INTERVIEW WITH CHRISTOPHER C. KRAFT
INTERVIEWED BY ANDREW DUNAR AND STEPHEN WARING
JUNE 28, 1991
WEBSTER/HOUSTON, TEXAS

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2. DUNAR: On the way down the hall you were mentioning about some of the problems of coordination in Spacelab. I wonder if you could maybe elaborate on that a little bit.

3. KRAFT: Marshall was given responsibility in the U.S. for coordinating all the U.S. efforts in this country relative to the use of the Spacelab and possibilities of interfaces with the principal investigators and the experimenters. They had to manage the program through ESA which was the European Space Agency which is really not a NASA. It's just a group of people that are responsible in Europe for pulling together the efforts of the European countries. At that time ESA was made up of ten countries and as you have found out each country that had X percent invested in Spacelab had to have that much business to put into the Spacelab. As a result you had MBB I believe it was, building the Spacelab primarily in Germany because they had the most percentage I believe. Then you had this engineering "organization" in ESA that was trying to manage that on top of them and trying to figure out what each country could do with their percentage of the hardware and the contract therefore. Contracts were made for trying to get something done, a long lengthy process very much like the Space Station is in this country today. Luther

Powell was as I recall the gentleman who spent an inordinate amount of time in Europe trying to oversee and bring that tough coordination job about. As operators, we at JSC were going to be operators for that machine, and Marshall was going to be the flight control effort for Spacelab and still is. It just was sort of a long arduous task to get anything done through that kind of a management change. You know what the arrangement was. They were going to build two, and they were going to give one to the United States for their own use, and then one they would do in cooperation with the United States. They were supposed to fly it on the order of once about every six months. In the shuttle and I don't know how many times that we've flown it since we've been flying the shuttle. Maybe three times in that whole length of period? It's some small number. I think the whole thing has resulted in a big disappointment for the Europeans and has sort of soured their look on the cooperation with the U. S. Space Program and certainly Space Station has done nothing to lay those fears or doubts. They're smart enough in the case of the Space Station to be building the Columbia part of their station to be a free-flyer eventually and be able to do its own thing and to build their Hermes to be a transport to and from that free flyer. I think they got wiser in that regard. I think that's the problem that you always have in trying to do things in cooperation with other countries. It sounds like it ought to be something easy to do, but it's very difficult to do. Flying with the Russians was extremely difficult. We had to become obnoxious with those people before we could get them to realize that there's a detailed coordination that's required almost on a daily basis. It should be on a daily basis if you're going to make the thing happen in any kind of a safe and useful way. I think it's a lesson in how to try and go about doing those kinds of programs.

4. WARING: Why did NASA decide to go to the Europeans to develop Spacelab?

5. KRAFT: Because the Europeans offered it. It was an investment that they wanted to make in the shuttle and to participate in the shuttle activities and they made the proposal that Spacelab be built and then U. S. accepted that as a means of international cooperation as well as a means of getting a space laboratory that could be used in the shuttle program as a lead to a space station in the future. Idealistically, it was a very good deal for both countries, I mean both sides of the Atlantic.

6. DUNAR: Was that a political decision to go with them, or was it made by NASA independent of people?

7. KRAFT: I think it was a little bit of both, but in that case I think NASA really made the decision and had it accepted by the administration at the time. It was probably the Carter administration if I recall. I think it was the Carter administration and may have been before that.

8. WARING: Why was Marshall chosen . . . .

9. KRAFT: Probably was before that. Beg your pardon?

10. WARING: Why was Marshall chosen as the lead center for Spacelab?

11. KRAFT: Well, I think that they . . . for a number of reasons. Number 1, they did the Skylab; number 2, they needed the work; they needed, JSC was sort of full up with managing the shuttle, and it was sort of a natural evolution. One which I thought was rational and reasonable at the time.

12. WARING: In reading about Spacelab, it seems that there was a great deal less conflict between Houston and Marshall than there had been on the Skylab program.

13. KRAFT: I think they would expect that because I think that they had gained a working relationship in Skylab that worked out fine. There was not reason why it shouldn't be expected to work out okay in Spacelab. I think there wasn't a more amiable transfer of knowledge, experience, etc. that brought the two together in trying to building a Spacelab that would be functional. The pointing system was another example of bad management and bad engineering. I shouldn't say bad management because that's probably the wrong choice of words. It was difficult management. It took a long while before that pointing system worked and as you well know the last time they used it several months ago the damn thing didn't work.

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14. DUNAR: Why do you see that as a management problem rather than an engineering problem?

15. KRAFT: Well, I'm trying to get people's ideas and experience level and knowledge of what's going to take place in space and knowledge of what's needed and knowledge of engineering systems. You've got people that don't know and are trying to learn which were the Europeans and people who do know and trying to be probably antagonistic or whatever you want to call it in trying to get their views expressed. The difference in cultures between the U. S. and Europeans anyway because we tend to say it like it is, and they tend to make it [?100]. When you get those things going, it's very difficult to get the guy that really has the responsibility for building it to listen to these people who think they know what they're talking about and they don't believe it. You get acceptance from some of the things you say, they tell you other things, and it's difficult for them to do it, or they have their own reasons for wanting to keep it as it is. It's all those kinds of things. It's the thermal problems, the environmental problems that you face with in space that people have to learn to design to, and it's not easy that those things are true. Things get hot when you expect

them to be cold and vice versa. Things don't work in a vacuum like they do on the earth. The oils and greases and things like that are different. All those things make for tough engineering problems that people with inexperience don't want to listen to because they don't believe them. Even if they did, getting somebody on our side to express it so they would or even getting them the information becomes an arduous task. That long management chain, anytime you're trying to build something, particularly when you're trying to build it on some reasonable schedule, you're going to have trouble. It's just the wrong way to do anything. That's what's wrong with the Space Station. You can't have that many people in the damn act and expect that it's going to be done efficiently particularly with regard to time. It ends up being sort of a debacle of sorts. You can't expect it to come out much better. You've got to have a clear definition of what people's responsibilities are and let them do the job. If you don't do that, I don't give a damn if you've got an organization of ten or 10,000, if that isn't done you aren't going to get there, or when you get there it's going to be not what you really wanted or not as useful as it could have been and a hell of a lot more expensive.

