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INTERVIEW WITH DR. GEORGE BUCHER

Can you tell me a little bit about your background in the Saturn Program. To begin with, how you came into it and just briefly some of your personal experiences in the Saturn Program and then we can get into project High Water a little bit more.

I came to Huntsville in 1956 at the time the Army Ballistic Missile Agency was first being formed and I became associated with Dr. Stuhlinger in 1956 and have remained with him during that time, so essentially I have been with the Space Science Laboratory since it consisted of six men and its formation until the time Dr. Stuhlinger and I left. This is during the ABMA days? Yes, the Space Science's Laboratory during the ABMA days from 1956 to 1960 was known as the Research Project Office and then the Research Project Laboratory and then eventually it became known as the Space Science's Laboratory. Originally the purpose of the Research Project Office was to try to build up a research program within the Army Ballistic Missile Agency and to keep abreast of what was going on in the field of science outside of the Army Ballistic Missile Agency and also to interface with scientific community outside. Essentially the same objectives were carried over into the Marshall Space Flight Center when the portion of ABMA that was headed by Dr. Von Braun essentially became the core of the Marshall Space Flight Center. The research Project's Office in the ABMA days essentially had to find its own fields of activity and those were scientific fields of research that were not already covered by other laboratories in ABMA. This was research related directly to the development of missiles? In a sense, but during the ABMA days there was one big difference between the operations of that agency and the Marshall Space Flight Center. In the ABMA days we had on Redstone Arsenal essentially a complete launch vehicle and payload development

agency. Not only did the Army have the capabilities of developing a launch vehicle such as the Redstone but it also had the capabilities of developing right here the payloads such as the Explorer I. In ABMA the Space Science's Laboratories was involved with payload development and the scientific objectives of payloads in addition to scientific research that supported the development of launch vehicles. In a situation change rather dramatically in 1960, because when we first became NASA the Marshall role then dealt only with the developing of launch vehicles and the development of payloads was the responsibility of another center on the same origin, one other center, but at least not the Marshall Space Flight Center, so we went from a situation in ABMA where we were working both on a launch vehicle and the payload to a situation in Marshall where we were concerned only with the launch vehicle. Does that make you feel kind of sad that you are not doing payload business any more? It certainly did because there was a great thrill and pride and satisfaction in working on the early payloads such as the Explorer I, we might also say that a number of people who were heavily involved in the development of the hardware for payload became disenchanted with the future role of Marshall and left Marshall Space Flight Center and some of them formed Spacecraft Inc. here in Huntsville, so our payload developers from the ABMA days are residing at Spacecraft Inc. right now, some of them I should say -- not all of them. So during the ABMA days, the four years that I mentioned from 1956 to 1960, the Research Project's Office was involved with quite a few of different kinds of activities and some of them had to deal with the effect of meteorite impacts on the launch vehicle or a spacecraft in orbit, meteorite physics so to speak. This eventually led to project ^{Pegasus} Vegas which was a meteorite measuring satellite, some of the other activities dealt with physics and radiation effect in space. This was a direct carryover from our involvement with Van Allen and developing of Explorer I which first detected the Van Allen radiation

belts. Now in the Research Project's Office and Research Project's Laboratories in ABMA we did evaluate much of the raw data from Explorer I and Explorer IV, both of which measured the radiation belts. In addition we were involved with reentry physics, the phenomenon of a ballistic body reentering the atmosphere, one of the projects resulting from that interesting reentry physics was project High Water. Project High Water was formulated with the intent that the empty upper stages of the theta launch vehicle could be used to carry any kind of a mass to simulate the mass of a false empty stage, during the early launches of the Saturn Launch vehicle where only the first stage was active, it was necessary to put on dummy upper stages, if you want to call them dummies, to load them with something which would give the appropriate mass, at one time they were loaded with sand which caused criticism.

Why did it cause so much criticism? There were comments, some criticism, I believe, in Congress and in the newspapers that we were flying tons of sands and it was a waste of taxpayers' money, so then it was recognized that to partially overcome this criticism and indeed to do something useful, it would be possible to load the upper stages with water and then at the apex of its trajectory or at the highest altitude to detonate explosive charges which would eventually fracture the upper stages and cause instantaneous relief of the water which is carried in the upper stage, then measurements were made to determine the speed of the association of the water, that is how fast it evaporated by dissociating and also try to determine and intermeasure some of the products of dissociation, so there was a period of complex sets of measurements from the ground looking at the water clouds resulting from project High Water. Now project High Water was fairly/ⁱⁿexpensive project as far as dollars go and within the Space Science's Laboratory Dr. David Woodredge would be project director of project High Water. His deputy project manager or project director I am not sure

