

Mrs. Lee: -Leave out apostrophe on dates: 1970s, not 1970's  
- colon after Waring.

**INTERVIEW WITH BILL SNEED  
INTERVIEWED BY STEPHEN P. WARING  
15 AUGUST 1990  
HUNTSVILLE, ALABAMA**

1. WARING: [Do you think] Marshall as a center is uniquely vulnerable to criticism because it has become the construction and engineering center for NASA and so if things work well, perhaps Marshall doesn't get the credit, but if things don't work as well as people hope, then Marshall gets criticized? Marshall's role in construction affects the perceptions that people have of it?

2. SNEED: I would think that the fact that we are a development center makes us maybe a little bit more vulnerable than an operations center. Unquestionably, the fact that we are in the propulsion business maybe more so than anything else also makes up vulnerable because it is a very unforgiving system as you launch, if something doesn't work, some things you can recover from during the course of flight, but so many things you cannot. Of course we saw one of those demonstrated and the shuttle program is full of that sort of thing with the shuttle main engine. A very, very complex piece of machinery. Yes, I do think we are vulnerable there. I don't know whether we are more vulnerable than other centers. I think NASA is a little bit vulnerable. Perhaps Marshall would be in the upper crust of that vulnerability.

3. WARING: Because there are some centers like Johnson, obviously, or Goddard, because they have control over mission operations, they get the benefit of being in the newspapers when there are real successes.

4. SNEED: Yes, they do. Be careful in how you deal with this one, but even on the failure on the Challenger, Johnson had the lead center responsibility for that. They came out pretty clean on that. They didn't have any problems with that. Yet as a lead center, one of their responsibilities was to insure that the program was fully qualified. I think we got into

an area that was questionable whether it was fully qualified for the conditions under which we flew. The people that have got the hardware out on the front are a little bit more vulnerable. Now had it been on the orbiter, than of course Johnson would have gotten the heat, just as Marshall got it here. I think that we have got to be big boys and accept the fact that when we have failure we are going to have to take the heat. I think it may be a message to us as we experience some of this. You know you get two or three of them right in a row like the Challenger and now the Hubble, it causes you to want to go back and say, "look, let's go back to the premise on which those programs were put together. So<sup>me</sup> of the risks that we had to introduce into the program. In the case of the Challenger, I think we had a motor in that program, called an Environmental Test Motor that was suppose to subject the motor to the various environmental conditions that we were suppose to see. Whether that would have carried it down to the conditions that we had at the Cape during the launch, I don't know. But it was designed to be able to test the joint and the whole system in that environment to see how it behaves. Did we have it around on those events? No, we had to take it out. Why? Because of budget pressures. I think that we have got to ask ourselves, just what are our limits into which we can introduce risk in an R&D which within itself is unknowns and unpredictable. When I start introducing risk in addition to what is inherent in an R&D program, then I think that we are going to bust the limits. We are going to have difficulties. I think we have done a lot more of that in the 1970's and perhaps in the 1980's than we should have. Whether we are doing too much of that on the space station or not, I don't know. But I would suspect that we are. I would say a good space station program today would likely have an article on the ground that is identical to the article that is in flight. Such that if we encounter difficulties after we get on the orbit we have a system on the ground that we can try to run the program down, isolate the problem, put a fix into it, verify it on the ground and then send it up to be fixed. I doubt that is in the program today. Its a vital part of the program. But because of budget pressures and so forth, or whatever the reason. It might not all be budget. I don't want to

put it all on budget. It might have been that we have had a little change in our culture where we have started to do that, have been doing that for the last 20 years and it is accepted now as a way of life. Well, I don't think that mentality was around during the Apollo program.

5. WARING Could you talk about how things were different in the Apollo program? What were the advantages that NASA had?

6. SNEED: I think that in the Apollo program, I really believe at that time I did not feel as constrained in the Apollo as a result of budget pressures. For example, if we had something that was not behaving properly or not doing just right, we had adequate hardware in the program or we would put hardware in the program that would allow us to get in and understand that anomaly in great, great detail. We didn't just waffle on over that and go on to the next step as though it were not there. We seemed to concentrate and we seemed to have an attitude that failure will happen and we are going to safeguard against failure. The attitudes today seems to be more in the direction, again I don't mean this critically, it is my observation that well, lets try to do the impossible with maybe something that we consider less than what is really required to do the job. Let's try to do it with a protoflight [074] instead of two units. Let's try to do the space station maybe with out this ground test article that I talked about. That's ~~seems~~ to be creeping more into our thinking. The element of risk seems to be that we are having to take more risks and are apparently willing to take more risks in order to get the programs approved and implemented than I think we did before. We would write a specifications on the Saturn, this valve will not leak. Well, there is no such thing as a <sup>non-</sup>leaking valve. Go right back to your house, you know, a leaking faucet. But that was the standard that we set for ourselves and then we would only back off from that when we felt absolutely comfortable to do so. Today, I think we said we

are willing to launch the shuttle, perhaps without an environmental test article and we will use analysis and judgments and perhaps introduce a little bit of risk in so doing.

7. WARING Do you think there has been a change in the NASA philosophy in testing? Would you describe that?

8. SNEED: Yes, I think that for whatever the reasons, I go back to budget, because I think that there is a fundamental reason. The pressures for dollars is probably the key thing. We have not done enough component level, subsystem level, system level testing in the sense that we did in the Apollo program. Not that the Apollo Program was all that great, I just believe that we had more of that in there and were able to get down more such that this one thing of a kind, we had more engineering confidence in it than we do today. I just don't think that we build the robustness into our programs today to allow us to accommodate the unknowns and the unpredictables. I read a report just here recently that came out of the NASA Advisory Council. It was to NASA and was dealing with this very thing. I have been teaching a program management and program control course for the last year, last year and a half, and I have really been hitting on that theme. I saw it recorded here in March of 1990 and I was just tickled pink. It is in this report here, the NASA Advisory Council Report of that, speaking to the need of building more robustness. In fact that is where the words came from "robustness" to accommodate the unknowns and the unpredictables. I think that is the very theme I talked about. Build more margins in. Do more risk analysis to understand where your real hot spots are, your real drivers in the program. Then set out to get comfortable with those risk areas.

