I "I didn't either, I just had a small portion of this picture. . . . he came up and brought me a photograph of this monster. It was thirty years ago , we brought this to this country.

"An analog computer for a V2 motion pattern."

"and one portion is still in operation, and this is the mechanical portion I think is the II SB Onyx , the rest was taken apart beca use they neede some tubes, components and stuff . OK what can I do for you here?"

"Well something about the roll a or computations. . ." ha ha

"Can you make dirty jjokes or is everything already on the tape, here?"

"It's on make whatever jokes you whant to ."

"Oh no, no, maybe ladies hear this later on and I don't care for that."

"This is the age of moral freedom. Do you think the computations and computers in the Saturn f program work with the breadboards per haps? If you were doing it at the development ~~a~~ made it check out telegraph report equipment things of that nature?"

"Well in general I htink I can say this, if you compare the Saturn development with what was done long before, for instance, the V 2 development or Redstone "issle development then there is quite a change. You prob ably have noticed h that none of the Saturn scales in spite of the facet that the Saturn is a much, much more complicated vehicle than the Redstone was or even the V2 was and we fired thousands to find out what was wrong until those things w were really re-worked. But the Redstone development was better but not much, where we had learned things, but we hadn't learned so

much with the Saturn that all of a sudden that things don't go wrong anymore. And there must be another reason, and the reason is f before we . . . in other words our computers and simulators we have today enable us to do a much, much better job than we did before. We don't have to use extra hardware to test it antmore we can do this now with simulator systems. And the Simulation is o done with computers, with analog computers, hybrid computers, and visual computers. This was fo fianally the reason in my opinion the most important reason, that the Saturn vehicle worked so well without any failures so foa far. Now cross your fingers that the remainig to also work, there's no reason why they shouldn't."

"About what time did you start introducing this kind of computational model?"

"Wel we did this really in the type of picture I showed you hear, of this thing. This thing was used here in the early development of the V2 and it had the little bit there already, because the required numberth f of things couldn't be explained even after experiments. Because after the V2 has didd dissapeared into the c clouds then there wasn't much you could see anymore and the telemetry business was not so well developed yet, but we really could see in to quite a few things that we just couldn't understand. And we did some computations,naturally, useng the computers, pencil and paper and so on , we had to linearize our equations and most of the interesting things we linearized ___ so they did not relly represent what went up anymore,. And so there was some idea to use a model of the rocket, an electronic model to study the behavior of the rocket a little bit more, not only of the rocket but of the whole fo flight. Because of the aero-dynamic behavior and the behavior of the control system and so forth. So in other words we developed a simulator. A simulator contains what we call

nowadays analop computers., this thing had integraters in it and adding circuits and what other ingredients we have today, analog computers. And we learned quite a bit , but after all wwe had only one or two tϕ/n of those thingsgs going and the technique ///// was not so far developed yet , some test firing shots, just launches. Well you know today we don't have anymore small things today a our computers fill the whole room. And we can do many many more sophisticated simulations. For instance the Pogo problem you know the Saturn. . the thing behaved like a pogo stick witha little bit of acceleration, it was a longitudinal postulation. The question was now where does this come from? So instead of makeng test firengs o or the whole businesss was simulated.//// And the simulated model then behaved exactly the wayy the Saturn propulsion system behaved. Then we had enoujgh time to study this business we didn't have to shut the test off because the fuel was gone or something like that. And so finally we found out what this was, at least this was one contribution to the Saturn program. Naturally in general our kind of things were simulated, actually simulation my need some definition some people say that the computationof orbit projectoryby computer is a simulation of its flight. Well I would not call this a simulation, I'd call this a computation. But anyway it was one of our contributions here to the whole development of this thing."

"But you made the point that early in the program say, there were a lot of REdstone, Jupiter failures, was this the introduction to more computerized more sophisticated equipment, or your ability to put the right kine of information in it?"

"Both , we have better computers now., we have larger and cheaper. WEcan process more data and produce more data and we squeeze more out of what the launches gave us. "

"Wasn't it b about '59 when you started the Saturn program?"