what terminology to use, was Mr. Ray Hembrick and also associated with the scientific evaluation of the dissociation was Dr. Spencer ^{Fram}Ferry and Dr. Ferry and Mr. Hembrick are still at the Space Science's Laboratory. Dr. Woodredge left Huntsville around 1961, so he is no longer here. Mr. Hembrey and Dr. Ferry can give you much more detailed information than I can about project High Water. When you say that congressmen objected to letting all of this Florida sand loose in the Atmosphere, did this thing water make them any happier, could you just say to them that we are checking the dissociation of water or was there other statements that you made to reassure some of the critics that this was indeed a valid scientific experiment? The criticism was not a unanimous criticism. It was fairly low level criticism, yet it was something that we should take heed to and might also say that the sand really wasn't released in the atmosphere, but the stage intact came back to earth, so we really didn't release sand in the atmosphere, but it was recognized that maybe we could do something worthwhile and it was thought that project High Water would be an undertaking which would provide some data and it would be an experiment that really could not be performed in any other fashion simply because there was no way to get such a large mass of water to such a high altitude at that time in the history of our space program, it really was a unique opportunity to carry such a large quantity of water to high altitudes, so we should point out that project High Water was not formulated only to remove objections from flying sand but that it was something that came along at a later step, it might very well had come even if there had not been any criticism about sand, but that is one of the things that did enter into our thoughts at that time.

Was there any consideration examining the reaction of water in space would have any connections with an accident involving a live _____, what would happen if all that hydrogen and oxygen got loose in the atmosphere? Was

exploding the water in any way related to this kind of feeling? Not so far as I can recall, however it was directly related to the release of large quantities of combustion by-products of which water was one, into the atmosphere as a result of the launch of the Saturn vehicle. When all the fuel and oxidizer in the Saturn launch were burned as the Saturn vehicle passed through space, there was released into the atmosphere a very large mass of by-products, so looking at the dissociation of a very large quantity of water in one place we might be able to gather information that we could not obtain as we look at a relatively smaller mass of combustion by-products. The answer to this experiment apparently was there is enough ^{dispersing} ~~disbursing~~ of association that there is no negative effects or anything like that left as a result of this? I don't remember exactly what the conclusions were again, again I would like for you to see Dr. Ferry or Mr. Hembrick, but I do remember one thing, that is from photography it was very obvious that the water cloud dissociated very rapidly, it remained visible only for a very short time, I really don't remember what that time period was. Do you have anything else to say about High Water or should we move on? I think we can move on that is about as much as I have to say. What other projects are related to the Saturn program after High Water were you involved in? I was involved in an overseeing sense, I suppose, in all the research that was conducted in the Space Science's Laboratory that was related to the development of the Saturn Launch Vehicle. One of the things that we tried to do in the Space Science's Laboratory was to formulate our research program so that the research would, if at all possible, support the development of the Saturn Launch Vehicle, but at the same time the research should provide contributions to the bodies of scientific knowledge. Within the broad guidelines there was some research activities that supported the Saturn developing program more closely than other research activities. I myself was involved from a personal standpoint in the study that was undertaken

to determine the need for power supplies, level of power supplies for the future and the kinds of power supplies that might be used in the future. I was also involved with the development design of heat rejection systems that involved with these power supplies. Power supplies generating electricity would be the primary power source for electrical propulsion systems constituted a major research activity in our Space Science's Laboratory. Right after we became part of NASA the Marshall Center was the center that was responsible for the development of electric propulsion systems within NASA. About 1961 or possibly 1962 this mission responsible for electrical propulsion was transferred from Marshall Center to Lewis Research Center in Cleveland. At that time the Space Science's Laboratory had to reorient many of its research activities because much of the research was related to the development of electrical propulsion systems in 1960 and 1961. What direction did you go from there then? We went into a direction that was largely governed by the needs of the Saturn program and by the disciplinary strength that we had in the Space Science's Laboratory. One of the areas in which we had a very strong capability and a strong interest dealt with infrared physics and ultraviolet physics. The work in these areas was a carryover from our early work in the design of thermal controls systems or satellite during the ABMA days during those days we had to develop thermal control proteins and have the proper reflectivity and absorption characteristics were strongly in evidence in a good portion of the UV and IR work that was being done in Space Science's Laboratory, so some of the IR work dealt with thermal mapping of the moon, for example, and at the present time in the Space Science's Laboratory, we can still see that the UV work and IR work is now being carried to the point of making observations in these wave length regions in the stellar field, for example, using the astronomical telescope in the Space Science's Laboratory. We can really

trace the chain of reactivity in infrared and ultraviolet from about 1956 up until the present time in the Space Science's Lab. Some of the same people that were working on the IR and UV problems in 1956 are those that are working in the same field today. Can you tell me anything about the starfish electrons in the Van Allen Belts and do you remember anything doing

