debriefing and says what he did right and what he did wrong. And everybody bears their sole. Now, that became a management environment within the Johnson Space Center.

Gilruth tried to bring about the same thing I suppose, because I don't know who else I learned it from.

And we had the kind of management where people were expected to say what they thought whether they were right or wrong, and to have it out. To get it out on the table and say here it is.

But, when we all decided that we were going to go do it this way, everybody had his say and then we went and did it that way. Might not of suited Max Faget, or Chris Kraft, or whoever else, because anything in engineering is a compromise, and anybody that doesn't recognize that is crazy. I mean, there is no system built that is perfect, it is a set of compromises.

McCURDY: When do you think that -- let me turn this thing over.

KRAFT: I think that that management style has not disappeared from NASA. I think it still exists in various corners of NASA, particularly in the flight operations organization here under Kranz.

I think Aaron Cohen is trying to do his best to keep that kind of an environment at the Johnson Space Center, but what happens under those circumstances is, is that kind of attitude gets misinterpreted as arrogance. It gets misinterpreted as a know-it-all.

It gets misinterpreted as these guys think there's nobody else in the world that can do things as well as they do, because they don't understand how this

organization grew and how it got its birthright. But, I think that that is one of the strong assets of this particular organization, as opposed to Marshall where they had the background of the German covertness.

Now again, I'm not -- Max Faget and I didn't choose to criticize the Marshall Space Flight Center for that kind of attitude. We recognized it, we dealt with it, and we knew how to live with their kind of world as opposed to our kind of world.

I mean, what happened with the seals is it's inconceivable to me that that could have happened at the Johnson Space Center. Now, in truth it did, because in truth the Johnson Space Center was responsible for the overall management of the program.

McCURDY: Yeah.

KRAFT: So they have to accept the responsibility for it. But I think it was a -- again, I go back to this management by fear that developed this environment that allowed those kinds of things to happen. I coined a word for an interview I had with the people after the Challenger. I call it discommunication.

McCURDY: Uh-huh.

KRAFT: People start to clam up. They don't want to be told that they're dumb asses. They don't want to be told to shut up and do things the way I tell you to do it.

They want to be able to express themselves and so that causes people to go underground. And after a while it's going to get to you.

McCURDY: Some people suggested that part of the problem with the Challenger was that the missions were too frequent, that during the '60's you had discreet operations, and during the Shuttle era you were beginning -- and especially now Space Station to become more continuous in your operation.

KRAFT: That says that there was a development of a -- what kind of attitude do you call it?

McCURDY: Well, operations became more routine.

KRAFT: No. Callous, but -- what's the synonym for callous. I can't come up with the word. I need my Roget.

McCURDY: (LAUGHTER).

KRAFT: At any rate, what i'm trying to say is that I don't agree with that premise. I'll give you a simple-assed statement, probably too simple. But, if you want a job done you give it to the busy guy. You never give it to the guy that's not doing anything.

And I believe that as long as people are busy that they're thinking their best, they're working their best, and they're going to do their best job. And I don't cotton to the idea that we were being pressed too hard, or

that we were flying too often, or that the astronauts weren't trained properly, or etc., etc., etc. I don't go for that argument. That may have had a smaller part to play in it, but I don't go for that argument.

I think it was a cancer. I think it had been growing within NASA for a long time and cancers are just like any -- cancers in management are just like they are in the body, they are eventually going to kill you. And, it's going to happen to them again.

I mean, you don't provide the kind of management environment that's happening within NASA today and not expect that those kind of things are going to happen to you. I mean, just plain -- the fallacies of man are going to catch up with you and sometimes it's because of management, and sometimes it's because you're dumb, and sometimes it because you don't know.

And so, it's inevitable that because of human beings things are going to happen. I don't know why it's going to change it's been that way in all the 40 years that I've been working and I can give you 100 examples of it.

I mean, I can tell you why Herb Hoover was killed in a B-45 at NACA in the early '50's. It wasn't anything wrong with the goddam airplane, it's because he flew it wrong. Now, the guy that wrote the flight request put him in that maneuver and he didn't know either. But, he didn't

do it deliberately, and he gave him the maneuver to do, not recognizing that it was a problem in flying the airplane, but Herb Hoover had the goddam flight manual and it was written in bold red letters if you do this, this is going to happen. And he went up and did it anyway. Now why, because it's the fallacies of man. So those kind of things are going to happen.

On the other hand, the Challenger accident, in my opinion, is inexcusable in the world we live in. I mean, you just don't let those kind of things happen when you know something is sitting there is going to bite your ass, unless you know what it's spots are, what it's character is, and know how to utilize -- how to get in the den with that rattlesnake.

You know, you could go fly this same machine that blew up in January of 1986. You could fly it again and it would fly satisfactory, successfully, if you treat it properly.

