# NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
# EDITED ORAL HISTORY TRANSCRIPT

JACK L. WARREN
INTERVIEWED BY SANDRA JOHNSON
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JOHNSON: Today is August 20th, 2008. This interview with Jack Warren is a continuation of his first interview on August 12th, 2008, and is being conducted for the Johnson Space Center Oral History Project. The interviewer is Sandra Johnson, assisted by Rebecca Hackler. I want to thank you again, Mr. Warren, for joining us today to continue this interview. I want to start today by talking about your work with space-flown hardware. During the ’80s, along with those early [Space] Shuttle flights, there was a concern for space debris, and it prompted some studies on possible damage to some of the spacecraft. How did you become involved in those studies?

WARREN: At that time, I was classified as a systems specialist, and we had plenty of techs [technicians] doing lunar work. I had already completed extensive work using a microscope, and this project involved using a standard microscope, so I was asked to initiate the beginning of these studies. We got involved with exposed hardware that was actually at [NASA] Goddard [Space Flight Center, Greenbelt, Maryland]. They were looking at some louvers that came off Solar Max [Solar Maximum satellite], and they noticed there were multiple impacts, and decided to study them. We set up a lab [laboratory], and most of the work was done in a fairly clean area using a standard microscope. We were scanning each louver one at a time, and then we would core out the impacts. We didn’t perform the scientific work; the core samples were sent on to other labs to be studied by an electron microscope.

This was the beginning of the space-exposed hardware studies. We also knew that we had a spacecraft that was due to return soon. It was supposed to be in space for one year, but it ended up being there for over five years. It was named LDEF, and it was the Long Duration Exposure Facility where the United States stored different types of materials, tape, and lenses. It was sent into space to determine what long term exposure in a low-Earth orbit would have on these different types of materials.

The satellite was brought back to Florida [NASA Kennedy Space Center], and we went there to meet with several LDEF investigators for three to four months. I was there for six weeks helping process the satellite material. When we received our part of the hardware at JSC, it was turned over to me to scan and document, looking for any crater size impacts greater than 45 microns. It actually started out lower than this, but there was so much material that it would have taken too long to get the data out. Anything less than 45 microns was not documented.

I started with an aluminum plate, making one scan across the plate. The scan was the width of six millimeters and the plate was about two feet wide. After we made two scans, we had over 400 impacts on this plate, and that's when we decided to scan 45 microns and higher. We had pure gold plates, aluminum plates and insulation material. The spacecraft carrying these particular plates was the size of a bus and cylindrical in shape. The shape required that we collect experimental materials from both ends as well as around the cylinder [middle] of the satellite.

This satellite had one end pointed toward Earth, and the other was pointed out into outer space. It did not rotate and it was traveling at a high rate of speed. It was imperative that we determine where the impacts were coming from as well as their direction. Of course, since it was traveling forward, the leading edge would get more hits than the trailing edge. Scientists were able to calculate approximately which direction the material was coming from and then design future satellites to protect them from projectiles that were speeding through space.

After LDEF, we received material from EURECA [European Retrievable Carrier]. We had a scientist from Japan that joined in with the material study, and we worked with him for about six months. The next material came in from the Palapa [satellite]. The material was from an [Indonesian] satellite. Russians brought in the blanket from the satellite after one of their missions. I worked with them approximately six months scanning this blanket.

The next material that came in was two different plates from the [Russian Mir] Space Station. We extended it out quite a ways away from the Space Station, and it just sat there and collected impacts from different directions. The material used to collect impacts was called Aerogel which we later used for the Stardust program. It is an amazing low-density material which is made up of glass flakes which are grown from several different gases under pressure. There were approximately 48 plates sized six-by-six [inches] and half to three-quarters of an inch thick.

Aerogel slowed down the space debris, unlike most materials used to collect impacts. When micrometeorites or space debris impact something, they're traveling at such a high rate of speed that they compress and burn up. When they reach a certain temperature, they turn to gas, and it usually melts the material or puts a hole wherever the impact occurred on. The Aerogel would actually slow it down, and you would have a particle at the end of the track. So this was good research with consistent data.

JOHNSON: It sounds like what you're talking about is the Mir Environmental Effects Payload, the MEEP, the first time the Aerogel was used off of the Mir Space Station. Does that ring a bell?

