

INTERVIEW WITH MR. GOODRUM ON LOGISTICS

You said you read this paper, was there anything that stuck you? No, and I think you are right on a good bit of this in here. We can talk about the fact that we got into Logistics Program late and I remember in 1962 there was quite a bit of discussion on setting up a logistics program for the Saturn Launch Vehicle and I can recall a number of people commenting that because of the fact that we were going to have only a few launch vehicles that we wouldn't need a logistics system. I am quite sure they were thinking in terms of military weapons logistics and also I am pretty sure Dr. Rudolph who now is one of the real supporters and myself who directed that logistics system, were two who thought we didn't need it at that time, and we didn't need the weapons system logistics system, we did not need to do that, that is ^{with the} the formal spares provisioning process. But I did note here that Dr. Rudolph stated that perhaps the logistics system we had to have to support just a few vehicles, but with very critical time constraints. This was perhaps more difficult than a military weapons system, we often talked about that, I think. That's very true. Alright, I'm glad you brought that up. It is one of the things I wanted to ask about and get some differences between a military logistics system and something about the Saturn.

The thing about a military weapons system is you are able to develop some data through usage that allows you to pinpoint pretty accurately how many spares you are going to need because you find out that over the course of say the first year of operations you needed so many spares of such and such a kind per weapon or for every 10 weapons. You know that every 10 flights of a rocket some piece of ground equipment is going to give you trouble in certain areas, so you are able to develop some data for some basis of what you are predicting what your failures are going to be and how many spares you will need, what kind of environmental conditions. Will they need to be kept in air conditioned or pressurized atmosphere or should you keep them all back in one place and transport them in when needed or stock them on site. The military

system, because of the fact that it does have a large number of items that you work with , allows you to make these predictions. Now on a system such as this, the Saturn and a system such as the shuttle, which we are getting ready to work on, we won't have that data that will be developed through usage, we have to be ^{back of} a lot more accurate in our predictions. This requires a substantially higher order of knowledge on the part of the engineers and the logistics people that are concerned with it, so we will put a lot more effort into engineering for logistics on the space shuttle, for example. Is this a result of the Saturn Program? Yes, as a result of the Saturn program and as a result of not being able to develop data over a long period in operations. We will try to first design out the need for maintenance and design in ease of maintenance when we have to do it and we will also try to desing our equipment so we can get by with a limited number of spare parts. Did designing in maintenance come in at all in the Saturn Program? Not really, the Saturn Program followed more of the traditional weapons system concept where you designed a piece of equipment and then delivered to the operations people to support as best they can. You didn't consider problems that the operations people were going to have as an overriding factor. You didn't design specifically for ease of maintenance ^{or} specifically, so you could limit the number of spares you had to have, your principal constraints on design on this ^{Saturn} whole program were weight, performance, this type of thing and if it required you have extra spares, then you just had to have extra spares, we would provide it. So the logistics program for Saturn reacted to the design process, it did not have much influence on the design process. Shuttle was different then? We hope to make it vastly different because the principal purpose of the Shuttle is to have low cost operations, that means design it so you can do that. In the Saturn you said you didn't think you needed the logistics system so much because there would be so few launches, but the time schedules and pressures put on logistics programs. Well most of us when we started talking logistics in those days were thinking almose entirely

in terms of spare parts and maintenance. All of the maintenance was done by very highly skilled technicians and engineers at the Cape. It was true we did not have to have the traditional weapons system logistics program. In the traditional program the weapon is turned over to some fairly low skilled people, that is, troops out in the field. They are just not trained as engineers or highly trained technicians. So you have manuals written principally with them in mind, your parts have to be so that they can get them without having to go through any engineering process to do it and the maintenance is such that it can be done with the minimum of skill. Now on the Saturn Program we had highly skilled engineers who could use engineering drawings for their documentation. They didn't have to have manuals, we had them but they weren't really required in most instances. If they had a problem in putting a part on they usually had enough knowledge that they could work around it, if a problem developed. If a wire didn't go in the right place or something hadn't been done exactly right they fixed it. It didn't have to go back to the plant to be repaired. So in ^{that} a sense, we had quite a different logistics program on the Saturn Vehicle. Well, the critical thing then became schedule rather than spare parts? ^{of manage'?}

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If we got into a problem we put whatever resources we had to on the solution of that problem.

If it required another few million dollars, we found a few million somewhere and put it on there.

^{okous} (Now we have to make it pay.) Thats right, now we are in a situation where that money won't be available, we are going to have to be right the first time. In Saturn Program was there a logistical problem that loomed larger than others? I guess I am thinking of Cryogenics; was time it seemed like time was kind of an exotic thing then? Well, there was a time when we were wondering whether or not we were going to make it, trying to get that plant in New Orleans on line and time to satisfy the requirements at Kennedy. Time got to be a real problem and we ran into problems on the plant. It was late getting on line and this gave us some real problems. At one time we also barged Cryogenics to the Cape and we ran into some problems on that.

