LUNAR ORBIT RENDEZVOUS

NEWS CONFERENCE ON APOLLO PLANS AT NASA HEADQUARTERS ON JULY 11, 1962

Members of panel for Press Conference on lunar orbit rendezvous, left to right: James E. Webb, Administrator; Dr. Robert C. Seamans, Jr., Associate Administrator; Dr. D. Brainerd Holmes, Director, Office of Manned Space Flight; and Dr. Joseph F. Shea, Deputy Director of Systems, Office of Manned Space Flight.

U.S. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NEWS CONFERENCE

NASA OUTLINES PLANS FOR APOLLO

NATIONAL AERONAUTICS

AND

SPACE ADMINISTRATION

JULY 11, 1962

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INTRODUCTION

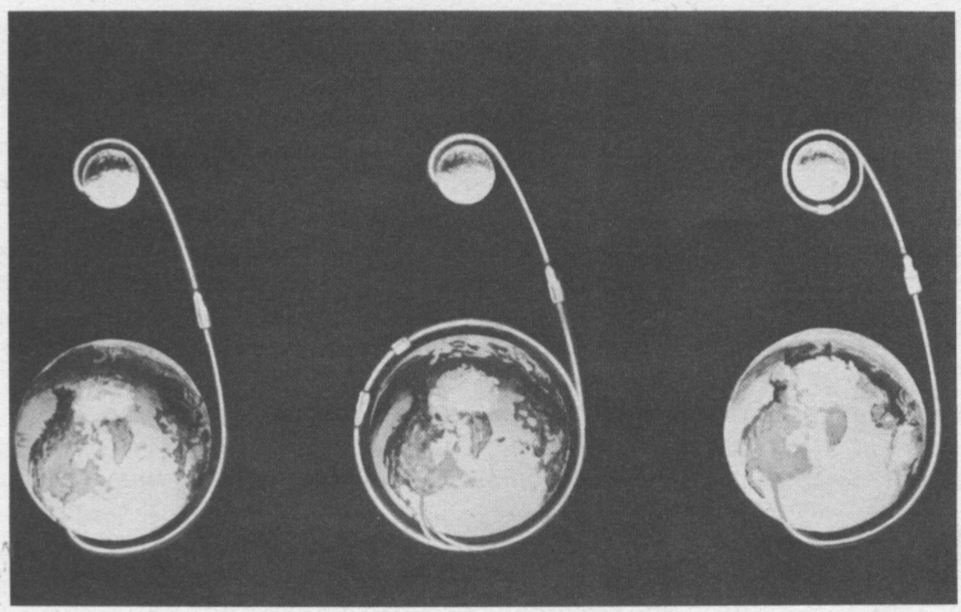
A decision to focus studies, planning, and procurement for lunar exploration primarily on the lunar orbit rendezvous mode, but with studies continuing also upon the earth orbital rendezvous and direct ascent modes, was announced at a news conference in the Auditorium of the National Aeronautics and Space Administration's headquarters office at 400 Maryland Ave., S. W., Washington, D. C., on July 11, 1962.

Administrator James E. Webb described the decision announced at the news conference as "a very strong endeavor on the part of the National Aeronautics and Space Administration to line up the forces, point them in the same direction, and get in motion now with the final stages of the lunar exploration."

Dr. Robert C. Seamans, Jr., Associate Administrator, NASA, explained that "What we are doing here today is to announce that we are going ahead with the procurement of the lunar excursion vehicle. We are going at the same time to study the possibility of a direct mode, using the Saturn C-5, considering the possibility of upgrading the C-5 and scaling down the spacecraft requirements so that we might carry out the mission by direct ascent."

Details of the lunar orbit rendezvous, and comparisons of earth orbital rendezvous and direct ascent were discussed by Dr. D. Brainerd Holmes, Director, Office of Manned Space Flight, NASA; and Dr. Joseph P. Shea, Deputy Director of Systems, Office of Manned Space Flight, NASA.

The report herein is excerpted from the transcript and includes all of the transcript except for certain portions relating to actions of Congress on the date relating to the NASA appropriations bill, and a report on the physical condition of Astronaut Donald K. Slayton.



Lunar Landing Flight Techniques, left to right: Direct, Earth orbit rendezvous, lunar orbit rendezvous.

NASA OUTLINES APOLLO PLANS

News Release

After more than a year of intensive evaluation of its Apollo manned lunar exploration program, the National Aeronautics and Space Administration has decided to:

1. Base the next phase of its planning, research and development, procurement and space flight program on the use of the advanced Saturn (C-5 configuration) to accomplish the initial manned lunar landing and recovery, using the lunar orbit rendezvous procedure as the prime mission mode.

2. Request industrial proposals immediately for the development of a lunar excursion vehicle -- a spacecraft to be launched on the same booster with the Apollo mother craft and capable of landing two men on the lunar surface and returning them to a mother craft in lunar orbit before the return to Earth. The plan is for a third crewman to remain at all times in the Apollo mother craft, or command module, now under development by the North American Aviation Company.

3. Employ a two-stage Saturn (configuration C-1B) using the present 8-engine Saturn first stage and the high energy S-IVB stage already under development for early flights to test the lunar orbit configuration of Apollo. These flight tests will be utilized to perfect module maneuvers in Earth orbit with minimal spacecraft fuel loads in the mid-60's. Saturn C-1B will develop sufficient thrust to put 16 tons into Earth orbit.

4. Begin an immediate in-depth study of an unmanned lunar logistic vehicle to determine how such a vehicle could be used to support the lunar exploration program.

5. Continue studies of the feasibility of the Earth orbit rendezvous mode using the advanced Saturn (configuration C-5) with a spacecraft somewhat smaller than the three-man Apollo under contract and employing a two-man command module. Possibilities of utilizing such a spacecraft for a direct flight to the moon, using the advanced Saturn (C-5) will also be considered.

6. Conduct active and continuing studies of a Nova vehicle with development deferred at least two years. The objective of these studies would be a Nova with a weight-lifting capability at least two to three times that of Saturn C-5 which could be used for possible missions beyond Apollo. (Saturn C-5 can launch 45 tons to escape velocity; 120 tons to Earth orbit.)

''We are putting major emphasis on lunar orbit rendezvous because a year of intensive study indicates that it is most desirable, from the standpoint of time, cost and mission accomplishment,'' NASA Administrator James E. Webb said.

''In reaching this decision, however, we have acted to retain the degree of flexibility vital to a research and development program of this magnitude. Many of the modules and booster stages are interchangeable between the various modes open to us. If what we learn in the future dictates a further change in direction, we will be in a position to make it.

"At this time, however, we have reached the point in our studies of the various Apollo modes where emphasis on the most desirable alternative is necessary if we are to move forward at the pace dictated by our national goal of lunar landing within this decade," Webb added.

"Meanwhile, the possibility of lunar landing through direct ascent with either the Nova or the C-5 Saturn vehicle will not be neglected, and we will perfect the rendezvous technique in Earth orbit in our two-man Gemini program. This will provide necessary training in spacecraft rendezvous, since the technique is essentially the same at any point in space," Webb said.

Members of NASA's Manned Space Flight Management Council -- chaired by Manned Space Flight Director D. Brainerd Holmes -- recommended LOR unanimously because it:

1. Provides a higher probability of mission success with essentially equal mission safety.

2. Promises mission success some months earlier than other modes. (National goal is to accomplish the mission by 1970).

3. Will cost 10 to 15 percent less than the other modes.

4. Requires the least amount of technical development beyond existing commitments while advancing significantly the national technology.

The Manned Space Flight Management Council is composed of the directors of the Office of Manned Space Flight, Washington, D. C., headed by Holmes; Manned Spacecraft Center, Houston, Texas, directed by Dr. Robert R. Gilruth; Marshall Space Flight Center, Huntsville, Alabama, directed by Dr. Wernher von Braun; and Launch Operations Center, Cape Canaveral, Florida, directed by Dr. Kurt Debus.

As presently envisioned, lunar orbit rendezvous would require a single launch of a Saturn C-5 boosting a 13-foot diameter, three-module spacecraft. The spacecraft would include a five-ton, 12-foot tall command module housing the crew; a 23-ton, 23-foot tall service module providing midcourse correction and return-to-Earth propulsion and a 15-ton, 20-foot tall lunar excursion module. The three modules would proceed to the vicinity of the moon, and would be placed in lunar orbit as a unit. Two astronauts would then transfer to the lunar excursion vehicle and descend to the moon while the Apollo mother craft (command-service modules) remained in lunar orbit.