"Well we actually a started around I952, something lije this, digital and we had a very primitive compute r manufactured by IBM our program calculator. And from there on we had more sophisticated ones until we finally ended up with an IBM 7090l and now we have a unit computer system and FO8 system consisting of three large computers comeing together. Anyway this our digital capability and the analog computers, the real simulators we have brought over from Germany because there were no computers available at that time in this country. And we started then to build a new one here this thing was for quite awhile and stillthink si is Astrionics laboratory."

"You developed your own Analog?"

"Yeah, before computers came into being commercially here, they differed a little be bit from the design you have here, for instance we did not use dc amplifiers, we used ac amplifiers. Idon't know howw I should go into technical details like this, maybe they are of interest to somebody. Dc amplifier has no stable zero position because you an cannot differientiate betweenthe single and the supply current and so on. So you don't know exactly the amplifier change or was this a single? If you have a carrier system that which has a carrier let's seeI I000 cycles or so, then the I000 cycles single only changes if you change it. And sincethe supply wanted to say the other frequency, maybe the re frequency C or over you ca n now distinguish bitween changes in the amplifier and changes in the signal. And to add ac voltages together is not more complicated than the dc voltages together. The only problem was integration, you can integrate a dc current easily because you just send the current into a condenser and the current shows the interval the summation of this current and with ac this cannot be done. Y YOU can put rectifiers in and rectify this and modulate this later

on . Or you can use kind of a ring modulator between your amplifier and the condensor,this makes the condensor think he has a dc amplifier and the amplifier think it has an ac condensor, so to speak. And this works fine and this was the way we developed this computerr here. Now a days we have made more progress and the stabilization of dc ampliifiers and the dc technique is what is used.

"Have other computer companies adoptedsome of these things?"

"There were some ac amplifiers in this country,after we were interrogated in this and other work. But still only for a couple of years, because in parallel to this there was the development of stable ac amplifiers. Which was a neccessity for their use in analog computers."

"When you brought the analog computers over your talking about I945-46, in that time period."

"They were brought over in I946, I believe. And in I949-50 probably in this time we started a our development and also,let's see maybe it was I950 whenwe came here to Redstone. WE did some paper designs but we didn't build anything here no that Iremember."

"Also you were using computers for the flight simulation, now were you using computers aththis time also in engineering designs?"

"Yeah, any engineering design naturally needs computations, you have to compute pressures and strengths and that kind of stuff. And youcan do those more things more accurately. And things like heat transfer, for instance, from the motor to other parts of the plane, or form re-entrying to the interior this is usually a very cumbersome computation, this leads to dis-illusion of partially differential equations, and that is a messy affair . WEhave to do this numerically because these are non-linear and close solutions are

debatable. So to do those things numerically with pencil and paper is cumbersome it cannot be done. For instance, just to work in matrix, something comes into my mind, there was a book which mentions this to work a 98or something by 98 matrix somebdy has to ; pick it out which takes a minimum of 2 yrs. 8 h rs aday no coffee break, no vacations, no nothing, for two years. And one of our modern computers does this now in 30 seconds. Actually what there has to be done in thes area not only to make the computers faster but also to develop new mathematical techniques. And this was altered down here, dr. Felberg for instance ant ths computations laboratory dowh here, developed new integration methods to integrate differiential equations, projectories and so on. He has had quite some success so he could press the time down toa couple of per cent to what it was before, what was needed before using methods a couple of hundred of years old. Actually accuracy is much much higher, for instance using one of hes /// methods you couldmake a trip frome here around the world and backin other words about a half a million miles roughly and come uplwith a computational error of .OOI mm. If you actually applied this thing to thec control system it would be that accurate, but the error int this computation would be of this magnitude."

"When you all began to plot some of these things out are you able to plot in some fairly easy things ? Anomales inan actual flight if the jet didn't go as long as it was expected, would it come out with alternative modes?"