How do you deliver the cryogenics now, basically? By tank truck and rail cars. They weren't available at that time then? Yes, but in a fairly limited quantity. Was the operation and development of this plant part of your office? Yes, we supplied all liquid hydrogen for NASA and the Air Force on the east coast and bought all the liquid oxygen and got it supplied, liquid nitrogen. Did you have any difficulty with transfer lines, valves, and jacketing and things of this sort? Some, but they were not too tough. You had the advantage of Air Force Programs that existed before with LOX? That's right, we had that and this group had a good bit of experience with that too. I was going to ask you about the von Broun team. Oh, yes, they and Carl Heinberg and his people down in test lab, I think, can solve any problem. They have some real fine engineers plus a tremendous desire to get the job done and they did miraculous things in the cryogenics area. Are there any other big problems that you remember? I think there is one specific question I would like to ask and that is about the improved logistics plan, I picked up this from a speech I think from Rudolph, I haven't found anything more about the improved logistics. Well, as he talking about for future programs? No, this was back in about 63, I think. Do you remember anything along those lines? No, not as such, I tell you what happened. The logistics program really got started, elements of it existed we were furnishing cryogenics and we were transporting certain pieces of hardware and we were working on spares and this ^{maintenance} problem, but not as an intergrated unified effort at Marshall and it was in October of 1963 that Dr. Reese created our project Logistics Office. He did this pretty much at the insistance of a man named ^{Smolensky} Stan Solenski at NASA Headquarters, he had been an Ordnance Corp Colonel, and Stan was ^{well} determined that we was going to have a well planned logistics program on the Apollo program. He got Dr. Reese to set up this office and staffed it and went to work and over the period of the next year or so we did an awful lot of work to ^srevive the logistics planning and in logistics management on the Saturn Launch Vehicle. I spent an awful lot of time in McDonald-Douglas

and North American plants on the West Coast, getting ^{them} ready to do things the way ^{we thought} they should be done and the problem was that the contract didn't call for that, the SIVB contract, for example at McDonald-Douglas, under logistics said, provide support as required, and that is all it said. And if ever there was a license to steal that was it. McDonald-Douglas, North American, and Boeing all had a lot of very experienced logistics people on the program and they provided excellent support, the problem was that they provided entirely too much support in some areas. Some, where they would have too much than not enough, they went out and bought spares and they went out and bought manuals that we just didn't need, now this was the Government's fault for not having written their specifications properly and not having managed it properly. That is interesting, for example, Douglas went out and bought spares and manuals, they were kind of reaching back it would seem to me in the old concepts of logistics management. Exactly, people they had came almost from all Air Force and so they did what their experience taught them to do. After you had a logistics office here at Marshall, did the contractors begin to organize their own offices? Yes, we had a much more unified effort then and I imagine this is what Dr. Rudolph refers to in talking about the improved logistics plan. I think we affected quite a number of improvements and at least we brought some order into it and got the logistics program made a part of the program management process and it reached the point where Dr. Rudolph would call me or some of my people and say if we did so and so what effect would this have on you, that type of thing which you strive for. For example, if he wanted to make a design change, he recognized that this scraped several hundred thousand dollars worth of spare parts and manuals and started ^{it} ~~all~~ all over again. This is the thing he would try to find out before he made some of these major changes in the program. Some of them he couldn't because we had to make the change anyway, in which case he just advised me that I had a lot of work to do. It was usually with a pretty short deadline. Is it possible to categorize to say that logistics in terms of cryogenics gave you more problems

than logistics in terms of supplies and spares? I think so, I think we had most of our problems in the cryogenics area , we had some pretty tough problems in the transportation area trying to get things like the guppy airplane ready on time and I don't know that I would classify any one area the most difficult, they all had problems but they originated for different reasons, we didn't have any parts problems so far as I know, that is I don't recall any launches or tests that were ever delayed for the lack of parts or inability to find out where the part went, you know, good documentation. We never had anything delayed for lack of transportation, transportation was always available on time. The problem was that we spent too much money, it cost too much , and so in that respect it was not efficient logistics, it was effective, we got the job done, but when we got through we had a lot left over. Can you give us a specific example? . Yes, on the SII Program we still got a lot of spare parts that we sure would like to give to somebody. I don't know how many but there is just an awful lot. And these are things that were bought before we were able to get the restrictions placed on the contractors. They were bought very legally under the terms of the contract. The contractor did exactly what he was asked to do. And again would you call this a case of the contractor going back . . into old Air Force experience traditional military logistics? Thats exactly right, that's the way they have always done it. What about transportation, are you left now with a surplus of barges and aircraft? Not if the Shuttle program comes through, we will need everything we have got. How about the barges, were they built from scratch, keel up? No, all of these were surplus Navy or Corp of Engineer Work barges and we were able to take them, we got them for I guess nothing in some cases and next to nothing in others and put the hangar structure on and whatever tie down fixtures we had to have. Did they require any other special modification to make them more stable? Yes, a good many of them did, I am not enough of a Marine architect to tell you what we did do but in a couple of cases we put in some baffles and ~~balance~~ ^{ballast} tanks so that we could make sure we had the things riding just right and we did have a pretty well controlled environmental system on these barges, they were kept just the right temperature

and just the right pressure and humidity. In looking back at it, I suspect if we had it to do all over again we probably wouldn't be quite as rigid on our control but we didn't know, we didn't need that. An example of that is an interesting one, for quite a long time in the Apollo program every time one of the barges went down the Mississippi River it had a Coast Guard escort because we were a little afraid . some moonshiner along the river would take a shot at it. I don't think any ever did, but we finally realized that they were going to look at that as just another boat, we stayed in the channel and didn't get over too close and ~~didn't~~ ^{we wouldn't} have any problem. We had the Coast Guard with us every inch down the Mississippi and then they picked us up with Coast Guard cutters and airplanes off the coast. Who paid for that, did Marshall have to pay for that or did the Coast Guard pay out of their operating fund? I think it was all done out of Coast Guard operating fund. You mentioned the guppy, did you have a great deal to do with the guppy? Well, our office ran operating the guppy. The development of the guppy was of course by private concern, Aerospace Lines. We had several people from Marshall working very hard on it. Don Steward⁺, who now works for me, just literally moved to the West Coast and watched with them, smoothing the way for them with FAA and others, to try to get the plane ready on time. How did the idea of the guppy ever come up? You get a lot of stories on it, but I think it is almost entirely the dream of Jack Conroy. He is one of the few ^{entrepreneur} people left in the world willing to gamble everything on something he believes in. Jack was going to build that guppy some way and we had a few NASA people who insisted that it wouldn't fly. In fact they were some pretty high ranking people who stood right there and shook their heads and said it just wouldn't fly, there is ~~just~~ no way. What about von Broun, did he like the idea of the guppy operations or did he oppose it? He ate it up, that's the kind of thing he does like because it is ^{creative} inovated and imaginative and daring and just appeals to him. I understand that von Broun actually took controls of the guppy at one time. He certainly did, he cause a few heart palputations around here when he did. ^{it} This guy Conroy, he decided