After a period of exploration extending up to four days, the two men would use the lunar excursion vehicle to ascend from the moon to a rendezvous with the Apollo mothercraft in lunar orbit. After crew transfer, the lunar excursion vehicle would be jettisoned and the command module carrying the three-man team would be boosted back toward Earth by the service module with an engine generating 20,000 pounds thrust. Just before entering the

Earth's atmosphere, the service module would be jettisoned and the command module oriented for reentry.

The Apollo LOR configuration and its Saturn C-5 booster would stand about 325 feet tall and weigh six million pounds at launch. The first stage (S-IC) of the launch vehicle will be powered by five F-1 engines generating 7.5 million pounds of thrust; the second stage (S-II) powered by five hydrogen-oxygen J-2 engines with each generating 200,000 pounds thrust; the third stage (S-IVB) powered by a single J-2 engine. All elements of the launch vehicle are currently under contract.

Using command and service modules now under development, Earth orbital rendezvous would require the additional development of two propulsion modules weighing about 50 tons -- a lunar breaking module and a lunar touchdown module -- in order to decelerate the 28-ton command and service modules to a soft landing on the lunar surface.

Under concepts emerging from our most recent studies, Earth orbit rendezvous, using the three-man Apollo, would mean that each mission would require Earth launchings of two or more advanced Saturns. One vehicle would boost into orbit a 60-foot tall liquid oxygen tanker weighing some 110 tons. It would rendezvous with the separately launched modular spacecraft attached to a fueled but unloxed third stage of a Saturn C-5. The LOX would be transferred and the third stage would then power the spacecraft to the moon.

A three-man direct flight would have the same requirements as Earth Orbital Rendezvous for the command and service modules and the lunar braking and touchdown stages. In addition this mode would require the immediate development of the Nova vehicle with a 12-million pound thrust first stage and upper stages employing the 1.2- million pound thrust hydrogen-oxygen M-1 engines.

Studies of the various lunar exploration modes were coordinated by the Systems Office of the NASA Office of Manned Space Flight, Washington, D. C., under the direction of Dr. Joseph Shea. Groups which studied and compared all three methods included NASA Office of Manned Space Flight, NASA-DOD Large Launch Vehicle Planning Group, Manned Spacecraft Center (Houston), Marshall Space Flight Center (Huntsville), Langley Research Center (Hampton, Va.), Launch Operations Center (Cape Canaveral) and the Massachusetts Institute of Technology Instrumentation Laboratory (Cambridge, Mass.)

The following studied one method in depth or compared two methods: Lewis Research Center (Cleveland), Ames Research Center (Mountain View, Calif.), Space Technology Laboratories, Inc. (Los Angeles), Ling-Temco-Vought Corp. (Dallas) and North American Aviation, Inc. (Los Angeles).

TRANSCRIPT OF NEWS CONFERENCE

JAMES E. WEBB, Administrator, NASA: Ladies and gentlemen, I believe the written material that we have distributed to you gives you a very good picture of the decision about which we are here to answer questions and to give you a general explanation.

It seems to me that we might look back very briefly to a little more than a year ago when President Kennedy made his original decision to put forward an increased augmented space program to build the big boosters necessary to give us real power in space and the things that have taken place in the meantime. You do know that we have not only proceeded to place under contract the essential elements in this program insofar as decisions were reached as to the mode to be employed; you do know that we have assembled a basic backbone of facilities which permit us to utilize industry in a very important way and to assemble these large boosters in a location that permits us to utilize them effectively, to test them effectively, and then to carry them on to Cape Canaveral to launch.

In all of this program there remains the final decision as to exactly how the first effort to make an exploration of the moon with men would be achieved. We have been studying very carefully the various alternatives. We are now endeavoring to proceed step-by-step to get all of the resources involved in this program pointed in the direction of achieving one mode.

The decision which we are announcing today is to assist Brainerd Holmes in this. I would like to caution you that as we call for proposals to build the lunar excursion vehicle, we will have a period of perhaps three months within which to get the proposals from industry, to evaluate them carefully, and to reach a final decision. In the meantime we will be conducting the other studies that have been indicated as a result of our work here in NASA, of our consultation with the Department of Defense authorities, of our consultation with Dr. Wiesner and his panel of scientists who have examined this question, and with others who have been brought in as consultants in connection with this matter.

So I think you might look on this as a very strong endeavor on the part of the National Aeronautics and Space Administration to line up the forces, point them in the same direction, and get in motion now with the final stages of the lunar exploration.

Whether or not this effort to get these forces all lined up in the same direction will materialize as rapidly as we hope is a thing that only the future can determine. We expect to remain very flexible with respect to doing the things that the facts, the studies, indicate are in the best interests of this country.

Perhaps with that I could turn to Dr. Seamans, under whom this effort goes forward, both the contracting arrangements with industry, the studies that have been conducted, and our relations with the Department of Defense which are so important.

May I turn to Dr. Robert Seamans, our General Manager and Associate Administrator.

DR. ROBERT C. SEAMANS, JR., Associate Administrator, NASA. I would like first to say that when I joined NASA almost two years ago one of the first places that I went to was Langley Field, and there reviewed work going on on a research base under Dr. John Houbolt. This work related both to rendezvous and what a man could do at the controls, of course under simulated conditions, as well as the possibility of lunar orbit rendezvous.

It was pointed out at that time that by not taking certain of the essential elements down to the lunar surface and back to a spacecraft in orbit around the moon, taking it down the last hundred miles and back up, that it would be possible to scale down the launch vehicle requirements in the ratio of roughly two to one. It was clear to us at that time that the key to such mode involves a rendezvous that must be carried out with very high regard to reliability and safety considerations.

Following this time, that is, in the following December and January months, NASA was carefully considering manned flights beyond Mercury. It was quite reasonable at that time we should not only consider the direct mode, which we did, but also the various types of rendezvous, both in orbit around the earth, in orbit around the moon, and on the lunar surface.

This kind of analysis was carried out along with the policy discussions that Mr. Webb has referred to in his opening remarks.

At the time the program was recommended by President Kennedy and was then under careful review by the Congress, we had in motion some much more extensive studies carried out in depth. We established at that time a working group, a joint working group with the Department of Defense under Drs. Golvin[1] and Kavanau[2], who had looked into all these possibilities from the standpoint of schedules, costs, reliability, and safety. It was the recommendation of the Large Launch Vehicle Planning Group that we should embark on a rendezvous approach, that we should consider as the primary mode at that time earth-orbit rendezvous, but that we should also consider the lunar orbital rendezvous. We should not drop it at that time. And that we should also have in the program at that time the direct approach.

During this period, last summer, we were forming the team that was going to take over, and has taken over, the responsibility for implementing this lunar mission.

On November 1 of last year Dr. Brainerd Holmes joined us as the Director of Manned Space Flight. Under him, directly under him, is the Systems activity, headed by Dr. Shea, that has since been carrying out detailed studies

1. Dr. Nicholas Golvin, Technical Advisor to the Special Assistant to the President for Science and Technology.
2. Dr. Lawrence L. Kavanau, Special Assistant for Space, Office of Director of Defense, Research and Engineering, Department of Defense.

of these various mission possibilities. We have set in motion the development of the Saturn C-5, of the Apollo guidance, of the Apollo capsule, and of the service module. This work is well under way.

What we are doing here today is to announce that we are going ahead with the procurement of the lunar excursion vehicle, subject to the provisions that Mr. Webb has discussed with you.

We are going at the same time to study the possibility of a direct mode, using the Saturn C-5, considering the possiblity of upgrading the C-5, and scaling down the spacecraft requirements so that we might carry out the mission by direct ascent.

At this point I would like to turn the meeting over to Dr. Brainerd Holmes, who has been pulling this activity together, both with his own staff under Dr. Shea, and at the same time of course using the full capability of our Houston activity and our Huntsville activity under Dr. Gilruth[3] and Dr. Von Braun,[4] and also utilizing the skills of Dr. Debus[5] at the Cape, of our other centers and of a variety of contractors.

At this point Brainerd Holmes will tell you about our plans in depth.

DR. D. BRAINERD HOLMES, Director, Office of Manned Space Flight, NASA: Thank you, Dr. Seamans.

I think as you all know, in undertaking a program of the complexity of the lunar exploration program, it is a fundamental, a must, a fundamental concept that you study in depth the systems engineering in order that you assure yourself that when you commit the nation, so many people, so much resources, so many dollars to this endeavor, that you are on the right path.

However, there is a balance between studying a program when one is running a program or project, and finally implementing it. There comes a point in time, and I think the point in time is now, when one must make a decision as to how to proceed, at least as the prime mode. It doesn't mean you cut off all possibilities for change, which would be very foolish in the development of a program of this nature. It does mean you concentrate your efforts down a road.