9. WARING Do you think in the sixties, NASA relied less on statistical methods and computer modelling and that sort of thing. Do you think that's been....?

10. SNEED: Yes, mainly because we didn't have it. It hadn't been developed. It is a great adjunct to what we had. In fact, we probably would have been able to do a better job if we had had some of the great things that have been made available by the computer. I think its a great augmentation to our capabilities, but I don't think it can be done at the risk of...

11. WARING It can't be relied on in itself?

12. SNEED: No way, it cannot. The other thing that is happening, and this is a real generalization now, but it was an observation or a generalization I had, the attitudes or feelings of other people, that the young kids that are coming in today, the freshout, the good engineering students are outstanding. If you look at their SAT scores or grade point averages they are probably well ahead of what we had. So they are very bright young people, but you put them at the computer and they can run circles around those of us who grew up with the slide rule. But then you get them away from the computer and get them to the hardware and they are a little bit in trouble. Because they don't have that hands-on "dirty hands" experience that kind of keeps your finger on the pulse of things. You know I am not an automobile mechanic. When my car goes bad on me I am in trouble. I raise the hood and if something hadn't fallen off that I can see, I don't know what the problem is. I take it to the shop. Now I contrast that to a person who has worked on a car before and something goes wrong, because he knows how that engines works, he has worked on it. He knows the behavior of that particular car, he probably could tell you right off the bat what the problem is. The hands on "dirty hands" thing. We have gotten away from that. We don't have much of that. We are more now into the mode of managing contractors. Even our in-house people are just managing contractors instead of having done it. We use to bring in just bouques, <sup>?</sup> in fact, I used to get aggravated with the laboratory people. I wouldn't, ~~~~~~~~~ I think if I knew then what I know today, flight computers, guidance computers, gyros and they would just run us crazy wanting more and more of those things. And they

would want the equipment to check it out and the facilities to check it out in. Well, those would give me problems. But on the other hand, it was giving them a means of really getting in and understanding what it was all about. Then when a problem happened, those people could stand up and give you some help in a hurry. Or they could prevent the problem from happening because it gave us not only the contractor who was trying to come up with a solution, but our people who were trying to come up with a solution. Two heads are better than one. They were put to work more effectively, I think, in being able to prevent problems. Of course if they did happen they could deal with them after they happened. I think that we have gotten away from that. I think anybody would agree that you talk to. You go into our laboratories and see if that what we have going. Probably less and less of it.

13. WARING Do Marshall people miss having all the machinists and blue collar technicians that they had during the Apollo years in the arsenal system? Do you think that ability to create models and prototypes in-house has substantially affected the work?

14. SNEED: I think we gave up something when we gave that up. I guess I wouldn't want to defend the machinist or the technician necessarily. I think maybe we could have gone out of house. But again, if you have got the machinist and the technician right there. The engineer carries the drawing out and he wants something built, you know you have got that finger on the pulse sort of thing. I think there is a plus that you get out of that. If I have to take that part that I want to have built and I have to go out and get competitive bids to get it done. I have to evaluate proposals. I have write statements of work. I have to wait six months to get done what I would like to have done tomorrow. So yes, I think we have given up a lot as we transitioned from some of the in-house. I will say not to build large stages or large systems, but perhaps that was an extreme that we should not had. Well, I should not have had. I think that if you could afford it that was great. It was a luxury. But to do that

on a smaller scale in building breadboards and engineering models and those kind of things, I think we have given up an awful lot. Of course, we had to give it up as the space program wound down in the '70's, that was what had to go. You can't give up your engineering talent. That had to be retained and that is what we opted to give up in order to retain the most important ingredient. I think that was the engineering and science talents.

15. WARING In fact, NASA pretty much mandated that Marshall had to give up that sort of funding. NASA's policy was against...

16. SNEED: NASA was responding to industry who felt they were there to do that. They were probably right in that case. I am talking about in the building of the large systems. We may have been on an extreme there. But I think it forced us to give up. It got so austere that I think we went into the red meat. We just about gave away the ability to do anything. We had these nice test stands out there and if we wanted to do a test we didn't really have the where withal to do it. The only way we could do a test was to bring in a contractor to do it. We would either use the prime contractor or hire another contractor. So what we had was going towards managing of contractors rather in the doing element, which we would rather have done more. You don't always get to do what you would like to do. But it put us in a position, I would say the wind-down of the problem and the system within which we operated. Again I am not doing this to point the finger, I am just saying that the country was in trouble and they had to do something. So that has to be allocated right down to the agencies. When it was allocated down I think that it forced us to take the actions that we took which I think were actions that are not conducive to success in an R&D environment where you are operating in an environment where the public and the Congress, the administration will not, and maybe even cannot, accept failure. Its a no risk environment we are in. A no-failure environment. NASA has had that reputation. Yet I

think that we have been put into a situation that is not commensurate with that type of environment.

17. WARING High risk and low money. Do you think that there was a specific date or couple of years in which the evolution of Marshall from this core?

18. SNEED: The decade of the seventies. It did us in. We were struggling to keep the doors of the center open in the '70's. We were struggling to find programs to be brought into the center in order to justify keeping the doors open. It was a struggle within NASA itself. It was certainly a struggle within Marshall.