the only way he could sell this thing to NASA was to fly it in here and show it to von Broun and it was not anywhere near complete, he braced the inside of it with two by fours and flew it to Huntsville, he borrowed gasoline from a friend of his in Phillips Oil Company in Oklahoma City, he flew it to Huntsville in order to test it we had to either load it with sand bags or gasoline so we put gasoline in it, in the tank to give it weight, and Dr. von Broun flew it here. With the two by fours in it? Yes, and then with that encouragement and that about all it could be just somebody saying you have a great idea go to it, he went back out there and he had a year or so of kind of touch and go operations where the bankers were trying to run him down to actually foreclose on what he was doing and he was dodging them and a couple of time I think he actually had to padlock his business to keep people from taking over from him. He finally got that thing going and flew it and I won't say that it saved the Saturn program, I think that is just a little too much credit, but had it not been for the guppy, we would not have been able to make the schedule that we did and make some of the flights on that ^{early} early schedule. We might have recovered and caught up, but the only other choice we had was to barge these stages up to Sacramento to be tested and that was 28 to 31 days down to to the Panama Canal and Cape from there. You did barge some of the SIV stages? Yes, we barged the ^{S-11} SIII stages. The SIV and some of the SIVB's traveled by barges. The real advantage of the guppy was to meet the schedule. ~~Wada~~, we had a critical period in there I guess in 67 or along there where we had to meet these real tight schedules and the guppy is what allowed us to do it, plus the fact that we were really afraid that we were going to get a stage to the Cape and have to have it returned to the plant. The guppy would give us the capability of getting it back in one day. We did not have to do that, we were worried about that eventuality and that was why the guppy was so useful to us. Was it used in other operations, besides just carrying the SIVB? Yes, we hauled the Apollo Spacecraft, the LEM, all the large elements of the Apollo program used the guppy, were delivered to the Cape by plane.

So it turned out to be a very useful item? Yes, and Houston depended on it as much as we did. Was there one phase of logistics area that you were involved in more than any others like transportation or cryogenics or something? No, I was involved in it pretty much across the board. What about von Broun, you mentioned Reese would call you up perhaps and say what change would affect you? No, Rudolph, did that. I beg your pardon, Rudolph.

Von Broun was very much interested, I don't think we would have had ~~quite~~ ^{really} as effective logistics program if it had not been for von Broun's personal interest. When a suggestion came down from Headquarters it had to go through von Broun's office? Yes, he was agreeable to it and he endorsed the idea of setting it up. I guess I am really curious about the cryogenics thing because it seems to be kind of an exotic development in the whole program. Did you actually help design the specifications later on trucks and railroad rolling stock to help deliver cryogenics? Almost all of this was done by private industry, Linde and Air Products and Air Reduction, all of course operated plants and bid on equipment. They have many years experience in this. They have been doing this type of thing in refining and building a little better piece of equipment and someone will come along with something a little better and they will add that to it. Most of the work that was done was done by them under our management, so when I say we helped write the specifications we actually did but most of the specifications were written by the industry man and we agreed yes this is what we want. We did impose ^{some} on requirements in the specifications that caused them to have to go back and improve upon some of the things they had done. We had trouble from time to time with high rates of evaporation and of course we were always concerned about the safety of the cryogenics operations. There were never any major accidents that I recall. No there were never any but were stayed concerned about that and worked ^{awfully} ~~very~~ hard with the contractor and made sure that their procedures and equipment was such that it was safe. You mentioned the plant in New Orleans, who ran that operations? Air Products. Did they make both LOX

and LH_2 there? No, they made just liquid hydrogen there. LOX was not a real problem. There was a number of places you could buy that, it is manufactured in a good many plants throughout the country. Hydrogen is the problem. Could you go into that a little bit? We have always been very marginal on the supply ^{of LH_2} and one of the problems arises because we couldn't really anticipate our requirements as we would like to. For example, we decided we wanted a plant on the West Coast because we had a M1 engine back in 62, 63, 64. That program was really big out at Aerojet. We anticipated very significant quantities of hydrogen that we would need for that engine test program out in Sacramento. So we got a big 60 ton plant built in Sacramento, I believe that is the Linde plant, and just about the time the thing got going good and we knew we could get production out of it they cancelled the M1 engine. So here we are with a huge plant on the West Coast, we used it but never at the capacity we expected to and I don't know if you are familiar with the way the industry sells liquid hydrogen, but it is sold on a curve that the first pound of liquid hydrogen that you buy costs about nine dollars a pound and then after you reach about a thousand pounds it is down to about a dollar a pound and to about five thousand pounds down to twenty or thirty cents a pound and gets to around sixteen and flattens out. So you have to buy a significant quantity of it before you begin to get a good rate. We never were backed up against the part of the curve that we were paying nine dollars a pound but we paid some high prices for it, and had the M1 engine program come along I think we would have been paying about sixteen cents. I am a little vague, you got the LH_2 from both the West Coast and the plant in New Orleans. Yes, and there were several plants in the Los Angeles area. ^{Ontario - L. Beach, + another} Were they established and were they direct in anticipation of sales because of the J2 program? No, not all of them. A couple of those plants were set up to service the steel industry but they had an over supply and we could buy from them. In spare parts you never ran into any problems? Was there any parts you had trouble maintaining adequate stocks, you were always able to deliver them.

