RCA

Memo From

D. E. Wise

10-14

TO | LOCATION | DATE

Bill —

01-089

Tape #22.

Only one more

to go.

Dave

01-01-018

SIEBEL

"Well since you have been here since '65, do you know Dave Christianson?" (yes) "He thought it would be interesting for us to talk to you, because he was under the opinion that you could give us some comparisons between the Saturn program manufacturing and engineering and some of your past experiences, I know you've written a couple of things about manufacturing and engineeringand the Saturn program. And we stillhave to find out more about those things maybe trace them down more o completely.Can you tell us a little more then what you did before you got into the Saturn program and maybe make some comparisons about engines?"

"Well I was in heavy industry in England and then heavy engineering and then I joined a company which makes components for the other space industries . I haven't really been involved at all before I came here, been involved manufacturing operations all my life but not in rocketry."

"Did you replace somebody that was here or did were you brought in specifically, to inject something new into the manufacturing operations?"

"It's very hard to find people who are interested in operations and manufacturing and have a reasonable technical background at the same time. And I had a great falling out with the company I worked with before and I was looking for something and specifically Dave C., Isaked im if there was anything going in Huntsville, he gave the situation I was in called available, to alot of people and of course preceede me here ... looking for a deputy."

"What did you think of the manufacturing operatiosn when you came here, did you think it was up to what you'd seen in private industry or behind, were there special techniques that were unusual

because of the space program , you want me to turn it off?"

"I think it8s not comparable to private industry because this is really a research development operation, really large scale, your objectives are different. And certainly the standards of the product are extremely high. The manufacturing operations have the opportunity for producing the high quality product and everything is geared to that, you have the facilities available and its a multi-purpose research facility of this scale which you just wouldnn't find. Inta that way it's different , the skills of course, the individual skills of the operators are very high.

"Do you find it interesting?"

"Oh yes, I find it fascinating."

"Where do the operators come from? You speak of the operating skills of the individuals , do they just kind of work into it over a long period of time in the space program?"

"I think so, they have a high demand for skills , part of this is their training. As you see in the sky-line program now th sophisticated thatwe move for from a launch vehicle into various scientificpay-loadsn like the ATM for the people we haven't been able to recruit anyone. This proves the quality.

Did you have the responsibility too of monitoring from the manufacturing operations of the contract?"

All the manufacturing contractors and 6 _____.

"Is it possible to make some mistakes about the styles of the seperate manufactures? Was boeing different, for example than North American? Was North American different Bessel?"

Each company has it own style. I don't think it is necessary

to assign personnal to a company, we need to talk about , to ~~xxxx~~ speak North American, talk about space and get an idea about what is the space mission division. It is different ~~fxxx~~ from the Lockheed, the North American is cold.

"Are you thinking of rocketdine division?"

Rocketdine division is also diffierent from the, I thinking of the main manufacturing. The Los Angles division. They are completely different. They carry, so with Los Angles an old town manufacturing ~~xxx~~ plant which has very great longivity for the people, they have all worked together for a long time and they are use to one operating code. As an idea it was a new organization, specfically created for the program. Completely different character.

"Wasn't one of the problams with that division, especially in the Parker's leadership that he got to put the whole thing togetherfrom other...."

I think most of the problems...

"companies and keep people off the street as well?"

Maybe some of the problems were associated with the rapid build up, but that applied to everybody. I don't really know. ~~I mxk~~ There were problems with the space program manufacturing in all companies really with the fact that you have a very rapid build up , very rapid decline. It is very difficult to have a team which is built up as you would for example, on a line of effort production, you build several hundred, so you have to have a very close, a very intamite relationship between engineering and manufacturing and testing and there is other operational parts of the company. These relationships are built up over a period of time and ~~xxx~~ very hard to organize then. The space program generally suffers . They hold on to the samll contracts like smaller satellites that is relatively easy to put together

a project team which would be stabler in size, so it is truly a team for the first unit, but if youget into a thing like one of the main stages of the Saturn or the command module and any of the other hearts of the program, it's so vast that a team of several thousand people is very difficult to form that rapid becasue this takes time. I guess of all the unique things of the Marshall Center, it's got a long continouous history of working relationships, of well established. Everybody knows with whom they can work and so we truly have a team here, which has been established through many programs , continuity and that's the reason for the success of the Saturn.