16. WARING: Given those difficult circumstances, how would you assess Marshall's management of . . . ?

17. KRAFT: Of the Spacelab? I thought they did about as good a job as anybody could do, and I was damn glad I didn't have it.

18. DUNAR: Concerning management in general, we're looking at the shuttle and then Spacelab you mentioned before. We're wondering about the, I've seen some of the memos you wrote at the time arguing for Houston as the lead center on the shuttle. I wonder if you could just, was there, we've seen your side in other words we really haven't seen the Marshall side yet and haven't been able to find memos that argue for their point. Was

there a struggle between the two for the position of lead center? I know there was clearly some political yanking going on.

19. KRAFT: I don't. I think that Marshall recognized that there needed to be some central organization to manage the shuttle, but they wanted it done at Headquarters rather than done at JSC. I think that, I don't, I think that's sort of a natural reaction from any organization that are supposed to be of equal rank. When you have two centers that are as competitive and as strong as both Marshall and JSC are, you would expect that neither one would want to be directed by the other. I suspect that was the reason why Marshall didn't want to do it. Didn't want to have JSC, and we tried to set the organization up even before we made the decision to show them that there was going to be an organization separate from JSC, at JSC, doing the decision making. I think post facto they were satisfied with that, but in the initial discussions of that matter, what's his name, the director then was . . . .

20. WARING: Rees.

21. KRAFT: Rees, Eberhard Rees, whom by the way I was very close personally, considered him a personal friend and I think he considered me a personal friend. He was livid about it. He just wouldn't have it, and he had to be directed to do it. I remember having a meeting in my office where he was when we made that decision, Dale Myers made the decision. Rees was extremely upset about it.

22. DUNAR: So an attempt to bring center's farther to ....[159]

23. KRAFT: Marshall always went to...they did then and they do today, they always try to get the politics involved in the damn thing, which is, I think, a very serious mistake that Marshall has made from the early days. I think that they have tried to play the political

element of the thing and I think that has had a very strong affect on the way in which NASA today has to make it decisions. It has become...not only...I mean I don't believe that Marshall is totally responsible for that, but I think that politics gets into this thing when technical decisions are better made without it. That is unfortunate. It is one of the things, I think, that is held against Marshall, because they do play a political game so damn strongly. It forces JSC to counter. So it gets into...I didn't do that when I was there. A lot of people thought I did, but I did not. I let the damn water seek its own level. Today, the Texas delegation is as equally as strong if not stronger than the Marshall, than the Alabama delegation, and so it brings a whole of politics into this thing that ought not be there. But on top of that this partisan politics involved so that just exacerbate the problem.

24. WARING: Do you think that that sort of politicking becomes more prevalent as budgets do become tighter? Marshall during the early seventies was struggling to survive.

25. KRAFT: Inevitably so, yes. I think that they probably knew that the study was made in the mid-seventies where NASA thought that they ought to close the Marshall Space Flight Center. I am sure that was very upsetting to them. We should have closed it. It would have been better for NASA and better for the nation had we closed not only Marshall, but several other centers. We had too many. Inevitably, if you want my forecast for the future, I don't think there will be a NASA. Ten years from now there is a path not to be a NASA, not as we know it. I don't think that they will be running the nation's space program.

26. DUNAR: It will be strictly a private industry?

27. KRAFT: No, I think that it will be some other government agency. Something will get created to run the space program because I don't think NASA can anymore.

28. DUNAR: What is the flaw at NASA today that is the major trouble?

29. KRAFT: It has become the same bureaucratic agency that any other agency in age does in the government in space. It is too big, it is too inefficient, it has lost its management capability, its nerve. It has got people managing NASA now that don't know what they are doing. Starting at the top.

30. DUNAR: What could be done...is the problem because of the revolving door with industry?

31. KRAFT: No, as a matter of fact, that is the opposite. You need that revolving door. It was very helpful to NASA to have that revolving door, so the prevention of it is lousy. It keeps good people from coming in and out of NASA. One of the strengths of industry and NASA was that there was a free-flow of people between the two organizations. Twenty years ago, if you had gone to any major airplane company in this country, you would have found NASA people in the top management...NACA/NASA people in the top management. It is hard to come by today in finding either one. Although Yardley just retired, but in Boeing and Lockheed and major organization you would have found NACA/NASA people because that encouraged, not discouraged. Today it is discouraged. I realize that at my age I am becoming cynical in that regard, but all I can do is look at history. History says that NASA ain't going to be here anymore. I see no record within NASA to rectify those problems.

32. DUNAR: The problem then, is a management problem?

33. KRAFT: Yes. It is a management problem...and a political problem now because they can't do the management things that they want to do, because the politics would prevent it.