I can't think of any off hand, I'm sure there must have been some, yes, I can too, we had the circuit boards on the RCA 110 Computer, we had problems with them, keeping an adequate supply and there is where our highly qualified engineering personnel came to our rescue because they would take a defective card and re-work it to keep it from becoming a critical item. Instead of having to replace these you simply refurbished it. Yes. I'm sure there were other items of a similar nature that I don't even know about down at the Cape. The Cape had some very good people down there on the Saturn Program and they kept the problems from happening.

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You said you read this paper, was there anything that stuck you? No, and I think you are right on a good bit of this in here. We can talk about the fact that we got into Logistics Program late and I remember in 1962 there was quite a bit of discussion on setting up a logistics program for the Saturn Launch Vehicle and I can recall a number of people commenting that because of the fact that we were going to have only a few launch vehicles that we wouldn't need a logistics system. I am quite sure they were thinking in terms of military weapons logistics and also I am pretty sure Dr. Rudolph who now is one of the real supporters and myself who directed that logistics system, were two who thought we didn't need it at that time, and we didn't need the weapons system logistics system, we did not need to do that, that is the formal spares provisioning process. But I did note here that Dr. Rudolph stated that perhaps the logistics system we had to have to support just a few vehicles, but with very critical time constraints. This was perhaps more difficult than a military weapons system, we often talked about that, I think. That's very true. Alright, I'm glad you brought that up. It is one of the things I wanted to ask about and get some differences between a military logistics system and something about the Saturn.

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We will try to first design out the need for maintenance and design in ease of maintenance when we have to do it and we will also try to desing our equipment so we can get by with a limited number of spare parts. (Did designing in maintenance come in at all in the Saturn Program?)

Not really, the Saturn Program followed more of the traditional weapons system concept where you designed a piece of equipment and then delivered to the operations people to support as best they can. You didn't consider problems that the operations people were going to have as an overriding factor. You didn't design specifically for ease of maintenance, ^{or} specifically, so you could limit the number of spares you had to have, your principal constraints on design on this ^{sat} ~~whole~~ program were weight, performance, this type of thing and if it required you have extra spares, then you just had to have extra spares, we would provide it. So the logistics program for Saturn reacted to the design process, it did not have much influence on the design process. (Shuttle was different then?) We hope to make it vastly different because the principal purpose of the Shuttle is to have low cost operations, that means design it so you can do that. (In the Saturn you said you didn't think you needed the logistics system so much because there would be so few launches, but the time schedules and pressures put on logistics programs.)

Well most of us when we started talking logistics in those days were thinking almost entirely

in terms of spare parts and maintenance. All of the maintenance was done by very highly skilled technicians and engineers at the Cape. It was true we did not have to have the traditional weapons system logistics program. In the traditional program the weapon is turned over to some fairly low skilled people, that is, troops out in the field. They are just not trained as engineers or highly trained technicians. So you have manuals written principally with them in mind, your parts have to be so that they can get them without having to go through any engineering process to do it, and the maintenance is such that it can be done with the minimum of skill. Now on the Saturn Program we had highly skilled engineers who could use engineering drawings for their documentation. They didn't have to have manuals, we had them but they weren't really required in most instances. If they had a problem in putting a part on they usually had enough knowledge that they could work around it, if a problem developed. If a wire didn't go in the right place or something hadn't been done exactly right they fixed it. It didn't have to go back to the plant to be repaired. So in a sense, we had quite a different logistics program on the Saturn Vehicle. (Well, the critical thing then became schedule rather than spare parts?)

That's right, and also lets face it on the Saturn Program we had pretty substantial sums of money. If we got into a problem we put whatever resources we had to on the solution of that problem. If it required another few million dollars, we found a few million somewhere and put it on there. (Now we have to make it pay.) That's right, now we are in a situation where that money won't be available, we are going to have to be right the first time. (In Saturn Program was there a logistical problem that loomed larger than others? I guess I am thinking of Cryogenics; was time it seemed like time was kind of an exotic thing then?) Well, there was a time when we were wondering whether or not we were going to make it, trying to get that plant in New Orleans on line and time to satisfy the requirements at Kennedy. Time got to be a real problem and we ran into problems on the plant. It was late getting on line and this gave us some real problems. At one time we also barged Cryogenics to the Cape and we ran into some problems on that.

(How do you deliver the cryogenics now, basically?) By tank truck and rail cars. (They weren't available at that time then?) Yes, but in a fairly limited quantity. (Was the operation and development of this plant part of your office?) Yes, we supplied all liquid hydrogen for NASA and the Air Force on the east coast and bought all the liquid oxygen and got it supplied, liquid nitrogen. (Did you have any difficulty with transfer lines, valves, and jacketing and things of this sort?) Some, but they were not too tough. (You had the advantage of Air Force Programs that existed before with LOX?) That's right, we had that and this group had a good bit of experience with that too. (I was going to ask you about the von Braun^a team) Oh, yes, they and ^KCarl Heinberg and his people down in ^LTest Lab, I think, can solve any problem. They have some real fine engineers plus a tremendous desire to get the job done and they did mir^aaculous things in the cryogenics area. (Are there any other big problems that you remember?) I think there is one specific question I would like to ask and that is about the improved logistics plan, I picked up this from a speech I think from Rudolph, I haven't found anything more about the improved logistics) Well, as he talking about for future programs? (No, this was back in about 63, I think. Do you remember anything along those lines?) No, not as such, I tell you what happended. The logistics program really got started, elements of it existed we were furnishing cryogenics and we were transporting certain pieces of hardware and we were working on spares and this problem, ^{maintenance} but not as an intergrated unified effort at Marshall and it was in October of 1963 that Dr. Reese created our project Logistics Office. He did this pretty much at the insistance of a man named Stan ^{Smolensky} Solenski at NASA Headquarters, he had been an Ordnance Corp Colonel, and Stan was determined that we was going to have a well planned logistics program on the Apollo program. He got Dr. Reese to set up this office and staffed it and went to work and over the period of the next year or so we did an awful lot of work to revive ^{the} the logistics planning and in logistics management on the Saturn Launch Vehicle. I spent an awful lot of time in ^{McDonnell-}McDonald-Douglas