19. WARING In that transition from the old Marshall to the new Marshall, did methods for managing contractors change?

20. SNEED: No. I don't think so.

21. WARING <sup>WAS</sup> Its ~~is~~ the same methods, just fewer people?

22. SNEED: Fewer people to do it. We didn't penetrate as deeply. About the same process was involved in doing that. I would just say the degree to which we penetrated. We had for the most part capabilities to be able to do almost what the contractors, not the capacity, but the capabilities to do what the contractors were doing. As a result of that I think we had a philosophy that we called, "Automatic <sup>responsibility</sup> ~~response-ability~~." In other words, if we had a technical person within the laboratory that was responsible for gyros, lets say. I mean down at the low level of detail. Or a guidance computer, or a mirror, the optics of the system. They were during the Apollo Era, not the program, but the era now, I think that we had people that were deeply entrenched in the engineering detail, the

manufacturing detail, the test detail. I think as a result of that we would penetrate down to excruciating detail on a continuous basis. Engineer to engineer. Designer to designer. At that same time, I need to say, we had like 7,500 civil service people at the center. Plus a pretty large contingent of supporting contractors which would add maybe another 50% or whatever those numbers are, I don't really recall, but it was a fairly large contingent that was supporting our in-house capability. We came out of that and started the decline after Apollo and that went from about 7,500 civil service people down to 3,100 civil service people. You will have to verify those numbers, but it was in that order. And we had to give up all of our technical support contractors. It went to zero. So we didn't have the resource in which to continue the old mode of operations.

23. WARING The philosophy of and desires to manage were the same, but the resources very ....?

24. SNEED: I think it was resources driven. Some people won't agree with that, but I absolutely think it was resources driven. You get into that mode of operation and then you go through a decade of operating that way. The people who would operate in the other mode were leaving and maybe the ones still around couldn't do much about it, then your new standard becomes the operating mode within that. I think that we are still in that mode to a large extent. That austere mode. In order just not to say Bill Sneed, I am going to say the illustrious NASA <sup>A</sup> advisory <sup>C</sup> council says build "robustness" into the program to accommodate the unknown and unpredictable. I can't agree more. That's the easier said than done, but I think that we must do that. We must build testing back into our program. We must have the budget to build the facilities to do that. Another interesting thing that I think happened during that time, again budget, were travel restrictions. Our travel budget went down with the other things and maybe proportionately more. So again as you become more and more dependent on contractors and less in-house, it says that I have to be able

to go off with those contractors and deal with them. Well, we can't do that anymore like we did then and certainly like we need to today.

25. WARING You can't manage contractor ~~at~~<sup>by</sup> looking at it on a piece of paper.

26. SNEED: ~~No~~<sup>s</sup> you cannot. And all these little computers where you electronically send stuff back and forth. I mean that's great and you can make a lot of mileage out of it. We would be in a lot of trouble if we didn't have that, but there is nothing like getting out and talking to the guy that's designing and testing and building it. That's how you do it. We really have given up a lot. I worry about it, where we are today because of that. I worry also that we have people around in positions of responsibility who can relate back to maybe how it was done, not that that was the panacea, I think the computer age has allowed us to do things different, we should have done things differently. So I am not trying to defend the past, I am just saying we can't forget it and just rely on analysis and rely on computers and the telephone to get our jobs done. I think if we want to do our job well we have got to have a balance between those things. I really question whether we have that optimal balance. I am not sure I could even describe it to you if I saw it, but I personally do not believe it is there today at least based on the experience that we had out there.

27. WARING That is all very interesting. A related issue to what we have been talking about is certainly in the early '60s and throughout the '60's, parts of the Marshall organization like the Saturn V program office rose in importance and in many ways had greater authority than the laboratories did. Whereas in the ABMA ~~days~~<sup>your</sup> very early years of Marshall, the labs were sort of top-dog. Could you comment about that? How did people feel about that change? Was there resistance to that sort of change in Marshall?

28. SNEED: I think there might have been some by the laboratory people. I think it was a case where the laboratory people did have a final say on what was done for their area of responsibility. I think that it was Marshall <sup>M</sup> management <sup>D</sup> directive <sup>N</sup> number <sup>O</sup> one that might have changed that and made the program office the leader of that activity. But it was very careful when it was constructed, to me it was almost a masterpiece in how it was counteracted. It did not relieve the laboratories of their responsibilities and duties. It just say they had to answer to the program manager who had to balance those decisions with cost schedule and technical considerations. Whereas their decision-making process was principally centered around technical excellence. The process kind of started right there, if you will, of having to balance your decision making process with schedule. The very thing you said, on a simple thing like writing a book. It's not so simply <sup>e</sup> actually, but a relatively simple thing like writing a book. If you are <sup>on</sup> <sup>tight</sup> <sup>fight</sup> a schedule it is a little tougher job for you. You have to do things. If you fix that...the president said, "I am going to get to the moon in this decade." Well, he fixed the technical job by saying to the moon and back, because that requires that certain things be done. "In this decade" you have fixed the time. But he didn't say I am going to do it for \$2! That was the variable that he allowed us. Now we started into the problem without that being the variable. <sup>v</sup> Its about the same thing we have today. No reserves to do the unknowns and the unpredictable. To build the "robustness" into the program. But we didn't stay in it very long before we came to realize that we weren't going to get it done in this decade if we didn't change. So the administrator, Mr. Webb, who was a very astute man, said, "I am going back in and tell these administration and Congress what this program is going to cost." This must have been in 1963, 1964, somewhere in that time frame if I recall. That's when the famous 20 billion dollars came in the plan. Well, when that happened the Apollo Program Director was able to allocate down to our Saturn V program manager a reserve of about 30%. I think we had more than that because we had some stashed away already. So it probably gave us 40 or 50 percent reserve in the program to deal with the unknowns, the unpredictable. As a result of that if we had

something that acted up on us we could do some tests. We would test it until we understood it. If we were having trouble with the design, we would initiate a backup design until such time that we were comfortable with the basic design that was going to come through. Or to substitute this one for that. Backed up designs are almost passe now. Back-up developments, I shouldn't say designs. We don't do as much of that as we would like. We continue to try to force our way through that wall even though that wall says you are not coming through here. You had better find another way.

