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AND SPACE
ADMINISTRATION

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IN REPLY REFER TO

Friday, March 4, 1960

PRESS MEETING

MULTIPLE AXIS, ROTATIONAL TEST FACILITY

The press meeting began at 9:20 a. m. with Mr. Harry McDevitt, Lewis Information Director, providing the introduction.

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Press meeting participants were:

Bruce T. Lundin, Assistant Director, Lewis
R. R. Miller, Rocket Systems Branch, Lewis
John A. Powers, Space Task Group Information Officer
The following astronauts:

Malcolm S. Carpenter
Donald K. Slayton
Walter M. Schirra, Jr.

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MR. McDEVITT: Good morning and congratulations to you all for mushing through a record snow storm to join us here this morning. We are well aware that some of you sat up all night on trains and drove great distances, since our airport has been virtually closed for 24 hours.

Today, with the assistance of John Powers of the Space Task Group, and three of the astronauts (three others will join us after the snow-bound train from Washington arrives), we hope to explain, in some detail, the Lewis Research Center's contributions to the Project Mercury program. Later, the astronauts will be introduced and you will have an opportunity for both questions and photography. Please hold all questions until our brief oral presentations are concluded.

Let me say that the next time we call a press meeting at Lewis, we will surely consult the almanac. It seems that this year's edition predicts just a little snow for today.

Bruce Lundin, Assistant Director of Lewis, will now provide a brief background of this Laboratory and describe the continuing phases of our work in the project Mercury area.

MR. LUNDIN: Thank you.

Our main business here today is, of course, to tell you about the astronaut training and test program that is being conducted here and to give you an opportunity to meet some of the people directly involved. I am mindful here, however, of a discussion I had recently in New York with some of the leading members of your profession regarding the job of the press in our society. As we discussed the great need, and some of the problems, of providing the American public with a proper appreciation and understanding of what we are doing in this space business, it was emphasized to me that this requires not only accurate and responsible reporting on your part, but also that it is the responsibility of we, in the technical end of the business, to give you the facts as completely, as accurately, and as many of them as possible.

Mindful, as I say, of this obvious truth, I want to summarize for you very briefly our total program here at Lewis relating to the Mercury program; others here today will deal in more detail with the astronaut test and training part of our work. To give you a little more perspective, I might also mention that our efforts on the Mercury program involve only some one per cent or so of our total research effort at this Center. Needless to say, however, a very high priority one or two per cent.

The central technical management of the Mercury program, and most of the design and engineering work is, as you may know, centered at our Langley Center in Virginia. Our activities here at Lewis relate to selected areas in which we have particular competence and research facilities. To properly relate these selected pieces of work to the total program, a brief sketch of Mercury -- what it is and how it works -- may be in order.

Project Mercury is, of course, America's effort to place a man in orbit about the Earth at the earliest practicable date. It has been viewed by some as the next logical, progressive extension of man's capability in flight that has been growing now for over fifty years; an advance in altitude of over five-fold and a growth in speed of nearly ten-fold. To me, however, Mercury is far more of a pioneering effort; man's first, small step of finally escaping the bounds of his earthly home. A preliminary, first step that must be taken if we are ever to achieve physical contact with our moon and the nearby planets.

To take this small, but most significant first step into space at an early date, a modified Atlas ICBM is used as the launching vehicle. This rocket booster will accelerate the Mercury capsule with its single human occupant inside of it, to orbital speed -- about 18,000 miles per hour, and inject it into an orbit about 100 miles above the surface of the Earth. The early flights will be of rather brief duration, a four or five hour ride of three orbits about the Earth.

To maintain human life within this capsule, means are, of course, provided to maintain the cabin environment at proper levels of temperature, pressure, humidity and composition. To protect the pilot from high acceleration loads of launch and re-entry through the Earth's atmosphere, he is provided with a form-fitting couch, an example of which you will see a little later today. Protection from the intense heat of re-entry is a most essential requirement that is satisfied by an ablative heat shield, a rather thick cover over the forward, or blunt, end of the capsule which, in partially melting away, absorbs the heat generated by air friction. To come down from orbit requires the application of a reverse, or braking thrust to reduce the capsule's speed. This is accomplished by firing small retro rockets installed in the capsule's front end. Return to the Earth's surface and recovery will be effected in the Atlantic Ocean, downrange from Cape Canaveral.