I think Dr. Seamans has reviewed very well with you the history of some of our studies. We have, as he indicated, ever since last fall, given top priority within the Office of Manned Space Flight to the study of this mission.

Virtually every one of the centers has participated in these studies. The great burden for the coordination of the effort and the direction of the effort has been on Dr. Shea and his organization. The largest concentration of support from the NASA centers has been from Marshall Space Flight Center at

3. Dr. Robert R. Gilruth, Director, Manned Spacecraft Center
4. Dr. Wernher von Braun, Director, Marshall Space Flight Center
5. Dr. Kurt Debus, Director, Launch Operations Center, Atlantic Missile Range

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Huntsville and the spacecraft center in Houston, with additional support from the launch operations center under Dr. Debus.

We who study this program, and who also bear the responsibility for implementing it, have unanimously come to the conclusion -- and so far as I know there is no one to contest this conclusion -- that of the modes we have studied, all are feasible.

However, the group within NASA has further come to the conclusion that the advantages of the lunar orbit rendezvous mode from the standpoint of cost, from the standpoint of schedule, from the standpoint of simplicity, from the standpoint of minimal additional developments which must be undertaken immediately, is the mode to go.

As I started out by saying, there is a balance in this time. There will never be, to my mind, until we do land -- and we will land on the lunar surface in this decade -- there will never be complete agreement among all technical people, and that is probably the way it should be, otherwise we certainly would be in a rut.

However, there is this balance where one must make a decision and go ahead. And I think we are at that point and thus have decided to undertake this mode.

Let me review with you just briefly, and then perhaps if you would like we can give you, for those who may not be completely familiar with the operational aspect of the modes, we can give you a qualitative description of it. I am sure Dr. Shea would be happy to do that with the models. Let me review with you some of the pros and cons and advantages and disadvantages.

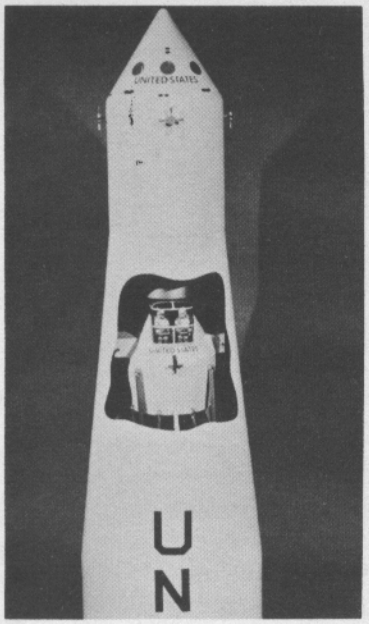
The three modes that were considered most in depth, as your know. were:

- earth orbital rendezvous, using the three-man command module and service module under contract with North American, and using the C-5 launch vehicle.

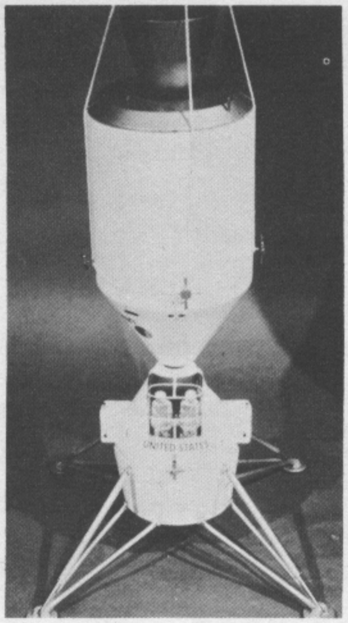
- The direct ascent mode, using the same command and service module as for earth orbit rendezvous, but also using a much larger vehicle for direct ascent, one capable of putting some 150,000 pounds or more to escape, contrasted with 90,000 pounds which the C-5 has capability to escape from earth, the Nova vehicle.

- And then the third, lunar orbit rendezvous, using the C-5 and using an exploratory smaller vehicle which will detach from the major mother vehicle into lunar orbit, taking two men in descent to the lunar surface, and then returning again to the mother craft.

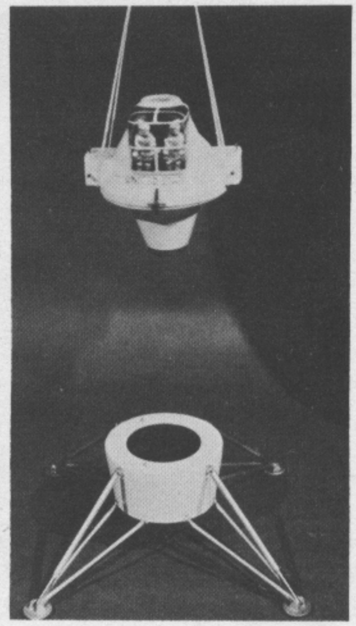
Earth rendezvous, of these three, appears from our studies to be the most complex operationally and to offer the least advantages operationally. From a mission success standpoint it has approximately half the mission success in the probability numbers that one plays in the probability game, for the



Apollo launch configuration (LOR) module which includes the lunar excursion vehicle showing two Astronauts inside. During launch of the C5 Saturn vehicle the three Astronauts will be inside the command module. After lunar orbit two Astronauts will go through air locks into the excursion vehicle and descend to the moon, while the command-service modules remain in lunar orbit.



Model of the trans-lunar flight configuration after lunar entry maneuver turnaround. These three modules would be placed in lunar orbit as a unit. Two Astronauts would transfer to the excursion module and descend to the moon while the command-service modules remain in lunar orbit.



After a day or two of exploration, the two Astronauts would use the excursion vehicle to ascend from the moon to a rendezvous with the still joined command and service modules in lunar orbit. At this point the excursion module would be jettisoned and the service module, with an engine capable of 20,000 pounds thrust, would power the command module back toward earth.

major reason, the total significant reason, is that one must launch two C-5s rather than one vehicle, be it C-5 or Nova.

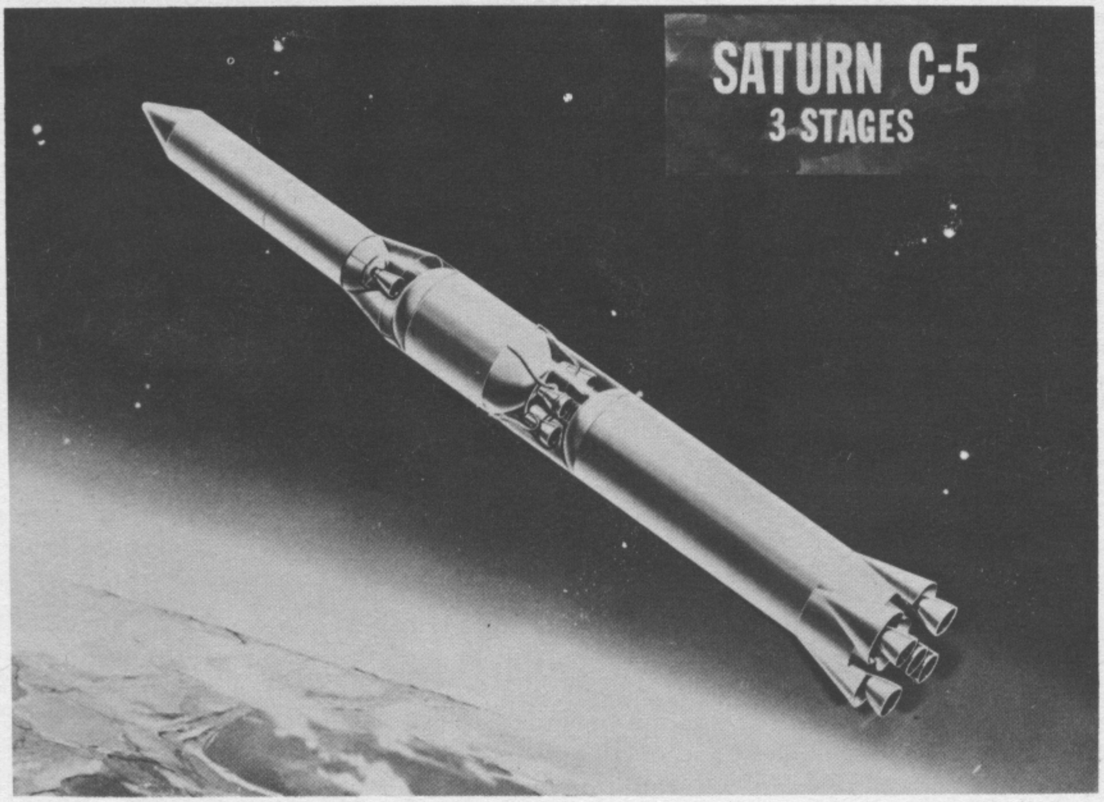
Further it has additional development requirements in developing a tanker, something which would be the second of the two, one of the two, and actually is the first to be put into orbit, which would refuel with liquid oxygen and spacecraft on its way to the Moon. So one would have to develop a tanker as well as developing the techniques for this refueling in earth orbit.