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(Is it possible to categorize to say that logistics in terms of cryogenics gave you more problems

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than logistics in terms of supplies and spares? I think so, I think we had most of our problems in the cryogenics area, we had some pretty tough problems in the transportation area trying to get things like the guppy airplane ready on time and I don't know that I would classify any one area the most difficult, they all had problems but they originated for different reasons, we didn't have any parts problems so far as I know, that is I don't recall any launches or tests that were ever delayed for the lack of parts or inability to find out where the part went, you know, good documentation. We never had anything delayed for lack of transportation, transportation was always available on time. The problem was that we spent too much money, it cost too much, and so in that respect it was not efficient logistics, it was effective, we got the job done, but when we got through we had a lot left over. (Can you give us a specific example?) Yes, on the ^{S-II} SII Program we still got a lot of spare parts that we sure would like to give to somebody. I don't know how many but there is just an awful lot. And these ^{were} are things that were bought before we were able to get the restrictions placed on the contractors. They were bought very legally under the terms of the contract. The contractor did exactly what he was asked to do. (And again would you call this a case of the contractor going back into old Air Force experience traditional military logistics?) That's exactly right, that's the way they have always done it. (What about transportation, are you left now with a surplus of barges and aircraft?) Not if the Shuttle program comes through, we will need everything we have got. (How about the barges, were they built from scratch, keel up?) No, all of these were surplus Navy or Corp of Engineer Work ^{yards} barges and we were able to take them, we got them for I guess nothing in some cases and next to nothing in others and put the hangar structure on and whatever tie down fixtures we had to have. (Did they require any other special modification to make them more stable?) Yes, a good many of them did, I am not enough of a ^m Marine architect to tell you what we did do but in a couple of cases we put in some baffles and ^{ballast} balance tanks so that we could make sure we had the things riding just right and we did have a pretty well controlled environmental system on these barges, they were kept just the right temperature

and just the right pressure and humidity. In looking back at it, I suspect if we had it to do all over again we probably wouldn't be quite as rigid on our control but we didn't know, we didn't need that. An example of that is an interesting one, for quite a long time in the Apollo program every time one of the barges went down the Mississippi River it had a Coast Guard escort because we were a little afraid . some moonshiner along the river would take a shot at it. I don't think any ever did, but we finally realized that they were going to look at that as just another boat, ^{it} we stayed in the channel and didn't get over too close ^{we wouldn't} and didn't have any problem. We had the Coast Guard with us every inch down the Mississippi and then they picked us up with Coast Guard cutters and airplanes off the coast. (Who paid for that, did Marshall have to pay for that or did the Coast Guard pay out of their operating fund?) I think it was all done out of Coast Guard operating fund. (You mentioned the guppy, did you have a great deal to do with the guppy?) Well, our office ran operating the guppy. The development of the guppy was of course by private concern, Aerospace Lines. We had several people from Marshall working very hard on it. Don Steward⁺, who now works for me, just literally moved to the West Coast and watched with them, smoothing the way for them with FAA and others, to try to get the plane ready on time. (How did the idea of the guppy ever come up?) You get a lot of stories on it, but I think it is almost entirely the dream of Jack Conroy. He is one of the few ^{entrepreneurs} people left in the world willing to gamble everything on something he believes in. Jack was going to build that guppy some way and we had a few NASA people who insisted that it wouldn't fly. In fact they were some pretty high ranking people who stood right there and shook their heads and said it just wouldn't fly, there is ~~just~~ no way. (What about von Braun, did he like the idea of the guppy operations or did he oppose it?) He ate it up, that's the kind of thing he does like because it is ^{we} inovated and imaginative and daring and just appeals to him. (I understand that von Braun actually took controls of the guppy at one time.) He certainly did, he cause^d a few heart palputations around here when he did. ^{it} This guy Conroy, he decided

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the only way he could sell this thing to NASA was to fly it in here and show it to von Braun^a and it was not anywhere near complete, he braced the inside of it with two by fours and flew it to Huntsville, he borrowed gasoline from a friend of his in Phillips Oil Company in Oklahoma City, he flew it to Huntsville, in order to test it we had to either load it with sand bags, or gasoline, so we put gasoline in it, in the tank to give it weight, and Dr. von Braun^a flew it here. (With the two by fours in it?) Yes, and then with that encouragement and that about all it could be, just somebody saying you have a great idea go to it, he went back out there and he had a year or so of kind of touch and go operations where the bankers were trying to run him down to actually foreclose on what he was doing and he was dodging them and a couple of time I think he actually had to padlock his business to keep people from taking over from him. He finally got that thing going and flew it and I won't say that it saved the Saturn program, I think that is just a little too much credit, but had it not been for the guppy, we would not have been able to make the schedule that we did and make some of the flights on that early schedule. We might have recovered and caught up, but the only other choice we had was to barge these stages up to Sacramento^a to be tested and that was 28 to 31 days down to the Panama Canal and Cape from there. (You did barge some of the SIV stages?) Yes, we barged the SII³⁻¹¹ stages. The SIV and some of the SIVB's traveled by barges. (The real advantage of the guppy was to meet the schedule.) Yes, we had a critical period in there I guess in 67 or along there, where we had to meet these real tight schedules and the guppy is what allowed us to do it, plus the fact that we were really afraid that we were going to get a stage to the Cape and have to have it returned to the plant. The guppy would give us the capability of getting it back in one day. We did not have to do that, we were worried about that eventuality and that was why the guppy was so useful to us. (Was it used in other operations besides just carrying the SIVB?) Yes, we hauled the Apollo Spacecraft, the LEM, all the large elements of the Apollo program used the guppy, were delivered to the Cape by plane.