Of somewhat more specific concern to us here today is the need for controlling rather precisely the position, or orientation, of the capsule during its flight through space. Shortly after its separation from the Atlas booster, the capsule must be rotated end to end so that the pilot, on his couch, is facing properly to take the re-entry deceleration and the heat shield, which was on the bottom of the capsule when in the launch position on the Atlas, is now facing forward. While in orbit, the capsule must be controlled to prevent tumbling about and the flight direction and orientation of the capsule must be properly lined up before re-entry into the atmosphere to prevent excessive heating or too high a deceleration load.

The principal flight events are, then, launch, separation from the Atlas booster, rotation and orientation in space, nearly continuous communication, and data receiving by a global system of tracking stations, line-up and retro rocket firing for return from orbit, a parachute landing in the Atlantic and recovery by one of several ships deployed in the landing area. I should also mention the escape system. This is an arrangement of special rocket engines which, if any malfunction occurs during launch and booster operation, will pull the capsule off of the Atlas so that it can land safely by itself.

The rotation and orientation of the capsule in space, where there is, in effect, no up or down and no air for wings or actual surfaces to bite on, is accomplished by several small jets of hydrogen peroxide on the capsule's surface. Some for roll, some for pitch, and others for yaw control. Now, control of these jets will be possible in a completely automatic manner by a gyro-referenced control system. This automatic control system is necessary not only to relieve the pilot of this chore, but also to permit early, unmanned flights and flights with animal passengers.

Should the pilot so desire, however, or as a manual backup, he is also provided with the necessary instruments, control stick and other control equipment to do much of the job of flying the capsule himself. He, therefore, becomes a part of the control system and his ability to read instruments, perform mental interpretations and decisions, and operate the controls in harmony with the rest of the control system while spinning about in many possible directions become of real research interest. To investigate the abilities and limitations of the man and the man-machine combination in this new and unique set of circumstances, a series of tests are in progress here in what we call a gimbal rig. In this facility, the pilot and his simulated capsule is rotated about all three axes, either separately or in combination and, when spinning about at various speeds, is required to perform various corrections or piloting maneuvers. But further details of this program will be covered by others here today.

I should tell you, however, that this gimbal facility was not actually built specifically for this job and that this area of research into human response and control capabilities is quite new to us. This is, in fact, one more example of serendepity in research facilities. Actually, the facility was constructed about a year ago to test and develop the automatic control system for the Big Joe shot last fall. The Big Joe shot, as you may recall, was a 1500 mile ballistic flight that had as its primary objective a test of the proposed ablative heat shield and other parts of the landing and recovery equipment. To properly test the heat shield required, as I mentioned, that the flight path and position of the capsule be rather accurately controlled. To this end the staff of this center designed, tested and developed the complete control system, the instrumentation and telemetry equipment and, in fact, the flight capsule itself was built in our shop. Although, as you may recall, a failure of the booster engines to separate properly from the Atlas prevented a perfect flight. The re-entry heat shield, recovery, and all other parts of the capsule equipment operated perfectly.

A third phase of our program here related to the separation system, the small rocket engines, explosive bolt, clamping rings, etc. that are provided to make sure the capsule separates clearly and properly from the Atlas booster. As you may imagine, a failure of any of this equipment would be most undesirable. Tests of this equipment in one of our large wind tunnels with the top end of an Atlas and a full- size capsule have now been completed, as is frequently the situation, various design faults were discovered in these tests and the information required for corrective action was obtained.

Immediately following the present program of pilot testing and training, we will be investigating certain aspects of the escape system. Because of the location and direction of firing of the escape rocket, the exhaust fumes will impinge upon the top of the capsule and the pilot observation window. The problems of capsule heating and erosion of the window will be primary objectives in these tests.

