INTERVIEW WITH HARRY G. CRAFT
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MSFC
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1. Dunar Initially, could you give me a sketch of your career at least since '69. I believe that's when you first got involved in payloads.

2. Craft Right. In the late '60s time frame, we here at Marshall began looking at various ways to utilize the capability of the shuttle. We knew the shuttle was committed to. We knew the agency was going to build it. We knew it was going to be a spacecraft with a large payload bay. So in the late '60s, we started looking at innovative ways to utilize the payload bay capability of the shuttle. We came up with the idea of why not place laboratories in the payload bay of the shuttle. We started various studies in the program development organization in that time frame to basically put what looked like a tin can in the cargo bay of the shuttle and to outfit the tin can with various capabilities. We worked on that for a couple or three years, and we came up with things we called Sortie Can, Sortie Lab. We had experiment modules that we had worked with General Dynamics some to develop. In the mid to early '70s, we began discussions with the European Space Agency about the possibility of them contributing to the capability of the overall STS of which Spacelab turned out to become

part of that capability, looked at having them build part of it. What gave way is they began then to recreate some of the studies that we had done of putting a laboratory in the payload bay of the orbiter. As a result of that, Spacelab was born. Spacelab was a brainchild first of some of the people here at Marshall in our Program Development directorate and was sort of the idea or the embryonic thought that gave way to the European version of Spacelab which we now have today. In the mid-'70s, we signed the agreement with ESA to do the Spacelab. Throughout the later part of the '70s and the early '80s, Spacelab was developed. About 1976, we began to recognize the need for scientific payloads to go onboard the Spacelab. In that time frame, NASA with the support of Marshall, did a couple of what we called announcements of opportunity to select scientific payloads for Spacelab 1 and Spacelab 2. The configurations of those two missions were selected to show the full range of capability that Spacelab would have to do scientific experimentation. Spacelab 1, being a pressurized model i.e. a shirt sleeve environment where the crew could get in and work and do experiments and interact with them very easily. The configuration of Spacelab 2 was selected to allow us to show the capability to fly large telescopes, advancing pointing systems to do astronomy, solar physics, high energy astrophysics onboard the same Spacelab capabilities. In the late '70s, scientists for those two missions were selected. As I said, Spacelab 1, the emphasis was on microgravity,

life sciences, materials processing, although we flew an array of experiments in just about every discipline. Spacelab 2, the emphasis was in selecting astronomy, solar physics, and high energy astrophysics. Throughout the later part of the '70s and through the early '80s, we here at Marshall held all the contracts for developing the NASA hardware to go onboard those particular flights. ESA, in both cases, contributed. ESA, in various ways, contributed to both of those flights to the scientific instruments that we flew. They basically entered into a process similar to us. They selected some experiments and had them developed throughout the Western European nations that belonged to the European Space Agency. I don't know how much detail you want to go into. I don't know that I can remember every experiment that we flew. There are documents out that you ought to be able to get your hands on very easily that will tell you what.

3. Dunar I think what we'd like to get at, and it is difficult for us as laymen to look at this and select what are the most significant things. What do you see as the most significant developments, experiments, the greatest achievements, and successes out of the flights?

4. Craft I think, if you go back and you look at the early Spacelab program, I guess one of the most significant developments is that I think we took a major step in putting

the capability in space that we, the agency had always invisioned being able to do. Skylab was the first space station, no question about it, but with Skylab still we worked in an environment that was not maybe quite as friendly to the scientific community as possible. Everything was rather rigid. You designed for one of a kind. Spacelab, I think the significant thing here is that we worked the design of Spacelab to make it as much like walking into a laboratory at UAH for example as possible. We tried to provide standard power outlets. We provided standard services in terms of thermal, in terms of communication, computer support. We tried to provide everything that one would see in a laboratory on the ground but merely move it a couple of hundred miles into space. We tried to make the working environment the earth's atmosphere which we were able to accomplish. It's a fourteen PSI atmosphere just like on earth. We tried to work toward the capability of flying off the shelf hardware. We didn't accomplish that on those very early flights, but we have since, and it does have the capability of flying off the shelf hardware. The significance of being able to fly the kinds of masses of experiments, I mean some of our satellites today totally weight 10 to 15,000 pounds. We were flying 10 and 15,000 pounds of science instruments on these flights, far more than anything we'd ever been able to do before. The instruments were huge. They were large. They could use a lot of power. We were no longer

necessarily having to microminiaturize or be really shotty on power capabilities. Those were the things that really made Spacelab unique and made that particular era that we marched through unique. Now the obvious thing is that the user community or the science community want to carry that same thing on the Space Station. I don't know if that's enough. Those are some of the uniques anyway.

