

**INTERVIEW WITH JACK WAITE
INTERVIEWED BY SARAH KIDD
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1. Kidd Mr Waite, I guess the first question I need to ask you, just tell me how you got involved in the space business and how you came to be at Marshall.

2. Waite: Alright. Well I got into the space business, really, first though, I finished Alabama in Mechanical Engineering in February, '51, and it was just at the time where there were very few jobs around, and I had been offered a job at General Electric, but I got a letter from Roman Haus Company that was on the Arsenal, working on a cost plus a dollar a year contract, doing basic applied research, and I went with Roman Haus on the Arsenal as a Research Design Engineer. Then about, three or, in 1954, May of '54, I went with the old [Jati Missile ?9] Development Division, you know, the von Braun team had been in Texas and they came to Huntsville. I went with them, and I was in the developmental test with the old Gati Missile Development Division. I really, I was with Marshall, well Gati Missile Development Division, then we became Army Ballistic Missile Agents, and then I believe it was in 1960 they, ABMA became the real core of the Marshall Space Flight Center, and we, 200 of us got selected to set up a new ABMA, sort of drafted to set up a new ABMA, and I headed the developmental test activities for the new ABMA. Over the next two, our main program was Pershing I, it was our biggest program, so I was out of the Space Program for that time, but generally on the Defense side, and for two years I helped set up a new ABMA, and then at the first opportunity, I went back home, you know, after I helped them out for two years, and then I went back to Marshall, and that was, I guess, in, oh let's see, in 1962. I came back and von Braun had an executive staff at that time, and our director was Hans Maus, was Director of Executive Staff, and I was chief of what we called

Advanced Planning Office, on the executive staff on von Braun's staff, and we developed all these Center long-range plans in the office you know. We were looking at Mars missions, Venus missions, dual missions and everything, and so I had the Advanced Planning Office, and Dr. Ernst Stuehlinger had what was called then a Research Projects group, later Space Sciences Lab, and that group, our groups worked together generating the Marshall long-range plans. I worked on Dr. von Braun's executive staff until about the time he went to Washington I guess, til 1964, and then I was always you know, in the various programs, but uh, the next program I was on, Leland Belew had Skylab, you know, which was really our first Space Station, and I had the experiment program on Skylab, with the exception of one that started out as one that started out as a separate payload that was not going to be a part of Skylab, it was going to be a free flyer, the Apollo Telescope Mount, the solar experiment that was not going to be a part of Skylab, and later we decided to mount it on Skylab, but I managed the Skylab Experiment Program. After Skylab, I was Fred Spear's deputy for the Space Science projects, and our biggest project was the HEAO series, High Energy Astronomy Observatory, and we had what we called a HEAO A, B, and C. OUR biggest program was HEAO B, and I was Fred Spear's deputy for the Space Science Project Office, but with the southern crash, our Project Manager on HEAO B was killed and so I took over, in addition to being Fred's deputy, as the Project Manager on HEAO B. That's one of the, its the same type thing as what they call Advanced X-ray Astronomy Observatory now, with just a small, smaller version of the AXAO, and we called it HEAO B. After, I stayed with Marshall until HEAO was completed, and at that time I had an opportunity for either an Early Out, or whatever jobs were available at that time, and at that time it looked like AXAO was many years away, and so I decided to, I really enjoyed Marshall, and I decided to take an Early Out, and I went with Teledyne Brown on their Space Program for a couple of years and then, it was the

head Advanced Programs for Teledyne Brown, Advanced Space Programs. Then, 1984 Bob Face and I decided to form an engineering company, and we've been doing a lot of business with Marshall and the Aerospace Industry here since. But Marshall, it's just really, if you work at Marshall and retire from Marshall, you're just a member of the family forever, and it's just a close-knit group, and we're invited to the annual picnics and dances and all the parties, and then Jack Lee, the Center Director, we have what we call what we call the NASA alumni, Lee, you know, really supports the Space program, and Jack Lee briefs us at least annually, and you just are always a part of the family. It's just a real fine institution, and I really enjoyed working there, and I enjoy working with them still and socializing with them.

3. Kidd Alright. So your career at Marshall has been very positive for you.

4. Waite: Always, I really enjoyed Marshall and all the work we did there. It's just been great, and we have, our biggest contract is with Marshall, we have a Configuration Management, Data Management, and Design Review Activities for all the in-house activities.