"Yeah,well let me tell you one thing, we had evaluated certain flights started with the Redstone and with the Jupiter development Well what we did when we fired those things at the Cape is that we have real lightss to fuller them and too determine the actually blown detectory this way. Naturally the other light basis came to

be known very accurately in thegeophysic coordinates. Otherwise you could not predict measured good directory account. If youmeasure such a projector you use more field like this than is absolutely neccessarily actually you need only three to determine a point in space. Now we use many more to make sure that overhead you look for clouds and also to verify the accuracy and now to use all of those measurements, we use a technique known as a 3-square technique, invented by Gowes originally. Gowes used this ot make computer orbits of celestial bodies, and so on. To get the errors out the reason errors out. And we use this method for the same purpose here and we found uot thant sometimes when one particular station was heavily involved that the sum of the squares n in this process was excessive. And so we experimented around with this business and just located arbitrarily this station a little bit sideways a couple of yards. And to our surprise the sum of the squares which gives an indication of the errors involved became less and so we finally arrived at a minimum there also . And we come out we could find out under what conditions, under what new coordnates for this new station assumed coordinateswould the sum of the squares be at a minimum. OK and we gave this information to the geodectic people at the Cape and they found out that their coordinates were wrong and that ours were right. In other words the station was not where they thought it would be. Things like this you can for instance find out through your computational analysis. And very similar things you can also find out , the flight naturally, what has a happened ansd so on."

"All this is a computational thing and support or at least it was involved in support at another center? "

"No at that time Kennedy was still a part of Marshall ."

"Oh I forgot that well the question I was leading to I guess

would you get intothe business of doing computational models or analysis of one kind or antoher for contractors say Boeing N, american or Douglas?"

"Well not directly I think, we had naturally the proper investigation with our own work here and what we i did is we made our computers, our hardware availab ble to contracrtors, because our computers were better and they were cheaper. We had purchasers and some of the people paid rent for thime and so on. "

"While were on that subject could you explain the relationship between your facility here and the facility at Spidel, the supporter of Miss U and MIssippi Tech ?"

"Yeah, when MIss U was ___ and Missippi Tech was establishe dthe re was the question of who should do the computations there and the data processing service, and simulation servece , and data reduction and all this kind of business . And there were several alternatives we could either tell the companies help yourselfand do your own computations by your computers and just right it on the bill. Now we found aout to do this would boe lmighty expensive and we found out that the combined center the combined c facility for all of those contractors for Boeing , for Mason , for Chrysler, for GE, and others , that a combined facility would have alot of a dvantages and would be much, much cheaper,. So we established the Spidel computer center we used Spidel because it was right in the middle of Missippi Tech and MIss u and the building was available , we inhereited this for one dollar from the Federal Aviation Agency. They didn't need this building anymore it was empty so we packed it fullof computers and established Spidel. And the computation laboratory here we operated this Spidel Computer Center for awhile using our own secret service people and our own contractor, this was GE at the time we sent people down . And after awhile then

it was determined that they should have there own support contractor. One of our people Mr. Reeds staed down there and became the manager af Spidel . And Spidel didn't perform a very good funcion for all of those contractors . Much cheaper than if those contractors had had there own facility. Some of them didn't like it in the beginning but there was no way around, because we saved quite a bit of money and it worked, this happens too see?"

"Is that why some of the contractors didn't like it because they wuuld rather have established one of their own?"

"It would have been more convenient maybe, but see if you have a common agency looking into your commitee's records , weal its easy to find out how many times your coming off a or how many reruns youmake. And when sonething went wrong and what should've been done easier , but this critiscm is nba what they like. And I think this was the reason they wanted to have seperate, not prpo profit reasons. They make more money on building th e $S_a$turn. But it was more convienent for this change of being critisied.

"Later on when the business fell off and slide down the need for a confuntation decreased. You're still running the center are you not?"

Stadinisstill operation but the situation has changed . We do not have this multi-contractor enviornment anymore and we don't have this heavy work load anymore. We are full of project heads, we are full of project Russia, one of the largest projects that ever exsisted. Stradilon was given to do this job. Now we have some people in the Mississippi tests, some tnents like the Mission ~~XXXXXX~~ Service Seattle ~~Graphics~~ Project

whether are showing up but this is by far the equivalent to the [illegible] Apollo project. Sorce like that is not used to the fullest extent. The computation laboratory here in [illegible] Marshall is underly mentioned for its job and is overloaded, so it is now at the problem of how to use Slidell remotely, natuarally this can be done. It has some money and, but it is not settled what our management wants really to do.