Dr. Seamans wrote a letter to the NASA alumni league...he didn't write a letter, the NASA alumni letter to its people, had a two or three page article that condensed Seaman's letter to the auditing committee. I could not have written it any better or said it any differently. Go read it, it is perfect. It tells you what the ills of the agency are in black and white.

34. DUNAR: Did you agree with the findings of the auditing committee?

35. KRAFT: No, they didn't have any guts. I told them so, also, by the way. I wrote a letter to the auditing committee. They asked me to have an interview, a hearing with them, twice they called me and I couldn't make the dates. But I did write them a letter and then I wrote them another letter. I even wrote the President a letter, which I never mailed, because I was so upset about it. They didn't face the problem head on. Nobody is able to do that, I suppose, in this political environment that we are living in. That is the trouble with NASA, they can't do...even if they had the will to do it, which I don't believe they do...even if they had the will to do it, I don't think there is...apparently there isn't a process through which that can be rectified. I am not just saying that, let me give you an example; the space shuttle at Cape Canaveral is operated by somewhere between 20 and 25 thousand direct people. Direct, not indirect, I am talking about direct. I don't know how many indirects there are, probably an equal number. There is on the contract side, eight major contractors. Nobody is in charge. Nobody. When you have eight major contractors and probably 20 minor ones and nobody on that side of the program is in charge, the incentive is not there to decrease the numbers of people required to do the job or improve the efficiently. The incentive is to do exactly the opposite because the only way the companies can make money under those circumstances is to put more people on the job. So they do. So NASA allows it. On the other side you have NASA trying to manage it. KSC is notoriously poor at managing that sort of thing. The management on top of them, Bruster Shaw, Bob Griffin, Bill Lenoir and Dick Truly, all astronauts, who know not a

goddamn thing about management have no experience at it, don't even know what you are talking about when you tell them what their problems are and I have told them in writing what their problems are and many, many others have. Dr. Seamans' has and I am sure many others. The Augustine Group refused to dabble in that subject because they said that is not our job. I know that they discussed it ad naseum, but they just didn't have the guts enough to say it. They probably have in the neighborhood two times the number of people required to do that job. It may even be less. Not only is that poor management, it is unsafe. It is much less safe to fly that machine under that management scheme, and I think that the experience proved it. You can't tell me that a good system allows a goddamn seventeen foot yellow-painted beam to be left in the back end of the orbiter, when it goes to the goddamn pad. I can't believe that. That is only one example, I could give you dozens.

36. WARING: When did those problems begin to develop?

37. KRAFT: I don't think that you could put a mark in the sand. I would say that it started in the mid-seventies and it has been struggling ever since.

38. DUNAR: Looking at Marshall's perspective, that was a time when there was great turmoil at Marshall in terms of retrenchment, budget cutting and everything. Was that a product of that environment at that time?

39. KRAFT: I think that that was the embryo. Things can be fixed. I don't think that NASA has had the management leadership that was willing to recognize the problem. Beggs recognized the problem, but he didn't know how to do it. He didn't know how to cope with it, he didn't know how to deal with NASA. He was so goddamn bull-headed to

listening to those of us that tried to teach him and help him and unfortunately he had a Hans Mark working with him also.

But NASA has not had good management since the early seventies. Since George Low left NASA, their management has been suspect at all levels.

40. DUNAR: Some political appointments to...

41. KRAFT: That is what I mean, I am talking about the top-level people.

42. DUNAR: Coming back to talking about the lead center and the shuttle, at the time that that decision was made, there was a memo that we have seen that Dale Myer's wrote that gave some indication that there might have been a quid pro quo that since JSC became a lead center for the shuttle, that Marshall would get other projects. Some that were mentioned were Space Station, HEAO, in particular I think the space telescope was referred to. Were there any bargaining over that sort of thing? It wasn't real explicit, but there certainly was an indication....

43. KRAFT: I don't think that there was any bargaining, no. I think that it was just a carrot that Dale felt like he had to do.

44. DUNAR: To appease Eberhard Rees?

45. KRAFT: Well, to appease whomever needed to be appeased. I think that...if you looked at the roles and missions of the centers as written in the early seventies, Marshall was not supposed to be in manned spaceflight. I mean that was not their charter, yet they wanted to be. Why not, they wanted to be in manned spaceflight, because that is where it is. But they were not...I mean manned spaceflight vehicles and those that supported

manned was supposed to be at the Johnson Space Center by charter. You can say, "Well who wrote the charter?" The fathers of NASA wrote the charter. Congress wrote the charter, but that didn't satisfy Marshall. I don't blame them. The unmanned program, the parts of the program...the engine development and so forth didn't satisfy their ego.

46. DUNAR: Was it the ego, or was it a matter of survival for the center? That is how they saw it that they had to do it in order to survive.

47. KRAFT: I don't think that you separate the two, can you?

48. WARING: Headquarters seems to have made a conscious decision upon JSC and Marshall both at pretty much the same level. You look at the funding at the beginning of the seventies...

49. KRAFT: Like two brothers. They always did it that way. They didn't have any guts to do it either to deal with management, either.

50. WARING: Was that something that was talked about?

51. KRAFT: Sure. All the time. That was almost a given. As an example, when they set up the lead center, they didn't give the money to the Johnson Center to run the program, those monies had to come from headquarters. Bob Thompson, who was the headquarters representative at JSC only recommended to headquarters what those monies could and should be. But the monies themselves were directly attached to headquarters and not attached to the Johnson Space Center. So Marshall never got their money through JSC. They got the money for their programs through headquarters. That was a ploy to satisfy their distrust in the system.