5. Kidd This is for my personal benefit. When you're working on the Skylab, what, specifically I guess, were your . . .

6. Waite: Yeah, yeah, let me tell you a little bit about that, because that was the most fun thing I did.

7. Kidd OK.

8. Waite: We had over a hundred Huntsville investigators and co-investigators on Skylab. We had a lot of different experiments on Skylab, and a lot of the things that you have now, is all, we're getting that from the long duration shuttle flight. Well, we had a 28-day mission and one that was supposed to be a 56-day mission, I see Owen Garret quite a bit, and you need to talk to Owen if you haven't. Dr. Owen Gary is the Vice President over at Teledyne Brown. Owen was one of our, he was the science, on the first - second Skylab Mission, he was the Scientist astronaut, and just a tremendous person, and well, what we did, we were responsible for, my office was responsible for the development of all Marshall Skylab experiments and the integration of all experiments, because we had some JSC experiments, we had some Langley experiments, and we had some air Force experiments, but we had, we worked, my office, I had an experiment integration engineer for each, assigned to each experiment, and sometimes the experiment would be small, and you might have two or three assigned, but responsible to work with the Principal Investigator, and see that the experiment could interface with Skylab. Make sure that no failure mode could jeopardize the safety of the primary mission of the crew. We worked with them, even if it was not a Marshall experiment, worked with them any way we could on a consultant basis to help them with the development of it. Now we developed in-house at Marshall a lot of the, a number of the bio-medical experiments, you know, like the, we built in-house there and all, Bob Swinghammer was very heavily involved, involved still out there, but we built the Urgometer, we had a very sophisticated Urgometer where you could check out the metabolic rate and everything. They had a lower body negative pressure experiment where you had a band around and you could evacuate the lower part of the body, so they could study, we were quite interested in the effects, you know [? 113] in long-term in space and reentering, and I'm trying to remember the longest Skylab mission, but uh, we had one that may have gone over, I know we had one 128 days, the third

mission, I'll try to get a little more [?115], but Skylab was a real interesting one. But another, we worked with all these PI's, Principal Investigators and co-investigators with all the universities, and it was one of the most interesting things in the world. They are wonderful peoples, and scientists are sometimes quite different, I'm, my oldest son is a Ph.d. Space Physicist, and they, they're just great to work with and a little different.

But another thing we did on Skylab that was a lot of fun and just really made you feel that you had really accomplished something. We had a competition nationwide for student experimenters, grades nine through twelve, and we had the National Education group make the final selection, and they selected twenty-five Skylab student experiments. We got them here to Huntsville, and worked with them on the development of their experiments, and then back for our design reviews and built their hardware for them here and all, so that there were twenty-five, and there were all sorts of experiments, Jeane Leaventhall, for example had, she was studying UV, ultra-violet radiation emissions from Jupiter. We had everything from, we had some bio-medical experiments, we had, I'm trying to think of whether it was mice or whatnot, but you know, some, I'll give you some literature on Skylab Experiment Program, but Jeane and I had them down and their families in our home several times, and the children and their families were down at the Cape for launch, and then we had, I guess, our fifteenth year Skylab, what we call a Revisit, invited everybody back to Huntsville, and then had a big program, and we, I had been staying in contact with all the students all the time. Jeanne Leaventhall ended up with a, she is a neurosurgeon, and one is an astronomer in Hawaii on the Big Island, Hamilton. So we have tried to keep up with them over the years, and we are having a Skylab Revisit the twentieth this next year.

9. Kidd Oh that will be, gosh, all the students who had experiments and then all the management team.

10. Waite: Yeah, and we'll try to get everybody here. I'll try to, I've got a couple of books and I'll see if I've got them here. If I do, I'll loan them to you, so you could, you know, I'll get them back from you sometime, but Skylab Experiment book and maybe one on the students.

11. Kidd OK. Alright. I appreciate that.

12. Waite: But we had a lot of fun, and I think it was a real good thing, that Skylab Student Experiment Program. But see we had a lot of interesting experiments. We had one where, you need mobility when you do extra-vehicular activity, EVA, and we had a backpack experiment we called, I don't remember the number for sure now, but anyway, we had a backpack experiment where the astronaut flew around inside the workshop, the Skylab workshop, and then that was later developed for pulling in for EVA. But see, the workshop was, we started off Skylab, we thought, we started off Skylab, we were going to use the Saturn 1B, you know the moon vehicle was a Saturn 5. The Saturn 1B was a smaller vehicle, it was twenty-two feet in diameter, but the upper stage on the 1B was hydrogen storage, you know the hydrogen tank was extremely large, and that was, it was that tank we used, and we were first going to put some scars in it, you know, some fissures, and then take everything up in what we called the air-lock module and multiple docking adapter, and then we were going to launch it into orbit with a Saturn 1B, which had eight H-1 engines 188,000-pound thrust each, but it had a, I don't remember the exact capability the low-earth orbit, but maybe 50,000 pounds, something like that. So we started off and then the moon program was so successful that a Saturn 5 became

available, that was the F-1 engine, and 5 F-1, 1.6 million pounds thrust each, 250,000 pounds capability load, low-earth orbit. So the orbit we went, Skylab launch was, you know we had orbited something between 150-200,000 pounds, so we, instead of having what we call the wet workshop, where we were going to use it as a propulsion stage and have hydrogen in that tank, we just, with Saturn 5, we just went two stages to orbit. Saturn 5 was three stages, and the third stage was the S4-B stage, and we used the third stage, non-propulsive, and just built it up into the Skylab Workshop. It was twenty-two feet in diameter and it had this large hydrogen tank that was totally outfitted on the ground with all the experiments and all, of course you can go over to the space and Rocket Center and go through an engineering model, have you ever been through it?