Further, for this mode one would have to develop -- and when I say would have to develop I mean things that are not presently under contract for development -- two propulsion stages totaling about 50 tons, one a lunar braking stage to let you get into proper orbit around the moon with the spacecraft and slow it down to perhaps 400 or 500 feet per second, a small increment of velocity, and the second propulsion unit -- the total 50 tons -- a lunar touchdown unit in the case of direct ascent we would have to develop not the tanker of course -- and we would have the simplicity of course of direct ascent as far as our operational problems -- we would have to develop both the lunar braking and lunar touchdown module not now under contract, and we would have to undertake the development of the Nova vehicle, the much larger vehicle than the C-5.

We would not in any event desire to drop the C-5 vehicle and jump to the Nova because then we would have a very large gap, we feel, in our payloads carrying capability, and jumping from the C-1 to C-5 is already something of the order of magnitude of ten to one in load-lifting capacity, and to jump then still farther, to the Nova, which would have been about eight-fifths the C-5, didn't seem desirable.

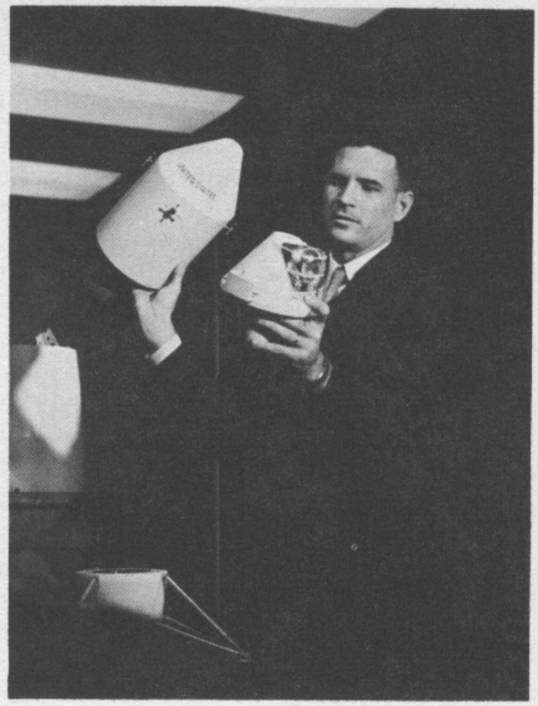
In lunar orbit rendezvous, the only additional development which we must undertake at this time is the one which we are talking about right now, and Mr. Webb and Dr. Seamans have described, that we are going out for quotations, and that is the lunar exploratory vehicle.

Further undertaking this as contrasted to direct ascent, it lets us do two things. One, it lets us save time, and the other it lets us save money. By pushing the Nova vehicle back a year or two, we can gain advantages there in our fiscal funding for budgetary reasons by moving that very large expenditure back, but further, produce a vehicle that is more advanced than just an eight-fifths C-5 -- eight over five, a little more than one and a half times over C-5 -- and make a vehicle which will give us greater capability, a better vehicle in our complement of boosters, and a vehicle which would allow us to do more major operations either for deeper space penetrations, for larger payloads in earth orbit, for larger payloads on the Moon.



Artist conception of the three-stage Saturn C-5 vehicle. The rocket plus the three modules would stand about 325 feet tall and weigh six million pounds fueled, loxed and ready to launch. First stage (S-IC) five F-1 engines, 7.5 million pounds of thrust. Second stage (SII) five hydrogen-oxygen J-2 engines, 200,000 pounds of thrust per engine. Third Stage (S-IVB), one J-2 engine. Total thrust of 3 stages - 8,700,000 pounds.

Dr. Shea demonstrates configuration that will go into lunar orbit.



Dr. Shea demonstrates "bug" leaving mother ship for moon.

These, then, I think, summarize the highlights of our reasoning toward this goal. It is a source of gratification to me, and I think to all of us here at NASA, that through the process of major effort in engineering, both here in Washington and at the centers, with major help both by study contract and by unsolicited studies from industry, that we have unanimously come to the conclusion that this is the way to go. I feel that over and above the feeling of certainty, the feeling of satisfaction that this probably is the most desirable mode -- and I say that because I have said we considered them all feasible -- it is of fundamental importance that you get the team pulling together and not spread out, some pulling one way and some pulling another. I think we have this today.

You know of the Management Council, you know of its constituents. These are the key men in NASA responsible for manned space flight. To a man, without a single dissenting vote -- and this certainly wasn't true six months ago -- they have come to the conclusion that this is the way to go, and they have done this by their own thought processes.

So to my mind now we have set the stage for really cutting the bait and I think we can start scheduling the details, start carrying this program forth.

I further think that it is somewhat remarkable -- and I say this in a somewhat detached view because a lot of this happened before my arrival last fall -- it is somewhat remarkable the accomplishments that NASA has made in effecting contracts and getting this program under way to date.

I think we can also be proud, having done our analysis to this point, where we can have a unanimous position to go ahead now.

Further, we are going to continue, and it would be very unwise for us not to continue, we are going to continue, as Dr. Seamans has said, studies of other modes and other matters in going to the Moon.

Further we are going to undertake immediately a study in addition to this alternate method such as a direct approach using a C-5 which will require a much lighter capsule and payload, we are going to undertake a study of a lunar logistic vehicle. This would then give us a back-up capability -- you might want to call it lunar surface rendezvous -- back-up capability for putting some support equipment on the lunar surface, and also back-up capability for increasing our exploration time on the lunar surface by giving people who should land there, being as this is an exploratory vehicle, more life-sustaining equipment, be it shelter, food, or environment.

I think with that I would like to ask if you would like a very brief, maybe ten minute description, of these three modes with the models. I think it depends on how familiar you are with it. Perhaps you are all familiar.

VOICE: No.

VOICE: Do it.

VOICE: Let's have it

HOLMES: I will ask Dr. Shea to do this. He is pretty good at it.

Assembled mockup of Saturn C-5 at press conference.

QUESTION: Dr. Seamans, while this is going on, could you tell us what would be the earliest possible date for success, if this mode works?

SEAMANS: What I think Brainerd Holmes said is that we feel we have an opportunity with this method to carry out the mission at an earlier date, but as far as naming a target date, we will stick with President Kennedy's message of May 25th of last year to carry out the mission in this decade.

DR. JOSEPH F. SHEA, Deputy Director of Systems, Office of Manned Space Flight, NASA: I think it probably appropriate that we concentrate primarily on the LOR mode. I think these models will give you a feel for the upper stages.

The launch vehicle, as has already been mentioned, is the C-5, consisting of the five F-1 engines in the S-IC first stage, five J-2 engines, S-II second stage, and a single J-2 engine in the S-1VB escape stage.

The basic mission mode calls for a single launch of the vehicle from the pad at the Cape. It will require the burn of the S-IC stage, the burn of the S-II stage, and a partial burn on the S-IVB stage, or third stage, to put into earth orbit the S-IVB, the lunar excursion vehicle, the service module, and the command module. This is the payload, then, that will exist in earth orbit. It will have to go around at least a half revolution in order to get to the proper launch window point, check out the spacecraft and see that we are ready to actually commit to the mission.

At the time that we commit to the mission, the S-IVB will burn again, provide the additional velocity increment to inject the spacecraft on the trans-lunar trajectory. Once we are on the trans-lunar trajectory, the total spacecraft weight will be the order of 85,000 pounds, or thereabouts. The injection capability of the launch vehicle is the order of 90,000 pounds. So at this stage in the program we have some comfortable weight margin between spacecraft requirements and launch vehicle capabilities.

After injection, we don't want to carry the S-IVB as an integral part of the system, and it is necessary to use the propulsion in the service module for possible aborts. The operational mode then consists of moving the service module - command module combination off the S-IVB and lunar excursion module, opening the fairings, coming back around, re-orienting the command module - service module so that we actually mate the command module - service module combination with the lunar excursion module, and then once that operation is accomplished the S-IVB is dropped away.

This particular set of model stages is a little bit easy, so let me uncouple them for a minute. The configuration which we then have on the way to the moon is effectively this configuration. (See photo, page 13, left.)