"didn't you try to remove one of the big computors from there? At one time and bring it up to Marshall because you had management responsibility and Dennis[illegible] and Jimmy kind of stepped in to prevent that?"

Yea. Well, I don't remember what happens, that was something between them and other headquarters but these Mississippi tests is quite investing in buildings and roads and then actually one, [illegible] two, two or three utilizers. They are trying to get companies into use this area and other corbant services and they need a [illegible] compatation to port for this business. So they are trying to make sure that their computors did not leave there. this probably was the reason that she wasn't with [illegible] exactlly with the center and to other headquarters. Though exactally I like my job.

"What about GE, are they stillyour ~~to~~port contractor?"

No, we changed it in the meantime.

"About what year was that? '65, '66?"

We had GE for about 7 years, 8 years. Aftert this about '68 or something. '67 or '68. The complict was _____. Ther's a policy in Marshall to put this on the market ever couple of years, now every

four years I think. At this time computot scientests probation wanted this and they had the contract anulled. They took over some personal that had left GE at that time with the _____. But they also brought in much of their own ~~xxx~~ people.

"I was going to ask you about what kind of dislocation you suffered when one company which has been with you a long time like GE was, can you say how you felt one way of the other about that?"

Well naturally this is, I was drewback. There is not doubt about this. The utlization of everything goes down because we have to train a new contrator even if the contractor is a specialist. You have to ~~xxxx~~ get him accustomed to your methods and so on. Fortunaley, at that time we still had a large capability in the computation progarming and so on which now we do not have anymore. So this could approached to a certain extent. If we should have to change comtractors again, we don't have the remotest capablitiy anymore, but we really feel this and this will cost the tax payers actually quite a bit of money. But there is nothing I can do about this.

"Why did you r inhouse capability goes on over? Did you think it was cheaper to use?"

No, the Congress of the United States apporpeated money to NASA and we couldn't pay the people any more. We had to go. We needed the money for other purposes. Which meant that it was a great idea either, I don't know. Anyway that is the reason why we had the con-contract anulled.

Side two. Questions garbled.

So this is page two.

"Yea, this is page two. Just like the guy on television. Anyway, what about the relationship between Marshall and Kennedy now, when you have a launch. Is there feedback directly from Cape Kennedy or Houstom to telemetry systmes, do you contirve here, are you running checks against Houston and Kennedy or what happens during launch?"

We are , well there are micorwave connectins between the Cape and Houston and between the Cape and here. So we are tied, we get our data then from the Cape and from tlemetry systems from the Cape. Here in Marshall we can dispaly most of this here. We are also tied in with Houston, but it is a supposting role to Houston. As soon as the Saturn is off the horizon here, we can also recieve some of the values of the various electry.

"Coming directly from the vehicle?"

Yea. Coming directly from the vehichle. We call this our project here. Launch information exchange facility.

"I saw that sign downstairs and I wondered if you had a large Scandanavin section here."

Launch Information Exchange Facitlity. A portion of this business is called the Huntsville Operation Support Center where we support our operations group here in Marshall. The whole thing consists of again some computors which reduce the data and meantime close, very close to the real time so that we can follow the dijectory and follow the orbit and the whole works. We also have a TV connection to the Cap and can then see the vehicle itself or portions

off ix the vehicle or drwings, or Dr. Dengis running around with a cup of coffee ar whatever.

"What about the prelaunch operations. Are you connected with those normally with the Apae or are you running checks here too?"

Yea. We are involved in the conduct demonstration tests and this is done followed up be a, using the same facitlity here and we are invloved befor the thing gets launched and making it ready with the launch itself and after the launch we then get our data which we have to evalutate and give back to the developeres.

"Did the automatic checkout procedures come out of Marshall here or did the contracors have a great deal to do with that?"

It came orginally out of Marshall here. We were invloved to a certan extent and estenics laboratory mostly, was invloved in this business.

"When they first, I forgotten the date, but wasn't the first automated checout preformed on ix a battleship SAB at Sacramento or Douglas?"

The battleship diversion...

"The battle ship diversion."

Yea. I think so. Yea.

"Did you send people out there to help Douglas set that up or how was that accomplished?"