5. Dunar One of the things we've looked at is the way in which at the end of Apollo, Marshall diversified out of propulsion into other areas. How did the development of payload capability help to develop those potentials for Marshall?

6. Craft What I'd like to say is that I'm not sure that we were responsible for starting the diversification. I think the diversification was probably always there and all we did was enhance the diversification. Even if you go back to Apollo, there were instruments that Marshall had played a role in microgravity and furnaces. We played a role in some early microwaving photos of the earth, standard take a picture of the earth. Our people had been involved in a lot of those things back in Apollo and Skylab and all we really did was enhance those capabilities. We grew them, but the nucleus of those capabilities had come back and had been developed really I think by the interest of very strong individuals within the center. You would find an individual

and a group of people who were interested in earth resources and the center had a large group of people who were quite interested in things like earth resources. You take that and you grow that into the kinds of things that we were able to do and the kinds of things that we were able to do and the kinds of things that we put onboard Spacelab, optical windows and airlocks and the capabilities of putting cameras in to look back at the earth. It was spawned by a group of people who have sort of had that and a willingness of management to let them pursue some of their dreams and desires. We had a space sciences lab where the people that worked there carried their own scientific credentials and were quite well-known in their scientific community. They were not just a group of obscure government scientists. A lot of them carried quite good credentials in the science community and their various fields. Then when you go look at space sciences laboratory, again you see this diversity of people who liked astronomy, solar physics, and micro gravity. Von Braun, for example, himself once said if he had any love of life, it was astronomy and again you look at that in the broadest since I'm not sure that he didn't include solar physics in that. Looking at the sun as a version as astronomy. I know that's not the way we do it today and the way we think. But even he, two or three times I think, had a love of that type thing. So it was the interest of our own people and the recognition that propulsion and getting up there is only part of the job.

What you do when you get there and what you can do with the capability is what's important. I think it is hard to sit around and work on the system that gets you there and not wonder what you're going to do with the system once it's there. One of the big stepping stones had to be Skylab. Skylab allowed us for the first time to start thinking and working in the scientific rhelm of doing experiments in space. We were responsible for the laboratory itself, but it's hard to work in an experiment for the laboratory and not be involved with the people who do the lab. So if you go back into that time frame, we even got involved, I did for example, in building life sciences experiments in support of the Johnson Center because we knew what the lab was, we knew what the lab's capabilities were, and we began to be able to talk about that easier and work in the lab's capabilities a lot better than anybody else. We picked up life sciences expertise, a number of us did. A number of others continued to enhance furnaces and microgravity processing capabilities. Other groups that were interested in astronomy and had flown then on balloons and worked cameras and all on some of the Apollo flights, they had the ability to continue to work those and grow those into more things that they were personally interested, larger things, other endeavors. I think it was always there. All we did was to just continue to provide the opportunity to allow somebody to utilize the spacecraft. It's hard to build a spacecraft and not think about utilizing it. Every time

they asked us to build Skylab or Spacelab or be a part of the Shuttle, you always, the first question you always ask is who am I designing it for? What does the user want? Pretty soon, you can get wrapped into helping the user doing what he or she wants.

7. Dunar Do you find, for example in getting into life sciences, what was the JSC responsibility or some of Goddard's astronomy responsibilities, was there tension between the centers in terms of moving into their turf?

8. Craft No, in fact of the early day of the life sciences stuff, I and we, the center, sort of did that in a subcontractor role to Johnson. In fact, we did it in concert with as opposed to in competition with. We worked with them and with their desire promise. They just didn't have the ability to build and do some of the things that we had the capability of doing in the labs and we could do them with civil service which was cheaper even in those days.