WARREN: I believe it did come off of Mir.

JOHNSON: Was that the first time that they'd actually put something out there specifically to collect the particles? Like you were talking about the Palapa and the EURECA—those were just impacts?

WARREN: Those were impacts on either equipment that they had removed and replaced or insulation blankets that kept the spacecraft cool. But this project with Aerogel was to collect samples because we had been testing the Aerogel here at JSC and other places, shooting different types of material at six kilometers per second into different types of material. Aerogel continued to slow it down and left particles along the track and at the end of the track. It worked and it was truly an exciting time for the collection of space debris. Now other NASA locations could have been trying other stuff that I was not aware of.

JOHNSON: On those earlier projects, did you actually collect any substances? Or was it only the impacts that you saw?

WARREN: Like I said, I was responsible for scanning, coring and sending it out to scientists. If there was any substance, it was minimal. Most of the impacts decompressed so quickly that they turned to gas and did not leave anything there for us to pick up with the Electron Microscope studies. But yes, there was slight material left from some impacts.

JOHNSON: You were talking about how many you were finding on the LDEF. Was that a surprise to people that that many impacts could be seen?

WARREN: I think it threw off their calculations to formulas that had been derived and they had to be redone. After the recalculations of scientific data, I think they had a better idea of what was coming in and from what directions, most was from material that we have put up in orbit [satellites, rockets, and spacecraft].

JOHNSON: It seems like an awful lot of impacts.

WARREN: Well, that could have been the leading edge that we saw, but we realized that when we started on this one particular plate that we were trying to document all impacts. We could get craters all the way down to 20-microns in size with the eyepieces and the X factor that we were using. This is a magnification that we decided to use, and we could see 20-micron impacts pretty easily.

JOHNSON: Then you mentioned the Aerogel—if you want to go on and talk about that with the Stardust Program and how that was used.

WARREN: Aerogel, as I previously stated, was used with Stardust which was the next mission. Aerogel was used on the Mir. [MEEP was deployed on the Mir/Shuttle docking module during STS-76 and retrieved during STS-86.] The MIR experiment went so well that several scientists decided to use it on a program called Stardust. This mission stayed in outer space for seven-years. It was launched before Genesis [Mission, Search for Origins], but it took a long time to get it lined up with a comet that was coming through our solar system. They position our experiment to be in an orbit that when the comet came by it would go past and then we would go through the tail of the comet and collect come of the material that was coming off.

We retrieved the satellite sample in January, 2006. The satellite spacecraft was parachuted in. It came in through the Earth's atmosphere at the highest rate of speed that any satellite or spacecraft had come in before. The heat shield worked fine, the parachute opened when it was supposed to, and it floated to Earth. The parachute had a couple of beacons on it to send out a signal for easier retrieval. Even with the helicopter above it, we could see the parachute, but not the satellite. When they finally landed to pick up the parachute, the spacecraft was beneath it.

Even though this project started in 2006, we're still working on processing the data; a lot here to study. We presently have four people working to get samples out to principle investigators all over the world. The Aerogel proved again that you can slow particles down and they wouldn't burn up; leaving something to document and study at the end. We had two panels back to back: one that was flown towards the comet, and the second panel that was attached to the back of it being impacted with interstellar dust. We're pulling out the first particle today that penetrated 110 microns. Until today, the most penetration was 20 to 30 microns. It's coming out with the Aerogel keystone.

We call them keystones when we go in with a glass needle and cut out something that looks like a doorstop. It's a triangular piece, three-dimensional. Once you get it cut, a microfork is used to pull it out, and then the keystone is so small that you can turn it around and take pictures of the track itself. Next, the keystone will be sent off first to a synchrotron and they can collect data without harming the sample. Later, the sample will be taken out of the Aerogel and most likely put in epoxy and microtomed where we can get maybe 20 or 30 samples from that two-micron sample of material to begin the study.

We have two scientists preparing keystones, and another person that is taking the particles out of the keystone or the craters and allocating them to different scientists for study. There is only one person doing the microtoming. Presently, I am photographing and entering data on the cells. We had 135 individual cells on each panel or tray, whichever you want to call it. We have four different levels of photography. Level one is using the camera for literal picture and documentation. Level two is preparing a mosaic, taking 20 to 40 pictures using a microscope system and a computer to create the mosaic. Level three is where you take a removed cell from the tray and do photography at different angles and lighting, to get a better understanding of what you have collected. This documentation must be followed in order to track where the pieces of the particles are located. Lastly, each track is photographed from an angle to get particle size, entry hole size, and then given a classification as to each type of impact.