29. WARING So in a sense in the 1960's when you had all that money, that made the relationship between the labs and the program offices simpler because they could work together. They had the resources to resolve technical problems.

30. SNEED: Right. If they said they had a problem, because the authority went over the Saturn V program manager, that just kind of put him on the hot seat in accidents because he had to balance those things off. But you had people like Willy Morazic, Walter Hauskermann [check in Bilstein stages to Saturn], <sup>e</sup>Orzerman, Billy Grau, Karl Heimburg and all those labs over there, who had those expertise you didn't walk away. When they told you look, I have a problem with this valve does leak! Well what happens if it leaks. Well you can have an explosion. You can blow up a Saturn V on the stand or in the air, well, you don't walk away from that. Yet, Art was sitting there said, "OK, I still have got the job for this decade. I still have that problem." But fortunately he had the flexibility to be able to deal with that problem an effective way. That was with back-ups.

31. WARING In the seventies and in the new Marshall, how was that different?

32. SNEED: Oh, it just went away.

33. WARING How did it change the relationship between the lab chief and the program office?

34. SNEED: I will have to think about that one just a minute. First of all just the basic program did not have the robustness in it that was really required for an R&D. Hubble Space Telescope, I am anxiously, anxiously awaiting the results of that <sup>group</sup> grove up there to see just what did happen. Most of my data is coming from the newspaper now, which I guess is pretty accurate in its reporting. But I am anxious to understand how was that mirror able to get through. I cannot recall that we would have done anything dumb or introduced risks that would have had that. I think we tried to do the very best scientific talent in that was available to NASA to make sure that mirror was properly ground and would do the job it had to do. I think that I recall vividly especially the relevant design of the mirror. Now that manufacturing problem was in an interesting article in the paper just the other day. You may have seen it. It got into the set-up that you had to have to machine and polish the mirror and measure to make sure that was right or not. I think it was this little thing right here that might have had the error in it. Well that is not a flight article. I don't know how much knowledge we had, how much involvement we had in going up to review the setup. You know you go back to this limitation on manpower that was able to go in and look at it, or, maybe even the expertise that we had in this area because we started to diversify because we are coming from a launch vehicle or a transportation propulsion center to one doing diverse things again to keep the doors open in the seventies, I am not sure what the depth of our expertise was to be able to get in and match one to one. I don't mean that literally. But to look over the shoulder of the contractor and make sure, give it one more test, ask the right questions to make sure that it was okay. I would imagine that we were probably limited both in terms of capability and because of the downturn in the center manpower from 7,500 down to 3,100 and getting into areas that we had not been in before such as maybe this.

35. WARING That is an interesting point. Not only the manpower being cut, but the jobs becoming more diverse and complex.

36. SNEED: Right. And more complex, right. Then you couple that then with maybe a limitation, even if we had had it to do that, for security reasons, there were probably good reasons for doing what we did. You can see that is saying I am really doing business differently than I did it before when I didn't have that. Might that have been a contributing element? I think that you have to say, yes, that may have been. We will have to look at what comes out of this review committee under Lew Allen and see what happens there. But you take what we just talked about there which is kind of back to the institution again, limitations of the institution and then go back to the basic program itself. Was the program robust enough? Did it have enough test program in to be able to do that? Interestingly we were not only machining this mirror with this contractor, but we had another one going with another contractor. With Kodak. Again, I don't know what all entered into the decisions to stop one and select this one. That was what will come out of this investigation. I just was not that deeply involved in that particular aspect. Its going to be an interesting thing to look at. Instead of out there writing, "Fire the manager, fire the people. Kill the center, close the center because they screwed up." Which is all you read about in this dumb thing. Why don't we get over and say lets understand what went wrong and what was the contributing factors to that and get those fixed so that NASA is the premiere research and development center. That is what bothers me. You fellers are just feeding fuel to the fire.

It wasn't Marshall's choice to go down. It wasn't NASA's choice to go down. It was an administrative...

37. WARING Well, don't blame us! We are not journalist!

38. SNEED: I know. But then I am just saying that the journalist comes back and jumps on this. Read the story. Read the story and see who is the scapegoat. Who can I make look bad. Marshall Space Flight Center and Mr. So-and-So or Dr. So-and-So cause he screwed up. <sup>^</sup>  
be

39. WARING Yes, I think that is because when Marshall becomes an engineering center they are an easy scapegoat. Journalists are not smart enough to think that Marshall is working in a system set up by Congress, really.

40. SNEED: But the pressure on the systems. Its not just the media. It's the Congress, the public. Maybe not so much the public as Congress, because they are politicians. So they want to come in and be able to point the finger and take the heat off themselves. Well, they had as much a role to play. I thought Dr. Fiske, the Associate Director for Space Sciences, who was testifying before one of the committees, did a beautiful job in saying "we have got to share in this. You fellows have a role to play in this too. You don't want to talk about it, but you sure did. Directly or indirectly." So lets <sup>↓</sup> get in and find the facts. I would like to see our emphasis going towards what went wrong, why did it go wrong, what do we really need to fix it, if we want to stay in the space business. You know there is some strategy as to whether it should have been up at Goddard. That is one of the stories that came out at Marshall that the job should have been done at Goddard. Well, Goddard couldn't do the job.

41. WARING Yes. They were used to doing little, tiny projects.

42. SNEED: Yes. Its the impossible job that was given, because Marshall was better equipped to deal with a tough complex job. We tried and yet we screwed up. I am not denying that. But, there might have been some cause. Rather than accentuating the

positive that we screwed up, I would like to go in and understand what contributed to that and fix it so that we don't screw up the next time. Or at least minimize it. We will screw up the next time. Give us another job and we will screw it up. If its not the kind of program that we are capable of, then we shouldn't be doing the program, I think. If it is painting the wall, lets go get somebody that can paint walls.