No, I don't remember much about that at all, there were some reports written about that during the ABMA days that were classified, that dealt primarily with there was a man by the name of [redacted] and [redacted] who predicted that would be an artificial ejection of electrons into the Van Allen Belts and this was accomplished and measured by Explorer IV I believe. I don't remember anything about starfish in those measurements. You said you were doing thermal surfaces at one time, did alodine come out of your work here or was that a commercial? I am not sure that alodine did come out of this work, if so it probably came out of the materials division in astronautics laboratory. There was somewhat a separation of the efforts here. The Astronautics Laboratory people at that time was called the Motion Vehicle Engineering Laboratory. The people in the material division there were concerned with the chemical and mechanical properties of materials. The Space Science's Laboratory was more concerned with the physics of the material. We were both concerned with the development of thermal coating. The Astronautics Laboratory maybe said to be more concerned with the physical characteristics of a flying [redacted], how it stood up under the space environment, how it with stood the launch vehicle environment temperature of vibration. In the Space Science's Laboratory our people were more concerned with what happens to the emissivity and absorptivity properties of the coating after exposure to space conditions. For example, we found that there was a darkening affect of thermal control on exposure to ultraviolet light. This was a physics phenomenon so consequently the Space Science's Laboratory intended to go in that direction and the Astronautics Laboratory intended to concentrate more on the physical characteristics, the material characteristics and the chemical properties. Can you recall in your experiences in the Space Science's Laboratory [redacted], did have a direct impact on the design of the Saturn vehicle or a change in its mission? There might have been one, off hand I don't recall any right now, let me point out one characteristic that identifies the research work that was going in the Space Science's Laboratory, most of the other laboratories had a direct role, clearly identifier role in the development of the Saturn. The Space Science's Laboratory had sort of a supporting role, rather responsible for one specific hardware element of the Saturn. As these laboratories have responsibilities for the development of one particular part of the Saturn, they also intended to do research in those areas that related to

their development responsibility area, so consequently in the Space Science's Laboratory we often helped on an informal basis the other laboratories. Science's Laboratory we often helped on an informal basis the other laboratories. But the end result of all the work that was done in a number of places, such as in one or more of Marshall's laboratories including the Space Science's Laboratory and possibly at a university. When all the results came together they usually came out of a laboratory that had responsibility for development of that particular part of the Saturn. We may very well have supported the astronautics laboratory in looking at some of the solid state physics problems concerned with micro circuitry or integrated circuits for example. We had only a small portion of the total problems. Space Science's Laboratory and the Astronautics Laboratory would publicize the overall results. You worked for the Von Braun team for a long time, how would you characterize the way the team worked, how would you count for the success? Could you say that the way it worked brought about some negative results on occasions? What was your feeling about the Von Braun team and about Von Braun as a working group? My feeling changed considerably during the years I was here, let me explain what I think the strong points of this kind of team work are by stating how I looked upon it from a very personal point of view. First of all when I came here, and set on many of the readings where all the laboratories directors were present and where Dr. Von Braun himself was present. We were presented many many opposing views would seem to me

You were mentioning being in meetings where where were many views being presented. At first I thought that the individuals there, the laboratories directors and their supporting people just didn't want to give in from their own point of view, in other words they were sort of stubborn, wanted to stand fast. Gradually though at the time I thought why doesn't someone in this case it would be very appropriate for Dr. Von Braun to say let's stop arguing, I am going to make a decision and that is the way it's going to be, but Dr. Von Braun in conducting a meeting like this very obviously was drawing out everyone in the meeting who would be a participant any action resulted from decisions made in the meeting, he was drawing from all those future participants their views, their hesitations, their limitations in their laboratory. He did it in such a fashion that they were never embarrassed and then when all the views had finally been presented Dr. Von Braun would try to summarize everything into one final summary meeting. He would put all the pieces together and this is where he was really a person that could not be matched by anyone else. He was a master at assimilating information, integrating in his own mind, and then pouring it forth in a fashion that was understandable to anyone that was listening. He did it with such a fashion that most persons could not argue or find fault with the conclusions that he drew, even though he didn't do it by pounding the table and saying that this is the way that it's going to be done, but rather he did by saying well then it seems that because of this we