9. Dunar Was Goddard another story since here's a manned center getting into an unmanned . . . ?

10. Craft In my recollection, and it may just be only mine, I'm not sure Goddard ever fancied themselves until the Spacelab program came along, of really wanted to get involved in manned spaceflight. When the Spacelab program

first started, Goddard made a very significant to get involved in manned spaceflight, i.e. astronomy, again solar physics, high energy astrophysics, the typical things that you normally think of as unmanned kinds of programs. They had been very successful in their unmanned programs in those areas. For about a period of about three years, Goddard worked some experiments to be flown on Spacelab in the astronomy area to go onboard shuttle. Shortly after that, they got, I think it's honestly a difference, and I'm going to use the term mentality. I don't mean to imply lack of capability. You do something in a manned program, you think different than if you do doing something different in an unmanned program. You have different specs and standards to design to. You have different hoops you have to jump through from a safety standpoint and that type thing. But Goddard quickly got out of most of the Spacelab work. They had a little bit, but very quickly backed away from most of the astronomy oriented Spacelab missises, and we picked them up again because we had the capability from the earlier days. We were able to pick up the astronomy instruments, continue to work with the P.I.s to get them developed and go fly them. We actually did that. Astro-1 was an all astronomy, big astronomy mission, and we're going to fly that mission again real soon.

11. Dunar Did you find, could you describe maybe the process for Spacelab I in particular since you were so

involved with that, the process of defining the experiments and how you worked with maybe scientists at Marshall and external scientists in planning the nature of that?

12. Craft I mentioned earlier that the basic process is that NASA makes a top level decision of what's the mission primarily going to be dedicated to. In the case of Spacelab I, it was an international decision as what to what it would be dedicated to. As you might expect, our interests were a lot of microgravity. Everybody wanted to fully display the capabilities of Spacelab on the first flight. It was an awful big task we were taking on but the mentality of everybody was "Hey, lets show everything that it can do, use it and let it be called in a sense, a verification flight." But nonetheless, we, ESA, our science people in Washington, decided what disciplines we were going to fly and as I said earlier both agencies put out announcements of opportunity to a select of those. The announcements of opportunity process is one in which you go to the science community and you say "Basically what would you propose to do in the area of astronomy, IR astronomy, and what would you propose to do in UV or X-ray or whatever given the capabilities of a given Spacelab flight?" You go to them and allow them to come back with proposals and we did that. Both NASA and ESA did that for both Spacelab 1 and 2. On Spacelab 1, NASA primarily emphasized almost each of the science disciplines in Washington. When I say in Washington, the way NASA

headquarters were set up OSSA, we had something just about in every one of the science disciplines, all the way through microgravity, all the astronomies, and even technologies. The process was one of allowing the industry to propose. I don't remember the numbers exactly, but I think we had like three hundred proposals from NASA scientists. ESA had about five hundred from all their countries. We ended up selecting something like, I think we selected thirteen experiments on the NASA side to fly. Experiments are major instruments. They had a lot of investigations that were done inside these capabilities. ESA flew about twenty-five. Generally, I think we had like thirty-eight instruments onboard and something in the neighborhood of seventy to ninety investigations and these are different samples, different targets, this type thing. On Spacelab 2, I think they flew about 13 instruments. The way we developed the instruments, we primarily let contracts to the user community where we could. We would go to universities, University of Michigan, Stanford, we went to the various universities in the country who were the sponsors of the proposals and we let them build them. We funded them with NASA funds. We at Marshall participated in oversight of the development of the instrument to make sure it met the specs and standards of this first time we flew a Spacelab kind of thing. As you have to understand, all the books and everything had to be rewritten now because we'd never flown a spacecraft like Spacelab before. But we worked with the

user community, each of the labs had people assigned to monitor the experiments as they were being developed. We brought many of them in here to be tested. We escorted many of them to the Cape to get them integrated into Spacelab. Our people at Marshall participated in the test and checkout of many, many of the experiments. Other cases, other NASA centers stepped in and developed some of the experiments if they had a more elegant way to do it. As I said earlier, some of the life sciences we did. A lot of the life sciences stuff on Spacelab was done by Johnson. The general process was, everybody showed up at the Cape about a year before flight. The experiments were brought in by their various scientific teams. We would let them check the experiment out initially in an off-line capability and then we'd bring them into a room and just make sure the instrument had met the transportation environment and still worked. They would do some checkout and they'd turn it over to us and along with the Cape and it was integrated into a Spacelab rack if it was inside the module or integrated onto a pallet if it was outside. Some of the most memorable times of those days was the close working relationship we had with the European Space Agency. I think most if us dearly appreciate that and have a lot of fond memories of it. Initially, it was very difficult. We were all engineers. We all were taught the same equations, the same principles, we applied them differently. The language was for sure a barrier. Most of us in he United States, we

speak English to some degree. We speak American. Some of us don't do a real good job of that. Working into their cultures, into their language was difficult. But with a great deal of tolerance on our part and theirs we pulled together and made a real good team. The example of IML-2 flying today is just a continuative example of the kind of thing that we worked with the European Space Agency now for over twenty years in developing and flying Spacelab and scientific experiments. I don't know if that's enough.