52. DUNAR: To satisfy headquarter's distrust?

53. KRAFT: No, Marshall's distrust.

54. WARING: If I am hearing you right, there was lots of money that was really being channeled through JSC, but the center budget...

55. KRAFT: Technically managed, but not controlled. That in management is unheard of.

56. DUNAR: Wasn't part of it the fact that headquarters was trying to exert more control over the centers?

57. KRAFT: Of course.

58. DUNAR: At the time that this was all taking place, I have again seen a couple of memos that you wrote arguing for a larger role at center level. Could you describe how that debate went on in the early seventies?

59. KRAFT: It went on even in the sixties. I think that George Mueller initiated that sort of thing and I think that George Mueller played the centers one against the other. I have a speech here that George Mueller sent me for comments. I haven't read it yet...he likes me now, he didn't like me then!

You know, human beings are human beings, it doesn't matter whether they are management or politicians, historians or anything else, you tend to have the same heady thoughts about how to do things at any level in management that I have ever experienced. People have a tendency to play one group against the other in order to do what they thing

brings about a better solution to problems. I never have cottoned to that idea, I think that you have to be precise about it and give people as clear responsibilities as you possibly can and then give them the wherewithal to do it. When you separate from that and start trying to do this thing of treating people like your children, which is what has happened over the last twenty-five years at NASA with regard to Marshall and JSC in particular, and even JSC for that matter, you get into these poor management schemes. You just get into this lack of decisiveness in making decisions. Irrespective of that, if you are going to do things efficiently, which in my opinion, if you are going to use the taxpayers money, you ought to do everything you can to do it as efficiently as you can, you cannot allow that kind of determination to take place in the world you live in. That has been done for twenty-five years. It has be perpetuated and after perpetuation for twenty five years, it becomes a way of life. It is almost impossible to turn it around. In my opinion, you can't fix it. That is the reason why I forecast that NASA ain't going to be there. Eventually, they are going to get overcome by their own top-heavy management scheme.

60. DUNAR: At that point, Marshall must have some ambivalence, on the one hand wanting more autonomy for the center, but on the other hand, feeling that it could gain leverage on JSC by supporting headquarters, I suppose. Does that sound right?

61. KRAFT: They always gave you the impression that they would do anything that headquarters would ask them to do. It was always suspect that that method lockturation [?407] because I think that it was just a ploy to get more on their plate.

I don't fault them for doing that. Had I been in their position, I probably would have done the same thing. I would hope not, but I probably would.

When you ask me those questions, all sorts of things go through my mind in meetings that I sat in relative to the wet workshop, relative to the free-flying telescope on a lunar module, all of which were dumb ideas, absolutely stupid ideas. It took five years to

get the goddamn thing rectified. Anybody that was making rational engineering technical judgments would never have done anything like that. It was done because of this, "well, we have got to give them part of it and them part of it." It was dumb. The goddamn space station is that in spades. So the next one that they get will probably going to be even worse. If you read that damn thing there...have you tried to read any of this? I had a little bit to do with this, the synthesis group? You know the thing that Stanford did? If you look in here, we talk about management...establish a national program office by executive order; appoint NASA as associate administrator of exploration as the program director of the national program office; establish a new acquisition strategy for the space exploration initiative; incorporate space exploration initiative requirements into the joint NASA/DOD heavy lift program. What we are trying to do is to take a shot at managing it.

62. WARING: One of the things that was relatively new about the space program in the seventies or at least changing degree was the increasing involvement of the Department of Defense in what NASA did. That showed up a lot with the shuttle...

63. KRAFT: That is because the shuttle was built to support both NASA and the DOD requirements. That was part of the agreement that was made in the approval of the program.

64. WARING: How did NASA feel and you feel about that?

65. KRAFT: I think that you would get a mixed reaction there. I think at the top level of management, both at JSC and at Headquarters, I don't think that we had any problem with that. When you got down to the next level people like Dr. Faget and others were very upset about that because they felt that we were being forced to build a machine which the Air Force was not going to use those capabilities and it was requiring very heavy design

requirements on a machine that was already too difficult to build anyway. As an example, cross-range. NASA didn't have any need for cross-range in the shuttle. All we needed was a couple of hundred miles just to make sure that you could get down in the right landing point. Whereas the Air Force wanted to go around the earth one time, fly over Moscow and land at the West Coast on the next rev and that required eleven hundred mile cross-range. At the top level, we said, "If that is what the nation needs, then that is what we require. So that is what we are going to build." Faget said, "You're nuts!" He was right but we built it. That is the reason we ended with up with a Delta I. The large mass into orbit requirements, a lot of things about the thermal environment, once in orbit in the payload bay, which we struggled like hell to meet. The environment around the orbiter in terms of materials propulsion requirements, if you will around the orbiter to do the thrustings...all that was things that probably drove design requirements. Vibration during the launch...all those things had to be worked out with the Air Force. It worked out okay in the end, because I think we did compromise to some extent when we found out we couldn't do it. Frankly, I don't think that it made the machine cost a lot more. But we did have a lot of battles with the Air Force over it.

66. WARING: Was that mainly on the orbiter, rather than on Marshall's part?

67. KRAFT: Yes. I don't think that Marshall really had anything to do with it. It was done through Bob Thompson's office.