JOHNSON: Are those photographs part of the Stardust@Home project?

WARREN: The Stardust@Home project is really interesting. That's the interstellar side where you have 135 Aerogel pieces. We can only do this in sections and right now we're doing the top half because a lab table would have to be larger the lab we are currently processing in. A video camera is placed on top of the microscope; coordinates are entered for the X, Y, and Z data into the computer while a high magnification movie is being photographed between 45 to 50 frames. There's over 2,000 of these movies from just one cell. It takes 16 to 18 hours to prepare and process one cell. If the lighting is not exactly right, it must be redone. It is tedious but rewarding work.

After we make the movies, they are sent to the University of California, Berkeley, where the information is downloaded, formatted, and placed on-line. Berkeley submits the studies and solicits help from the public to look at these movies to locate tracks in the cell.

Originally, the calculations showed that we may have 10 to 30 impacts on the whole tray of the 135 pieces of Aerogel. However, just in the top section alone, we've already found more than 30, so this is great! You're talking about a large area, so you can look at the Aerogel and look at over 2,000 movies just for one piece and maybe never see anything. Then you can go to the next piece, and it may have three or four impacts on it. They're really hard to see, and it takes a keen eye to catch it, so it does have the public interest. The movies are now being produced by Berkeley. It used to be done from here at JSC, so transferring this work to their documentation has helped us a lot. We just get the tray out, zero it in for them, and now they're doing all the work from California [over the internet]. We've pulled approximately 15 keystones from the interstellar side of the tray. I'm not sure as to the exact count as to the number of Aerogel cells that have been completed with movie documentation.

JOHNSON: Was the lab constructed specifically for Stardust?

WARREN: Yes, we did a demolition of three different rooms here in Building 31 at JSC and re-ran all the facility lines while stripping everything out of the room. We used an epoxy paint on the walls, put in a new floor, re-ran all the AC [air conditioning] ducts, and insulated and painted, while trying to keep the contamination down. We had a Class 100 cleaning room installed inside the area that was prepared specifically for the Stardust Lab. Air is filtered going into the prepared area and the clean room pulls that filtered air in and makes it meet Classification 100 facility. We do all the work in the Class 100 room to cut down on the contamination that might occur. It is imperative that the samples are not contaminated.

The interstellar tray is actually worked on in the Cosmic Dust Lab. The interstellar tray requires a Class 100 tunnel. Instead of having a vertical flow, the flow is horizontal. The Cosmic Dust Lab was shut down in order to process the interstellar tray from the Stardust mission. After eight months of using the lab for Stardust, we turn it back around to a Cosmic Dust Study Lab. We needed to process the Cosmic Dust flags and this process takes approximately four months to complete. After completion, we will turn the lab around again for Stardust.

In the Cosmic Dust Lab, a general observation of each Cosmic Dust flag is completed and we have approximately 10 curatorial orders to process. Particles are sent to scientists for further study. Last year [2008], I processed and sent out over 325 samples to different PIs [principal investigators] which was completed in a three to four month range. The reason for shutting down and switching labs is so that each mission gets it own priority and there will be no cross-contamination on the different projects.

JOHNSON: I was wondering if you could talk for a minute about the [meteorite lab] and your involvement in that group.

WARREN: I don't recall the exact date it was established, but I do remember it was after the new 31N Building, which is dedicated to the lunar samples. So that left us a complete lab downstairs, and they started up our meteorite lab. We have scientists from all over the USA that travel to McMurdo [Station], which is located in the Antarctic [South Pole]. This group of scientists and data collectors are looking specifically for meteorites. They usually leave after Thanksgiving and do not return until February or March. I can't tell you exactly how long they're on the ice, but it takes them a couple of days to get there, then they attend safety training for several days. They must then check out their equipment, get it loaded, and are flown to their destination and unloaded on the ice. They set up one tent and start one gas stove. Air transportation leaves them and they're isolated except for a satellite telephone and walkie-talkies.