13. Dunar You said that you worked on the same principles but applied them differently. Could you think of an illustration of that?

14. Craft Yes, there were a number of different cases. We all read the same books on materials for example, but had different ideas about what the limits of the materials were. The way we fused and used wiring inside a spacecraft. NASA's a little more conservative than ESA was. ESA had very little exposure to manned spaceflight working in the environment of human factors associated with the crew doing things. It was a great deal of give and take. How big do you make this? How do you design it so the crewman can operate a switch, turn a knob, release a handle? That type thing. There was a lot of infusion there. We were dumping into them in a lot of cases. There were other instances where cultural differences, we would go to a lot of trouble

to test. I can remember one. The Japanese had some experiments on the early flights and our German friends. We did a lot of testing to verify that something worked. There culture was it's going to work don't worry. So you might obviously understand that very quickly there was a "Hey, what are we going to do here." We always test to make sure and the other cultural makeup says "We designed it to work. That's the way we work. That's the way we do things." Well, we design it to make it work to, but we weren't quite as willing to step out on a limb. It was just part of a cultural makeup especially the folks in Japan had participated. I appreciate that, and I've learned a lot from them. They do a lot of up front work and trust their people. Trust is not the right word. Have a great deal of responsibility that they put on their people to make sure that everything is done so that it will work the first time. We at NASA probably had a little bit more of a pessimistic approach knowing that Murphy was out there somewhere and Murphy will get you no matter how good you do the job sometime. It was interesting to watch the cultures come together over a period of time. No matter how hard they worked to make sure that nothing ever happened, things did happen. No matter how much we tested and tried our approach, still when we got to the end, there were still things that we didn't test for that still caused us problems. But it was interesting to watch our culture and our teams grow together to when we work with them today

there are no longer the great tug of war in terms of specs, standards, approaches, testing, verification of design. The barriers are not there anymore. But it was interesting to watch those two changes. We changed and they changed. It was just interesting to watch those.

15. Dunar Could you, I'm not real clear to your description of the process of integration on Spacelab. To what extent does instrumentation drive experiments, or is it the other way? Do you develop experiments first and then instruments?

16. Craft A little bit of both ways. A lot of times what we'll do is we'll develop an instrument and the instrument would be developed because we know that another, let me pick one. Say we'd build a one-meter telescope in a certain spectral range, and we build that, or the agency builds that, because it knows that there are hundreds of astronomers that would like to operate a telescope of that range in space. What you do is, we would work with those hundreds to develop, I'll call it a generic telescope, and what you do then is allow various people to come to the back of the telescope and put different instruments in the focal plane. A lot of times what happens is a capability is there and the experiment is really utilizing that capability to look at a given target and that's what it is. Then when you go to the integration process where you take and integrate basically means bolt the instrument onto a pallet or into a

rack if it's a rack mounted kind of instrument and connect it to the services to give it power and give it a data stream and all that. The integration process just physically putting it in there. The biggest problem that we had in integrating Spacelab with the large number of experiments that it always has is not so much making sure that one experiment will fit into its slot, but then when I put 25 of them into that same mission, into their slots, do the 25 all work together. We knew each one by itself would. The process of integration is really making sure that the 25 will work together. The other part of your question, are there some instruments that come first or the experiment comes first, the one I just gave you is an idea of an instrument comes first. There are a lot of times where the experiment and the instrument are basically one so they are coming on together. They are single ended, single pointed, single science thrust. They're really not multi-use. They're going after a specific answer to a specific phenomena that somebody wants to study. So the experiment and the instrument then are normally just considered one. It's not really usable for anything else.

17. Dunar You mentioned earlier one of the things you've worked with was instrument pointing systems. I remember reading a little bit about some of the problems in the development of one of the early high pointing systems.

18. Craft Well the IPS which is on Spacelab 2 was probably the most complex pointing system that we'd ever tempted to build. The European Space Agency again built that as part of the overall capabilities. Do you know what Spacelab looks like and all?