68. DUNAR: In Marshall's development of the management support, was there concern while the discussions were going on about the possibility of closing Marshall and the impact that would have shuttle development, what contingencies were there if Marshall would have been closed?

69. KRAFT: I don't think that it ever got to that stage. I don't think that was ever a consideration. I don't think that any of us with any backbone thought that would happen anyway.

70. WARING: Marshall's whole expertise with rocketry was with liquid fuel rockets. Yet, for the shuttle, Marshall oversaw contractors that built solid fuel rockets. How were they convinced to build that or how did Marshall itself make that decision?

71. KRAFT: I am not sure that I know. I would have to say this and I am not a rocket expert. But I would say that the requirements for building solid rockets and liquid rockets are certainly not the same, but I think that the fact that you are a liquid rocket expert gives you a long leg up in knowing how to do solid rockets, particularly in nozzle design and strain structure, chemistry of that stuff, burn rates and the insulation. Hell, I think that Marshall was in the best position to do that. They were rocket experts, whether that be liquids or solids. I never had any problem with that decision. I never had any problem with them building the tank.

72. WARING: Did Marshall engineers ever express reluctance about getting involved in solids? The old Germans, sometimes, still speak about the dangers of the solids, but did the people in the seventies express concern about solid rockets for manned space flight?

73. KRAFT: No. They probably did, but I think that was a natural concern, not for building solids, but for building a solid that big. Yes, I think that many people had doubts about building solids that big. They were considering building even a larger diameter rocket than we built and that was decided that we really didn't have the technology to do that in this country, for one thing, secondly, you couldn't get it on a flat-bed of a train. So all those things played into limiting the diameter. But, I am not sure that those things were

discussed in the early stages of the shuttle. But, after the decision was made to go with the solid, I don't think that was a big issue in anybody's mind. Not in my mind. When you want to talk about the Challenger, I will say something different about it. But, it is a technical thing, not whether Marshall wanted to be in that business or not. I don't think that they probably were anxious to go do it, but I think that once the decision was made that we were going to use solids...recognize that there was nothing new about stacking solids around liquids. Even they did it. Everybody did it on the THOR. Russia had been doing it for years and etc. So, I don't think there were any technically doubts about whether it was good, bad or indifferent. JSC didn't want to do it that way either. JSC, who had more experts in solid rocketry probably than Marshall did, initially, cause they had all those guys from Langley that had shot all those damn rockets up at Wallops Island, Guy Titbedo [?576] was an absolute expert in solid rockets. So was Max Faget. But that never bothered me particularly. We used solid escape rockets on Mercury and Apollo, so we knew about those kinds. But that is probably child's play compared to the size of the rocket in the shuttle. Nevertheless, my bottom line on that thing is that I don't think that was ever a big issue.

74. DUNAR: I think that what we are trying to sort out is whether a lot of what we heard in terms of Marshall's resistance to solid is Challenger ...

75. KRAFT: Is a kernel for the Challenger accident?

76. DUNAR: Yes, if it is a post-Challenger...

77. KRAFT: If you want my opinion on that, I would say that it had zero effect. Zero. That isn't what caused the Challenger accident.

78. WARING: It had nothing to do with whether they were solid rockets? It has to do with other managerial ...

79. KRAFT: I was going to say JSC wanted a liquid-fed first stage rocket. It probably would have been a much better way to go, even in the eyes of Marshall. But, we were told by the experts that the pressure-fed booster development would cost us a billion dollars, whereas we could develop the solid rockets for probably a quarter of a million. That is the reason we did it that way. Plus the fact that I was convinced by the experts, recognizing that I am not an expert, that the solid rocket could be built with a factor safety of one.

80. DUNAR: You said that you don't believe the solid rocket situation had any impact on Challenger. What do you think was the problem of Challenger?

81. KRAFT: Well, there were two major mistakes made in Challenger. One was an abstract reason. One was an engineering, technical reason. Which one do you want me to go at first?

In an abstract sense, the management style, like it or dislike it, of Beggs ... and I don't know how much Mark had to play in this. I don't know whether you know it or not, but Hans Mark and Beggs, in the last year they were there never even spoke to each other. They were at one end of the building and when they saw each other coming they went in opposite directions. They despised each other. Beggs did everything he could to get rid of him. Or else he did everything he could to get rid of me. Both of them. Mostly Mark. But that is either here nor there. [end of first side of the tape]

...General Abrahamson, who is one of the worst people I ever worked for in my life, promoted underground decision-making. Every time he had a major issue, and he thrust himself into those issues, he set himself up as being omnipotent in his ability to determine what ought to be done and he was not. We had technical people, we knew a lot better how

to do things, both at Marshall and JSC than he ever thought of and ever would have thought of. But inevitably when we got into these kinds of issues. As an example, when we decided to bring the shuttle down because we had lost a fuel cell and we still had two left, he was pissed off to a fair-you-well and gave us hell for having ended the flight. Whereas we had a mission rule, stated, written, approved all the way from God to everybody, that said, if we lost a fuel cell on the first flight, we were going to end the damn flight early. And we did. He was really pissed off about that and gave us a hard time about it. After that, I don't know what happened...I can only tell you what happened at the Johnson Space Center...we made a decision that we would never allow ourselves to be put in that position again. We are going to go make a decision, we are going to do it and then we are going to tell him we did it and this is why we did it. Because we know a lot better how to operate this goddamn machine then he would ever know. So we adopted the attitude that said, we are going to do things the right way, because we know how to do it. We will inform him, keep him informed of what we have done, but we were not going to let him participate in the decision-making process because it was a pain-in-the-ass. I am sure that Marshall began to feel the same way. He was that kind of guy. So, that kind of management put on top of that General Abrahamson, whom we would make continuous decisions with and then he would walk out of the door and do something else and I can give you lots of examples of that and Marshall will tell you the same damn thing because they were in the same meetings I was in...drove this system into an underground decision-making process. Now that is totally foreign to the way NASA had done business for twenty years, or for how ever long it had been when Beggs came on the scene. Previous to that, everything that we did was in the open. We never hesitated to say what we thought, why we thought it, have total open discussion of it and then make a decision and live with it. But he forced the system into a reactive mode under which I just described. Now, I didn't say that was good. I say it is bad, but that began to have a very detrimental effect on NASA and I think that is what created Marshall's decision-making process in the early morning hours on the days