13. Kidd I think so.

14. Waite: You'll see the lower body negative pressure experiments, you'll see [? gometry 196], you'll see, we developed showers for, you know, taking a shower is sort of an interesting thing, we had a human vestibular function, one of the experiments where we would spin them around in a chair, a human vestibular function, but anyway all those experiments are there. So all that was outfitted on the ground, and then the uh, oxygen tank was really used as waste disposal, you could say it was a septic tank. If we had, we had an airlock, so any trash and all was disposed of into the, what would have been an oxygen tank if it had been a propulsive stage. That's just a little bit about Skylab, but it's been a real interesting program, and it was, no doubt, our first Space Station, and it was quite a large program, and you, there are, some of the astronauts, well, just a little bit how we work. For every mission they, we had, I had a focal point to work with from the astronaut chronol experiments. They worked with us always through on the experiments on that particular flight. I

mentioned Owen because Owen worked with us extensively on the second flight, but we had somebody on each of the flights there. Let me let you ask any questions, and then I'll just see what books I have here that I could load you to look at.

15. Kidd OK, One of the things, especially I guess with the Skylab that we're kind of interested in was what exactly was the relationship between Marshall and Johnson during this period? When you're talking about doing experiments, was there a degree of competition between them or . . .

16. Waite: Yeah, let me go on to that a little bit, but the expert on that thing is Leland Belew, who was my boss on Skylab, the Project Manager. When we first started out, there was a lot of competition. We started having what, I guess, first time we ever had them, we'd have hide-away meetings, and the main ones involved, you know there were some Langley experiments and Lewis experiments and all, but the ones that, other than furnishing individual experiments, we had Johnson Space Center, and Kennedy Space Center, and Marshall. From the experiment side, we started having, not very often, but we started having hide-away meetings where we'd get together and for several days, just work problems. You'd be there together at a hide-away meeting somewhere and working the various problems, and we got to know each other and trust each other, and it just started working really good. We worked very closely with the medical people at JSC on the medical experiments we developed. We had a major contract with Martin Denver, and I had a group supporting the work we did from Martin Denver, and also Martin Denver built some of the experiment hardware. But just overall, it was very competitive at first and it started out that we worked quite a bit on roles and missions, and the thing that really probably helped a lot, if you looked at a space lab mock-up, let me get just a couple of things here.

17. Kidd OK.

18. Waite: Glad to bring you some in, but I don't have anything with me. [Knock at door] Come in.

Unknown: Jack, I'll see you later, I'm going to pick up some information.

19. Waite: You'll be back in? We'll go over it together.

Unknown: Right.

20. Waite: Ok, fine. This is a fragment of one that re-entered, a little piece that they sent us here. We had a rather major problem when we launched Skylab. We thought we'd lost it for a few days. These are solar panels, and there should have been one on the other side.

21. Kidd Ok, is that when it didn't open up, or something?

22. Waite: Well, what happened was it didn't vent properly and when it, during the ascent, you had pressure in a little compartment there, and the vent didn't work properly and the, as you got into the vacuum of outer space, it just blew off and we lost the whole solar panel, and it blew a lot of the protective thermal shield here. I guess we worked around the clock for probably three days without sleep trying to get everything oriented so it wouldn't overheat. Now we had made a decision just a month before launch, this is a solar experiment, the Apollo Telescope Mount, it had about five solar experiments. Up until a couple of months before launch, this had

it's separate power supply and the workshop had a separate power supply. Knowing that, with a loop, we might get into trouble, something might go wrong, we'd better inter-connect these, and we did. And it saved Skylab, because we lost this but we still had plenty of solar power with this plus this, and we also sent up some, on a, when we sent the crew up, we sent a thermal curtain, and you know, where the meteoroid shield had blown off and the insulation, we actually, the astronauts EVA'd and put a thermal shield around it. But I was going to mention, you asked me what kind of conflicts there were between the Center's. When it started out, there is a multiple docking adapter down on this far end, and you can, you know you had, i don't remember how many ports, one on the end, at least two more, and I can't remember, at least three ports. We never did have over one vehicle up there at a time, but we had multiple ports. Marshall always had the responsibility of the MDA, multiple docking adapter, and the workshop itself, but there was an airlock module that was pretty much the brains of everything that was in between the multiple docking adapter and the workshop there. It had all of the controls for the environment, the environmental controls, and power circuits, everything was controlled from the airlock module. That program was contracted from JSC to McDonald in St. Louis, and the multiple docking adapter, that was a JSC contract on the airlock module. Marshall had the multiple docking adapter contract and it was also at McDonald. Now somewhere in this time, Douglas Aircraft Company and McDonald combined, and you have now McDonald Douglas. But Marshall was developing the workshop and outfitting it, Marshall was doing the multiple docking adapter, and JSC was doing the airlock module, and they had direct responsibility for some experiments, like Earth Resources Experiments, and so. As we went along, JSC got more and more interested in the shuttle program, and finally got to the point where early in the Skylab program, fairly early, they just said, "Look, Marshall, we are so snowed with Shuttle development, why don't you just take over

the airlock module. You already have the multiple docking adapter at McDonald." So we did. But it started out a lot of jockeying and fighting at first, but finally ended up to the point where we had such harmony on the experiment program, no problems at all, and JSC was so busy on shuttles, they even had us manage the MDA and the, the, what did I just . . .