"Isn't that team getting pretty old now though?"

Yes it's getting old. The team, a team isn't necessaily all the same people. A team can be replentishied by recruiting and I think one of the prejudices is that we haven't been able to recruit meaningfully and in large quanitude. I must be one of the last recurits.

"Why is that?"

Well, the angencies have been under pressure. Planning something no new emissions, no new editions. I think the manufacturing has proven its interest in challenge because, for a number of reasons. One is that you go to drive the first time which means that you a reasonable amount of propieatory work, to make sure your process is working including works, designers produce and all those things. And secondly because it is so important that the first unit

works so you can have, implement programs as insurance against fialure, in paralell with the many aspects of the program we have to insultation for the doubtful area. So the first 8 will produce the honeycombing insultation experiment that followed the S29 and the construction crew was very formal. Its very form developement took place in paralell with the production of the stages just in case. Our S28B other insultations also pretty good but we changed over because correction on relaibility. On many programs these back up solutions are implemented and again the inhouse capibility gives us the possiblity of doing the propieatory work which I mentioned, also in parrellel insurance work so that we can have paraellels, paralell programs which could be implemented with the first approach by the contractors and doesn't work.

"Is this inhouse kind of thing unique rather to Marshall or is this a....."

I think to the best of my knowledge.

"It's not necessarily a thing that you would find in a rather large ..."

Not a large part of the programs, setting of Houston and the Cape. We've done alot of work for Houston and the Cape and these type of things.

"Could you comment on your relationships with HOUston and the Cappe? Primarily Houston?"In the differnt velocities of inhouse contracrs?"

I don't to much about Houston cpaibitlity. Houston is also ;;;

but I can say thatI had resident people, contractors for the ~~Apollo~~ Apollo program whose mission is was to make sure that all the available technologies were applied by all the contractors. If Boeing had a problem that could go to Douglas with that. That was also an unique achievement. All of this work on the mission. It worked very well. We had joint manufacturing meetings with the prime contractors. Not only our Saturn contractors, but also the Apollo contractors. We had resudent people, Houston contractors as well as having the Marshall contractors and they communicated very well with Houston and Houston welcomed us because they didn't have any compolicated abliity. We are now beginning to build it up allitle bit by the appointment of Dr. Burlington,,to work with produce ablility aspects and the manufacturing apects of the Shuttle. Thise two people were very imtamily involved in our own regiment people. Our regiment people were not resident contractors, to solve problems. They were there to make sure that attention was given to the problems by the contractor. Then they made help availible if needed by makeing the technology, by finding out where the technology boosted, whether another contractor for expamle whether it boosted inhouse at Marshall. With this working together, many costs were avoided.

"Did it happen very often? Or maybe I misunderstood you, that if Boeing had a problem they we go go down to Douglas and say give us the help and Doglas would very easily ....."

Oh yes. Took alitle time to get it going but it worked fine. McDonald and Grummond and North Americam all on the project, welding

problems, insulation problems, wirign problems, manufacturing management problems, they all worked together. It was a real manufactuing ~~xkkm~~,team. It really was quite remarkable.

"Quite a national porportion that..."

Yea. It even appeared in the reports to Congress. Northmellows report to Congress.

"When you came into the program, did you find that you had to develope or there were in exsistance certain processes for machines that were unique and exoctic and did you have to, even after '65, press the state of the art in manufacturing techiniques, machines and processes?"

Oh yes. ~~Mx~~ the uniqueness may not be so much in the, well uniquness of scale rather than of kind I think. The uniqueness of scale, of coure, produces the uniqueness of kind becasue, for example welding we have a conference. You better ~~kxxx~~ make 100 feet of weld to get around. That 100 feet of weld has to be without flaw. I don't think anybody ever made any weld 100 feet long continously without flaw. So you say OK everybody knows how to weld. But how do you weld with that degree of ~~xx~~ relaibility.