43. WARING After reading these newspaper articles and then at the same time reading Smith's book about the telescope, <sup>h</sup> His book shows that there is more than one manager who is having trouble.

44. SNEED: I thought it did a pretty good job of treating the complex environment in which that program was undertaken and developed. The institution you see, coming back to your question of how did the manager and labs react to that, the so-called automatic responsibility back then our people, I think every person in our organization again in the Apollo Era. Probably some even today, but not to the degree, felt a personal responsibility or obligation <sup>[to make]</sup> that gyro work, or whatever their responsibility were. If in his analysis anything cropped up that would suggest that it wouldn't work, then the automatic response, his mechanisms kicked in to want to make sure that he didn't screw up. If that meant another test <sup>h</sup> or if it meant getting another test article in-house to do something with, another piece of hardware to do something with, whatever, he kind of automatically picked that up. He didn't wait for somebody to pull his chain and say, <sup>h</sup> hey that's not working. With the decline of people and a diversification of projects, that automatic responsibility went away and we tended to get more in a reactive mode of operation. React to a problem, rather than prevent the problem.

45. WARING There were too many jobs, too complex a jobs, so the fewer personnel had divided responsibilities. They couldn't oversee. They were doing many things at once.

46. SNEED: We were spread more thinly. I think that we tended to find ourselves having to get ourselves engaged like we have in our programs, you sign a contract, then there is a preliminary design review. Those things might be 6 months to 18 months apart. If I have got ten jobs to do, I can't stay in there everyday and know what's going on. If I can't travel out and find out what's going on, I can't stay engaged. So really what I do is engage at critical points in the process like the critical design review. At that time the job is already designed and I am having to respond or react to a bad design, or something I don't feel comfortable with, that I don't think will work, or the contract hasn't convinced me will work. That puts you in a negative mode of operation. I am having to change what somebody has already done. That's a more difficult thing to do.

The basic relationships have changed between the labs in that ~~accept~~<sup>except</sup> perhaps we are depending on the project office to get more of the job done with less support from the in-house. So there was or is a tendency to bolster up the project office to do that job which is not maybe being done quite as well or thoroughly or equally by the lab. We try to keep things in balance as well as we can. Our labs we still rely on them for the in-depth technical support. They are being more and more stressed to provide that ~~in~~-depth technical support that they had. I really believe that we have evolved a little bit more into a reactive system than we had. I am looking for the Marshall strategic...I was personally responsible for writing into the strategic plan something that tried to deal with that. We are talking about commitment to excellence. "To provide excellence and continuous improvement to successfully accomplish our programs." Of course we had a lot of discussion and a lot that goes behind that. In an earlier version of this I think we had something written in to get more proactive and less reactive in doing the job. I think we have become more reactive in our job. That is primarily technical, laboratory areas.

47. WARING I would like to ask you about program development. How and why did the Program Development Office get started?

48. SNEED: In the early 1970's, Marshall was winding down on the Apollo Program. I think we had finally flown the last one in 1973. That was the end of it. There was no more Saturn Program. So what built up to a tremendous peak <sup>[that]</sup> was going to zero. We had going at that time the Skylab Program and that was it. As you forecast your business base for the 1970's, we were on a going out of business curve. Dr. von Braun was very aware of that. I don't think any of us anticipated that the nation would be winding down the space program. I think that we felt as we came off that curve we would be going to Mars, we would be building that space stations and space shuttles and those kind of things that we finally got around to doing in the 1980's. For national reasons that didn't materialize. We were in bad shape at the center in having anything going that would justify our existence. Our fears were later proven to be right because some very serious studies were undertaken in the mid-70's about closing centers. I guess Marshall and Lewis were the targets in the closing of centers. Well when Dr. von Braun, of course being the visionary that he was, saw the need to try to get in and do some things. I guess his last acts at Marshall was to form the Program Development Directorate with Dr. Lucas being hand-picked to do that. He couldn't have picked a more capable person to put that organization together. I have said privately and publicly to Dr. Lucas that his work in structuring that organization, chartering it and the whole mode of operation was a classic in how a job should be done. In my retirement of May a year ago, I acknowledged his role in that and I thing I said I personally would not change one thing, not one that he did. It was an absolute classic in organizational strategy and structure.

49. WARING What sort of plans were developed? How did the office work?

50. SNEED: What he did and what we did...of course Jim Downey and I were headed two of the five organizational groups that he had there at that time. Jim was on the revival part of it looking for payloads for the center. We felt that...the shuttle had been approved in about 1972 or so. Of course we had that coming up. No, no the shuttle came through our place, I am sorry. The shuttle had not been approved on the first program. I guess the lunar roving vehicle was the first thing as I recall that came through program development and went out of our place as an approved program. I think the shuttle, more than likely, was the next, if I am not terribly mistaken.

But what we did was put together an organization that said who are our potential customers, what is likely <sup>t</sup> to be approved in the foreseeable <sup>sp?</sup> future. What is likely to get out and which of those areas would we have a capability to compete and maybe win. So we identified any number of those. We set up organizational entities that were there thinking when they came in in the morning and when they went home at night, what can I do, what kind of ideas can I come up with working with the science community or where else. To come up with an idea that is saleable and worth its consideration.

51. WARING So people in your office were perceiving themselves as being like businessmen. You had to create products, envision customers and sell them?