23. Kidd The airlock module?

24. Waite: The airlock, right. So Marshall ended up with, basically, the total responsibility, other than of course, Mission Offices is always at JSC. The Earth Resources were all at JSC, and they were heavily involved in the medical, and some of them, one or two of them were developed there, and the others were developed with very close coordination with them by Marshall.

25. Kidd On some of this, how much of the Skylab stuff that I guess Marshall was in charge of, how much of that was in-house, how much was contracted out?

26. Waite: It ended up really, as far as any in-house cutting of hardware, that was basically zero. The Wet Workshop Marshall was doing in-house, you know, where we were going to launch it on a 1-B and the propulsive stage was going to be [pasivated] but after we went to the Dry Workshop, I don't remember anything. A lot of, a lot of involvement of Science and Engineering in the design, the design reviews, the testing, and everything. Heavy involvement with the contractor from Science and Engineering at Marshall, but I believe all of the hardware was with a contractor. The Workshop was McDonald, as we ended up, McDonald Douglas, and now the multiple docking adapter and the airlock modules, and . . .

27. Kidd Do you think more should have been done in-house, or do you think that this was a good relationship?

28. Waite: It was a good relationship, and Science and Engineering was so heavily involved in the design.

29. Kidd It wasn't like there was no connection between Marshall and the contractor? You all were still working together?

30. Waite: We had working groups and panels, and the final technical decisions of there were with, you know, Marshall Science and Engineering in the Project Office working together. We had an arrangement where we had, on all programs when I was working out there, and probably still do, we had a Chief Engineer that was out of Science and Engineering, but co-located over with the project, and if we needed, any resources that we needed from S & E, we went through the Chief Engineer for those. But I think it's probably a good thing every once in a while on a smaller project that involves sort of every aspect but not such a monstrous project, that you do it in-house. But its varied, we tried to do, I worked out there thirty years, over thirty years, and we've started a lot of things in-house, but most of the time, we ended, ultimately went to the contractor. But we were heavily enough involved, a sort of von Braun's philosophy, and we tried to follow it through, we wanted to have the capability of doing anything, but you really want to carefully select programs you do in-house, you don't want to try to manage something you don't really understand. And to really understand something you need to do the total job, so you have to carefully select those. I think Marshall has done a fairly good job of that. You know, they did a lot of more of this Apollo Telescope Mount in-house than, you know, hands on type things, now that was a big program. From over the years,

they've carefully selected, the Wet Workshop, the workshop itself, all the initial design was done in-house, and then turned over to McDonald Douglas, and Marshall continued working with them real closely. But some of the people that were involved in about every decision that was ever made on Skylab, Leland Belew, and we had several program managers at Headquarters that managed all the activities of Marshall, JSC, and Kennedy on Skylab, and, but the final, well, we had the, he was here for this Space Station not to long ago, I can't think of Bill's last name right now, but he was the final Skylab manager for the last several years of the program. Uhm, I'll give you his name.

31. Kidd Ok. What do you think were the legacies of Skylab, or more specifically the lessons that were learned?

32. Waite: Well, you know, we did publish a document one time on "Lessons Learned on Skylab." One that's still working out there that stayed on the program and finally published the "Lessons Learned" was Rein Ise, out at Marshall. You ought to talk to Rein, definitely.

33. Kidd OK.

34. Waite: Now Rein also, on Skylab, managed the Apollo Telescope Mount, which was, this was going to fly separately with commanded service modules, it started out that way. It was finally mounted on this, and these were folded up, and this is a hinge, and it was launched this way with a shroud over it, and then after the shroud was ejected, it tilted up. But this was a rather major activity here, this Apollo Telescope Mount for the Solar Experiment Program. Rein managed that and then Rein stayed with the Program after, you know, all of the flights were over, because