We will be able to check out the lunar excursion module and determine that its subsystems are working, the actual mid-course guidance corrections we need to keep us on this trajectory will be determined by on-board guidance equipment in the command module itself. The propulsion will be provided by the service module propulsion system.

When we get to the moon, approximately 72 hours later, the service module propulsion will burn. This entire configuration will drop into lunar orbit.

In lunar orbit we will then have again this assembly. The orbit will be approximately a hundred miles above the lunar surface and will be roughly in an equatorial band, some plus or minus ten degrees latitude from the lunar equator.

After determining that all the subsystems are working and that we are ready to commit to the mission, two of the three astronauts will transfer from the command module to the lunar excursion module. Once they are transferred, we will then, using the propulsion aboard the lunar excursion module, put the excursion module on a trajectory which has the same period as the circular orbit of the command module-service module combination, but has a much lower perigee, a perigee of approximately 50,000 feet. This will enable us to go down and in effect examine from an altitude of something like ten miles the intended launch site.

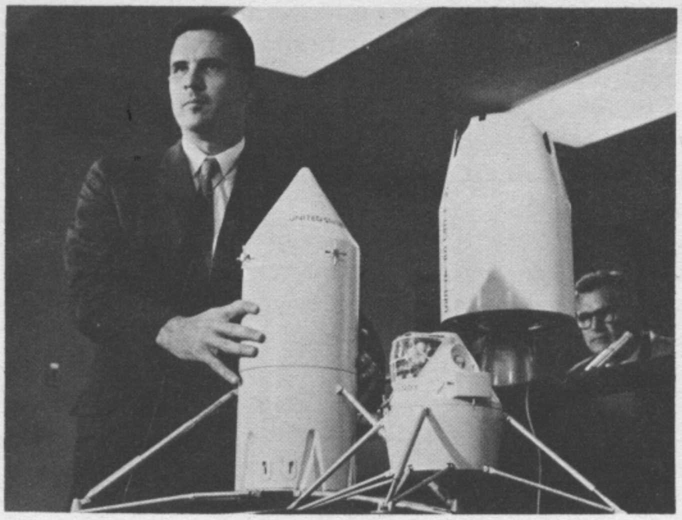
The equal period nature of the orbit means that it is sort of natural that these two vehicles will come together again once each orbit, so you have a natural position for re-rendezvous if for any reason you want to abort the mission or decide not to commit down to the lunar surface.

Once you decide to commit to the lunar surface, you then again burn the engine on the lunar excursion module and it will then provide approximately 7000 foot per second velocity gain to bring you down to a hovering position with respect to the surface. You now have your landing legs extended. You have the capability to hover for something like a minute, to translate the vehicle something like a thousand feet to actually pick the point of touchdown, and then the vehicle will land on the lunar surface.

The trajectories again can be constructed in such a way that all during this retro-maneuver, hover and maneuver and landing maneuver on the lunar surface, the command module - service module with the one astronaut aboard up here, will always be in line of sight and radio communications with the lunar excursion vehicle.

All during this descent phase, if again for any reason an abort is desired, there are a very simple series of trajectories which will allow this vehicle to abort and rendezvous with the mother craft itself.

I think you can see some of the features and characteristics of the LOR just by looking at the size of the landing vehicle itself. Basically, we were able in this mode to design a space vehicle specifically for operation in the vicinity of the moon, to provide a reasonable amount of glass area so that the landing maneuver can be under visual control of the astronauts, and that the actual touchdown site can be given a reasonable observation before we touch down.



Dr. Shea comparing the size of several modules.

Mr. Webb and Dr. Shea discuss LOR.

In addition, the size of the landed vehicle is such that landing gear restrictions are somewhat minimized. The entire vehicle is just optimized in effect for the landing maneuver itself.

That also lets us, incidentally, optimize the command module for reentry into the earth's atmosphere, and essentially optimizing that configuration requires a minimum amount of glass, a shape which is in effect a shape like the Mercury capsule at this point in time, a positioning of the astronauts so that they are able to withstand entry Gs so that their normal position is in effect lying on their backs, so far as this configuration is concerned, rather than the vertical position that we would like to have them at for landing.

After the mission is accomplished and we have something like a two to four-day stay and exploration time on the lunar surface, we decide to commit them to the return capability. We stage the lunar excursion module and leave on the surface the tanks required to carry the fuel for the landing, the landing gear itself, and this landing stage in effect becomes a launch pad, a lunar Canaveral.

At an appropriate time, we have a launch window here, something like six or seven minutes. With the orbiting spacecraft coming up overhead -- as a matter of fact about two or three degrees just behind you -- you ignite the engine in the lunar excursion module, climb up a trajectory which enables you then to rendezvous with the mother craft. All during the ascent maneuver we have radar contact and visual contact between the lunar excursion module and the command module-service module combination. We provide a capability for making the rendezvous from either the lunar excursion module or from the command module-service module combination. This, in effect, being a critical maneuver, we are able to provide complete redundancy, in fact in some cases double redundancy in terms of sensors and control systems aboard both the excursion module and the command module-service module combination.

Assuming everything works, we come up here, make a mid-course correction about half-way up the ascent trajectory, a bit further on when the two craft are about three miles apart, using the radar data, and possibly the optical data, the lunar excursion module will reorient itself, bring itself to a position where it has a very small velocity error and very small linear displacement from the mother spacecraft, and then, under the control of the astronauts the two craft will again be joined.

The astronauts that have been on the lunar surface then transfer back to the command module -- the lunar excursion module will then be left in lunar orbit, the service module will burn to provide the propulsion to get out of lunar orbit, put you on the return trajectory.

Coming back the guidance system on board, plus ground corrections, are used to determine the corrections necessary to get you into the re-entry corridor, propulsion again provided by the service module.

Just before re-entry you drop off the service module, command module reorients for re-entry, and the mission is completed.

QUESTION: At what point did you jettison the last stage of the lunar excursion module?

SHEA: It is still hanging in lunar orbit. We left it up there.

QUESTION: Will it stay there forever?

SHEA: Reasonably so; yes.

QUESTION: Will you instrument it to send you back some information when you have no men left in it?

SHEA: No, sir, I don't think we probably will. I think the unmanned program by that time will have provided us most of the information we should be able to get from an unmanned vehicle.

QUESTION: Will you be able to go back and get it?

SHEA: We haven't planned to. Not because we are not interested in the economy, but because of the problems of bringing up propulsion and the long time of operation associated with the systems.

HOLMES: Show them the comparison of the size of the vehicles going to the moon.

SHEA: If we talk about the direct flight mode or earth orbit rendezvous mode itself, you get a feel for the difference.

HOLMES: It is either this, by either earth orbit rendezvous or direct ascent, this would be the part going to escape to the moon, by those methods, and by the method that Dr. Shea has just described for you, it is this. So it is that thing, if you can imagine that up there, the command and service module, compared to this. The major difference in size is this lunar braking and lunar touchdown modules as contrasted to the bug. That should give you a feel for it.

SHEA: Another comparison which is worth while I think is the landing configurations themselves. I might just go through the mission mode associated with direct flight or earth orbit rendezvous.

Basically there the requirement is to put to escape a spacecraft weighing approximately 150,000 pounds. You can do this either by rendezvousing in earth orbit and in effect tanking the escape stage, or providing a large enough launch vehicle to inject 150,000 pounds.

The spacecraft that is put in, as Brainerd said, is the lunar braking module, the lunar touchdown module, the service module and the command module.

In this case you burn into lunar orbit, using the lunar braking module. In addition, when you decide to commit to the mission, you again burn the lunar braking module in order to put you on a trajectory that brings you down to the landing point.

One of the problems in the direct mode is just a question of landing anything that is this big. It may not look big on the table, but it is approximately 80 feet from the bottom of this thing up to the top. It becomes a fairly unwieldy dynamic structure.

We then concluded that the way to properly implement the direct mode was in effect to use this stage, which is a hydrogen stage and therefore reasonably efficient in terms of propulsion, use it until we were a few thousand feet above the lunar surface and required about another 400 to 450 feet a second before you came to the hover condition. And during this descent phase then to stage off the braking module and provide yourself with a landing configuration which looks like this.

At this point, then, the legs would be extended. We are still going down, hopefully slowing down from the 400-odd feet per second, come to the hover condition, and at hover we then have the same situation prevailing as before. You hover, translate, and actually land, and I think you can now contrast the two landed configurations.

As far as the rest of the direct flight mode is concerned, again after performing the experimentation and exploration on the lunar surface, in this case the service module itself provides all the propulsion required to inject first into lunar orbit, and then out of lunar orbit back on the return trajectory. The return trajectory is then essentially the same as for the LOR mode.