52. SNEED: Yes, and to interact with them. If a scientist, for instance, had an idea that I would like to see ten times further into space, 50 times fainter objects, we said okay, is that something we could do. Our developmental capabilities. We, in putting this organization together, we had the idea people. We had the business people which was my expertise, I guess. Then we had the design people, who at ~~there~~ <sup>their</sup> desk, not using contractors. He would not let us have a single contractor. He moved desks out and put design boards in each office. He said, "I want you to be the brains behind this." A beautiful, beautiful [692] move. [It] served the center extremely well. Of course the nice thing about this was civil

service people salaries were paid for. So we did not have to have any money from anybody to do the market analysis, preliminary design, the conceptual design. Instead of going in waving my arms to the associate administrator for space flight, or Space Science, or wherever at Headquarters, we could go in with a nice brochure. Here's the requirement. Here's some alternative ways of doing it. Here<sup>s</sup> some preliminary design concepts. We really believed we could do it in enough depth to give you a warm feeling that it could be done. This is how long it will take us to do it. This is how much money it will take up to do it. So you go in to them with nice sales package to the people that you were interfacing with. You could have enough with absolutely no cost. I didn't have to say "may I" to anybody. If I were going to have to go out and have this done by contract, I would have to go out and say "may I have a half a million dollars or a million dollars". No you may not. You go back and go again. But here we didn't have to say "may I." We could do that to the point that you could put enough meat on the bones that you could convince the people that you had to convince that it could be done. That made the job a little bit easier by doing that. No other centers had that capability. So we had a truly tactical advantage over any competitors that we had because not many [end of the tape, side one]

...operate them then we put together an organizational group that could interface on a continuous basis with those people to peruse any idea that appeared to have merit. It was absolutely beautiful. Exactly the way industry works today.

53. WARING When Marshall got into the energy business with solar energy and that sort of stuff, did that come out of Program Development?

54. SNEED: It sure did. NASA's funds were still so restricted when the energy crisis hit we saw that there was big monies becoming available. We started to assess what technologies do we have in the space program that could perhaps be applied to the industry to help with that problem. We had solar<sup>ar</sup> rays and solar cells on our space projects back then. Very<sup>^</sup>

clearly solar heating and cooling were the natural evolution. We bid for that and got it. DOD didn't have anything compared to NASA in terms of engineering talent to do that. We had difficulties to be frank with you. We were used to doing things where we were the customers. We were the user of that product. It may go from here to Johnson or here to Goddard to be the operator. But solar heating and cooling, the user there would be the homeowner or the commercial company. We had difficulty acclimating to that. What we were trying to do is build an industry capability to be able to build solar heating and cooling units to go into the home. That was a radical departure from us where we were the... and it was one of a kind with us for the most part.

55. WARING Did you work with a regional construction firm or engineering firm? Were there any contractors involved?

56. SNEED: Oh yes. What we would do instead of going out with a procurement that was highly spec to NASA standards and so forth, we would go out almost with the capabilities. You know we are interested in building a residential solar heating and cooling system, or a commercial that would do these kinds of jobs in a performance sense. Any of you out there in industry who have a possible solution of your own choice. Again, we were trying to develop industry capabilities and as much diversification as is there. So anybody that had a good idea that could demonstrate to us that they could build a good unit would be given a chance to build that. We would work with them to demonstrate that it would work and then by that demonstration in essence it was qualifying it to go to the marketplace. We were not involved in that so as a deal it was very helpful to us. As it was structured they had to hit us with a 2 X 4 to tell us how to do it. But they did bring us around. It was difficult because we wanted to build it to our specifications. That wasn't the purpose. The purpose was to let industry do it their way the best they could because they were the ones that were going

to have to market it after they had demonstrated that it was going to work. We succeeded pretty well. Again, that is one of those spin-offs that you need to know about.

57. WARING Can you think of any companies that were over that?

58. SNEED: Yes. Don Bowden right down here off of University Drive, Bow~~X~~den Industries. You need to go down and talk to him. He was our manager for that program here. I think he resigned from NASA and went out on his own and formed his own business to do that. Down at the HIC building and was doing very, very well for himself. A fire wiped him out, but then he set up again. Don, I guess, was a ~~pretty~~<sup>better</sup> engineer than businessman, but he had to really explore his product. He had to go out and sell some stock and then some folks got control of it and they relieved him of his responsibilities and the business went under. I don't think it would have gone under had he stayed on. He had an excellent product. He now has another very interesting product now. He is doing very well. He is a person that you might want to talk to.

In the mining end of it, we worked with the Bureau of Mines, again, using some sensors that we had developed in space. The mining industry goes in to mine coal and you go into a coal seam and that seam might not be more than 5, 6, or 8 feet in depth. In mining that they did not want to mine and break through the coal structure and get into rock, dirt or whatever is there because of cave-ins and I guess damage to the mining equipment and so forth. Of course they were just mining and they didn't know how much they were leaving. It was just guessing. What we did was work with them to develop a sensor system that would tell the long, long shearer that went down this seam of coal, to go up or go down because you are about to run out of coal. We have got a company here and I don't know the name of it, I think, but a fellow by the name of Robert Pease, was our leader on that. When he left NASA he is still doing some work. I saw him just the other day and he said he was still doing some work in that area. If you look in the phone book

you could probably find him. Robert Pease. He is still here and still doing work in this related area. Another one of those spin-offs I was telling you about that you probably don't hear much about.

59. WARING Well, I know that Marshall got into mining, but I didn't realize there were still actual people associated with it.

60. SNEED: Yes, they are still around. Those were the two bigger things, the mining and the solar heating and cooling. We got into some other things. We were looking at large satellite systems. But a person very deeply involved to generating electric power was person named Charles Guttman who could just fill you in on all kinds of details. He is now the owner of the Golf Attic down on South Parkway. Now that was not a spin-off!

That was again looking where is the money, where are the potential customers we identified as a possible customer. We went after it and we were able to engage 100 to 200 people to keep them up. If we hadn't had it they would have been off the payroll.

61. WARING So for solar energy and for the mining project?

62. SNEED: I would say we had least two to three hundred people working in energy related activities which might have been somewhere between five and ten percent of our total resources. So it was very important to us in terms of keeping that many people on the roll. They would have been off the roll if we hadn't of had that.