you still have all the data to be evaluated, all the scientific data and everything, and Rein stayed with the program til the end. A lot of us have inputs, but Rein published "Lessons Learned" document from Skylab that I'm sure he'd be glad to get you a copy, and I'm sure there would be one in the library, but it would be really good. But, oh, you know, there were several things that uh, uh, I hadn't thought about in a long time. Probably from the experiment side, some things we learned real fast. You know, we started out and I hired through Martin some medical doctors to interface with the medical doctors at Marshall, a Ph.d. astronomer to interface with the astronomers, whatnot, and we soon learned that they didn't need help with the science, and they didn't need, in their field, they needed a good Systems Engineer to interface with them, so we very soon on the Skylab Program, we had a group of real top-notch systems engineers that worked with, you know, lot of times you have some of the best scientists at some of the small universities, and the NASA documentation would scare them to death, so we had an experiment integration engineer that would go there and work with them, and help them generate the required documentation. It's, there's just a certain minimum amount of documentation you've got to have on a big program, but you can't burden brilliant scientists at small universities that just doesn't have that capability to generate requirements, experimental integration documents and whatnot. So, we had some systems engineers to interface with them, and were sure that they developed experiments that could be integrated on Skylab, for instance, all the resources required operating experiments, and we did a lot of work, Marshall had the first neutral buoyancy thing, I don't know if you've ever seen the thing, but about the best thing to simulate activities at zero-G is to put on scuba diving gear and getting in the neutral buoyancy tank. We had the first tank, Houston did not have one early on, even though they had all the astronauts, they had to come here to do all the, and we did a lot of that EVA, working out the procedures and everything on the EVA here

in the tank. I remember one time, it's just a side-line but I thought it real interesting, Dr. von Braun was involved in so many things and he was so interested in everything, he kept in very good physical condition, and I remember one time we had a group of the astronauts in for the neutral buoyancy tank, and Dr. von Braun was a certified scuba diver, and he geared up and went in with them. And they were going through their activities, and you measured heart rate and all, and Dr. von Braun could keep up with the astronauts fine at that time, and when I was on the Advanced Planning Staff, von Braun took us with him when he would go on trips to Washington to the Center, not a good bit but occasionally, and we had a [? bi-count 867] then, it's a turbo prop Rolls Royce, turbo prop, Marshall had a little bi-count plane, nice little plane, held fifteen people or so. Von Braun would always take off and then come back and join us, but then he'd go back up and land it. He was a very good pilot, you didn't feel it at all with him flying the plane, very good, just a very unusual person you don't run into many times in a lifetime.

35. Kidd I don't think, there won't be another man like von Braun to come around, you know, I've heard many, many, many good things about him.

36. Waite: Yeah, yeah, he was very unusual. Now von Braun was just a real dreamer and always thinking about what you're going way out, . . .

37. Kidd Yes, he was always planning for the future.

38. Waite: And he had a deputy that was just a real hardware-oriented, conservative mechanical engineer, Dr. Eberhart Rees, and they were the best team there ever was. Dr. Rees is, I see he lives up on Monte Sano, still active. Last time I talked

with him, still playing golf. If you could get a chance to interview Dr. Rees, it would be good.

39. Kidd I'm almost positive they have, I'm sure he was one of the first ones they interviewed.

40. Waite: Yeah, and Leland Belew, for sure. Bill Snyder was the Program Manager, William Snyder, at Headquarters, I was trying to think of. He, I think, is just recently retired again. He was having some, I saw him about two weeks ago when we had the Space Station here, he was having some cancer surgery, probably has had it, I need to check on him. But that was the most fun program anyone ever worked on, and it took a long time to get everything started and everything organized, but it went real well. And you know the way they operate, we worked very closely with the astronauts on experiment development and trained them in the operation, and they knew all about the experiment, worked very closely with us, and we worked up the training program for them on all the experiments, and then during, they were involved in all our design reviews, and they then, when we had the mission, I was down at JSC at what they call the, I'm trying to think, anyway it was the Mission Ops area there, and we had three shifts there. We had a planning session, a general planning session, trying to timeline everything at night, and then a detail planning session, and then of course the implementation of, and during the daylight hours at JSC was when we were working it. We would have a conference with the crew every day at a specified time to go over problems they were having and solutions we'd come up with and whatnot. One of the first things they did when they got back we'd have probably a full-day crew debriefing where you just really learned so much about what went on. It was almost as good as having been there, although I'd still like to fly, like to be an astronaut. Anything else? There are a few

books and if they're not available in the library, call me and I'll loan you my copy. There is a volume on Skylab, a thick volume, that Leland Belew, Bill Snyder, and several others edited. There is one on Skylab experiments and then we have one that's strictly on the Skylab student experiment program. All those are available out in the library and I think would be real interesting. And then also lessons learned from Skylab.

41. Kidd OK.

42. Waite: Now then, you asked me about some of the lessons learned. I spent every night for several weeks furnishing inputs into Rain Ise. After I was out of the Skylab program, I went from that on to Atmospheric [? 613] in Space, AMPS, Atmospheric Magnetospheric [613] in Space, but Rain Ise was pulling together all of the data evaluation and all on Skylab for "Lessons Learned". I think one thing that we definitely, over the programs we worked on, you need some contractor that has the over . . . [turn tape over 623]

. . . for example, even though the program went really good, I think it would have been better, for example, the last one I managed was HEAO-B, High Energy Astronomy Observatory, the x-ray Astronomt Observatory. American Science and Engineering developed the payload and then the overall space craft and integration was TRW. I though it would have been better had TRW sub-contracted to AS&E so the government didn't, I never was real thrilled about what we called "government furnished equipment." I think you ought to give someone a total job, the prime contractor with the total job and keep the government furnished equipment at a minimum. What I mean by government furnished, the government didn't necessarily have to build that but the sometimes separately managed a big piece of the program and then would furnish it to the prime contractor.