following the Challenger accident. They didn't want to surface these issues. They wanted to make the decisions themselves and they wanted to then say, "This is what we are going to do." They didn't want to make it visible. They knew that if they made it visible it would be hell to pay. So that is the kind of abstract root cause of the Challenger.

Why in the hell, the Rogers Commission never interviewed Beggs, Hans Mark or General Abrahamson is beyond my comprehension. I would like to see those gentlemen discuss their management role under oath, which is what happened to the Marshall management under oath in front of the Rogers Commission, where they had to spill their guts.

Now secondly, technical reasons. The creed, if you understand what I mean by the word "creed", I am talking about the creed that you say in church on Sunday morning. The creed of manned spaceflight is, "you never fly with a known problem." Never. Get that word, "never." So, when a back-up ring, when the main ring is burned and the back-up ring is scorched in a joint and you don't stop the goddamn thing right there and fix it, regardless of whether it be a band-aid fix or any other kind of fix, you have made a cardinal sin. You many times fly with unknown unknowns, but you do not fly with known unknowns. So, flying with that goddamn thing known as a problem, and then compounding it with the weather conditions and the environment that existed on the pad that morning, is the worst engineering decision that has ever been made in the space program.

82. WARING: Why did Marshall do it?

83. KRAFT: You will have to ask Marshall. I don't know.

84. DUNAR: Part of this is underground decision making.

85. KRAFT: I think so. I have often said and I can go on and on here, but I think that, by the way, you have to fault the Johnson Space Center just as much as the Marshall Space Flight Center. They knew the goddamn thing was bad. It was written up in their files over and over again. That came out in the Rogers commission explanation. I don't know why the whole system allowed that to continue to fly. They are all to blame. Every goddamn one of them are to blame. I don't blame Marshall any more than I do anybody else in the system. Johnson Space Center, KSC, NASA headquarters, Thiokol, any of them. I think they're all equal.

86. WARING: There was a major discussion of that in August of the year before at headquarters and all the centers were there. . . .

87. KRAFT: Sure, they were all there. They knew what the hell the goddamn thing was doing. Now, you can add to my thought process, I think that, there were those of us who had exited, who grew up on failure. We in the early days had many failures and we expected failures and we looked at everything as if it were going to fail and were gratified at its successes. I think we had the successes because we were always looking for failure. They got in a mode where the goddamn think was success-oriented. They forgot that they had to look for failure. They were looking for success. They'd done it. They'd done it eight times for God's sake and hadn't failed, so "why not today?"

88. DUNAR: Part of that decision making process, one of the terms that was used often at the times was "pressure to launch." Was that a probable reaction?

89. KRAFT: I can't speak to that. I can't visualize that. I can't visualize somebody pressuring me to launch. Maybe they were pressured to launch, but I think that's an excuse. It certainly was an element to be considered. I agree with that, but I think it's an excuse.

90. DUNAR: In part though it would seem what you're describing in terms of Beggs in trying to take decisions away from them would give Beggs an opening if you refused to launch.

91. KRAFT: Of course. All of that plays into the psychology of the thing. You're right. I think it's a secondary, I think it is a result, I don't disagree with you, but I think it's a result of these earlier [?0119] that got built up there. I think, if you asked me to name a single person that was responsible for the Challenger accident, I would say it was James Beggs. If I ever wright a book, I would put that in writing and sign my name to it. I don't blame Marshall for it. I blame Marshall for the technical aspects of it, and I blame Johnson Space Center for the technical aspects of it. You shouldn't let that happen, and Thiokol didn't want it to happen. You have to look at the top man at Thiokol and they were doing what they thought NASA wanted to do.

92. WARING: Besides the flaws in the decision making process that developed by the 80s, many people also point to flaws in the development process through the 70s and 80s. Particularly they point to changes in quality control at NASA. Was there a deterioration?

93. KRAFT: I think that's bullshit. I think that's pure bullshit.

94. WARING: Why do you think that?

95. KRAFT: Because I don't think that we ever did anything or made a decision to my knowledge that wasn't based on doing it the best possible way and preserving the quality of products. I've visited every goddamn major subcontractor in the Shuttle and they were seventy of them and I bet you I was there four times. I saw what was going on in the

factories. I saw the people who were doing the job. I saw the decisions that were made. I saw the agony that everybody went through to make sure it was done right. I don't believe that.

96. WARING: That's not what people are implying to make this criticism. They're not implying people were not as committed. The implication is that NASA did not have the resources; they did not have as many people as before; they were relying on DOD inspectors . . . .