After spending the rest of the day getting all the tents assembled, a plan is made to search for samples. Since the terrain is ice and the snow is so white, if something dark is seen on the ice, it's most likely going to be a meteorite. Over the years they have found as few as 200, and as many as 2,000 meteorites in a season. The samples are shipped back frozen and after we receive them, each one is inventoried and placed in a freezer. They also have data logs from the researchers at McMurdo. After they are selected for study, they are photographed, given a number, and placed in a Teflon bag. The meteorites are then rechecked and re-numbered to fit our [JSC] data system. Each one is photographed, a piece is taken off, a potted butt is done, and thin sections studied to figure out what type they are. The remainder of it is stored, and they are shipped as soon as we can get them out to the Smithsonian [Institution, Washington, D.C.].

As far as my work with the Meteorite Lab, it was mainly facility work, making sure that all the cabinets are hooked up correctly, and they have the appropriate safety relief valves, $GN_2$ coming in that meets spec [specifications], and that the cabinets are monitored, also having to meet specifications. Researchers find a rock every now and then that they can't break, and they bring me in to either break it or saw it. We use a stainless-steel blade with a diamond-impregnated cutting surface and they're cut dry. That's about all the involvement I'm in as far as the MET [Meteorite] lab.

JOHNSON: When you talk about how they bring you in to break it, how would you break it if you didn't saw it? How do you do that?

WARREN: There is a platform for the smaller rocks that has a top chisel knife that you can rotate with the handle down until it makes contact, and then you've got about two feet of leverage to put pressure on it. Sometimes you get enough pressure to chip off a piece. Otherwise, you take a hammer and a chisel and you beat the "living daylights" out of it. Some of these have a lot of metal in them, and they just don't break, so if they really want a piece off of it and it looks interesting, then they will saw it, taking a slab off of the sample. Actually, they'll take an end off, cut a four-millimeter to six-millimeter slab, and from that piece they can get anything they want because it's thin enough to break.

JOHNSON: You mentioned Genesis. Do you want to go ahead and talk about that project?

WARREN: Genesis required us to look for several rooms that we could demo [demolish] and clean up and revamp as far as water supplies, electrical supplies and AC supplies. Since you're talking about atom-size material that we were bringing back, everything had to be set up for another clean room to be installed. This particular clean room was going to be a Class 10 instead of a Class 100. It's the only one here at JSC.

Class 10 means that in one cubic foot of air, you're going to have 10 or less particles at .5 microns, you count all the way down to .3 microns, and you're only allowed 300 of those. This facility is very small, but highly filtered. In fact, in the assembly part of the lab, we had to wear rubber suits including a hood and you had a battery-powered filter sucking out air. By sucking air out of your suit and filtering it before it is returned to the room, it is pulling air in around your face. This is the air that we were breathing. This was done to keep contamination off of the spacecraft.

The Class 10 rooms, one for assembly and the other for cleaning, were divided a window pass-through and glass wall. The first was to start the disassembly of the spacecraft. During this process we started the cleaning of all the pieces that were coming off. The whole spacecraft was cleaned, piece by piece. We used a soap and water wash, a cascade rinse, a spray rinse and an alcohol spray rinse, and finally a drying cycle. Samples were taken after each cleaning to check for contamination. With the smaller pieces, I would take one sample out of 10 to check for contamination using a particle count method, and if it passed, it was bagged and sent to the assembly room.

This sample water and the final rinse were 18.24 megaohm water, which means that it is not common water. It contains nothing but hydrogen and oxygen and some stuff, but at parts per billion. You can actually put an electrical charge in it and it won't pass from one side to the other. We have removed the sulfur and iron and everything else out of it. The water is looking for material. I like to refer to it as being "hungry." It'll actually etch surfaces. It can only be stored on plastic material, and it must still be watched because it will etch almost every surface.

Ultrapure water is the liquid that chip factories use to clean their silicon wafers. Ultrapure water is really something! You wouldn't think that water could disintegrate certain substances but on one occasion, during a safety sim [simulation], we had to figure out a timeline of how long it would take us to disassemble the whole spacecraft, clean it, and then reassemble it. In the simulation, they actually gave me the shims from one of the trays. There were four trays that had to be deployed in and out of the spacecraft. As different occurrences happen on the Sun, one tray may be brought back in as another tray was deployed out. If they were having a solar flare, and didn't want to contaminate the main tray, they would designate one tray for solar flares and see if that made a difference with the samples coming off of the Sun.