43. Kidd The prime contractor, you're saying, should have been able to make that themselves instead of getting it from another contractor?

44. Waite: I always think just have one person, group to look to for the total responsibility for everything that's developed. You can't do that to the total extent. But we had three, and I decided I ought to retire after that one. HEAO, we had A, B, and C were totally successful. We did not have any significant failures, got all the data we were going after, were on schedule, and under cost. I decided it was a good time to retire. It might never happen again.

45. Kidd To switch gears just a bit. You were involved in the space sciences and this is just for my own information. Can you give a good layman's term definition to space sciences? That sounds kind of abstract, in a way.

46. Waite: We really just related it to everything that you can do better in space. A lot of the experiments, we wanted to go into space because you just have such a shield, sometimes it's not as good as we'd like, like the ozone layer and all. UV is really shielded. If you want to get above all the filtering of the earth's atmosphere, a lot of your astronomy experiments, your UV experiments, your gamma-ray. We did a lot of gamma ray, x-ray, UV, ultraviolet. So that's one thing. You want to get above that shield around the earth. The other thing you're trying to do
[interruption] . . .

47. Kidd We were talking about space sciences.

48. Waite: The astronomy of course is one thing and another thing that I think is really going to be fantastic is what you can learn in zero gravity. We did a lot of work even on Skylab, we had one we called the furnace. We did the early crystal growth experiments on Skylab, the very early crystal growth. I think that's going to be phenomenal. UAB, we're bidding on a little job with UAB. This protein crystal growth in zero gravity is just a fantastic promise. I think that we're going to have some real breakthroughs, medical breakthroughs, because of the crystal growth work in zero gravity.

The other area that we did a lot of work on Skylab, of course, just a lot of medical research and you just learn a lot. They even studied some of the bed rest type problems. All the medical and astronomy and then just the phenomenal thing is the earth resources area. It is just fantastic what has been done in earth resources and communications. There are a lot of things that, especially during the development, it is great to have man in the [loop ?67]. The astronauts fixed a lot of things on Skylab and changed their operating procedure and all. Now, there is so much that you can do unmanned because we've made so many advances in robotics. We learned a lot with man in the loop that now you can reprogram the software from the ground to change your procedures. I really enjoyed Skylab and man in the loop. I still though, we were able to do a tremendous of science and we were able to accomplish a lot with HEAO, which those were unmanned programs. I think there's going to be more and more activity that we can do with robotics. Space Station, you know the astronauts time, the scientist or the astronaut's time is so precious and so expensive that you still don't want the astronaut doing anything that's routine or mundane that could be done otherwise. A lot of activities, EVAs, there's a lot of preparation for Extra Vehicle Activities, and I think Space Station, robotics will really play out a fantastic role.

49. Kidd Did you see a difference, we may have touched this earlier, the way Marshall managed its space sciences other than different Centers? Maybe its relationships with their scientists? Was there something that you saw that may have been unique about the way Marshall did that?

50. Waite: There are Centers where their primary purpose in life is science; Langley, science and technology, and Lewis to quite an extent. Marshall's major role has been in propulsion, but even so, they've always had a very good space science laboratory. It never was the primary emphasis on Marshall, but I think they've gotten good support.

51. Kidd You mentioned that Marshall always had a good relationship with their scientists?

52. Waite: Yes. And you know, it's a, I don't know how it is now, but on Skylab it was a lot easier to get project money than it was for the scientists over in SSL to get money. We funded through Skylab a lot of scientific activities at Marshall that supported Skylab, and I'm not if Space Station will be the same way. We had a very good relationship. I get out to visit friends at Space Sciences Lab all the time. We had a real good rapport with them.

53. Kidd OK, just a few, I guess concluding questions, maybe just kind of general. How have you seen, in terms of overall Marshall management, did you see a change in a way the management people made decisions from the time you came until the time you left?

54. Waite: Well I saw it very different with different directors. The way I like to operate and the way I was always most successful, Headquarters were very much a part of the team. We worked together, and on Skylab, our HEAO, if we had a problem, even before I really understood it completely, I wanted my Headquarter's counterparts to know about it so they're ready to help me when the time came, and I felt like I was always, had a real good working relation with the Headquarter's Program Office on the programs I worked on, and I found them a tremendous help in getting the program done. I found they got involved when you asked them to get involved. They stayed back and let you work it out when you felt that you could better work it out here, but I always tried to keep them totally informed, and considered them always our best friends, and very very important under the team. You keep them informed, that's where the money comes from, you keep them informed and they can anticipate need of additional money for a problem or so, and you need to give them all the lead time you can. So, you know, some people are more inclined to not ever want to let anyone know that they're having any problems, they think that will look, will make them look bad. I think that's, that can get you in a lot of trouble, and I think the people I really enjoyed working with most were totally open on everything. Von Braun was just totally open on everything. Marshall's had some good managers. I never did work there while Jack Lee was Center Director, but I knew Jack forever, and uh, uh, uh, I always felt very free to talk anything over with Jack, and he was always open. I have a real high regard for Jack, I think Jack Lee has done a real good job.