97. KRAFT: I think that the lower number of people you have, the more apt you are to do it right. I don't believe in numbers and that's what has happened to them at Cape Canaveral. When you've got seventeen goddamn people that have to sign off on the fact that that beam was taken out of the back end of the orbiter, you're probably going to have the first guy say that the seventeenth guy will catch and the seventeenth guy will say certainly sixteen people will have seen this goddamn thing done and I don't have to worry. Nobody in between worries about it all.

98. WARING: Everybody passes . . . .

99. KRAFT: Whereas if you just have one guy worrying about it, he's going to worry about it. I say bullshit to that. I never have believed in numbers. I think if you've got a job to do, you'll get it done if it takes you twenty-four hours or forty-eight hours in a day to do it. I think that's been, what made NASA as good as it was in the early days because there weren't this damn bureaucratic numbers game put on top of it. I don't cotton to the idea that we didn't have enough money. Let me tell you something else. People say that we didn't have enough money to do the job. That's bullshit also. We had plenty of money to do the job. We had to fight for it. Thirdly they'd say well you might have gotten it done

quicker. I doubt that also. Had we had all the money we could have had, we may not have gotten there any quicker and we'd probably spent twice as much money. The fact that they didn't give us enough money may have made it cost less, and not more. Go talk to Bob Thompson, and he'll give you somewhat the same though on that. He was the program manager. I bet John Yardley probably give you the same thought also. It is true that we postpone things because we didn't have money. Take as an example the tiles. we consciously decided not to build the factory or expand the factory at Lockheed because we didn't have the money. We said "well we know the characteristics of those tiles so we'll put off until eighteen months later the real testing this material until we can get the factory going because we don't the money to start the factory." So it wasn't until we started producing a lot of tiles that we found out that we were wrong. It was a statistical problem. We found out the damn strength was only half of what we thought it was. Yes, that did delay making the program and making the schedules. I bet in the end, it didn't amount to more than two months at the most if that. I think it made us use the money efficiently. That's a terrible admission on my part, but I believe it's true.

100. WARING: So, some in NASA make complaints about the lack of money now. That's . . . .

101. KRAFT: That's bullshit. I think that's a goddamn excuse. Crippen makes that statement, and I wrote the goddamn administrator a letter and said he's full of shit. I'll show you a copy of it if you'd like to read it.

102. DUNAR: Another explanation that some have offered is that NASA lost, and this especially applies to Marshall, lost a lot of in-house capability with contracting everything out, and . . . .

103. KRAFT: Now that I agree with. That I agree with. That's not only true at the development centers, it's true at Langely, Virginia. You pick up the damn Aviation Week and say that Langely Field, Virginia, Langely Research Center has a new design for the supersonic transport. It has this, this, and this, and will do this and they're thinking about it doing that. Then down at the bottom, it says "this work was done by the Boeing and Lockheed companies." That's shit. What the hell are they there for? When I was there, we didn't have a goddamn single contractor at NACA. Not one. That's ludicrous. How in the hell can you teach your engineers to be engineers if they don't do engineering? All they're doing at NASA today is management. You can go look at the record at JSC and find that I've fought that tooth and nail until the day I left there. I knew that was the further demise of NASA. Yeah, you get me started on that. This guy will say the same thing. I don't know if he says it in his paper or not, but I can show you in other accounts where he will produce the same thing and so does Dr. Seamens. He says exactly the same thing. We all are amazed at that. I go over and make speeches over here at the young people at the Johnson Space Center and they've heard me say these things that what I'd like to have is two hundred of them and I'd go across the street and I'd do the same goddamn job they're doing, get it done quicker, better, and more efficiently and have two hundred and one happy guys. Whereas you guys across the street are no longer capable of making an engineering judgement decision. They come to me and say "We hear that, now how in the hell are we going to do that?" Because the way for us to get ahead, the way for us to get increases in salary is to have more people working for us, more contractors working for us. That's how they get judged. I say, "well I understand that", but the first thing you've got to do is go be an expert. You've got to become an expert in something. I don't give a goddamn what it is, but go become an expert in something. Until you do, you have no idea of what it takes to do something. If you haven't experienced all these heartaches and tough decisions you have make to get something done no matter how small or big, you don't what it takes to the job. How can you tell somebody else to do it if you don't understand it

yourself? All the way up the top, Dick Truly. What the hell has he ever done? Go look at his ?[210]. He's flown airplanes. He's flown spaceships, and he helped the Navy a little while in running the satellite program. Then he comes back in NASA and becomes a top level program manager and doesn't know what the fuck he's doing. Now, he's the administrator with no experience. He's never directed more than six people in his life. How can you expect him to be a manager? I know I'm cynical, but how can you expect that? It makes no damn sense to me. Bob Crippen is even worse. Bill Lenior is even worse than that. They don't have any experience. They don't know what it takes out of a factory to build something. They've been there.

104. DUNAR: The only way people coming into NASA now to get that king of experience is to be out in the industry for a while.

105. KRAFT: Absolutely. I couldn't say that any stronger. There needs to be this transfer of people between NASA and industry. It's like the Space Station. Can you imagine these guys in NASA are going to perform an integration job which is what NASA propose they do? They have zero experience in doing that. Those guys out at Rockwell have hundreds of guys that every goddamn morning at six A.M. met to discuss those integration problems, and then disperse hundreds of people across the goddamn country to get it done, and knew that the next morning they had to do it over again, every damn day seven days a week to build that damn orbiter. Now NASA's going to go off and do this integration job. They don't have the talent. They don't have the numbers. They don't have the means of training people to get it done. How the hell are they going to do it? They can't create it out of a new piece of cloth. It's inevitably doomed. Us idiots out here have been looking at NASA on that Space Station for five goddamn years now telling them you're crazy. Aaron Cohen wrote a report for Dr. Fletcher and told him what the management problems were when Fletcher first came back into NASA. How many years has that been? He told him that it

was screwed up. I told him personally that it was screwed up. Fifty other people told him that they were screwed up.