These trays had to line up perfectly, so they used shims to align them correctly. They were supposed to be made out of stainless steel, and they gave me six shims from one tray. I cleaned them, and I went through the cleaning procedure just like I had previously done, and all the times were right and everything was done per procedure, and I gave them back after placing them in a clean bag. They came back four hours later and said, "We're missing one shim." I said, "No, what you gave me is what I cleaned, and that's what you got back."

"No, you're missing one shim." So I went back, and I looked in the tank, and it wasn't there. I looked in my records, and it said I had six shims, and my records also showed that I gave them back six shims. I said, "Go back and check. Either you didn't give me enough or what." They had in their QA [quality assessment] data the size of each shim, the thickness, and it showed six, and it showed the sizes. I let them know that the shims they gave me must not have been stainless steel no matter how "nice and shiny" they were. It turns out that they were half the size of what they were supposed to be and that told them that the shims they gave me were not stainless steel, that they were made out of a nice pretty shiny metal, but not stainless steel, because the ultrapure water "ate" it up.

The QA department got all over JPL [Jet Propulsion Laboratory, Pasadena, California] because they had used something besides stainless steel. Then they got the right stuff, re-measured it, and when they gave me the stainless steel shims, I cleaned them and gave it back to QA again.

The Genesis simulations started around 2002. We got samples back in 2004. Genesis was launched after Stardust. Like I said, it came back in 2004. It crash landed in the flat terrain of Utah. It was supposed to have a parachute open up, a helicopter was there to grab it in mid-air and then set it down softly. Since the parachute did not open for them to catch it, the Genesis samples came into the Earth's atmosphere and hit the surface out at the Utah Salt Lake [desert] at over 200 miles per hour, and the impact breached the capsule. However, as of about three weeks ago, there's been calculations made that we retrieved approximately 85 percent of the samples that were inside the capsule. They are not in the original large sizes, but we were going to have to cut the wafers up to give to the PI's.

Our problem is that we're trying to determine whether any of these pieces got contaminated because of the salt air and the container being breached. Since you're talking about angstrom-sized particles that embedded approximately 150 to 400 angstroms into the material, it's fairly close to the surface. We're cleaning the contamination off while trying not to disturb the samples that are embedded in the silicon wafers.

We're getting better and better at this. They've retrieved three or four main samples including the concentrator, the aluminum kidney, the gold plate that were still whole and not broken up. One hundred per cent of the material impacted Earth but 15 per cent of the materials collected in silicon wafers were reduced to powder due to the impact.

When the Genesis samples were received at JSC, I asked to be taken off that mission to work on Stardust, since I had been an integral part with setting up the lab and selecting contractors to do the work, being a part of it from beginning to end. I was selected to serve on the spacecraft receiving team going back out to Utah for Stardust retrieval and decided to spend 100 percent of my time on the Stardust project.

I think that covers everything, except to revisit the information on the Cosmic Dust Lab. This was a project which started up around 1990 with a scientist named Don [Dr. Donald E.] Brownlee in the state of Washington [University of Washington, Seattle]. He was collecting all types of meteorite materials in different ways. He had some collectors that were attached on the wingtips of a U-2 Spy Craft. He got NASA involved, and we built a room here at JSC, which, like I said, was a Class 100 tunnel instead of a regular Class 100, which is vertical. The size of these particles were usually from one micron and up, but since the one- and two-microns are very hard to see, I usually start around five to fifteen microns for "picking." Of course, you're going to get some in the 25 micron size. The largest I've seen is 75 microns, and it was a metal sphere.

The room is required to be Class 100, and everything must be cleaned and then ultracleaned before it is shipped out or stored. If this particular type of cleaning process does not occur, there would be so much contamination that a researcher wouldn't be able to find the particles. We're presently flying flags that at the most are two and a half by four inches. There are scientific calculations that Earth grows by 10 tons a day, and these particles come in and hit the atmosphere, slow down, and then gradually fall down through our atmosphere to Earth. Scientific calculations show that we're collecting one to two particles per hour of flight time at 60,000 feet in the upper atmosphere.

