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Gadsden, Ala. Civitan Club
June 7, 1963

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SATURN AND THE FUTURE

It gives me great pleasure to be here today and to tell you where a large portion of our tax money is going. Since the National Aeronautics and Space Administration was created in 1958 its budget has increased from 339 million dollars to a proposed budget of 5.712 billion dollars for the fiscal year 1964, and that is a lot of money!

In order to explain the reasons for such vast expenditures I will start with some background information about the space program.

Our objective is to be first in space and to share its benefits with the world. This responsibility lies on the shoulders of the National Aeronautics and Space Administration and is a national project which demands all that we can give.

About two-thirds of the National Aeronautics and Space Administration's budget will be spent on Manned Space Flight; our first goal will be our closest heavenly neighbor, the moon. But before we risk the lives of the astronauts on such a trip, a great deal more knowledge about the moon and such long duration trips must be found. We honestly are not sure what problems the astronauts will be faced with upon landing on the moon. To determine man's reaction to space flight we have the Mercury and Gemini projects. The Ranger and other related programs will give very valuable information about the lunar environment.

This brings up a very interesting question, why does anybody want go to the moon or any other heavenly body? No explanation should be

needed for this question since man is innately a curious creature. Man was born to see what's over the next hill or mountain, to study the atom and to gaze upon the stars. However, this answer is not really sufficient for those who pay for such projects, although history has shown that exploring usually pays off even though it is usually in an unexpected manner. A classic example is Columbus's search for a new route to China and instead his discovery of a new world. One must admit that although he did not accomplish his purpose, look at the results of his exploration!

Nevertheless our primary purpose to go to the moon, and other heavenly bodies, is to obtain scientific information to help us understand our universe more clearly. What side benefits we might reap no one really knows.

The moon will be an excellent starting point since it will serve as a good laboratory for studying the Universe. Since it has neither atmosphere nor weather and except for craters caused by meteorites, its surface is very much the same as it was from the beginning.

Another reason was clearly stated by the President, that our success is essential in our role of world leadership. This requires that we be not only the first in space but also the best.

Already we have accomplished many missions which are beneficial to mankind, such as Weather and Communication Satellites.

The following slides will help to illustrate our space program and the role the the Marshall Space Flight Center plays.

Slide #1

This shows the Mercury-Redstone during a launch. The redstone, of course, was developed in Huntsville by the same people who are now the nucleus of the Marshall Space Flight Center. Two astronauts were flown into the regions of space by the Redstone; Alan Shepard, America's first man in space, and Gus Grissom. These were ballistic flights.

Slide #2

This is the Mercury-Atlas in its start into space. Astronauts, Glenn, Carpenter, Schirra, and Cooper all rode the Atlas on orbital flights, which culminated in Cooper's 34-hour; 22-orbit flight. The Atlas is an Air Force vehicle developed by General Dynamics.

Slide #3

Here is the Mercury spacecraft and although a great many things were learned from these flights, the most important was man's contribution to the exploration in space. These flights showed that man can be more than just a scientific observer but also adds to the space vehicle's reliability. This was demonstrated by nearly all of the astronauts.

Slide #4

Slide #4 shows the Gemini spacecraft (two men instead of one). Project Gemini will extend our knowledge of man in Space; especially in orbital refueling, and will help to pave the way to manned lunar and interplanetary trips.

Slide #5

This shows an artist conception of an Apollo spacecraft on its way to the moon. Project Apollo calls for manned lunar landings and is mainly supported by three NASA centers. MSFC will provide the Saturn launch vehicles, Manned Spacecraft Center (in Houston) will train the astronauts and supply the spacecraft, and the Launch Operations Center at the Cape will provide the launch facilities.

Slide #6

Now more about the Marshall Space Flight Center. Here is the physical area of the Center; it is a large place and is still rapidly growing.

MSFC was officially formed in 1960 and was made up by former employees of the Army Ballistic Missile Agency. The original number of employees was around 4400, and this has already grown to over 7500 employees. Headed by Dr. von Braun, MSFC consist of a number of service offices and ten technical divisions*. This gives the Center the capability to design, build, and test the entire vehicle and its associated work. However, our primary task is to supply the Saturn launch vehicles for the Apollo program.

Slide #7

Here is the Saturn family of space vehicles. The Saturn I is a two stage vehicle and has already had four successful flights with

*Aero, Astr, Comp, Launch Veh. Oper., Manuf E, P&VE, Quality Assur, Research Proj, Test, Michoud

dummy upper stage. This vehicle can place approximately ~~35,000~~ 22,000 lbs. of ~~(includes upper stage weight)~~ payload into a low earth orbit.