should go in the following directions. As a result everyone did indeed know what he was thinking when he summarized his thoughts. He also most frequently took the very diplomatic approach of turning to the persons who had presented views which opposed the final outcome and said how does this sound to you now, do you think you can live with, does it sound logical and reasonable. Almost always that person would say alright I'll except it, it sounds okay I think we can do our part and so when the meeting ended there was a unanimous feeling of sense of direction, everyone believed in the attaining the same goal. Everyone understood the directions to be taken and even more important, and this is something that I myself did not realize at the beginning, that every person in that room knew what the strength and the limitations and personal hesitations were on every other lab employee every other person that was there, so this "arguing" that seemed rather irrelevant to me when I first came here, proved to be really the most effective means of communication that we had. Everyone fully understood in just as much detail as Dr. Von Braun did why we had done certain things, why certain decisions had been made, why we were going in certain directions, why we had to do it a certain way. This really is a very productive way in which to get everyone on board at the same time. To me much of the success of the Von Braun team must be given to the fact that there was such a great amount of communication fashion and then set forth a conclusion that was so very logical and understandable with everyone there. I heard it said that he never said that this is the way that it will be done, it was always a matter of convincing or reaching a wholehearted consensus that this was inspite of certain limitations the best way to do it and that he never really closed the meeting until the last man in the room obviously and sincerely enough to go along with it? That's very true, and to me that's one of the strong points.

We have prepared this book which honored the fiftieth birthday of Dr. Von Braun. There are a few words in here in the preface that describe just the things that I was mentioning. The preface by Fren Artway, Dr. Stuhlinger, Jerry McCall and myself. Those who worked with him for years point to another gift that might be more responsible for his unparalled successes than any of his other many brilliant talents. It is his innate capabilities as a great engineer to make a transition from an idea, a dream sound engineering plan and to carry this plan most forcibly through its unaccomplishments. It points out that the reins were loose during the first phase, many ideas were considerate large number of studies were made different, the were investigated, schedules were established and modified, ideas of others were analyzed and compared, opinions were requested from many outside sources. Every possible facet of a new project is discussed in technical meetings with Dr. Von Braun always provide guidance

with most inquisitive questions, sharpest mind, the most convincing arguments and the most tireless grasp for farther analysis. When a meeting such as this is all over and you look back on it, you recognize that if there were twenty different people with twenty different ideas on how to approach particular tasks that were being discussed, there was a marvelous transformation so that everyone homed in on the same procedure before they left the room and that everyone was thinking as one before they left. What happened when someone like Miller came from headquarters came down, was Von Braun still able to convince many many people of the soundness of his ideas. Often there were restraints of a political nature for example that made it impossible to really accept the proposal set forth by Dr. Von Braun, so it really wasn't always the lack of soundness or the lack of Dr. Von Braun's ability to convince others of the wisdom of his thoughts. There were political restraints that kept us from doing certain things at certain times. Would you like to pinpoint one of these. One is the launching of the first satellite, Explorer I could have been launched by the ABMA team, just because of political consideration ABMA was not allowed to launch it, but Vanguard was officially and formerly recognized as the United States first satellite in space. Were there any similar occasions that you recall during Saturn program, were there political limitations? These are the kinds of things that we really didn't see too much of in the Space Science's Laboratory, because as I mentioned we were in a supporting role rather than had a direct responsibility role. I am sure that Dr. Stuhlinger as director of the Space Science's Laboratory participated in many meetings, many decisions making discussions such as this, but I was assistant director in the laboratory and prior to that time assistant of the director in the laboratory. I personally did not get into many of those very momentous decisions making sessions in the Saturn Program. Do you recall any of the events in the Saturn program that had special meaning to you and really high point that you felt tremendously good about and had a sense of satisfaction? The one high point has to be the successful launch of the very first Saturn. There was very great desire among everyone at the Marshall center to see that that first launch. Everyone was extremely thrilled with the first main launch of the Saturn and with the Apollo VIII first circular lunar mission. These were all very very high points, I guess that we have reached a greater number of peaks of enthusiasm as the years have gone by we can look back with less feeling upon them but at those times everyone was very very highly motivated to see that the hope and the wish or try to see that those missions were successful. Do you have any other summary comments or questions that you want to read into our tape recorder here? I think that we have seen quite a transition in the scientific activity of the center as evidenced by the act of these space science's laboratory, as an example, first in

1956 we were interested in all scientific aspects of the space program, not only the scientific problems that were related to the development of a launch vehicle but we were also concerned with the scientific problems related to the development of payloads and we were also concerned with scientific finding of those payloads. Starting in 1960 then our view was restricted somewhat because we then mostly concerned with the scientific problems related to the development of launch vehicles only, since we did not have the responsibility for the development of the payloads. Now we have progressed to the point where our realm of interest is just as broad and broader than it was during the ABMA days. Marshall has gone through the phase of being a launch vehicle developer and is now in the phase of being a payload developer as well. We are working very closely with principal investigators who have experiments on those payloads and so we are very deeply involved in the scientific objectives of the payloads as well development of the scientific payloads. Do these scientific emphasis began with the skylab program? The sky lab was surely one of the big steps because the apollo telescope mount is indeed a scientific payload which is a component part of skylab. The ATM to represent a very big payload development on the part of Marshall. That was the big step for Marshall to get back into the payload development business. Thank you very much.