McCURDY: Do you have the sense that NASA has solved this problem for the Space Station era in the way that it's organized the Space Station?

KRAFT: No. It's not only not solved it, it has made it infinitely worse because there is nobody in charge. All they have done is spread it around and try to come up with a fix, a patch on the tire, by putting the management

at headquarters under -- and in my opinion, it created another Center up at Reston.

But god almighty, anybody that would think that that management scheme is a good one is crazy. On the other hand, not many of NASA's management schemes have been good in the first place.

We made them work in spite of the organization schemes, not because of them. You know, you get back to your treatise here. You go back and look at the management of Apollo. That was a lousy goddam management scheme, but it worked because people like Gilruth, and Lowe, and Kraft, and Phillips and others recognized the damn limitations of that management system and did it in spite of the management scheme not because of it. Because they recognized the spots on the tiger.

McCURDY: Do you think that NASA is still attracting capable people to the agency? High quality people?

KRAFT: Yes.

McCURDY: I'm not talking about the training of them.

KRAFT: Yes.

McCURDY: I'm just saying, are you getting them in the door?

KRAFT: Less and less everyday because I think

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that NASA is no longer -- particularly since the Challenger accident -- NASA no longer has the drawing power that it had in the '60's and the early '70's as a result of the Apollo and the thought that NASA was in the forefront of the technology and w the place to go.

It isn't that way anymore, because it isn't. I mean, hell let's recognize it. What we did in the '60's was developed, a whole new world of technology and we consumed it in the '70's and put nothing back.

The Shuttle didn't have any new technology to speak off. I don't mean that literally. We had to develop a new heat shield. We had to come up with a new engine. We had to fly a mach 25 airplane. But, compared to the technology developed for Apollo, it bore no resemblance.

McCURDY: What about the Space Station?

KRAFT: The Space Station should not be built with new technology.

McCURDY: Yeah.

KRAFT: You know, now that's a rather strange statement. But what we ought to do is build the best laboratory we can build in space and in order to develop technology in space. You see, it's just like war. War used to be -- and it will be again with SDI. But, in the early years, it was war that drove technology.

McCURDY: Uh-huh.

KRAFT: In the '50's, '60's, and early '70's it was space that drove technology, okay? In the '40's and '50's it was the nuclear world that drove technology.

Now, going into space is what drove technology. It was the technology required to get there. Today there is no new technology required to get there in the Space Station. What we need to do is develop technology after you get there.

McCURDY: Uh-huh.

KRAFT: That's where the technology is going to come from.

McCURDY: Are there any missions you're supporting that would create that kind of driving technology?

KRAFT: No.

McCURDY: (LAUGHTER).

KRAFT: No, I'm not in that business anymore. I'm a consultant. I'm a retiree. I'm on the board of directors of four major companies in Houston.

McCURDY: Uh-huh.

KRAFT: I don't do that kind of thing. And, I'm writing a speech for the National Geographic which is a pain in the ass and I wish I hadn't done it.

McCURDY: (LAUGHTER). It's quicker -- easier to agree to do it than it is to write it.

KRAFT: Yeah, and I've been smart enough not agree to make any speeches since I -- I've made one or two. But since I left NASA, I used to make a speech a day practically. And I said, I'm not going to that anymore.

But, you know, hell look, I've made this point in speeches both here and everywhere, but particularly at Johnson Space Center. New ideas, new capabilities, new ways of doing things all come from the young. They don't come from old farts like me.

What you get out of people like me is experience. And so what you need to do is, is you have to have a proper chemistry -- the mixture of the new ingredient has to be a proper mixture of the young, and the old, and the middle management.

You've got to have that thing mixed up properly in order to get the proper ingredients that produce good things. Hell, that's no revelation is it. I mean, anybody that's studied people -- any university you go to will tell you after a guy reaches age 40 you might as well throw him away if you think he's going to make any new inventions, because he's not. He doesn't think that way anymore. All the doors start to close.

Remember that sermon that the preacher gave where he said, "When you're a young man you start walking down this hall and all the doors are open. You can go in any one

of them you want to, or come out of any one you want to, but after a while all those doors start to close."

The first thing you know, you start walking down that hall and the doors are all closed. That's what happens to the brain. Now, you know why all the doors closed and you know all this experience that you've gained, and you develop all these fears of not wanting to do this because you're afraid to do that, you've been there. And that will happen.

And you're afraid to do this, that will happen. So, I don't want to do that. So first thing you know, you don't want to do a goddam thing. The young guy doesn't know that. He says, I'll go do that. You name it, I'll do it. He doesn't know that the damn road is paved with all kinds of trouble, and politics, and money, and failures, and all that sort of thing. He can run down that damn road like crazy.