Oh, I don't remember what we did. May be somebody was there, but this was usually done by the estrenics laboratory. We had the estrenics laboratory to do this. The question was did we send our people along, which we probably did this but I can't tell you

anymore how this was.

"Dr. Helstrem was under the impression, after talking to some Douglas people , that they had workied out an automatic checkout scheme and then Marshall came out in order to help them with this facitlity and insisted on throwing several levers and swithches in to the program so that it could have some human control over it, as they were going through automatic checkout. It was not really a fully automatic checout and Marshall kind of gout in the way at least intially of the automatic checkout."

Yea. Well in this word, checkout area I think I cannot help you too much becuase we were not carring the bar. The bar was carried by estrenics labortory. Why they did this I really can't tell you. We had some people form the computas side to help it so , but how to do it and what the tlelmentyr was , that was not our...

"Can you tell us how IBm came up with , Marshall and IBM, came up with the program, the actual flight for through the launch vehicle computor? Did you have anything to do with that?"

No, this was also handled by the estrenotics. They used our computors here and our forblanch and so on. But the responsibilty was the astrnomics. She and the computation laboratoyr sometimes go this way: We make sure that computors systems , in other words the heart, we enter soft there for this computor to make this computor run. How and when can it be used by the people in that we have programmers to program there problems. So for instance we set out to asist them. How to compute dejectories. But what

dejectories they compute we don't care. Somebody has the responsibitliy and so astronomics may use what we have to offer here but what the decisions were I very often didn't know, didn't have to know really.

"are you invloved with the direct board materials too?"

Yes, some of our people were involved later, under the later phase if the trouble was involved from a sofer side. Then again as only, in the supporting role.

"As you look back over this progarm, the Saturn program and the role of the computation lab, ..."

We would do it entirely different next time.

"Can you say what you would've done differently? What seems to you know to be a wrong turn someplace?"

Well, since we will know that the Apollo project got curtailed earlier thatn we thought, if we would have known at the beggingin., that the United States are not really carrying that Apollo project through the way it was planned. Lots of things would have been done different. We would have used, could have done this with fewer test stands and with less effort, therfore we would be undoubtly sure it was not necessay and so on. Unfortunatly we flew a strange way into this country, we flew a little bit in a shock way. We are very often, and this was donehere also. So it has been know knowing what has been, I could have told you what I would've sone differnetly. But not knowing what happens later, I probaly would've done it the same way.

"What about the conputation lab in germal. Are there xxxx certain points of it points of it that stand out in your memory., certain things you remember more than others?"

In the computation laboratory at Marshall. You mean how this differs from other complexes?

"Something like that, yea."

Well it does. Usually computation laboratoreis are in nedd of a xxx processing service like filling stations, you get the 10¢ digits or something like this. Now this computation lab is a little different. We have found, or we have tryed to avoid one thing which was very detramental to lesser industries and other government agnecies. Namely that computors, computor user groups is going up in five kinds of portions of the organization. For instance the controller usually was the guy who used the computors ofr comercial purposes. For payroll, for purchasing, or for personell porpuses, for accounting and so on. OK , the scientifc people, the engineers used them for selving mathamantical problems and enginerring problems, naturally there somputers were different computors and they were in another place and thy were in a xxxx different organization. There was another use of computors manely to use computors for xxxxx simolation this agian was another xxxxx department, or was developed in another department. Sometimes wven data reduction was in some places, very often you had in industry and governemt organizations computors are all over the place and sometimes half full, someti es if you want to borrow a keypuch

you had to go all the way out to the president of the company and down the letter on the other side to be able to get that keypuncher. All of this we tried to avoid in the computation lab by making sure that we had all those things together, and so in the computation lab now not only we did our processing service, in other words, the processing of raw data. We also have a simutaltion depatment where computors are used to run a simulated imparement this could be a scientific experiemtn or it could be a mathamatical model of the whole organization, how it functions and how it would function better. So in other words we used of computors for simulation and the data reduction is operated into this business do that we always have computors use to the fullest extent. Sometimes, well let me put it this way, our latest step we took here in the computation lab was the switch over to what we call Generation 3 type computors. May be I should explain this a little bit. Gneration 1 was a very primitive computors like the decard program calculator from IBM research, early computors. Those computors could only digest one job at a lime. We put a job in and you used punch cards, you used outside memory again punch cards as made memory a job. Later on we had generation 2 type computors, those computors were used already transitors and we right with the IBm 711-04. But still this computor could only handle one job at a time and when the job was through we had to shutt off the computor and we had to mount it to the next computor and so on. This naturally was not a very good utlization of the computor the computor has to wait to get a tape mounted or to write something on tape. Usually these computors could only either compute