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So it turned out to be a very useful item? Yes, and Houston depended on it as much as we did. (Was there one phase of logistics area that you were involved in more than any others like transportation or cryogenics or something?) No, I was involved in it pretty much across the board. (What about von Braun, you mentioned Rees would call you up perhaps and say what change would affect you)? No, Rudolph, did that. (I beg your pardon, Rudolph.) Von Braun was very much interested, I don't think we would have had ^{nearly} ~~quite~~ as effective logistics program if it had not been for von Brauns personal interest. (When a suggestion came down from Headquarters it had to go through von Brauns office?) Yes, he was agreeable to it and he endorsed the idea of setting it up. (I guess I am really curious about the cryogenics thing because it seems to be kind of an exotic development in the whole program. Did you actually help design the specifications later on trucks and railroad rolling stock to help deliver cryogenics?) Almost all of this was done by private industry, Linde and Air Products and Air Reduction, all of coarse operated plants and bid on equipment. They have many years experience in this. They have been doing this type of thing in refining and building a little better piece of equipment and someone will come along with something a little better and they will add that to it. Most of the work that was done was done by them under our management, so when I say we helped write the specifications we actually did but most of the specifications were written by the industry man and we agreed yes this is what we want. We did impose ^{some} on requirements in the specifications that caused them to have to go back and improve upon some of the things they had done. We had trouble from time to time with high rates of evaporation, and of coarse we were always concerned about the safety of the cryogenics operations. (There were never any major accidents that I recall.) No there were never any but were stayed concerned about that and worked ^{awfully} very hard with the contractor and made sure that their procedures and equipment was such that it was safe. (You mentioned the plant in New Orleans, who ran that operations?) Air Products. (Did they make both LOX

and LH₂ there?) No, they made just liquid hydrogen there. LOX was not a real problem. There was a number of places you could buy that, ^{low} it is manufactured in a good many plants throughout the country. Hydrogen is the problem. (Could you go into that a little bit?) We have always been very marginal on the supply ^{of LH₂} and one of the problems arises because we couldn't really anticipate our requirements as we would like to. For example, we decided we wanted a plant on the West Coast because we had a M1 engine back in 62, 63, 64. That program was really big out at Aerojet. We anticipated very significant quantities of hydrogen that we would need for that engine test program out ^{at} in Sacramento. So we got a big 60 ton plant built ^{at} in ^a Sacramento, I believe that is the Linde plant, and just about the time the thing got going good and we knew we could get production out of it they cancelled the M1 engine. So here we are with a huge plant on the West Coast, ^{well,} we used it but never at the capacity we expected to and I don't know if you are familiar with the way the industry sells liquid hydrogen, but it is sold on a curve that the first pound of liquid hydrogen that you buy costs about nine dollars a pound, and then after you reach about a thousand pounds it is down to about a dollar a pound and to about five thousands pounds down to twenty or thirty cents a pound and gets to around sixteen and flattens out. So you have to buy a significant quantity of it before you begin to get a good rate. We never were backed up against the part of the curve that we were paying nine dollars a pound but we paid some high ⁱprices for it, and had the M1 engine program come along I think we would have been paying about sixteen cents. (I am a little vague, you got the LH₂ from both the West Coast and the plant in New Orleans) Yes, and there were several plants in the Los Angeles area. ^{Ontario + L Beach + another} (Were they established and were they direct in anticipation of sales because of the J2 program?) No, not all of them. A couple of those plants were set up to service the steel industry but they had an over supply and we could buy from them. (In spare parts you never ran into any problems?) Was there any parts you had trouble maintaining adequate stocks, you were always able to deliver them.)

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I can't think of any off hand, I'm sure there must have been some; yes, I can too, we had the circuit boards on the RCA 110 Computer, we had problems with them, keeping an adequate supply and there is where our highly qualified engineering personnel came to our rescue because they would take a defective card and re-work it to keep it from becoming a critical item. (Instead of having to replace these you simply refurbished it.) Yes. I'm sure there were other items of a similar nature that I don't even know about down at the Cape. The Cape had some very good people down there on the Saturn Program and they kept the problems from happening.

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Goodwin & Johnson

65 its been several years since most of those people have built the part in question so they would write us a letter and say "Look fellows if you ever want any more of those parts you had better order them now because we're changing our production line over to make something else and one of them just went out of that business completely. Maybe they were in the business of making some hydrolic actuator and they would shut that line down maybe even shut that plant down and go somewhere else and build some other parts .

(So you had to make a decision on the spot to place an order (Right) Place an order or make provisions that we could get the part built somewhere else. Which usually caused us to have to get the part requalified. And that ment it had to go through another test program to make sure that it met the requirements for manned space flight. That could get expensive. (Did Houston have a similar logistics program? That you had here?) Yes they didn't have a logistic office as such they usually had one or two men who worried about this type of thing located in the program office. Now you mentioned Smolensky head-quarters who started to stay and I wondered if they established a logistics office at all three centers at all the same time or whether the logistics problem was primarily the Marshall story.) No, no, the first logistics management office was established here at Marshall. Houston never did establish a logistics office and Kennedy always considered themselves a logistics oriented center.

Anyway, they said that's our business to begin with so we don't need a logistics office and in a sense they were right. And NASA Headquarters did establish an Apollo Logistics Office under a man named Forrest Wall that they got from the Airforce. And he had eight or ten people working with him at the height of the program.