63. WARING When you were thinking of this, were you thinking of this as a permanent project or was this just a way to keep people on the <sup>pay</sup>roll so that when and if a space exploration and science expanded you would have talented experienced people still on the payroll<sup>?</sup>

64. SNEED: I don't know that we looked at it one way or the other. I am sure when we got into it was there to get a job done. There was no over expectation knowing when space would come back. So I can't say it was a holding pattern. I think we got into it with a view to first trying to contribute in an area that we could have contributed to. I don't think we would have gotten into it if we didn't think we could have related the capabilities that we had back to that. On all of those areas we were very selective in what we got into to make sure it was a technology areas where we had a core capability where we certainly wanted to retain that sense of...you know you have to have no matter what you work on. Solar <sup>ar</sup> rays you have got to have no matter what you work on whether it is the space station or not. We tried to keep some centralism of what we did there with the space program. We didn't try to go out and develop new capabilities to sell that.

Now contrast that to Lewis Research Center. Lewis probably had over a third of their total center working, maybe even more than that...in fact they made some overtures to maybe leave NASA and go with DOD and ~~per~~<sup>u</sup>sue...because they were having so much difficulty in getting challenging work from the space shuttle. The dollar really dried up then. They very consciously got into it and were doing some very big things. They got into an energy, building more efficient engines, automobile engines. They got into it in a real big way, much more than we did. I know that we had less than ten percent of our people working at it. It might have been right at ten.

65. WARING What was the reaction of Headquarters and the other centers to Marshall getting involved?

66. SNEED: Very supportive. In fact, they encouraged some of it. Of course they had to approve any inter-agency agreements that were entered into. They actually formed an office at NASA headquarters, the Office of Energy that really was the coordinating arm of

all of NASA's involvement in this. There were quite a number of center's that got involved in it some way. It was with their encouragement. The president, I guess it was Carter at the time, well, we had a big problem. He wasn't going to just restrict that DOE, so I think the policy that came down might have influenced NASA to do that. That went on for a goodly part of the seventies. Of course the energy crisis went away a little bit and the new administration came in, the Reagan administration, deemphasis the DOE role quite a bit. I think that we phased out almost entirely. I don't think there is anything going on at the center right now in that area.

67. WARING I think that is all my questions for this time. I will probably be back next summer. Is there anything else you think I should know about the seventies, particularly. That is what we are concerned about now.

68. SNEED: The seventies in opinion were very austere and of course resulted in a great wind down. They were not fun years at all. I really believe that the actions that we had to take in the seventies did change the culture of NASA and certainly of Marshall Space Flight Center. I think some of the difficulties that we are experiencing now are out-growths of some of that change in culture. I think that they are right now manifesting into the problems and we will probably live with for sometime. I really, I won't say I worry, but I do have some concerns that the agency and Marshall, Marshall particularly, perhaps has an understanding of all the history that took place there and have sorted out what might have contributed to what we are today, or what we are not today. They perhaps, then, can take that into consideration in reposturing the center to be able to be a better center. I think the center has had more than its share of bad publicity starting with Challenger and right up to the Hubble. I am not sure that the public makes any distinction between Marshall and NASA in the grounding of the shuttle. I don't think that was on the ticket. But by association we were involved in it. I do not believe that the center will be able to easily

survive much more than what we have encountered. In other words, if that continued at the rate of severity that we had in the last four years, I don't believe the center could survive. For that reason I guess I am very much of the opinion that we need to take stock and do everything in our power to get better. I am not aware that we are doing that much.

69. WARING Where do you think that reevaluation has to come from? Congress? Headquarters?

70. SNEED: I think that it has to be done from within. The Congress and Headquarters are too removed from it and don't probably have the continuity, the corporate memory that resides at the center. It is getting away from the center rapidly.

When I left, I shouldn't say when I left the center. When J. R. Thompson came to the center and from that point on. I said it when he came there and I said it when I left, because I think we, I won't say him, but we, I don't think we ever got to the root cause of the problem. I think that we were looking for what went wrong on the Challenger. I think that we found it. I think it was the joint. The O-ring that we all have read so much about. But I personally don't think that we got to the root cause of the problem. What allowed that to happen. That is what we should have been attacking. I think that we fixed that joint. I think we fixed that O-ring. I would be greatly surprised if we ever have another problem, unless it is some just absolute screw-up or oversight. I don't believe that will happen. But the thing that permitted that was a breakdown within the engineering and management process. A much more intangible thing. If there is a breakdown in that area or a degradation in that area, then it says it can happen again, and again, and again in some other area. And will likely happen again. In the presidential commission report and within our own center or within NASA, I don't think that was ever mentioned. I don't think it was ever talked about. We just seemed to be happy when we could get it down to the O-ring and fire the people that were associated with it. We just had an orgasm when it happened.

Everybody was just tickled. Even the attitude of the presidential commission. Well I would have liked to have seen them look deeper.

71. WARING Yes, they thought there was just one thing wrong and it was a quick-fix.

72. SNEED: They were in a reactive mode. Now I want to be in a proactive mode. I want everybody including the press, the administration, including the Congress to be in a proactive mode. We want space. We want to do the impossible. We want to explore the unknown and the unpredictable. To do that requires a very special capability within this country. Not only within NASA but within the industry. Let's understand where that went wrong. Let's understand that Congress contributes to that, the administration contributes to that just as much as the poor guy that was picking around with that O-ring or that joint. Probably more so because that process, that system, drove those decision-makers to do what they did. Let's go back and fix the system so then that we will be able to do well in all areas and minimize our likelihood of that ever happening again. But that was never, I think, addressed. I would have liked to have seen it addressed. I talked to J.R. and I would talk to Jack and everybody that I could talk to. But it was words to a large extent and that is a difficult thing to get back to. A very complex thing to get back to.