or write there outputs on the tape or read their read there inputs from another tape or something similar. Anyway, all this was avoided in Generation 3 type computors. Those computors have multi-processing so they can process more thatn one job at a time. They can read while they compute, they can write while they compute and with multi-programming you can have more programs in the computor and in the forward generation computors and you have time sharing. You cna use the computor from remote stations. Remote stations share the computor and every remote station thinks it has operate seperatly. Anyway those computors allow a much better utlization of the computing equipment thatn what we had built before. But also thoss computors are built so that scientific jobs, mathamatical jobs can be done the same way as commercial jobs, buying, payroll, accounting and so on. But the computor doesn't make any difference anymore between those differnt jobs. As a matter of fact, it balances its resources a little bit, well not a little bit, quite a bit better. For instance in commercial computors and Generation 2 type comercail computors, you have lots of input data and relatively few computations, there is a lot of sorting of data and lots of output so you need a trmendous aray of input/outpuut yeild, you had a very smart computor inside that and you had lots of output here again. The scientific computor is different. They have only a few data going in and you have lots of computations which keeps the computor busy for quite a while there and after a while you have

a little bit of output. So you need lots of computor and you need little investit input/output gear. Ok. Now the Generation type 3 computors that are equiped so that they compensate each other. You have alot input/output gear for the little jobs. You have a lot of computor for the scientific jobs. So it dovetails so to speak. The whole utlization of this type of computor is cheaper than is you would have seperate computors for these three uses. So this is much more economical. As a matter of fact, our Third Generation conputor we have is about 60% of the price of what we had to pay for about the same, about beofre. The amount of computation and the same utilzation before and it has about 60% more capability.

"When did that third G Generation come out?"

Well I guess it was a couple of years ago. I think about 4 years ago that we atarted to introduce the third Generation.

"Towards the end of the rpogram,,the Saturn program."

Yea. OK. But I want to tell you how this computation lab differs from others. This was the orginal idea, but I wanted to explain this. OK. Since we were organized the right way, this switch to detrerational computors was easy here in the convent and here in Marshall. It was not so easy in other companies just because they had allowed the faclity , there scientific and commercial uses and their simulation and their data reduction and so on and sometimes this isn't easy. You know in dividing charts or something this is his own empire and you all of a sudden tell hem you are not the king a anymore. He gets mad, huh? This happened inlots of installations and this was what they gave us here. So it was really easy to switch over to something new. And this is the direction in which the t computer development or the ____ of computers really goes. LOts of commercial co

of commercial companies like Boeing, or like Douglas have consiladated their computational resources and their computers, now even into a subsidary of their company. So now thiy don't have thier old company director anymore, it's now a subsidary of the company, which serves the company but also gibes service to others. And so far we are at the right track g here at Marshall, not only were we at the right track wea were also leaders, so to speak in this area, and we hope our management will see this clearly, sometimes at present they don(t."

"Ya know I was going to ask t you if you could make some comments about the style and utilization of computers, by m Marshall as compared to the other companies? If you thought you were ahead of them a or at least abreast of them or if you were less of more sophisticated, maybe?"

"Yeah, well we were for quite awhile really ahead I think. But lately with the reduced money we get we are falling more and more behind. And if this trend continues, I think we wont have any leading role anymore."

"Soat one time you were in a position to say to a contractor it might be better if you re-organized your compautational work a little bit more along these lines."

" "We sent some teams out ot companies and told them to consilidate this in order to make it cheaper and so on, and there was quite and interest. But I don't know how this will be in the fubure because, you know, we cannot afford, we il will lose our ____ completely if we continue, at the computation laboratory, yeah. And then to send the support contractor to another contractor you just a can't do it ."