The Saturn IB is composed of ~~three~~ two stages and is able to place ~~10,000~~ 32,000 lbs in orbit - 10,000 more ~~more weight~~ than the Saturn I ~~into a low earth orbit~~. This will also be used to test the Apollo spacecraft.

The Saturn V is a ~~four~~ (three) stage vehicle and places 120 tons (240,000 lbs) into a low earth orbit and 90,000 lbs to escape. This vehicle stands over 350 feet tall or is taller than the Statue of Liberty!

Slide #8

This slide depicts a Saturn V launch. To compare this to the Saturn I, and IB, a Saturn I can place the equivalent of about 7 Mercury Capsules into orbit, the Saturn IB, 11 capsules and the Saturn V, 80 capsules!

Slide #9

Here are some of the MSFC's future projects. We are responsible for any related research which might lead to space transportation systems of the future. (LIGHTS)

As well as the Michoud Operations, MSFC will also have a test site (Mississippi Test Operations), for static testing of Saturn V ~~boosters~~ stages & engines in Southern Mississippi.

More distant future programs will depend on the present programs. They will include vehicles that mainly appear in Science-Fiction Novels, such as electronic and nuclear propulsion. A great deal of work will be necessary for these undertakings but we at Marshall are confident that

man eventually will reach the planets.

~~any problem that is found will be solved, including perhaps flight to the stars!~~

Admittedly we are still a long way off from interstellar flights (flights to the stars) and we may not achieve this, but if we do some very interesting problems may be answered.

One of the most interesting subjects will be the role that the theory of Special Relativity might play in future space travel. I will not attempt to explain the theory, even if I were capable to do this, but only discuss some results where it is applicable.

One of the most famous statements from Einsteins Special Theory is that mass and energy is equivalent; i. e., $E = mc^2$, (The speed of light is 186,000 mps or 669,600,000 mph.) and means that whenever mass is destroyed energy is created and vice-versa. This equation is the basic of our atomic energy research programs and also can give the space age a tremendous source of power for future space vehicles. By use of methods where mass is converted to energy it is theoretically possible for a space vehicle to approach the speed of light! However, presently there are several shortcomings to such propulsion systems. The major problems are due to the great amount of weight needed for a nuclear system as well as the very low acceleration it provides. Present processes for converting mass to energy in a controllable manner are very inefficient, and hence have serious shortcomings. Only a tiny fraction of mass can be converted to energy and this will cause very poor performance of such space vehicles.

Even when all this is taken into account, a speed of approximately 1/100th of the speed of light (approx. 6,600,000 mph) can probably be attained.

If perhaps man breaks through and can reach speeds which approach the speed of light, then a very interesting paradox occurs as a result of the Special Theory of Relativity. This is often called the Twin Paradox. Before actually going into this I will give a little background to the paradox. In special relativity one does not talk about absolute motion, i.e., motion with respect to some completely fixed points, but rather motion which is only relative. In other words things move relative to each other, a man walking on a train moves relative to the train and to the ground, and the ground moves relative to the train. The ground, the train, and the man all move relative to each other. To further clarify this strange concept think about a man on a platform which is facing another man on the ground. Now if the man on the platform is slightly moved such that he doesn't know it, it will appear to him that the man on the ground is moving, but to the man on the ground the man on the platform is moving. (*example)

Another famous result of relativity is that moving clocks appear to run slower, than still clocks. Time appears to be slower in moving systems. Now imagine two future astronauts which were born identical twins. One is chosen to travel to our nearest star with a speed around .9C or about 167,400 mps. Our nearest star besides the sun is Alpha Centauri which is about 4.3-light years away, (a light year is the distance light travels in

one solar year thus α-Centauri is approximately 25,000,000,000,000 (million million) miles away). In other words it takes light over 4 years to reach us on earth from α-Centauri. Now according to the earth-bound twin, the total round trip will take approximately 10 years. However he finds that his space-traveler twin has only aged a little over 4 years. But the space traveler thinks the trip will take him ten years, since as far as he is concerned he was motionless and his surroundings did the moving! Then upon his return he says his earth bound brother has only aged 4 years: Which twin is right? Well, according to the Special Theory of Relativity, both twins are essentially right! However, I must point out, as Dr. Einstein did, that this theory is restricted hence the name Special. Einstein in order to overcome this restrictiveness also developed the General Theory of Relativity. Although the general theory is not as well tested as the special theory it nevertheless settles this paradox. Due to the presence of masses which causes gravitational fields and the fact that according to this theory an accelerating field* is identical to a gravitational field, the traveler is the younger of the twins. I must admit that this is not the absolute in answers but is sufficient until a better theory comes along. This concludes my talk and I will be glad to try to answer any of your questions.