55. Kidd Did you see any differences in the way each center director made decisions? Did they have a different style?

56. Waite: Most everybody does. And I think the ones that had the, did the best job got input, a lot of good input from a lot of good people and then made the decision, you know, the ones who knew how to really utilize their people. But I think the Center has had some very good ones, and Jack is continuing to do a good job.

57. Kidd Do you think, I'm going to stay on the same topic of the Directors, do you think, I'm trying to think how long you were there, were you there, and please forgive me if I get my chronology messed up, when Dr. Lucas was?

58. Waite: Yeah, I was.

59. Kidd What was your impression of him? He seems to have gotten a reputation of being sort of bullish.

60. Waite: Bill and Polly are good friends of ours, our kids went to Grissom and Polly was Vice President of the PTA when I was president, I know them real well. Bill has a little different management style than mine. He's a very brilliant guy. Bill was the first, you know, we had a lot of von Braun's Peenemuende group here, and some people resented them and felt like Americans couldn't have an opportunity. I never did feel that way, I felt like they had a headstart on us and we had a lot to learn from them, and they were good friends, and I felt like should have been in the key jobs they were in. And as Americans developed, they got their opportunity. I guess the, you know we had what, the lowest supervisor was the unit chief, section chief, branch chief, division chief, lab chief, and I guess Bill Lucas was the first, Bill Lucas and Brooks Moore, now Brooks Moore would be another good one to talk to, Brooks is a real fine person. Brooks was director of the [?Galveston 155] Control Lab when he retired. But Bill Lucas was the first American section chief, first

American branch chief, he and Brooks Moore, one or the other. Then of course Bill became head of Program Development and then Deputy Center Director, and then Center Director. There are, a Center Director, and you know this can all, can vary from time to time. If you have to decide between somebody who is a genius technically or somebody with a lot of management expertise, you know, in a role of Center Director, I would choose the management expert that knew how to select a Chief Scientist and so, in that rare occasion where you can have both, it's fantastic. Von Braun was an example of both. Bill Lucas, who is a very brilliant person in materials, and everything there, I think he did a good job of getting the people to compliment him there.

61. Kidd OK.

62. Waite: The one area where Bill and I did not break the same way, I'm a very open person, and some people would want to try to solve a problem without ever letting anybody else know that the problem existed. I don't, I want to be real careful there, because Bill's a real good friend of mine.

63. Kidd No, no, I understand.

64. Waite: You, is the tape still running . . .

65. Kidd Yeah.

66. Waite: Well he was, he just in the Materials Lab, he did a fantastic job there, and we worked real close, and he kept, you know, the internal people, there was a good interchange of information there, no doubt, within. I liked to have that same

open thing with Headquarters. When Bill was there, we had a staff meeting every Monday, and we had staff luncheon Tuesday, Wednesday, Thursday, and Friday, [laughter] there was a lot of togetherness, and it was a good communications loop. There were, and everything was, it was very formal with everything, and with the big programs we had, it takes a good bit of formality.

67. Kidd Right, right. But even though you were saying that you preferred to be more open, and even with [176], Lucas didn't, he still would definitely want the input of all the people?

68. Waite: Oh, yeah. And we had a, good communications within the Center. We had staff luncheon and staff meetings everyday.

69. Kidd Is there anything else that you think historians should know that might be, not necessarily about Marshall, but your experiences at Marshall?

70. Waite: Oh, it was, the most fun times were when we were very much involved in the hands-on activities, and I think you really miss something when you don't get that opportunity, the hands-on activities. Just sort of an example, my brother is a good bit older than I am, he finished in electrical engineering and he went with Southern Bell Telephone, and the first thing I ever saw him doing was digging post holes with post hole diggers, and then they worked as a lineman, and then cable splicer, and by the time you got into the engineering office with the telephone company, you knew from the ground up, and when you asked somebody to do something, you knew, when you designed something, you knew what you were doing to them. In the early days, that was, you just had some wonderful opportunities, you know, for example, I was in Research Design early on, and I got carried away about