QUESTION: That is 150,000 pounds?

SHEA: This assembly is 150,000 pounds. The thing on the lunar surface is approximately 48,500.

HOLMES: Explain how the tanker works.

SHEA: Really we didn't have any fun in the study until we made the models.

SEAMANS: To make it clear, why don't you put the other stages on top.

SHEA: If you take this configuration, this is basically the S-IVB stage itself, which would be the escape stage for Nova, or the escape stage for the earth orbit rendezvous mode. And the spacecraft then, during the launch phase and during injection, is mounted on top of the S-IVB stage. As I said, the spacecraft weights about 150,000 pounds or thereabouts; S-IVB weighs 255,000 pounds.

For direct flight the Nova vehicle -- this is the real large launch vehicle that Brainerd discussed -- would inject into earth orbit this combination with the S-IVB completely fueled and LOX'ed and the spacecraft on top.

To do the mission with the C-5 vehicle requires utilizing two payloads that can be lifted into earth orbit by the C-5. C-5 puts into earth orbit about 240,000 pounds or thereabouts. So that it turns out that you can't really break the payload into two packages, one of which would be the injection stage and the other of which would be the spacecraft itself. It turns out when you go through the weight analysis that the thing to do, in order to utilize two launches, is to assemble on the launch pad on one C-5 the S-IVB stage and the spacecraft, the spacecraft completely fueled and LOX'ed; the S-IVB only fueled. It has hydrogen in it, and hydrogen is a fairly light fuel. It turns out that you need also about 190 or 195 thousand pounds of LOX in this vehicle. So that if you take the LOX out of the S-IVB you have a payload which can be injected into the high earth orbit by the C-5 vehicle.

Then in order to get the LOX into this sink, so you can use the fuel, it is necessary to have waiting up at earth orbit for the assembled injection stage in spacecraft a tanker, the tanker carrying within it then all of the liquid oxygen, the pumping necessary to transfer the liquid oxygen from the tanker to the S-IVB.

The mission mode calls then for injecting into low earth orbit the tanker vehicle, the single launcher C-5, then as soon as you can get the second C-5 counted down and ready -- a period of something between a day and a week as we estimate at this point -- injecting the unLOX'ed S-IVB and spacecraft. Once it is in high earth orbit -- you would have these two things now going around in earth orbit -- determine from the ground at what time you ought to fire the engines aboard the tanker in order to effect a rendezvous between the tanker and the orbiting spacecraft.

At the time that the tanker comes up after the firing of the engine, at the time the tanker comes up toward the spacecraft, it is under the command of the astronauts in the spacecraft. They can actually control the motions of the tanker and they use radar and optical sensors to determine what order should be given.

The tanker is swung around, comes up and mates at the tail end of the S-IVB. The LOX is transferred, and the tanker, the tanking structure, and all the auxiliary propulsion systems are dropped away. You then have in earth orbit a fully fueled and LOX'ed S-IVB in the spacecraft and you then inject to escape in the same way that you would for direct flight mode.

QUESTION: I wonder if you could elaborate a little bit on how much time and money you will save by going into lunar orbit, in a little more specific terms than 10 percent.

HOLMES: Estimates vary as far as time. It is a pretty consistent estimate that going direct ascent, with the 20 months or more later than going lunar orbit rendezvous, in earth orbit rendezvous the estimates vary from 6 months longer to 15 months longer for earth orbit rendezvous over lunar orbit rendezvous.

As far as costs, I don't think we can give you any better estimate right now -- because these studies were done on a relative comparison basis -- than to say consistently our data showed that lunar orbit rendezvous ran between 10 and 15 percent less than either of the other two modes.

SEAMANS: With regard to the direct ascent. Brainerd is referring to the direct ascent with the Nova. A lot of that time delay is the extra time it would take for the development of this much larger vehicle that as yet of course has not been committed to a contractor.

The reason we are studying the possibility of direct ascent with the C-5 is to see whether, by upgrading engines and scaling down the spacecraft, it would be on the same footing timewise and costwise.

We have not studied this possibility in as great depth as the other modes.

QUESTION: Could you tell us how much weight you lift off at Cape Canaveral and how much weight you get back at the end of the lunar orbit, back to earth?

HOLMES: Yes. If we go the lunar orbit rendezvous, -- I assume you are talking about that.

QUESTION: Yes.

HOLMES: We will lift off 90,000 pounds. That is the maximum the C-5 will lift off. We may have some slight margin on that. I think that is a reasonably good figure. And the command module weighs somewhere between 8,500 and 10,000 pounds, which is what will be returned to earth.

SEAMANS: That is the escape weight.

HOLMES: That is the escape weight. I am talking about payload. Six million pounds, if you want the total sitting on the pad; 8,500 for the command module if you want rough figures.

QUESTION: Under this new approach, what will you not do in the Nova program that you had planned to do up to now, and how much money do you think you will be able to channel from not doing that to this program?

SEAMANS: I don't think we are here today to discuss our budget in detail. What we will do is to go out on a study of the Nova vehicle that will be more of a conceptual study to investigate different kinds of propulsion, to see what might be gained by use of solids as well as the liquids, to see what we might do with nuclear upper stages as well as the liquid hydrogen upper stages, before committing ourselves to actual design programs.

WEBB: Maybe you might say it this way: We will not go forward to put under procurement the 8-engine Nova but will rather try very hard to find designs that will give us 2 or 2-1/2 times the lifting capacity of the C-5.

In essence I think that is the major element of what we will not do and what we will do.

QUESTION: Will the M-1 program be affected?

SEAMANS: No. We will continue the M-1 program. As to how it will be time-phased, this is still under review.

QUESTION: Are you deferring the development of this lunar braking module and the lunar touchdown module that will be used for EOR or direct ascent, the same two years, as you are for the Nova?

HOLMES: No, we are deferring them indefinitely unless we should decide to undertake one of those modes.

QUESTION: Can you describe the earth orbital missions you could carry out with the Saturn C-IB? Specifically how much would the empty structure of the LOR spacecraft weigh and how much fuel could you get in it, and would you have fuel for both the service module and the bug, and how long would these missions last?

SHEA: We are still studying the exact amount of fuel. It turns out that the empty weight of the command module-service module and the bug itself is several thousand pounds under the lifting capacity of the C-IB. It is our intention then to inject into earth orbit this combination, and in earth orbit to exercise completely the rendezvous maneuver in the same manner in which it will be performed in the vicinity of the moon.

QUESTION: And would the astronauts climb into the lunar landing device?

SHEA: The astronauts will be in the lunar excursion module, yes. There will be an evolutionary series of tests. We don't have the exact number. Each time you get a successful injection of the three modules we will be able to carry out several rendezvous. We will send the bug away, in essence, to the limit of its acquisition box, give it different velocities and different displacements, and exercise the rendezvous maneuver completely.

I think you will find in the first few missions, until we are assured of the reliability of the rendezvous operation, that we will send the lunar excursion module away and use the option of performing rendezvous from the command module itself.

As you begin then to develop the facility with rendezvous, the astronauts will be committed into the lunar excursion module and they will exercise that particular mode of rendezvous as well.

QUESTION: Is it planned in the first few missions to have a cable attachment of some sort between the two?

SHEA: It has been discussed. I would say we don't have any definite plan at this point in time. It is our expectation that -- my expectation -- a cable would not be necessary.

HOLMES: I think we might emphasize here, the appropriate time, what Mr. Webb has voiced many times, and that is that we believe it is extremely important to gain proficiency in space, and specifically to gain proficiency in what people call near space, or earth orbit, and earth orbit rendezvous, earth orbit operations. It is significant to our decision that doing lunar orbit rendezvous provides in our opinion as much experience and as much technique development in operations in earth orbit and in rendezvous around earth orbit as in any one of the other modes.

QUESTION: Dr. Holmes, does the unanimity or the LOR extend to your Defense people? I understand that they were more interested in EOR than LOR.

HOLMES: If your question relates to did they agree with us as far as considering that we will gain sufficient operating proficiency for any needs they might have, I think the answer is a very definite yes.

As far as there being agreement with us as to this being the proper mission, I don't think they would say, because they haven't studied it as such. So I think they were just taking our judgment on that.

WEBB: I think the way to think about it is that we have given them a full briefing and understanding of what we plan to do, and we have gone into considerable detail with them right up to Mr. Gilpatric and his immediate associates. We have not asked them to concur in this decision because indeed we will not make the final decision to procure this lunar excursion vehicle until we get the proposals back from industry and see what they really look like.

We are very anxious to spread the problems involved here over the total complex of brains in the Aerospace industries in America and get the best ideas we can.