73. WARING It is hard to change an organization when you have new programs going on everyday.

74. SNEED: Extremely hard. A lot of inertia. It took a decade for that, in my opinion, to change the culture. It would probably take a decade to change it back. Now Jack Lee, when he assumed responsibility for the center, one of the things he said I really want to do is to get back to this total quality management. But those are words. Those are just words. I am not sure that we have done much. I applaud his vision to do that because I think it is

needed. I think that is one of the things that might have come out of the discussions that we had and he had his own opinions of things that might have happened. Jack was deeply involved in everything that goes on in the center. He probably was putting some things together. He probably said, I need to get better, I need to get people assuming greater responsibility, having better interaction among themselves, proactive versus this. Probably he had more database to work with than I had. Just to declare that as an objective or goal for the center, even if you devoted a lot of time and energies to make that happen, which I am not sure has been done, except to declare it, that won't make it happen. If it is how you function, how you deal everyday, it is inherent in an organization. As a result of that, it is an intangible thing that will take a lot of time to restore it if it was lost. I personally think it was. Jack may or may not have.

75. WARING What's the one thing that you would change, or the most important thing?

76. SNEED: I think it has to start with an attitude. It's just how you approach and I would say operating philosophy. I believe that if it has to start somewhere it has to start there and start right at the top with the person like Jack. That has to be carried right on down the organization with meaning. Every decision you make has to be consistent with that. Over a period of time then I think everybody starts catching up in it and over a period of time hopefully you have accomplished that.

I would like to say that it might sound that in some areas or cases I sound negative. I am not negative. WE have maybe lost something. I am not one that holds on to the past. But as you try to integrate over a career of the good points and the bad points, I tend not to sit around and dwell on the positives. I tend to want to constantly become better and retain the excellence that we have. I am more interested in what went wrong with what we have done and what we have to do to make it right rather than "oh boy, we did good again, didn't we!" I guess that is where we are coming from. So if I dwelt a little bit on the....

77. WARING Well, that is very understandable. Last month we were in Houston and we interviewed some of the top people at Houston. Some of the people of your generation and they were all feeling the same way. So it is not just a Marshall thing. From people we have talked to it is throughout NASA. There is a feeling that things, through no fault of any person, not because of bad intentions, but because the organization deteriorated and it's important to...

78. SNEED: Yes, and for the reasons we talked about today. You look today and you lost in that same time some of the names like the Heimburgs, the <sup>Morazec</sup> Mozetts, the von Braun's, the Lucas, people that had dirty and we replaced them with fresh-outs. Good people, but certainly not with the heritage that those people had. They grew up in that arsenal concept where they had their hands on the hardware. They designed it, they built it, and they tested it. All these people that are coming in now are smart. Most of them are coming in with a computer in their hand. You take the computer out of all of it and I am not sure they would know what direction is ahead. You give me a choice and I think I will take the people coming out of the old environment. But the challenge we have now it to take those people, because they are what they are and to provide them with good facilities. Good laboratory environment, where they can get some of that same experience. It probably will never be as good, or great or big as it was in the past. Those days are gone. Maybe it doesn't have to be as good, but it would be more in that direction, balancing out. Then when a problem occurs, they can respond to it. I will never forget, we were out at Houston, kind of celebrating, a coming out party. I think it was when the first astronauts landed on the moon, they were isolated for about a week, nobody could talk to them. Then when they came out we had a big blowout at Johnson. I and many from the center went out there. Then we had people from throughout NASA that went out there to celebrate. I talked to Dr. Petrone there, I had worked closely with him building and launching the Saturn. I was telling him what a tremendous event that was. He said, "Yeah Bill it was, but you know, I

almost knew that the launch of the first Apollo as maybe as significant or more significant." I said, "you are going to have to explain that one." Then he said, "Well, you know when we launched the first one, we had a brand new launch facility, and launch concept. We had a brand new Saturn launch vehicle system. We had a brand new spacecraft. All of that had to come together and work well. As I look back I really attach a lot of significance to that." We got into a discussion of automation checkout and he said the great thing that we could not have done a program without it, he was almost predicting the future, but he said one of the problems that has given us is that yes, it will allow us to check a lot more things in a shorter period of time just before you press the button. But in doing that if something goes wrong we are having more and more difficulty getting back to the root of the problem. What went wrong and why it went wrong. You are getting more automated. In other words you are removing yourself more and more from the process. You don't have your finger on the pulse as you did before. He said it is a problem, a growing problem. We are going to have to be sensitive to that." How true he was! I think that is where we are today. The automation has got a lot of nice features, allows you to do a lot more analysis and a lot more with fewer people. But, in the end product, its that hardware.

79. WARING Well, that's a very interesting point because that's a criticism that people in business often make of the direction of American businesses. There are too many hand-off managers today. They know how to read an accounting sheet and they can run computer programs and do mathematical modeling of the market, but that's all they can do.

80. SNEED: Yes, and their product and everything won't work when you bring it out of the plant. It's not just the culture, I think the country maybe has slipped as the world market has gotten more competitive. You know I think we always built throw-away automobiles. I remember the first one I bought, if I could get 60,000 miles out of it I thought I had done pretty good without a major overhaul. I think that we have made some inroads, but I think

that we are still blowing smoke. If we would just quite talking about it and just do it and let the performance of the product do the talking for us, then we will be there. But we aren't there. We still have Iococa coming up and saying, "We build better cars than Company A," and I say "Bullshit." I have driven both and I don't think he is even in the ballpark on performance. The cars are looking better and performing some better, but better than what they were doing before which was absolutely deplorable. George Hardy, my other associate that we haven't talked about, had to replace a motor in one of those better cars three times. So I think we have a ways to go.

But I think that we are capable of doing it. We just need to give that more emphasis and more priority to make it happen. We have got to in the very broadest sense. I think there are certain industries where I think we are there. Others that are trying to get there and if we stay after it I think we can make it.

81. WARING Well, thank you very much, I don't want to take up anymore of your time. This was very helpful, very interesting.