"How did you develope the reliablity?"

By careful preperation, attention to detail, we did some research contract on what causes flaws ans what causes cracks, the perfection of weld, what can be tolerated and what can't be tolerated and developing causes parralities. We have a research division with prime time for this age of developement and process assumption, "B" to

develope process controls, automatic controls so that the processing is controlled to within the limits.

"Did you have any particular problems in reading X*Rays of welds for example?"

Well yes, there were an intrepatation of those X-rays. What we didn't take X-rays we recaluculated. There was a long learning probe between the design module, quaility and our goal. What could be tolerated and what could not. Any weld has a little conservative blister in it. If that blister harms it or not, the weld two boding edges may not be exactally aligned, this may fly an offset. How much offset can we tolerate? These kind of things have to work out over a long period. What is perfect, nothing is ever 100% perfect, but our requirements were very high. Over a long period again we see team work gradually iron out what a really good weld looks like. This took alot of experience, a lot of work, a lot of test examples, a lot effort.

"So your appro ach was to try and iron out these procedures and techniques and transfer it to the contractors work."

Sometimes. We told the contractors to do things. For example the common bulkhead on the S2, that was a contract to develope the thing. We encouragwd it and we funded it. There were studies made on these common blukhead, we found a considerable study on how to build them.

"Didn't you also, at the same time, found another study? Paralell developement?"

Yea. It was part of the Douglas. The reazons and methods of

building common bulkheads.

"I think Marshall was thinking of laughing at..."

There were three ways of doing it.

"Laughing arivaity."

Not arivaity. blotting and then putting a bonded duffler over it."

"As we go through this, I've found that I8ve tried to write some of these things, you rread in Report that they put in the ___ __ or maybe they joined the aft dinner faces and you wonder how they do it. And we really don't know."

"To get back to the Orbit Count Dock History, Marshall felt that the N. Amereixan design the one that is curently used, wouldn't be successful. And the parrallel development which they asked N. American to use they sij simply funded under a different contract?"

"No, that isn't true, N. American method was developed w there was a sucking about it and so the larger side decided in dropping it on, it was a joint development between us in the beginning of the program. The bulkhead where we did do thorough studies was the Douglas S4B rocket. It was the I8 ft. bulkhead where three approaches were tried one was the standard approach, with two face sheets put together, anoth er was withone welded face sheet and segmented face sheets on the hydrogen side with bonded dopplers,and the third was completely segmented bulkhead unit with the honeycomb between the face sheets in segments like slices of pie and welded, welded pie pieces together top and bottom and that didn't work nohow."

"That's what N, American ended up doing."

"N. American machined the honey comb and tried to make the honey comb perfect and dropped the, they had to welded skins applied

to the ____. They made a mistake when they welded them and then when they had a complete dome and put it on, the other thing is you make complete pieces with skins on them and then you weld them together after you've got the honey comb dome between the stages."

"Ddid you do a lot of development of work using programmed machines or melling and tooling things of this type?"

"Well they came in more and more during the program. Most of the . . . I don't think that inm mØSt/ the stages there was that much. There was quite a lot MC machining in thrust propulsion areas like that, but mostly skins were meld using tracer machines."

"And something else too, the magnetic hammer."

"Ah yes, the magnetic hammer."

"Could you tell us alittle bit about the magnetic hammer, how it came about, howit was developed, w how it was used?"

"It's stupid, it's got no place in this."

"Well why not we'd love to hear it."