We expect to stay in very close touch with the military people and to develop these programs so that they not only help us perform our mission but also render such service as they can to their immediate complex.

QUESTION: Dr. Holmes, on an emergency basis, how much of any of these missions can be controlled from the ground?

HOLMES: You mean whether or not we can take over complete control if the men were incapacitated?

QUESTION: Completely or partially.

HOLMES: I can't give you a definite answer. We are studying that in considerable detail. There are many people who are of the opinion that we must have considerable ground control or ability to take over from the ground. It does, however, at least at first blush, seem to add some complexity to the equipment. This is the kind of pros and cons and the balancing of the scales.

If you want me to take an offhand guess I would say we will have considerable control from the ground.

SEAMANS: Adding to that point, I know one of the items that I felt was particularly significant in reviewing this was the fact that using our deep-space net, here on earth, it is possible to measure the ephemeris of the capsule in lunar orbit precisely enough that you could actually carry out the rendezvous operation. And we will have considerable band width with the large 200-foot antennas that we are planning to have as part of the deep-space net.

QUESTION: Did you find any extra risk in the conducting the rendezvous maneuver so far away from the earth where the capsule couldn't come back to a friendly planet?

HOLMES: Of course we did take a good look at that. It is something that people focus on right away because rendezvous hasn't been done in space.

However, I think the proper way to look at it is to analyze the entire mission, that is, that it is a hazardous mission. You analyze each step. If one does that, and tries to put numbers associated with each step, one finds that the safety of the mission is directly comparable between any of these three; that certainly that rendezvous in lunar orbit is an ingredient that has to be accomplished. Still, if you give it its proper weight and you give landing on the surface a proper weight, and the take-off from the surface of the moon and the original take-off from the surface of the earth, they turn out to be quite comparable. In face, within the accuracies of the numbers I would say equal as far as mission safety.

QUESTION: Dr. Holmes, could you at this time give us more details on how you could possibly use the Gemini-type vehicle for a direct ascent, and is there a possibility that this might even beat the bug?

HOLMES: There is absolutely no intention of using the Gemini vehicle for escape to the moon. It is designed and its plans for use are in earth orbit.

QUESTION: You stated here possibilities of utilizing such a spacecraft -- and this is a two-man module type -- for direct flight to the moon using the advanced Saturn will also be considered.

SEAMANS: That does not say use the Gemini capsule as such. This will be a new capsule that will have to be developed.

HOLMES: A capsule like that one, but smaller and lighter so it will meet the lifting capability of C-5. I thought you meant Gemini.

QUESTION: On this two-man program, using the C-5, when will you decide to make the decision on this new capsule?

SEAMANS: We will make the decision at the same time that we have the proposals from industry on the lunar excursion vehicle. We will have completed the study of the two-man direct ascent at the same time, and at that point will obviously have to make a decision as to whether to go ahead with the actual development of the lunar excursion vehicle.

QUESTION: Do you know how much you would have to increase the thrust on the C-5?

SEAMANS: This is the purpose of the study that we will be carrying out in the next few months, to determine exactly what augumentation would be required.

Brainerd, do you want to add to that?

WEBB: There is a question over here.

QUESTION: For the last two weeks NASA put out requests for design studies of orbital space laboratories and manned orbital self-directing space laboratories. I wonder how these fit into the program and will these go ahead.

HOLMES: These are all just studies. We do not have programmed today anything but studies for a space laboratory. I think we feel that the volume, and the masses that we can put in space with Apollo, both with the C-1B, and later with the C-5, might well be the first groundwork for our space laboratories. But that entire effort is just in the study stage at the present time.

WEBB: Bear in mind, we are encouraging our centers, like Dr. von Braun's center at Huntsville, to make these studies, to accumulate just as much information as possible, to utilize the resources of industry to the fullest extent possible. That is the process you see going on. And you will see a lot of studies made in this general level of financing which they are authorized to go forward with on their own initiative.

QUESTION: Mr. Webb, the cost estimate here, to get back on John Finney's question, ten to fifteen percent saving, ten to fifteen percent less, is this ten to fifteen percent of the commonly quoted twenty to fourty billion dollars cost? In other words, do you anticipate saving two to six billion dollars?

WEBB: Let's let Mr. Holmes answer that.

HOLMES: This was a specific comparison among the three modes. In doing so, if one picks lunar orbit rendezvous, then you are not doing the Nova. However, in doing our overall manned space program, where we are talking about these figures that you mentioned, that is a different sort of thing. So I don't think there is any ten or fifteen percent saving there. I think the only significance of those figures is if you trot these out side by side and do an analytical comparison of costs, this comes out ten to fifteen percent less. Its implications to the total program are not necessarily a ten to fifteen percent saving.

QUESTION: Would it be one billion dollars, perhaps, or two billion dollars?

SEAMANS: We are just not going to discuss it here.

WEBB: We will know more about this when we look at the proposals coming from industry on the lunar excursion vehicle, for instance. I think any estimate that we give you today, other than the statement made by Mr. Holmes, would not help you particularly in explaining this program.

QUESTION: What about the unmanned lunar landing support vehicle? Can you describe that some more? How big would it be? What would you use to get it up there?

WEBB: We are going into a detailed study that will perhaps last six months in this case to study this. It would appear that if we go forward with a lunar excursion vehicle that a logistic support vehicle would be very important to use in conjunction with it. It would also appear that this might be expanded into a direct ascent vehicle.

We expect to do this with very great care, because this means a line of development of unmanned lunar landing equipment, which is quite an undertaking.

QUESTION: I have a question on money. I am not sure I understand Dr. Seamans correctly on it. Did you say by pushing the Nova vehicle back two or three years you could use that money for this excursion vehicle? And are you talking about 1963 money?

SEAMANS: I am not sure you are quoting me. I think you discussed that.

HOLMES: I didn't mean to say that. What I said was that by moving Nova back, we do not have such a peak in budget fund requirements, and indeed the fund requirements that we presently have in the budget, where we went in showing Nova and so forth, we needed to do this mission, to do the time scale we want to. By moving Nova back we cannot only get a more advanced vehicle but further the funding requirements for it come later, so that we don't have to say we need even more money. It is a try to balance and have a balanced program.

QUESTION: You are not talking about using 1963 Nova money on this LOR excursion vehicle?

SEAMANS: That is a hard question to answer.

WEBB: I think what you have to say is that we have a program before Congress. It has been approved in the House and the Senate. They have to have a Conference now to adjust differences of that. Then you have to go through the appropriations processes. Then we are going to have to balance out the result that comes out of this legislative process against the requirements of all of these things.

You do know we already are into 1963 fiscal year, and you know that we have at least a three-month period here to have industry make its proposals and to consider them.

The funding requirements on the lunar excursion vehicle in Fiscal 1963 could not be very large in terms of this program.

QUESTION: Mr. Webb, is this the specific reason for deferring Nova for two years? Don't we see a need for Nova beyond the Apollo itself?

WEBB: Yes. We are very anxious to continue with the Nova. But we are also very anxious when we go into this large-vehicle development to know first of all if we require it for the first lunar landings, and a good deal of this work that we have been describing will give us a solid basis for judgment there. We also are very anxious to have a vehicle that steps up considerably from the Saturn C-5.

One of our many purposes here is not to build something, as Mr. Holmes has said, or Dr. Seamans, that is only eight-fifths of the C-5. We would like very much for it to be two and a half times, at least, maybe three times as effective in thrust as the C-5.

QUESTION: Could you discuss briefly the problem of getting back in the earth's atmosphere without burning to a crisp? Will there be plenty of fuel to maneuver? As I understand, that is one of the tricky aspects to this whole problem.

SHEA: The re-entry problem is somewhat more difficult than the Mercury re-entry problem, but doesn't really represent, I think, one of the major critical elements in the program. You have coming back in a re-entry corridor approximately forty miles wide that you have to come in to with the proper re-entry angle. The re-entry is controlled in effectively the same way as the Mercury re-entry is controlled. There is no propulsion needed as such except for attitude control during the period of maximum pressure and maximum deceleration.

QUESTION: How about from there on down? How do you get these people back on the ground?

SHEA: From there on down again it is similar to Mercury. We are talking at this point in time about three parachutes deploying, a shock absorber which will allow us to land on land. We are also investigating a paraglider, which is being developed in the Gemini program. It is possible that the paraglider would be selected as the mode of actually providing a controlled landing.

QUESTION: Is there any plan to make the thing give an L/D of more than zero in order to come in?

SHEA: It has an L/D of more than zero coming in. The C.G. is offset and the L/D is approximately .5. It might be as high as .7. So it has some inherent maneuverability as it comes in. Mercury has none.