19. Dunar Yes.

20. Craft It was recognized early that the Shuttle itself being able to point as a spacecraft was crude at best and that if you were going to really hold on a given target in a celestial sphere someway, you had to have some secondary pointing. The IPS, as I said, was probably one of the more sophisticated that anybody had every attempted to build. It was large. It had to operate on a rather unstable base of the orbiter itself. It had to swing outside the cargo bay so you began to worry about safety of what if it doesn't come back down, the computers to control it and the control theory to get it to really hold in there and do exactly what you wanted it to do and to fly those in space, and the size of this. We'd flown small pointers, but the size of this thing, it was a massive pointer and it flies. I mean you could have three or four one meter telescopes mounted to it. It's a big pointer. It was really again more of a size problem. But coupled with the size problem of bringing the pointer technology, it was just big. You had more intertia when you were moving things, motors, the torquers, the

wiring, the structural aspects, bringing things across the gimbal. Instruments of that size a lot of times needed extra cooling and you just can't get a lot across the gimbal because you begin to load the gimbal if you put a lot of stuff across it. That's the kind of things that we faced. We were just taking a giant step forward in terms of capability.

21. Dunar I want to make sure I understand this because I think this is important.

22. Craft Yes.

23. Dunar Does this provide essentially a platform through which several different telescopes can point in several different directions?

24. Craft No not in different directions.

25. Dunar They all have to be aimed in the same location.

26. Craft They could off the access pointed, but what it was, or what it is, there's a little model of it over here. What it does is, this is Spacelab 2. It's coming apart a little bit. This thing's unplugged. There we are. It's fixed. What it basically did, is each had developed this to all the gimbals, three access pointing and this structure.

Then you can come on with various kinds of experiments and mount them to that structure.

27. Dunar This whole unit would be the IPS?

28. Craft The IPS itself is the gray area.

29. Dunar OK.

30. Craft The experiments are the blue. You build onto this front end of this IPS, this [338?] form area we call it right here. You can add or build on whatever experiments you want. You just bolt them on. It's like bolting them on [339?] you bolt them on to the front. You just have to have the structural capability to hold it. Then when you get in space, this whole thing tilts up and you point all of these, and you can hold them in row [342?] this is three access [343?]. OK, what else.

31. Dunar Could you just comment a little bit on about how all this payload work, both related to Spacelab and other work, affected Marshall's capabilities over that period? Well, if we take a period from '69 up to '89, say a twenty year period.

32. Craft When you say effect, I'm not sure which one to talk about. Obviously, we put more people to work and

working science instruments. We had more people working payload related items, we had more people looking at how you operated them. We had more people building software programs. We had more people worrying about training. And what you saw is the Center take another step forward in diversification. That's why I said earlier. The diversification, we didn't start it, we just kept it. [interruption for phone call]. All we did was just further something that started. During the '70s and all as the shuttle was developed and all, and we made it through some of those initial development things of the STS some of the engineering capability became free to go work the science side and work the Spacelab. All we did was to take people who were electrical engineers, mechanical, and etc., aeronautical and turn them as opposed to designing as they finished the design of the shuttle, we just merely refocused them into some other areas. But the basic capability of somebody knowing that we knew how to build a telescope or that we knew how to build a furnace or that we knew how to operate them in space or build a spacecraft, that was all put into place many years. All we did was just to continue to grow it. It was an evolution of an embryonic thought that had started way back in Apollo.

33. Dunar You mentioned that back in the early period, that scientists were self-motivated and driven I think by those individuals that were developing capability. As time went

on, did the people involved in payload development foster for the scientific development of the center. Do you think . . . ?

34. Craft Yes. I sort of liken it to any organization. I don't care how small or big. An organization will always tend to grow. You take an embryonic thing, and the organization will tend to grow. It will tend to foster itself. UAH is a good example. You'll continue to tell how good you are. You'll try to build your History department. You'll go and you'll gather, and you'll grow off of some embryonic, maybe one guy who walked in one day and said Chancellor, sir we need a history department at UAH in Huntsville, and it grows out from there. And you'll probably find out that at your department as we did here at NASA that there's a lot of people with varied interests. Everybody doesn't have exactly the same interest. Everybody here didn't have exactly the same scientific interest. We had people who were materials experts that thought that going into the microgravity aspects of space would allow them to do things that we never thought about doing. Early we envisioned things like factories in space. Later, we have come to find out at least to this particular point in NASA's history, we've come to find out that this is still a fantastic way to do research. It's probably not yet ready for manufacturing in space because the overall infrastructure for doing something like that just still

doesn't exist. I don't know how else, I don't know how much farther to go.

35. Dunar Could you then, I guess especially with Spacelab I since that was your project, sort of summarize what the greatest achievements were there and what you see what were the greatest experimental success maybe.