"When I was still in England there wasth this large steel company and one of the tasks I had, I worked for one to these vice presidents you call them here in charge of production. ONe of the tasks there, when somebody came in witha weird invention I was sent forth to see if it was any good and applicable to our business. There was some nut, who had a big blanket combustion in his basement and by the charging of this combustion through the crandk case coil,he could apply a truckload to a plunger which would then blank out small parts but the rocketry and rythmitudes blanked out so fast that it didn't have time to crank and they thought it was a great idea. He even showed me with g his cranking coil that he upside down he could flip a copper disc int the air and it wouldn't come down for 20seconds or so. So he showedme a great deal of impact with this coil and

I said, gee that is very curious and nice, but we're not in the electronics business so were not interested in blacking out small rytheam plastic parts and sa for throwing copper discs in the air were not interested in tha t either. And so we dropped the whole thing. And then the next thing I knew I was here and we were discharging big banks of plastic _____ . The problem was nobody until after the war who was developing the radar could switch lodge currents in a short time, you need a electronic switching device. Swithc the current from the capacity discharger rocketry through something, and this was an independent development here , when it was applied to metal forming, which of course we could have used anyway . That thing was very useful to us in getting rid of imperfections in welded structures which tend to buckle."

"You could control it down from large wrinkles downto small wrinkles ."

"What you want to do , a wrinkle is present for a very simple reason, it's like a picture you get a wrinkle when there is more paper than the frame will allow, the only place for the paper to go is to wrinkle up. So the way to get rid of the wrinkles is to stretch the frame which every painter does with those little wedges in the corner. And so what you do with this hammer, is by applying this impact you cause the metal to stretch a little and so pull out wrinkles,. And in welding you get wrinkles so what you put th through the weld is the frame of the picture, the weld shrinks and wh you get wrinkles inside the weld area and so by hammereing the weld you can stretch the weld a little if not get rid of the wrinkles. But that hammer was very was useful and also you could, well there's all kinds of things you can look at as wrinkles. But the other we originally used we had the suction lines tunnels of suction lines

through the tanks they were made by off the nozzle process and they c turn out to be were not exactly the right size they were about a quarter inch too large. By making a coil around them they were reduced in size, sufficiently to fit the fittings and so could be welded, so this way we saved the program untold amounts of money and time."

"OK, you used that on all stages?"

"On the early ones mainly. The techniques did get perfected, we used decreasing I think it was on the SIC it was certainly used right up to the end."

"Do you have as much large hunks of material as that?? Was that a unique Marshall development that hammer?"

"Alas."

"Were there any other unique tools like that, that you recall being used effectively in the manufacturing?"

"Yes , certainly the so-called strep-tonsil welding (strap clamps), which is soft tooling. You weld two cylinders together like in stagee space you could have two cylinders two feet long build up the stage as you make the cylinders you don't end up with same diameter each time, very high accuracy so what you ned to do is to compress one cylinder slightly and expaned the other one slightyl and you can do tthis w with heavy hard tooling which would ~~not~~ be expensive and hard to use and generally undesirable. Or you could use itwith local little clamps which e were developed here, which are very ingenious, are very neat.

"Are these the little clamps that just kind of snap in with the drill ?"

"No, no they got a little stainless steel strip you screw this in fact two jaws are held basically by this strip which goes through the gap bstween the two cylinders and draws this together and the cylinders are lined and you do this all the way aroundand then you make tacklers and thenyou break the little strap which then comes

apart , you can then weld all the way around . And you've got y the thing aligned you don't need heavy tooling."

"What other tooling were they using in the back up bars in i the S2 stage to get it aligned was that heavy tooling?"

"Yeah, but they went to strap-clamp. And also for example thre question of whether you should travel with the welding torch or whether you shold rotate the cylinders. IN the S2 stage went ultimately to rotating the cylinder although it started with welding the skates , the welder went around the stage as opposed to the stage turning around the welder. "

"This concept of rotating the stage around the was that formed in the B 70 program? Do you know?"

"No I don't."

"Did they ever plan this kind of work before' did you ever rotate the object to be welded before a fe fixed weld pad?"

"WellI'm sure that you do know later we were welding small cylinders , glass blowers do it . But to do an Olympic stage nobody ever builds these big stages. JUst a rotating turn table , accurately speaking , so there was no problem ."

"When did that come into the program?"

"__ I C the first table was used."

"And then NN. American h just picked up that technique?"

"No,they started and they had all kinds of problems and ultimatilythe table was made available to them and they stole it."

"I s that government equipment."