"Awhile ago you mentioned asimulation and you mentioned management among those, have you ever run in simulated management org-

anizations that hve resulted in any changes that you know of?"

"Well we haven't done this here , but this was done and should be done. People at MIT Dr. Forester for instande has done lots of things like this,. He simulates portions of the American economy and he's very successful in what he does there. This e is quite interesting, you know some people callthe computer era the second industrial revolution, because of automation and so on. Now this apparently seems to be in contrast with the first Industrial Revolution, this would be the second one/ Now the first Industrial REvolution was the mechanization that was started I think in England but pretty soon it spread on over the world,huh? And it had the consequence that lots of people left there jobs, that things were donne not by hand anymore that big factories , line work was done, the m machines took over. And as a result you had unemployment,tthe prolintary arts, and after all communism and so on. OK now why did the Industrial Revolution have those terrible consequences , l it was because v nobody really d knew what was relly going on. No body could predict what consequence s this mecharism would have, and so nobody could do anything about it and it just got out of hand. Now the 2nd Industrial Revolution which we are experienceng today maybe the computer and automation Revolution it is nto neccessary go for this to be an uncontrolled Revolution. This can be a very well handled revolution, because now we can use the computer to find out it's own influence onthe economy , for instance . And we can use the cut bread itself , the computer, to predict it's own influence. Which is started for instance by the people at MIT but not only there but by people all over. And why should we have war games, we might as well a have peace games too. You know to avoid wars. All those things can be done with computers and it can be done in a controlled way. I don't think it's neccessary to have something to go aout

of hand again. Wecan avoid it if we od ti right and if the country spends some resources on things like this ."

"Dr. Hoelzer can you say, perhaps a few word s about Von Braun as a technical manager of the Saturn program ?"

"Yeah, I can tell you some stories. I wanted to give him a snow job once , but it didn't work. And then I tried it again. I think that Dr, Von Braun can catch things faster than other people technical things . So let me put it this way, we have a neew name for a certain simple things here and this is systems engineering We need all of a sudden systems engineers . Which is not a bad idea because it q pays out to think along the line of a system instead od running blindly into componenets development and having /lots/of changes made later on. Now if you look at what Dr. Von Braun did in his like I think he was one of the greatest systems engineers we have e here. // He was the systems engineer,because all those different components came together in hes mind, at least until we finally came to the Fuller project , there big structure a little bit complicated I have to admit that. But I don(t thind he ever lost track of the most important things there either."

"IS part of that too because he was willin or able to delegate authorities to the various land chiefsand sort of when it came together at the meeting the information that was given to him from the laboratory was pretty hard and fast stuff. And he was really up to make good decisions based on very realistic information ."

"Yeah well this what we would call systems engineering .m Maybe to make straight up studeis and make the right decision of what shoul d be done , what should be put aside and what should be followed."

"We asked for an hour we started early and just about ran aour hour out , what about the, I shouldn't ask you this, you're going to tell us some dirtyy stories, to begin with,what about to begin wwith

do you remember any humurous things in the Saturn program?"

"Well we had the Russian Cosmonauts here for a visit, but I think I have just a picture . Here they are, here is one of them what was hes name? Nicolai and the other one was oh I've forgotten that. They were aloud to drive a our moo n vehicle simulator, so we let them take a simulator drive on the moon . It was so realistic that they couldn't differeintiate between the real ride on the moon and the simulator ride. And ___ Audrin was with them you see and Audrin had one of their little signs theya had here from there space city in Russia. I don't know what this thing looked like but anyway it had the little Soviet star on it and what you usually find on those things. And on this mat , on this moon map which we used for simulation we had some small ____ blocks to tell people where t ey were and so on as they drove around . And so Audrin says here why don't you glue one of these things on one of those rubber blocks , he drives around and he sees a big sign of s Soviet Spave Center there/ WE give this to one of our technicians and he did this . So while Nicolai drove the simulated space vehicle , suddenly he saw something way in the distance, he came closer then and looked what this was and he said well it looks like I'm in /Russia again . He was quite surprised to see it. "

"Can/ you pick out one particular instance when the computation lab was of really immediate and signifcane value to the space program ?"

"It was the Pogo, there was something where you made a king size contribution to it . "

END