using a chrome [moli-tool steel 192 ?] 43-40, it was really good, and you could heat-treat it and it was great. But I got carried away using it. Well our general manager at that time decided maybe we needed a machine shop course for engineers, so for several months, three days a week, we stayed over for about two hours after normal work hours, and actually worked on the lathe, and all. And one of the first things they did to me, all the engineers, about six engineers at a time, and of course they gave a mild-tool steel to do something, you can't tell the difference looking at it, and they gave me 43-40, and we were making something like a vice. They finished theirs and all I'd done was just resharpen the cutting tool, because that stuff is very difficult to machine. The shop foreman finally got a chuckle out of it. I was very careful about specifying a chrome moli-steel after that unless it was absolutely necessary, because it can machined but [it's] about the hardest. And there's just a lot of things we learned by doing in the early days, and it's, you were talking about in-house projects. I think they were very important. You can't do many of them, but selectively, they're very important. I think one thing that I think is extremely important is don't ever get yourself in a position that you run out of funds before you've done all the qualifications testing you need to do. I mean, I don't remember ever developing anything that we didn't learn a lot, and we wouldn't have been successful if we hadn't tested and tested and retested, and I'm afraid sometimes now the limited funds, something has to give, and I think it should be a total project canceled out, so that you don't cut back at all on the qualification acceptance testing, environmental testing of all types, because that's where you ought to have a problem, not in orbit. You ought to shake them out [226], and we did some very extensive testing on all the programs I worked on. HEAO, there's some things you can't test like what is Zero-G going do to you. We kept eliminating stuff. We had the KC-135 aircraft, and you can get, oh, about 35 seconds of, you know, in paravolumn projectory, of Zero-G, and we did a lot of work with the KC-135 to see

what zero gravity was going to do the operation of some of these little buggers. You can't get the long-term effects, but it, couldn't be anything more fun than Space Program. I guess I had so much fun with it, my oldest son was going to be an M.D., and ended up a space scientist. He's in planetary physics, and that can get real exciting.

71. Kidd Yeah, when I first started this project when I first started school down here, to be honest with you, I didn't know beans about the Space Industry, I didn't know a thing, and I never dreamed, like with the Skylab Program, with Saturn, with the Shuttle, it's just a tremendous undertaking that they've done, and of course you were a big part with the Skylab part, but it's . . .

72. Waite: Well there were a lot of big people working on Skylab. Probably the one person who had the most to do with Skylab overall definitely was Leland Belew. He's just retired the second time, or is this month, from USBI.

73. Kidd The second time? [laughter]

74. Waite: When I say USBI, he's the vice president for United Technologies, which is you know, USBI is a part of United Technologies. So he lives here.

75. Kidd You mentioned several people, in fact I think I can make sure, . . .

76. Waite: Bill Snyder.

77. Kidd Bill Snyder, do you know where he is?

78. Waite: He was Program Manager, and he, I don't, he's in the Washington area.

79. Kidd Ok.

80. Waite: He just recently retired, retired from NASA a little while back, but he recently retired totally, he's had a prostate cancer operation about this time. But he would be a dandy. Leland Belew I mentioned earlier.

81. Kidd Rein, what was his last name?

82. Waite: Rein Ise. Now let me tell you some of the people that are still out there, and I'll probably miss some, but they can give you something. Rein Ise would be real good.

83. Kidd Is he still at Marshall now?

84. Waite: He's still at Marshall. He is in the, he has the experiment area there, under the Space Lab. Another one that was heavily involved was Bob Swinghammer, very heavily involved with bio-medical experiments. Now Bob Swinghammer is one of the Science and Engineering deputy directors.

85. Kidd Yes, and you mentioned Owen Garret.

86. Waite: Owen Garret's an astronaut.

87. Kidd And he's at TBE right now?

88. Waite: TBE, and he's Vice President in charge of Space Program. There's so many astronauts that were so heavily involved, but Owen is, you'd enjoy Owen. I see him two or three times a month. Let me think at Marshall, let me do one thing.

89. Kidd OK

90. Waite: Rein Ise would be one of the best to tell you who is still at Marshall that you might want to talk to. But most everybody in key jobs at Marshall were somehow involved in Skylab, many of them. Now this was a real old book. Thought it would give me some . . . Those are the main ones that I think of.

91. Kidd If one of my professors wants to, I guess, they can get a little more in depth than I could, since they're the ones writing the book. I feel like I've left so much stuff out with this kind of time. But if they needed to, would you do another interview with them?

92. Waite: I'd be glad to.

93. Kidd OK.

94. Waite: You know, I'd like to not get too involved in any one person because, how did one center director do versus another, because they all had different management styles, and they were all very good, so . . .

95. Kidd I was talking more about your involvement with experiments, because we could go on with that for eons.

96. Waite: I guess, it's a, I hope it's as much fun working there as it was when I was there. You know, during Skylab, we were on what we call a forty hour tour, and I guess over those several years on Skylab I probably averaged better than sixty hours a week. And when Skylab was over, I hadn't gotten a chance to take any annual leave vacations, and you could just carry over so many hours. They gave us, they had a special Congress, gave us three years to use our annual leave. I lost months [laughter], and I got on HEAO and got involved with HEAO, and not only didn't get to use my Skylab leave, I didn't take any leave during HEAO.

97. Kidd How much have you built up? It must be amazing.

98. Waite: You couldn't, you know, you couldn't, I think it was at that time, I don't know, it was a lot. Then they let us carry it over for three extra years to use it, and I didn't get to, and also didn't even use what I was building up to at that time. But it was a fun place to work.

99. Kidd OK, good, I guess that takes care . . . [tape off].