"I think it was takenout of my chute, I forget where it came from. I forget how it was done if you want I can find out. Oh there were a lot of things , bulkhead welders , domes, how that was done is an interesting thing."

"Can you explain it?"

Well, we had vacuum trucks to hold the boding segments together. But the problem is that you get one side alittle hotter than the other so one segment lifts with respect to the other and there was a developement that was done here so the two would be ductive together. So couldn't have, the two boding segments which you are trying to work together. The first machine sized to have a convex and a concave edge and then processed so this, in fact, machinacally was straight. This again did away with our need for hot tooling. A very ingenius method developed here.

"Do you have anymore _____ like that?"

I can't think of any at the moment.

"Guess what I8m treating is how you transfer this technology then or how it is useful to the manufacturers. Did they say that you a circular and say, Hey we have a new way of doing this?"

No. The S2 is very simple. You couldn't transfer it and then finally we got various vice presidents from North American to come down here. We made two short cylinder _____ 18 inches wide and put them on a turn table, with our stroke plans and demenstrated how we welded and how good the weld came out.

"But you couldn't convince then to take up two vice presidents down here."

"who are these vice presidents? Did you have to bring Parker

down here?"

Um

"Yea, we brought him and talked to him when we were out there but he was away at some meetings."

We talked to Ralph. He's a real xxxx....Ummm.

"He was with the L.A. division wasn't he?"

Yea, but he was transferred to the S2 program when they developed some trouble.

"Can you list some of the reasons that the S2 program got in trouble?"

Well I think the S2, that's a purleyimpossible thing. The S2 I think is the most elegant design of any built. And an elegant design heracute is phsyical to gold. I don't think enough attention has been paid to its ablities such an elegant design. Once it was built it was a very light stage. Structurally light, good mass fraction. It worked very well. Can't say any against the S2. The old stories that manufacturing people , just I din't recognize the problem , or to what consultant to confirm to. There are also other problems of this thing like contracotal requirements, the crimes to go to small business and subcontractors. They chose small business and subcontractors.

"They think they've granted that touble with the insulation."

That's right.

"They just rubbed their hands and siad to the small contractors to just go away, we can't build you any. I didn't know that was a

requirement of the contractor and the small business to get into it."

Also the trouble with the skin mill, the mill skins is also a part of the skins. And they tried to be milled and they couldn't. "that was what, the Douglas?"

No.

"North American. Didn't they end up milling them over at L.A.?"

Yea. I think. Yea, I think they did. Falling, they are falling problems.

"Yea. Didn't they do their own explosive forming down at El Tora?"

Yea. But that was also drawing developement. It is that what can be formed, what can be explosively formed, what needs to be break formed. How the design and parts....

"It was my feeling that explosive forming can in just because North American didn't have a big enough stretch breath. What kind of equipment."

I don't think that is the whole story. You can always make two peices and weld them together and you gain weight.

"I was under the impression that explosive forming kind of grew out of the Army technology that they have been ..."

Explosive formimg is was know because of the very large part. You can explosive form filler parts thatn you can strecth first.

"Do that again now, what you can explode thinner forms?"

[illegible] If you want a thin part, you can use an explosive form , if you want a pickup part you go to that

stretch place.

"Didn't they start off using some explosive forming, you know, on that heavy part of the bottom of the bulkhead up till when they welded that first part and the rest is stretched breasted isn't it?"

Yea. The other way around. The thicker part can be explosive form, particularly is it has a waffle patern and the thinner part can be stretch breasted.

"They stayed in flight with the waffle pattern in them. They put them in gorge segments, put them underwater and explosive formed then. Then welded the rest of it up on the outside."

Correct.

"And Marshall had a part in that devleopement."

Yes, they wanted, North American initally wanted to explosive form the whole common bulk head. The two skins.

"The whole thing in one piece?"

Again this was the form I felt a little whoozy on it.

"Of course a little whoozy on the basic processes that's why. Our background isn't into it at all."

We have quite a developement in stretch press. All the problems is the grips. So you get an even tension. Push and Pull. You need to correct the edges with the hard material. It's knd of difficult to grip.