But, the guy who has been down there can sure help guide him around the shoals, and the pitfalls, and the bad places. So, you've got to have the right mixture.

McCURDY: It's surprising how young people were who ran the space program in the early '60's.

KRAFT: Do you know what the age of my organization was in 1969 when we flew to the moon? 26.

McCURDY: (INAUDIBLE).

KRAFT: The operations organization at the Manned Space Flight Center in 1969's average age was 26.

McCURDY: In 1969?

KRAFT: In 1969.

McCURDY: That (INAUDIBLE).

KRAFT: My organization was 26 years average age.

McCURDY: Sort of like a military operation in some ways when you think of the average age of the pilots flying over Germany in World War (INAUDIBLE) was down in the 20's.

KRAFT: Yes.

McCURDY: When somebody was 30, they made a general, or at least a colonel.

KRAFT: Yeah.

McCURDY: It's (INAUDIBLE). Let me ask a question about budget if I can. We're going to run out of time here, I'm sure, but it's said that during the 1960's, or at least the early part of the '60's you folks had just about all the money that you needed to run the programs. Is that true, or is that a myth?

KRAFT: That's a myth. I don't think that -- it is true that as we went through from '58 to '68 I'd say that cost was not a major factor in our thinking. Now, I have to explain that, in that we had so many unknowns, so many new

things to do, so many places that we had never been before, that we couldn't have told you what it was going to cost anyway. What we were doing were was giving you wags, which I assume you know what a wag is, a wild ass guess.

McCURDY: (LAUGHTER).

KRAFT: And we tried to do that, but we didn't spend money to be spending money. We spent money to get the job done. We did submit budgets.

We were limited in the amount of monies that we had, but I don't think it was a driving factor in either the mind of the engineer or the mind of the budgeteer. I think that's true. But I don't think that we had in mind that we had all the money we wanted. I just don't think that came up in our minds.

McCURDY: Uh-huh.

KRAFT: Okay? So there was that aspect of it. As opposed to in the Shuttle era, I often made speeches about that -- I thought the hardest thing we were going to have to do at the Johnson Space Center was turn people's minds around to thinking cost first, good engineering second, but only second in terms of dollars, not second in terms of getting the job done if that makes sense to you.

McCURDY: Yeah.

KRAFT: I mean, I don't think we -- it's said that we short changed ourselves in the Shuttle, but that's

untrue. We just let the schedule move. The rubber band in the Shuttle was the schedule.

McCURDY: Uh-huh.

KRAFT: If we couldn't get it done for the dollars we had, we just slipped the schedule. We didn't want to do that but cost was paramount in every goddam engineer's design that worked on the Shuttle, because we made it so. We wanted it to be so.

We knew now where we were going. We had the experience of the past. We could afford to not develop this thing and take the risk of avoiding this series of development tests and 90 percent of the time be right. And the 10 percent we were wrong, we had to go back and fix it, and we did. Tiles as the perfect example, and it delayed the program.

McCURDY: Uh-huh.

KRAFT: But we accepted that way of doing business as opposed to the Apollo way of doing business which was not spend all the money you can get. But we don't know and so we're going to have to do a lot of different things in order to get -- we're going to have to go a lot of different ways because this way may not work and we didn't want to take the risk of delaying the schedule.

Hell, when President Kennedy said we were going to go to the moon by the end of this decade, most of us in

the Space Task Group thought the guy was daft.

McCURDY: (LAUGHTER).

KRAFT: I mean, we didn't think we could do it. We didn't refuse to accept the challenge. Thank god. But, god, we didn't know how to do orbit determination much less project orbits to the moon.

So, the environment was entirely different because we didn't know where we were going. We couldn't chart the course. Now that isn't literally true, but I mean, there were too many -- there were a whole flock of unknowns.

Too many things that we had to explore to find out how to do things. You know, I can ask you today, you sitting right there -- and I tell you in the world we live in it's a dumb question, but how do you get liquid out of a tank at Zero G? You can't tell me because you're not an engineer and you haven't had the experience of it.

McCURDY: No.

KRAFT: You know, everybody said, "Oh what's so hard about that? You can pressurize it." Pressurize it my ass. The pressure exerts on everything and the damn liquid is just floating around. It's liable to be in globs someplace in the tank and you don't even know where it is in the tank. You don't even know how much you got left in the tank.

McCURDY: Yeah.

KRAFT: But that's -- hell, I mean, that's a fundamental now of Zero G. And everybody knows that you've got to put a bladder in there, or you've got to use capillary action to suck it out of there, or some other technique. But, we didn't know that in 1958 and '59.

We didn't know what the condition of the lunar surface was. We didn't know what the radiation was going to be between here and the moon. We had never heard of a fuel cell in 1960 and '61.