(Did you have much to do with people in Quality and Reliability? I'm thinking about all these parts coming in and you have the decision maybe to ask the manufacturer to keep on making them. And did quality of reliability ever call you up and say hey, these things are no good anymore) Yes we got into that sort of thing with and uh we did not, my office did not direct, what quality lab did or or ask them specifically to work with us, they worked with us just like they worked with the program office. And they would let us know if they felt there was a problem somewhere.

(Can you tell us a little bit about Von Braun? Things that you remember at particular meetings?) I guess I'd tell you about the same things that everybody has about him he is a-I thought he ran the most unusual meetings I've ever seen.

Uh you wasn't, ^{were not} first few times I was exposed to him I wondered how he ever got anything done because I can recall very few times when Dr. Von Braun ever ^{really} made a decision as a result of a meeting. Uh, he operated more by getting his people to discuss something and finally kinda coming to an agreement themselves, it was more ^{of} committee action. Now I seen him at times when he was

quite decisive in what he wanted to do, but he, I think, was much more of a leader than he was a manager, he relied on other people to do the managing. For example Author Rudolph of the Saturn 5 program and Lee James from the Saturn I and ^BIV Programs. They ran those programs and he backed them. He had a very inquiring mind he, wanted to know about everything. He was one of the easiest people to know and to work with I've ever seen, but as I said I don't recall that he ever made many just plain outright decisions. I'm sure he did when the time came, he just some center you know if there was some center policy he said we will do this and let's go and that's the end of it. But, primarily a politician, ^{and a} leader in the sense that he got ah people enjoyed working for him and went out of their way to do it. And its quite a job because he had - I don't think I've ever been around any group of people that have as many diverse interest as this group has. every one of these lab directors is a personality all of his own or was at that time, I can't say that about Marshall now. every program manager was a distinct different personality. Lee James and Author Rudolph could not have been more different. Lee James was the typical Army Colonel who listened until he had enough information to make a decision, he made a decision then got up and left the room and expected it to be carried out. And Rudolph on the other hand would worry a problem until midnight or later and maybe start again the next morning and worry about it. And yet they were both effective and Von Braun I think would hardly have favored one over the other, ^{he} they knew how to get people to do things. I think Von Braun could have

been a trimendous success in every thing he did including coaching a football team I believe he would have made a great coach because he could I would go into his office you know a meeting and I'd come out of there so charged up I — I just had to go solve the problem right now.

(Did he do this because he was so enthusiastic in a meeting of just a forceful personality) Well his trimendous personality and a he is the best listener I've ever known, he, when you talked he gave you his undivided attention you knew that he was listening to the whole problem. And he could always talk to in you such a way that he felt like you were the authority and you where the man he personally was depending on to get something done. As so as a results you went out and did more than than was on your job sheet. And you knew also that when you did something he was going to back you.

(You mentioned that there were very strong personalities. Are there other people ^{we} esides Lee James and Rudolph _____

I think the strongest men I know one of the most distinct personalities is Carl ^{Hinburg} Hinburg who was a man I had an awful lot to do with this logistics program and I can say safely Carl Hinburg is a distinct, very forceful personality. I don't think anybody would argue with you on that including Carl Hinburg. But he was very strong—he knew what he wanted to do he knew what should be done and you had better be right if you opposed him. He would ~~he was~~ he respected opposition, he respected that would stand up for what he believed to be right and

he would help him but it had to be an honest conviction and I don't think he would tolerate being wrong very long.

(You smile as if you remembering a few incidents. _____)

✓ Yeah, sure Carl Hinburg his laboratory really had the job of developing the transportation equipment that was used on the Saturn program. Don Stewart I said worked Guppy was a Hinberg was a test laboratory man. Julian Hamilton, Bill Spivie, a fellow named Red Bird I sure he's got a different first name than that but they called him Red Bird. And he had a fellow Captain Evens yeah at one time they were all test lab people working under Carl Hinberg and they were the ones who did the engineering associated with the converging^{sion} of the barges and the ships this sort of thing. And Carl had a tremendous interest in ~~that~~^{this} when my office was created in October of 1963 one of the first things I did, well let me part ~~from~~^{preface} this to say that a year before then, for the previous year, I had been working as an assistant director of the Saturn Systems Office with Dr. Longrain and in October 63 my office came into being when the center was reorganized and Dr. Longrain's Saturn Systems Office was abolished.

So Hinberg had already been working in this area for some time so one of the first things I did was to go over - I recognized I'd have a problem with the test laboratory, because I had been given the responsibility for managing the transportation portion of the logistics program. and as such I would be asking Carl Hinberg ^{to} people to do things in support of my office. so I know that Carl was quite jealous of his, the work that he had done and rightly so. He done an

excellent job, and one morning I went over to see Hinberg I had an appointment with him and I got in there and ah I didn't take but just a few minutes for him to let me know in no uncertain terms that he didn't appreciate the fact that I had been given this job. An I told him that I intended that we work very closely together but I did have this responsibility and I would be asking him for support, so you have talked to some other people about Carl but he is the kind of fellow that a lot of his people are literally scared to death of him. He walked over to the side of his room and he picked up a mallet that was made out of reinforcing steel, the handle was about a three quarter inch bar, and the head of it was a good two inches, and he picked that thing up with both hands and swung it around at me and said this is what I use on people that don't agree with me. So, I had to go pick up the mallet and swing it a couple of times myself and tell him that two people could swing that thing. And we didn't have anymore trouble. But this is the kind of fellow he was, and I can tell you another thing, illustrate his personality beautifully, Jack ^{Balch} ~~Boss~~ who is presently the head of Mississippi Test Facility was sent down by Dr. ^{Reece} ~~Reece~~ to work as a special assistant to Carl Hinberg, this was in 1962 and one morning Jack came to work and he was late getting in about 8:30 and he saw that Carl Hindbergs parking space was empty so he figured that Carl was out of town so he just pulled in in the parking space, well he didn't realize that Carl was late getting to work too. And when Carl came a few minutes later he he saw that someone was in his parking space

so he got somebody one of the fellows that was walking down the street to come over and the two shoved Jack's car out of the way and then he put the other guy into Jack's car and he pushed Jack's car about three miles down the road and left it parked in the woods. He came back up and put his car in the parking space and it took Jack two days to get up nerve enough to ask where ~~was~~ his car. ^{was} But he never did have that problem with his parking place again.