As you may well imagine, proper functioning of the retro-rocket system, which reduces the capsule's speed so that it can come out of orbit and back to earth is of real importance. A fifth aspect of our program will therefore test out this system. In particular, we want to make sure that the misalignment of the line of thrust of the rocket with the center of gravity of the capsule will not be so great as to exceed the capabilities of the control system and tumble the capsule just before re-entry.

The last phase of our presently planned program is devoted to the little hydrogen-peroxide control motors themselves. Investigating their starting and stopping capabilities, their efficiency of utilizing the propellant on board and their general endurance. Without proper performance here, of course, all control is lost.

Well, I didn't really intend to talk this long, and perhaps I shouldn't have. I did, however, feel that some outline of the Mercury program and our various programs here at Lewis may help you in understanding the more detailed aspects you may be exposed to either here today or elsewhere in the future. I certainly thank you for your attention.

MR. ROBERT R. MILLER:

The Lewis Research Center is currently working on five projects concerning Project Mercury:

a. Separation tests
b. Abort rocket firings, blast and noise effects on the capsule
c. Retro rocket firings, thrust allignment tolerances
d. Hydrogen peroxide, starting characteristics and performance evaluation, and
e. Pilot disorientation tests and astronaut training.

I am concerned only with the multiple axis facility. There are three concentric cages with complete rotational freedom about three axes which simulates pitch, roll and yaw.

The inner cage contains a life support couch, the pilot is seated in the couch and can control the rotation system with a side-arm controller, the same as in the Project Mercury capsule. The controls operate nitrogen jets causing the cages to rotate.

The test engineers turn each cage independently up to the test speed desired, at this time control of the Gimbal is transferred to the pilot. By action of the side-arm controller the pilot reduces speed on all three axes to zero. We then record the research information.

There is an old saying that a picture is worth a thousand words. (MASTIF Film dated November 3, 1959)

The major objective is to determine the pilot's reaction during tumbling and his efficiency in recovering from tumbling. While spinning on one axis, the reaction time is zero, and the efficiency good. Multiple axis runs have shown a definite reaction time and the pilot's efficiency during the runs drops appreciably.

Runs have been made at speeds up to 50 rpm on one axis and at speeds up to 30 rpm about three axes.

Tumbling of a pilot at speeds of about 20 rpm induces an interesting condition, ocular nystagmus, which is a blurring of the pilot's vision. Sharp vision returns almost immediately when accelerations are eliminated and rotation at a constant rate is experienced. Although blurring of the pilot's vision would hamper the proper control of a space vehicle, our investigation at Lewis goes well beyond the rates contemplated in the Mercury Project. The test conducted on the NASA astronauts in the Multiple Axis Facility showed the astronauts would have no problem controlling the Mercury Capsule in space. Some recent runs have evidenced that the nystagmus condition may possibly be controlled by the pilot, in other words with practice the pilot may be able to overcome the eye blurrings.

Since the facility was put into operation, it has been in constant useage and we feel it is quite unique. The scope of its usefulness is very broad, both in the field of controls research and aeromedical investigations. Much interest in the use of the facility for future research has been expressed by the Life Sciences Division of the NASA and the medical people of the military services.

In closing, I would like to say that I have enjoyed working with the astronauts. They are an earnest, hard working, highly competent group and I feel our Project Mercury is in good hands.

I would like to introduce to you now, John A. Powers from the Space Task Group, Langley Field.

JOHN A. POWERS: Thank you.

We last met with the press at Edwards Air Force Base in December where the astronauts were undergoing zero gravity training in an F-100-F. This training was done under the guidance of the School of Aviation Medicine.

They have been busy, but not in group type activities since this time. Each astronaut has been assigned a specialized area and during January we had seven men in seven different locations. The men also had time to catch-up with their military duties. The areas of the three here are:

Schirra - Life support system and pressure suits. He has made a number of trips to Akron regarding the Mercury full-pressure suit.

Slayton - He is the Atlas expert on the program.

Carpenter - Star gazing. He is studying navigation and communication aids.