I mean, in terms of, you know, what the development problems were and whether it could be used, and how much power we could get out of it, and what kind of fuels we were going to use, and could we build a membrane, and what we were going to do with the water and you know, god, on and on and on.

But, when we got to Shuttle we decided we were not going to utilize the state of the art and only do those things that we had to do to get the damn thing to fly. And so we consumed, I keep repeating that, we consumed the technology that we developed in the '60's and the '70's, and we didn't pay the price. We didn't pay the tax to development the technology in the '70's that would allow us to build the Space Station in the '80's.

McCURDY: Why did that happen? I mean, let me

ask you two --

KRAFT: Because we were pressed for money and the management wouldn't let us spend the damn money on it.

McCURDY: Let me ask you a money question in two parts. First, do you think that the public still loves the Space Program?

KRAFT: Yes, I do. But, I don't think they think it's as exotic as it was before and I don't think they think that it's as unique. And I don't think that they believe that it is as much a requirement of the country's investment as it was before and that's because we, NASA, dropped the ball.

We didn't continue to drive like we should have driven. We should have been -- even though we may not have gotten everything we asked for, we should have been going forward and having good, consistent, solid leadership and goal setting, and continuous prodding of the administration as opposed to withdrawing and accepting our lot.

McCURDY: Where do you think you turned the corner on that?

KRAFT: In about 1975/76.

McCURDY: I mean, look --

KRAFT: When you lost the people like Tom Payne.

McCURDY: Uh-huh.

KRAFT: We didn't get any more back after that.

Fletcher came in and Fletcher's not that kind of guy. He accepted what he had in NASA. George Lowe was, but he began to retrench. Even he began to retrench, recognizing the demands on the budget and so he was trying to compromise that position. I was getting older.

McCURDY: I wasn't going to say that. (LAUGHTER).

KRAFT: All right, you know, it's a shame. But, I don't think you can blame any one particular set of NASA management. I think it just happened because it started to happen. And when those things -- you start deteriorating. And the weaker NASA got, the weaker leaders we got.

McCURDY: Uh-huh.

KRAFT: People didn't want to give up their world to come into NASA. It sort of was a cascading thing.

McCURDY: Okay. Have I asked all the questions?

KRAFT: I don't know.

McCURDY: (LAUGHTER). Again, I'm trying to capture a picture of the NASA culture. Is there anything that I have missed? I have five pages of questions here and I have asked all of them.

KRAFT: I don't know. NASA has been a wonderful organization, but I think it is going the way of all other organizations. It's maturing. It's becoming extremely

bureaucratic and has all these crazy new policies which are all -- cause bureaucracy to build on bureaucracy.

And how you get away from that is extremely difficult and the only good way is to throw it in the trash can and start over again. And, that's what has happened in history. If you are a historian that's the way it is.

McCURDY: Strangely enough.

KRAFT: Strangely enough that's the way it is. And all of us -- I shouldn't say all of us, but many of us here at the Johnson Space Center recognized that a long time ago. And again, I made speeches about it.

I used to -- my personnel guy, I'd get him in and say, "Look, I don't know what makes this damn thing go that we've got here that makes us so good and so great, and our capability to inspire people. But I'll tell you this, if we ever lose it I won't know how to tell you to regain it."

McCURDY: Uh-huh.

KRAFT: "So what you and I have to do is make sure that we don't lose it." Because it's just one of those tenuous things that when you have got it, you have got it, and after you have lost it, it's extremely difficult to get it back. Ask the New York Giants.

McCURDY: (LAUGHTER). What did they do on Sunday?

KRAFT: They won without Sims.

McCURDY: Yeah, it is sort of fascinating that as the budget drop, you would think that you would have more people working on the core functions of the agency, like space operations. That would be the last thing we would cut back.

KRAFT: No, because we have changed it into a contractual organization and we've got all these mouths to feed. All these things that feed on this is there. And we've gone from the idea that you do it with the people you have got. Too, you do it with the industry that you have. Now that's not all bad, but you have to make a balance there.

McCURDY: Well this has been absolutely fascinating. I really appreciate you taking the time to come in here and do this.

KRAFT: Just remember, you have to take what I say with a grain of salt, because I am a very strong -- I have very strong and somewhat crazy ideas about this agency. But, I believe in them.

McCURDY: Well, I'm interviewing people that you worked with. I went down to Kilmarnac and interviewed your old boss.

KRAFT: Yeah.

McCURDY: And I must admit a definite pattern is emerging in all of this.

KRAFT: Yes. Well hell, if you don't get that from Gilruth, I'd be a liar wouldn't I.

McCURDY: (LAUGHTER).

KRAFT: (LAUGHTER). I mean, hell I'm a student of Gilruth's.

McCURDY: Yeah. So thank you very much.

KRAFT: Your welcome.