"I can see why this would be more disireable then others."

Other things you had a mill-traddle had to be developed ____ form which changed its shape.

"did you get into production technology in the engines as well as structures?"

Some. For example, when we were in _____.

"But never Saturn engines as such."

Yea. Weh had a resident at the Deholder and welding. Not really, we didn't have very much...

"Did the ____ have a seperate resident of people in different in addition to all this program management who had people like Don Botten out there and..At North American?"

Roberton?

"Yes."

I don't know who, we had one there. But I don't know...

"But out at your layout."

Yea, there was one there.

"Did other layouts have that pratice to so you would have a representative program..."

I think so. Yea. I don't know specifially. The engine program generally , they had more people than we did generally. But with different missions.

"Now did you go, better curves for that mater, did you get out into the field, where you examined the problems ?"

Oh yes. Of course I spent also of time on the S2. Again we spent some time out there and I might have_____.

"You know I had a question I had to ask but now I can't think of it. Oh. I realize that there are differnt kind of programs

but do you think that in comparision with private industry or at least your other experiences, the Saturn manufacturing program was well ran or average a little, it could've been less expensive or maybe they didn't go enough here. Could you genarlize?"

I could always generalize it in retrospect you could have done it better. I found that in rpivate industry , the president of the company always said to me, Gc you could have done it cheaper, you could have done it better,and I always have to agree. But under the circumstances it was a fantastic acheivement. A clever achievement, I don't see how, under the circumstances, at the time it was done, that it could have been done different.

"Do you keep in contact with some of your former colleages in England about, have you talked about the differen kinds of processes that you run into here?"

No. They have been away too.

"What would you have done differently, you said looked back you might have done something differently?"

I think I would've , another trend in engineering in general. In the, rather than trend in manufacturing in the areospace industry which you see had several companies. Where there is more aggressive engineering talent introduced into the manufacturing operations. That is true that most of the areospace manufacturers, some had it already and some are introducing it. I think this was the result of the Apollo program. It's the result of two things.

One is the Apollo program and the other is the result of the fact that engineering talent is readily availible to manufacturing beats today. The recognistion of manufacturing technology in general which covers everything from manufacturing management and interface with engineering down to the process developement and actual production. This is suffiently technical now that one has to have a equal say with design engineering and consequently you have to have people who can talk manufacturing, talk sensibly to design engineering and evolving areospace industry you find this trend everywhere. This is, it should have come 10 years earlier and we might have avoided some of the problems that we had.

"In some way it strikes me that you have found a unique viewpoint in the Saturn-Apollo program because you came in establishment, did you notice or ever hear any stories of fricton between the Von Brown team as Germans, as opposed to the other American engineers as Americans?"

No.

"They had developed a very close appreciation, understanding relationship?"

I haven't heard any. Frankly I was looking for it too.

"No, neither have I, at that time, but it is a question I'm sure John and I will be asked by some of the critical historical readers."

No more friction than in any two groups.

"how did you see the working relationship to the lab directors around here? Did they fight each other tooth and nail in the table of times, is it always harmony, how did it work?"

"There was no harmony, the thing that was constructive, was discord if you like. If you share harmony then I guess nothing gets achievedyou know. There was s a certain amount of professional opinions, though not neccessisarily identical. While there was discord, it was entirely constructive discord, it wasn't very political And Ithink this misunderstood by very many people, there are meetings, today maybe a our lab directors are as sharp as tooth and nail, but this doesn't mean that we hate each other. We all try to do the best we can and how you do the best you can isn't neccessisarily interperted the same way by everybody. In fact our work ___ are called "frank" discussions. "

"What about Von Braun, f can you make some comments about Von Braun administrative rule here at Marshall during your time here?"

"Well he had hes own style. He has a very democratic style if you like, and any GS 9 could go to a meeting and say I don't agree and he ~~say~~, he'd be listening to them. And that was very good and I think Von Braun had a great genius for "systems engineering", making the whole thing jive somehow. "

"Well we've asked for an hourand we've had an hour, and thank you very e very much."

end