We were collecting good data from these collectors and so we decided to design something bigger. We went to nine-inch collector plates. They are flown side by side, sandwiched together; they then open up giving you an area 18 inches across. We have calculated that for each hour of flight time with the larger collectors that we are now collecting 14 to 20 particles per hour. Since the beginning of this project, the U-2 aircraft has been retired or redesigned, and they are now called ER-2s for government work and TR-2s for military-type work. They fly higher and longer and give the pilots more room in the cockpit as well as being able to fly more instruments than the U-2.

They presently have two ER-2s at Edwards Air Force Base [California]. I believe it's called [NASA] Dryden [Flight Research Center, Edwards, California]. Before that, they were at [NASA] Ames [Research Center, Moffett Field, California]. There are also two aircraft at Ellington [Field] here in Houston. They are WB-57, with a pylon for each wing, and we fly four at a time on each pylon. At this time, I'm only flying two flags on each pylon due to the cost of the material to make these flags and the coffins to hold them. So we put one on each side of each pylon, giving us four collectors. This particular aircraft is mainly doing crop studies, mapping and some DoD [Department of Defense] projects.

This is an ongoing project. The areas where we usually attached to the wings had super pods installed, and there was very little time for us to collect on this aircraft for about two years.

But this year [2008], we're going to start getting continuous sample times. We have had a very good year [2008] with the ER-2s out of California and then the WB-57s at Ellington [Houston].

The CDL [Cosmic Dust Lab] is only open three to six months a year, and then Stardust takes it for eight to twelve, and then it gets turned back over to Cosmic Dust just to log in the samples and send out materials.

The reason we're getting material processed and sent out of Cosmic Dust is that we've been flying every year around June, when the Earth passes through a comet cloud. The gravitational force pulls it in and what we're finding scientifically from this collection of samples is that they're matching up with many of the samples that Stardust brought back. It's showing up as being the same material. This makes my collection a lot more valuable.

This year [2008], we have also found and classified a new mineral that was collected on cosmic dust flags three years ago. Dr. Keiko Nakamura is the scientist at JSC that does the microtoming and also works with samples from cosmic dust. She is nationally recognized as the one who analyzed and determined that this in fact was a new mineral. It was named *Brownleeite* [after Dr. Don Brownlee who was previously mentioned] approximately three months ago. The CDL lab has gained much more respect because of Stardust and the discovery and designation of this mineral.

Space-exposed hardware is an off-and-on project. Presently, we have the capsule out with the top and bottom off, exposed in the room, and last week we were photographing it. Because this particular canister will be sent to and displayed in the Smithsonian, we're trying to get as much photography as we can before it goes out. We're looking for and documenting out-gassing that occurred during orbit because it will cause a different color on the spacecraft. Later, if questions come up, we will have photographic documentation. These photographs will give us information that might be needed for further studies and flights.

The arm in the canister that held two trays will be removed and a different arm from another project will be placed on it creating a new prototype. We're keeping and storing the original arm because it was exposed at the same time that the trays were exposed. They had witness plates on the arm, and we wanted to keep them for future reference and studies. Once we find instruments that can analyze data in different ways, this information might become significant for comparisons in future space flights.

I often move from one area or project to another. In fact, this week I'm working on the coupons that were on the arm. There was a piece of aluminum, a sapphire, and a piece of Aerogel. The cover plate holding in the aluminum and the sapphire is aluminum also. So all of that is being photographed for the next three weeks and will be downloaded onto the Internet as requested by [Dr.] Peter Tsou, who is one of the head scientists. I'm also working on space-exposed hardware and Stardust at this time, and that brings my work schedule up-to-date.

JOHNSON: Since you've worked on so many different projects and been involved in so many different things over the more than 40 years that you've been here, what is your favorite or what are you most proud of?

WARREN: Well, it was exciting to be the first man to open the original Lunar Rock Box [Apollo 11 Lunar Sample Return Container], but I can think of different occasions like getting the Lunar Receiving Lab ready to receive the lunar samples. It was a very exciting time for space travel and space retrieval. We were working long hours, which included the electronics department, the electrical and the vacuum department, which at that time included the mechanical department. We were all working together seven days a week, and we became quite a team as well as "extended family members" within the team. The camaraderie was fantastic. All of the excitement slowed as time moved on at the Space Center. Then a new program called Genesis came about. New teams and friendships were formed and the spirit of a team effort was reborn. It felt good to know that a group of people could come together with a common goal while striving to be the best. It was great being a part of the whole team effort during Lunar, Stardust, and Genesis.