36. Craft I think the greatest achievements, from my standpoint and I think from NASA's, we probably internationalized NASA. It was probably the first major step in internationalizing America's space program. It has continued to internationalize it, and it has shown us the way for space station which is obviously international in its nature now, far more than just ESA. We did, during that same period using those same people internationalized with the Japanese, so really the coalition with the exception of the Russians, one of the biggest I think achievements was internationalizing space which I think is a good way to draw the nations together. It's a peaceful application of our technology. I always think of that as one of the most, and I cherish that as one of the most. We took a major step in the capability of scientific experiments in space. We were no longer, everything had be microminiaturized because we didn't have the capability. We took a giant step with the Spacelab program and the STS. We took a giant step in our ability to put massive amounts of scientific hardware in

space. We entered into an era where the scientific can go fly. It is something we always talked about even from Apollo. Can we ever fly the man on the street? We have literally flown the man on the street many times now in the Spacelab program. They are effective. They've done a good job, and it's a continuing program that I think it's the wave of the future. We do have to let the scientist himself get up there. We can always be pretty good serrogates, but we can never be perfect serrogates for them. I think letting them fly is one of the major achievements. I guess that about summarizes it. I don't know if I would throw anything else in there. I may be missing something in there I don't remember, but those are the ones I remember the fondest.

37. Dunar Has this gone some way then toward winning the argument in terms of manned space vs. unmanned space experiments?

38. Craft I'm not sure, in my mind, that there is an argument. The argument is there, but the practicality is that there are some things that man can do in space and we've proven it. There are capabilities where man can interact with his science and get more out of it in a hands on kind of environment like they're up there doing today. There's no question about that. There is a place for the unmanned. No question about that. They both have their

place. They both have the area that they ought to point toward. I'm not sure in my mind if NASA can exist in the eyes of the American public without the thought and the romance and all of manned space flight. You can say whatever you want to about it. Man can still contribute and do in space, there's not question about that. But each one of us are far more excited, I think, and I know me, I work for NASA. We're far more excited when man is involved as opposed to somebody saying here's a picture from a satellite and we know that we have pollution in the upper Tennessee river. That's obviously of interest to us. No question about it. It's obviously of interest to use to pick up a cellular phone and it work and would be able to talk through it maybe through a satellite in the near future to somebody anywhere on the globe. No question about those kind of capabilities we just sort of take for granted unfortunately. But I think the thing that still captures the interest is the, and you watch it in space camp out here. I saw a young child last night give a better plug for NASA than NASA gave for itself. It was a little 10 year old boy, and he seemed to understand more of what we were about than we did. He put it in 10 year old terms, and probably a lot of people listening to the program on that particular news cast probably understood more of what he said than if you or I got up there talking about it. They sort of look at us as being biased and jaundiced about it, and I guess we are in some ways.

39. Dunar Can you think of any that we might use as an illustration of any important technical challenges that were overcome in these programs, by the Spacelab program in particular?

40. Craft Well, going to a 14 psi standard environment atmosphere was a major challenge. Let me put it another way. Providing that shirt-sleeve environment in Spacelab was a major challenge. That's probably one of the biggest. That doesn't sound like much, but that was probably one of the biggest.

41. Dunar Why was that so difficult?

42. Craft Well we designed our spacecraft for 14 psi and we'd never designed them. They were 5 psi spacecraft. They were all oxygen. There were just a whole lot of things that we had to overcome with the nitrogen and oxygen mixture and provide the crew pretty much the atmosphere that they breath here on the ground. There were a lot of materials issues associated with it and that type thing.

43. Dunar Let me just ask you one last thing. Are there other individuals that you would suggest that I talk to concerning payload development.

44. Craft Yes. Rein Ise. I don't know if you know Rein.

45. Dunar My colleague has talked to him.

46. Craft Rein has been one of the fathers of experimental development at the center for Skylab and Apollo eras. Dick Marmann in my old shop.

47. Dunar We have an appointment with him on Tuesday.

48. Craft Jack Jones. Did you talk to Jack?

49. Dunar No.

50. Craft Jack was one of our engineers that followed along throughout the program with us, and he'd give you a perspective from the engineering challenges. He'd be a real good one for that. Bobby Jackson from a Spacelab standpoint. He worked in that office for many years. Sam Wall on the Spacelab side. You sort of ought to get the same story from both of those, but you might get one and not the other, but they'd both be good in that regard.

51. Dunar That's great. Well thank you very much.

52. Craft No problem at all. I appreciate it. [end of tape 513]