In February at Lewis, six have completed training. Cooper has been absent due to illness in the family and has quite a bit of catching-up to do.

Previous to this they were at Moorehead Planetarium for training in astronomy. The orientation of the location of heavenly bodies with particular emphasis on those stars and constellations seen while in orbit. At the conclusion of this training they rode in a simulated capsule and were disoriented and required to navigate with the stars as their guide.

Introduction of astronauts, Malcolm S. Carpenter, Donald K. Slayton and Walter M. Schirra, Jr.

The astronauts are now available for questions from the floor.

QUESTION: If at 20 rpm you experience ocular nystagmus, how many rpm do you expect to be going at in the actual flight?

WALTER SCHIRRA: Control in the capsule is automatic; if the automatic controls fail, manual control, such as that in the gimbal rig will keep the rpm low.

QUESTION: What are the rpm you plan to encounter in space?

WALTER SCHIRRA: We expect to keep it under control, hopefully it would be zero, possible one or two rpm to be brought under control in less than thirty seconds. Minor adjustments would be made from then on. Any rotations would then be only to look at specific stars or constellations but, the rotation would be very slow.

QUESTION: Aside from specific training here, summarize specific progress on the program.

MALCOLM CARPENTER: Because this is the first program of this type, every effort has been made to overtrain. The rotation here, for example, is far and above anything we expect to encounter. If we can handle this, we know we can handle what we would encounter in space.

QUESTION: How far has the program progressed - has a target date been set for completion?

MALCOLM CARPENTER: The dates are only for the training program which will be up to flight time. More time will be spent on this and getting out of the capsule.

JOHN POWERS: Yes, certainly a date has been set. You have to notify contractors when to deliver hardware - you have to schedule launch facilities, etc.

QUESTION: Can you tell me if a date has been set?

JOHN POWERS: Yes, you can't have a program this big without a date, you have to notify the people involved.

QUESTION: What is the date?

JOHN POWERS: The specific date is classified. The only thing available is that it is in the year 1961.

We have been in business with the Space Task Group at Langley since October 1958 and since that time we have gotten organized. The purpose of the program is the investigation of man's capabilities in the space environment. We are simulating as many conditions as we know about and that he may expect to encounter. We have launched four research development capsules with the Little Joe booster, and one research development capsule on an Atlas booster. We have done tests on the different subsystems in the escape system and achieved satisfactory results.

QUESTION: From the standpoint of physical and mental stress, I have heard you thought the centrifuge was the worst. How does it compare with this?

DONALD SLAYTON: The centrifuge was the toughest. This is the most nauseating. It is difficult, but not a physical strain. Just nauseating.

QUESTION: If you fall down in any part, will you be eliminated? Is there much discussion among yourselves as to who will be the first man?

WALTER SCHIRRA: First, probably only by reason of physical disqualification. Second, there is probably about one-hundredth as much among ourselves as among the news media.

QUESTION: In the training here what was the highest rpm encountered?

WALTER SCHIRRA: Thirty rpm on all axes and 50 rpm on the roll axis.

QUESTION: In your experiences of nausea, were you or were you just about to be?

WALTER SCHIRRA: Just about to be.

QUESTION: Is there a noticeable slow down of reaction time?

WALTER SCHIRRA: Your mental ability is still with you, although your vision is blurred and this clears rapidly.

DONALD SLAYTON: If it comes on, you are aware of it and recognize it.

QUESTION: Does it increase?

DONALD SLAYTON: It continues as long as you are accelerating.

MALCOLM CARPENTER: We found in the centrifuge that, with a little practice, you can avoid ocular nystagmus or delay its effects. With proper training, the effects can be greatly reduced or, if you strain, you can see much longer than in ordinary conditions. You can learn how to fight it.

QUESTION: Step-by-step, what happens up to the point when you experience this?

JOSEPH ALGRANTI: Under the hood you have no outside references, there are three rate gyros. When starting, you are quite aware of what is going on and are greatly inclined to stop the motion. It is similar to an uncontrolled spin. After several hours of exposure you are used to it and it is not bothersome. It is just another type operation, like flying an airplane.