(Yeah that's a strong personality.) He ran laboratory there was never any question about that. (Why do you think the people have changed so much in personality? You made that comment.) Well I think we've all gotten a little older for one thing but I guess the urgency of the mission is just not here now. We're are becoming a little more typical government agency I'm afraid. / Also we've lost some of them haven't we? ^{chens} Yeah we've lost some of the people that were really the exciting leaders. ^I In my opinion one of the great mistakes we made at this center was letting Lee James leave here. ~~Was in his~~ he was a very forceful man and very strong and things happened ^{he} he made decisions he moved you knew where you going. ^F I don't think we have the leadership now. Get the record!

I don't think we have quite the leadership we had and of course we don't have the urgency of the program there's not that goal that we have to do certain things by a certain time. That business of getting to the moon and back in this decade was sitting out there like a target all of the time. I don't believe

^E Von Braun ever had a meeting that he didn't mention that. ^I In some way. So you're always concenious of the fact that you had to do that job now get it done.

(The sustaining effort over such a long period does seem quite remarkable.)

It is, I think that it's amazing that it could be maintained and it wasn't just

Von Braun, a lot of people here like to ^{credit} phase Von Braun which is fine but ~~if~~ we

had that same leadership in NASA Headquarters, and at Houston and at the

contractors plants, I don't know of anybody that was dragging his feet. (What

effect did the Apollo ^{line} V have I know that you was probably more related to

Houston but did you feel it one way or another did it make a difference) and Why

yes, we a we became considerably more safety conscious not that we weren't

already but we did a lot of things we went back and checked an awful lot of ^{re-} ~~parts~~ ^{hardware}

as a result of that. So it had quite an effect in the quality area. (I heard one

comment that there was feeling perhaps between the Von Braun team and the

American engineers that they were kind of working together, but in a sense they

were kind of competing. That they were kind of picking the ^{mines} ~~mines~~, the Von

Braun team and after the fire people realized that they really had to get together

and work hard together. Because there were too many things resting on it mens

lives for one thing.) Oh I don't know, I never was really conscious of that, that

may be true. I thought there was good bit of, I suspect that there was some

competition between Houston and Marshall we were pretty much considered

the Von Braun team here and Houston was the old ^{NACA} ~~CA~~ group. That had become

manned spaceflight. So I think it was some rivalry there and it was a, but I

don't think ^{within Marshall} within, but there was some rivalry between the Americans and the

Walter Hausermann

Germans, ~~and~~ I guess you pretty well understood that if ~~Bozal Halzelmen~~, Dr.

Halzelmen didn't like something that was going on he'd go by Dr. Von Braun's house that evening and get it straightened out. And Carl Hinberg and the other

German people ^{that} were members of his staff. But I think really kinda you orta kinda expect that. After all they had been working together a long time. But

I don't recall, I don't really think they took advantage of that, to at the expense of the American group. (Was this feeling of rivalry different after the fire?

You mentioned it was just kind of a factor that's been) I don't really know I wasn't in an area where that would have been too noticeable. (O. K.)

I really think that they made a little more of that Apollo fire than they should have as far as NASA was concerned, ~~it occurred~~ it was a very bad accident and

it should not have occurred. But I think things like that will occur on a program of this kind. (You ^{ahms} expect it don't you? I think it was amazing that we got through

all of these things the way we did without any more accidents you mentioned little accidents in the transportation *Cryogenics* units area. To me, that's an

amazing thing. Because we hit a bridge with a large load of hydrogen down there in Florida and it tore the barge up pretty bad. (When was that that

do you remember) the Yeah the one and only time that we took hydrogen to the Kennedy Space Center by barge. I'm glad we didn't have to do it again

because we had to go through that Florida Canal. And that's where it happened

Was that 63, 67 can you begin _____

ok
(an in-flight logistics uh? I mean it won't be in your area? No, we hope that our plans are and I'll be talking to NASA Headquarters on this Thursday and we hope that we'll be given the job of doing all the logistics planning and *train* executing for the shuttle and its ground operations now not in its flight operations Throughout NASA? Throughout NASA. *ok* Great. This is what we are aiming for. It would be terrific. We have the people here that can do it. O.K. we thank you for your comments _____.

~~This is an interview with Dr. Johnson on the subject of the Pagosis Meteor Detection Satellite. O. K. I don't know if you've had a chance to read that paper over of not I have had a chance only to a briefly scan it. There were a couple of specific questions I had in mind if you don't mind maybe we can go through those. O. K. good. The thing was the Meteor Detection Satellite was designed to protect not only space _____ but lost vehicles is that correct? I can't say I don't want to use the term protect. Alright. The problem that probably existed at that particular time is a problem of attempting to design vehicles which would in fact survive for periods of several weeks in space and one of the hazards was the danger meteoritic impact you know this tied with the time that the Pagosis was initiated or that *Auto manual* _____ was initiated which ultimately lead to the Pagosis. The design concepts or the concepts of what is the Lunar landing was concerned was one of earth orbital rondavou a somewhat smaller vehicle than the Saturn V and the operation was~~