106. DUNAR: The problems with Space Station are much deeper than just questions about funding.

107. KRAFT: Oh God yes. They've already spent more money than the fucking thing should have cost.

108. DUNAR: Then there's the integration of ESA again too.

109. KRAFT: That's a much better, I agree with you, but that's a much better defined interface than the one's you've got in the US trying to build that machine. At least you've got a, it's like the IU in that Saturn V in the Apollo spacecraft. There were about ten or twelve wires that crossed that interphase and that's all. That's a pretty damn good idea.

110. DUNAR: Anything else you can think of?

111. KRAFT: I'm sorry I'm as expressive as I am.

112. DUNAR: No that's great.

113. WARING: Well maybe one thing that we didn't talk about is the shuttle came to be seen as the nation's exclusive launch system. How did that idea develop?

114. KRAFT: That was certainly not the fault of NASA. That was not NASA's fault at all. I made speeches personally and I know that George Low and the others did too in front of

the Air Force advisory committee, in front of the Air Force brass. We implored them, don't put all your eggs in this one basket. We're not trying to displace your other rockets. We're not trying to take over the defensive of the country or the reconnaissance requirements or any thing else. It's just that the way this country goes, the politics said "My God you're going to spend all this money on this thing that NASA says is going to do everything and is the greatest think since canned beer, God why don't we use it?" Hans Mark as secretary of the Air Force forced the Air Force to use it exclusively. I must say I think his motives were pretty good there. He was trying to preserve the building of the shuttle. Everybody was saying "Let's do it all with the shuttle."

115. WARING: So there was a lot of political . . . ?

116. KRAFT: Yes, but let me go back and reflect on that for you. It wasn't too bad an idea. Throughout the Challenger accident and think about the shuttle. It's the space policy that we have today that says you can't fly anything on the space shuttle is ludicrous. We've got the best, most reliable, most competent lifting vehicle the world has ever produced in terms of efficiency, and we say you can't use it. There are two sides to that story as far as I'm concerned. The space policy ought to be changed. We ought to be able to fly what we want to fly on the space shuttle, and fly what you want to fly on unmanned vehicles. This argument that says that you ought to go back to a multi-purpose and man-rate certain rockets to put men on as carriers for men is stupid. It's just what Augustine has to say about that is dumb, and I told him so. He's dumb. It makes no damn sense. He says that he said on television when he had his press conference that the space shuttle is dangerous. Wonder what he could say about the 767 that crashed over Thailand because the goddamn thrust reverser activated inadvertently and killed a hundred and something people. Did they stop flying the goddamn thing? Haven't stopped flying it yet and I could cite you a hundred examples like that in the aviation industry. They don't stop flying those dudes

because it means too much money in the pocket of somebody. Those accidents are a lot worse than the shuttle accident and they're arguing yet about whether you know what happened to the 767 over there that killed those people. I know what happened. I'm a damn aeronautical engineer enough to know that it broke the fucking tail off. Read the damn Aviation Week and there was this big loud snap in the damn recorder. What the hell do you think that was? That was tail coming off. Then there was another big snap. Do you know what that was? That was the wings coming off. This country is politically very difficult to make decisions. I'm not dumb enough to know that there's nothing we can do to change that. We've got to live with it. You've got to know how to work within it. You've got to know how to work the system. That's just the way it is. The shuttle is the best machine that we have ever been able to build. I'll tell you what. I think you'd have a hell of a time building a better one right now. It would be better, but it wouldn't be any safer and it wouldn't be any more reliable. I doubt that very seriously. There's an Augustine report that says, have I got that Augustine report here somewhere? I'd like to read you what it said. [mumble, mumble, mumble away from the recorder] Anyway, they say you ought to do such and such and such and such and we believe that this can be done for less money and made more reliable. Then it says if you can change the system at NASA, I'm paraphrasing, they know what the problem is. They just didn't have the guts enough to say it. Where do you want to go from there? You won't lack for opinions when you come to see me.

117. WARING: Maybe just a bit of advice. Who should we talk to about the Space Lab?

118. KRAFT: At JSC?

119. WARING: At JSC. We've lined up an interview with Glenn Lunney.

120. KRAFT: That would be good. Arnold Aldridge would probably be a good one to talk to about Spacelab.

121. WARING: Is he still with JSC?

122. KRAFT: He's up in headquarters. He'd a big wheel in headquarters. All the centers outside of manned space flight report to him on research and development and things like that. Gene Krantz. Definitely talk to Gene Krantz or somebody he would direct you to.

123. DUNAR: He's here now?

124. KRAFT: Yeah, he's head of operations.

125. WARING: That's probably enough for our purposes just to get a JSC perspective on things.

126. KRAFT: Those guys could certainly do it. Arny Aldredge and Krantz I think would be the two best guys to talk to you about it.

127. DUNAR: Well, thank you very much.

128. KRAFT: Yes sir.

129. DUNAR: You've been very helpful.

130. KRAFT: I don't want to say that. You should have enjoyed it.

131. DUNAR: I hope you write that book you mentioned too.

132. KRAFT: I tried once but I'm too lazy to write about myself . . .