QUESTION: How does it feel physically? What happens step-by step?

JOSEPH ALGRANTI: Your internal organs move about and you do move about under acceleration. At the lower rates you can tell you are being spinned about. At a high rate, you feel high-speed jostling. In terms of something familar, it is like what a trampoline or gymnastic artist experiences every day, except you are restrained by a harness.

MALCOLM CARPENTER: Nausea comes from sloshing around. In space there will not be any nausea experienced as long as you are in orbit. The only sensation will be from the inner ear.

QUESTION: Where do you go from here?

JOHN POWERS: Back to Langley, there is nothing firm enough at this time to discuss.

QUESTION: How much time was spent by each of you in the Rig?

JOSEPH ALGRANTI: About four hours per man.

WALTER SCHIRRA: The rig has to be stopped periodically to recharge the nitrogen bottles. The rotating and maneuvering lasts less than a minute and a half but seems longer.

QUESTION: What safety devices are there, is there a parachute device?

JOHN POWERS. The emergency escape system which has three possible sources of action:

1. Automatically by the equipment built in the booster
2. By the launch control officer in the block house, and
3. By the astronaut, by what they fondly call the "chicken switch."

There is the chance of failure of the rocket and a means for the pilot to escape from the vicinity of the rocket motor during the initial phase of the flight has been provided.

A small rocket motor is mounted on the front end of the capsule. This will fire the escape rocket and will burn long enough to get the capsule away from the booster. After the escape rocket is fired, the tower is jettisoned and the capsule turns around. After the attitude changes, a parachute is used to stabilize it and recovery is made in a normal manner.

QUESTION: Do you have a pet name for the rig?

WALTER SCHIRRA: It was originally called MASTIF and I believe that is a good name for it.

JOHN POWERS: The best place to be after the capsule lands is inside it. If difficulties are encountered, or the capsule is damaged and does not float, he will naturally have to get out.

MALCOLM CARPENTER: Langley has a towing basin with a one-half mile long channel and a wave making machine at one end. We dropped the capsule, without separation rockets, into the water and practiced getting out. First in a flight suit and then in a regular space suit, in still and rough water. This is called a water-regress trainer. We are not strapped in the couch, they close the hatch and push you out into the water. You remove the right side of the instrument panel and get up on your hands and knees and release the pressure hatch behind the instrument panel. As this is done you can then stretch out and begin to stand up. The parachute canister has to be pushed out before you can get through the hole which is about one-half the size of this upper neck of the capsule (pointed to model). You have to push the parachute canister out with your helmet, or hands if you can get them up. You then take hold of the lanyard which leads to the life raft. By this time you can look around. You lower the raft overboard and it then inflates automatically. You then get from the capsule into the raft. It is difficult in rough water because of the pitching and rolling. The capsule tends to tip over and you have to get out fast or try to control the capsule by moving around the top. Another thing is the landing bag which extends about 4-inches below the capsule and fills with water, this is a stabilizing device. As the capsule tilts the water runs out of the bag and the capsule tilts over further, you have to get out quick. It is not desirable to let the capsule tip over because the capsule will be a total loss.

QUESTION: Are you satisfied with this system?

WALTER SCHIRRA: This is an emergency operation only, you have from one to two minutes before the capsule turns over. The environmental control system must support you in the capsule after impact. Getting out is merely the choice of the astronaut. The best place would be with the capsule. If you get out, you will sacrifice the capsule and lose it. You can also get out the side hatch (Pointed to model) but this would also sacrifice the capsule since it would fill with water and sink. The thing to remember is that we should not have to get out of the capsule.

QUESTION: What are the chances of landing on land?

WALTER SCHIRRA: A land landing is most probable in an off-the-pad abort. That is why we have the impact bag, it can withstand the shock.

GENERAL STATEMENT: Every conceiveable safety device has been included in the capsule and is backed-up. About three things would have to fail before the unexpected would occur --- we are training for this.

(The press conference was concluded at 11:00 am)