Genesis was different in that we had to work with Lockheed [Lockheed-Martin Corporation out of Colorado], JPL, and NASA. Three groups from different locations, and each of them wanted to take the lead to head up the project. During this time we were told, "Well, you all won't ever be able to work with JPL." JPL came out, and we met their team, and yes, there was a few times that there were some disagreements, but we jelled. We just said, "Hey listen, we're working as a team, and here at JSC we're a team, and you just have to become part of it."

We had a meeting every morning for the day's agenda. After working together, especially when you go out to Utah, you're away from home, so you all go out to eat or you start getting to know each other. Everybody knows where everybody's going, and then you make up your mind, "Well, I want to go with that group or this group, or, is that the restaurant I want to go to?" On weekends, if we had the weekend off, we usually had something going on. We usually said, "Okay, let's use the barbecue pits and have a cookout." That made for more unity of team building while getting prepared for the Stardust retrieval.

So I enjoyed the excitement and preparation process for the lunar samples, the Genesis project, and the Stardust project. The team effort on Genesis and Stardust was so evident that we named them the A team and B team. Both teams were excellent and well trained. We would have fallen behind schedule if it hadn't have been for both teams. The A team for Genesis was almost identical to the team that was assembled for Stardust. We called ourselves the "can-do" team. Whatever came up, we figured it out, solved it, and completed the task at hand. It was a great feeling of camaraderie and accomplishment.

JOHNSON: What is this area or the lab going to be doing, or is there work already in preparation for the new Constellation Program?

WARREN: I've been asked to attend these meetings, but it's so far ahead of schedule I have yet to attend. I don't know if they're going to use this lunar facility or if they're going to create another lab, but I do know that they're not going after large samples, since our instrumentation has gotten so much better and for scientific data, we just don't need large pieces of materials. We're either going to take chunks off of big rocks, or smaller materials where they take a shovelful and run it through a rake and that's the samples they will keep. The rake will keep it to a certain size, which is like running materials through a sieve.

I am not sure whether an existing lab will be used for the new Constellation project or whether a new lab or possibly a new building is in the future.

JOHNSON: Since you've had over 40 years' experience at NASA, I was just wondering what would you say to someone if they were considering a career at NASA? Considering that when you started you began as a technician just cleaning, and now with the work that you've done and the different things, the experiences you've had here, what would you say to someone else?

WARREN: As far as my experience goes, I attended college for four years but never received my diploma. If I had completed my degree, I would have come up through the "chain of command" much more quickly with higher pay and position. However, if you're willing to come to NASA and work hard, I think you will really enjoy it. There was never a job that was "too large or too small" in my mind. I wanted to know something about everything, whether it was old or new information. I feel blessed in knowing that I was in the right place at the right time. I learned on my own, like particle counting and cleaning room technology as well as NVRs [nonvolatile residues], TOCs [total organic carbon], which is all about cleaning. I kept reading manuals and literature that would help me become knowledgeable about whatever was occurring at that time. So if you come to NASA and put forth 110 percent, I think that you will be satisfied with your life experiences as well as your job benefits.

If you are fortunate enough to be chosen for one of the missions, then it is absolutely fantastic. You see Mission Control [Center] on television, and when a major accomplishment occurs, you might see everyone cheer and hug each other. Many times these teams have been working 7/12s [7 days a week, 12 hours a day]. You get to know everybody, know their family, as well as their "comings and goings". Again, the feeling of extended family is a side personal benefit that is not always part of the corporate world.

JOHNSON: Is there anything we haven't talked about that you wanted to mention before we end?

WARREN: The only thing I will repeat is that I regret not completing my college degree after spending four years at the university. I would just like everybody to know that I feel very blessed to have been in the right place at the right time, and that I have enjoyed my work for the past 40 plus years.

JOHNSON: Well, with that, I guess we'll end for today. Thank you.

WARREN: Thank you for the opportunity to share this information.

[End of interview]