QUESTION: Mr. Webb, will there be any changes in the Gemini program as a result of the decisions you have announced here today?

WEBB: I do not think so. I think of course again we have to be very flexible. We are trying to explore every new opportunity that comes to us. The Gemini program is an experimental flight program to test out by repeated flights with two men many of the concepts and many of the pieces of equipment that will be developed.

Undoubtedly we are going to have changes in that program, and we are going to develop new ways to use this combination effectively. But basically we want to get experience with weightlessness, to get experience with rendezvous, to study in every way possible the effect of weightlessness not only on men but on equipment, on fluids and so forth. Would you want to add anything to that?

HOLMES: No, sir.

QUESTION: Mr. Holmes, you know where you are going to take off from the earth, and you know more or less where you would like to land on the Moon. Do you have any idea where you would like to land when you come back?

HOLMES: No. We are studying that presently. I think that the significant thing is that we would like to land on land, and not on a hostile sea. I think it is significant that we are planning, by having a L/D something greater than zero -- as Dr. Shea said, .5 -- and by communications hopefully right through the blackout region, to be able to guide this vehicle, if you will, just by controlling his attitude and thus having this offset center of gravity, to a localized landing area which might be an area ten miles on a side, something like that, and then much more localized through a parachute or paraglider.

So that we are studying now the feasibility of doing those things and then the various sites which would offer the most advantage to land should you be able to do those things.

So that we have considered several areas, the Plains areas in the United States.

We would like to have, of course, good visibility and we would also like to have large unrestricted areas.

QUESTION: Are you planning any changes in your Apollo module being built by North American?

HOLMES: Very minor changes. The contract with North America for that Apollo service module and command module at its present status is such that it is about equally applicable to any one of these modes. If anything, perhaps the way the developments have come so far, it is more applicable to the lunar orbit rendezvous mode. But they do need -- and it is one of the reasons we have to firm up the decision -- they do need now, as we go along, decisions so that where changes would develop, they would make go toward the mode that we are going to use.

To answer your question very succinctly, we don't expect many changes.

QUESTION: May I ask one more question about time from leaving the Cape to the Moon and back.

HOLMES: Seven days; typically.

SEAMANS: Total.

QUESTION: You are still studying three routes to the Moon, as I get it. First you favored the earth orbital route, now you favor the lunar orbital route. When will you make a final commitment? Do you know which month or which year, or about when?

WEBB: When we get the equipment that we are satisfied with in earth orbit and make the decision that it is going to be committed to the mission.

QUESTION: When will this be? Mid-1965?

WEBB: I think this apparatus we said would be ready by mid-1965. I think that is in this release.

You see, we simply don't want to make irrevocable decisions here in an area that is as new and broad as this. We expect to get some breakthroughs. We expect to do the job with what we can extrapolate out of our present position, but we also are praying for some important breakthroughs that will save us time and efforts. So we don't want to say irrevocable commitment but rather getting everybody pointed in the direction, proceeding rapidly in that direction, adding one unit to our program, which is the lunar excursion module, using all of those we now have in the program, adding to that as required, but moving as rapidly as we can.

QUESTION: Mr. Holmes, is there any action that you could take contemplated at this point if they missed a rendezvous with the command module coming back from the Moon?

HOLMES: Yes. We have it planned with redundancy such that if, for instance, in the first rendezvous, the lunar exploratory vehicle or so-called "bug," was not able for some reason to rendezvous with the command module, the command module would have both the guidance equipment, sensing equipment, as well as propulsion capability on board to go after it. An abort, an initial abort does not mean failure to rendezvous.

Is that your question? Command module rendezvous in lunar orbit with the bug?

QUESTION: On a return, if you fail to rendezvous, is there any action that could be taken?

HOLMES: If you fail after all these redundant things -- in other words, if you fail to rendezvous because the men in the exploratory vehicle can't rendezvous with the mother craft, and if in turn you fail to rendezvous also because also with a duplicate failure the mother craft can't rendezvous with the exploratory vehicle, with redundant systems in both, then unless the exploratory vehicle could get back to the lunar surface, and as I think we have had some kind of a logistic vehicle -- I am pre-jumping the study we are doing -- to support it, if all those things fail, no, then the men have failed to rendezvous, and that is it.

QUESTION: But the mothership could still get back?

WEBB: Yes.

SHEA: Many people seem to focus on this rendezvous as being an operation which is unique and separated quite apart from anything else that we are doing in space. It turns out to be not really true. If you look at the elements associated with rendezvous, you need guidance, for instance. You need the guidance to get off the lunar surface and come back home again. You also need it to rendezvous. If the guidance failed, you are not going to get back home, never mind making a rendezvous. You need mid-course propulsion in order to correct the guidance that exists in the vicinity of the Moon and enable you to get back into the re-entry corridor we mentioned.

The mid-course propulsion for direct flight is about the same size and same order of magnitude as that that you need for rendezvous, and it is only one part of the total amount of propulsion we provide in redundantly giving us a rendezvous capability.

When you break rendezvous down into its constituent parts you find that there are a series of analogues between the things that you have to do in executing rendezvous and the things that you need to do in order to complete a normal direct flight mission.

By the time you analyze these things out, and really study where the risks are, which are the difficult operations, you find that the mission with rendezvous is in effect no more risky than the mission with direct mode.

QUESTION: Mr. Webb, in conclusion, as far as I am concerned, in three months you are going to select a system and a contractor. In other words, this is another decision on the road in three months?

WEBB: That is right. And we will make that decision in the light of the submissions from industry, bringing the best brains of the industry in, and also in the light of our continuing studies of the possibility of direct ascent with the two-man capsule, our studies that will then be about halfway through on the logistics vehicle.

In other words, we will now proceed to try to implement the lunar orbit rendezvous, if we can. If we cannot, then we will obviously do something else. But our purpose now is to make every effort to implement this call for procurement by buying the vehicle and moving on up the road.

QUESTION: Does this logistics vehicle amount to a re-orientation of one of the JPL programs or prospective programs?

WEBB: I would say no.

Brainerd, maybe you want to answer that. Certainly we will take advantage of all that they have done.

HOLMES: I think as far as Prospector, as you know, it is not an onboard authorized program. We will try in this logistics vehicle to give it maximum service for both space science program, scientific investigation, which after all is the gray area to the manned program; we must have this data before we go. With the logistic vehicle we will probably use it for both. Prospector does not exist as an authorized program.

QUESTION: Could I ask another question?

Back in 1958, I recall vaguely, Fred Singer, I think, gave a paper in Denver about the instability of lunar orbits based on the instability of the surface. Is this an astronomical question now, or was this a theory at that time?

HOLMES: It is one that I am sure that Dr. Shea will be glad to comment on, because he has done a lot of studying, and our people have, on what perturbations there would be for this mother craft in lunar orbit which might give you difficulty or might not in rendezvous. We think it is not a problem.

SHEA: It is an astronomical question, but the answer isn't. We have studied the stability of the lunar orbit, particularly in the lower lunar orbits, of the order of a hundred miles or so that we are talking about. It appears that the maximum circular type perturbations are of the order of 100 to 150 feet, this occurring over a several-day period of time. So we don't feel that there is really a problem here in the stability of the orbits per se.

QUESTION: Could you tie things together for us by summarizing for the radio and for the record the announcement concerning the method that we are going to attempt to use?

WEBB: Before we do that, there is another question.

QUESTION: I will get it later.

QUESTION: Mr. Webb, before you get into that, could Dr. Roadman or one of you other gentlemen give us a status report on the 253 preliminary selectees, and also speak to the question as to whether it is logical to assume that one of these men might be in the first lunar mission? Or would you have to get another --

WEBB: I think I could say that we have gone through various elements of the screening processes. We have narrowed the field down to approximately 32 persons. These are under examination and screening now. I believe five of them are at the station today.

DR. C. H. ROADMAN, Director, Aerospace Medicine, Office of Manned Space Flight, NASA: Undergoing medical evaluation.

WEBB: We will proceed right on to make the selections.

As to the second point of your question, I think it is reasonable to assume that some of these men, being selected in this process, will be on the first lunar mission.

HOLMES: I am sure they will.

WEBB: Now if you would like a very quick summary -- I am assuming by that you mean that you want one or two minutes and not ten or fifteen after all this time you spent here - I would like to say that we have studied the various possibilities for the earliest, safest mission to make a manned lunar exploration, and have considered also the capability of these various modes of conducting this exploration for giving us an increased total space capability.

We find that by adding one vehicle to those already under development, namely, the lunar excursion vehicle, we have an excellent opportunity to accomplish this mission with a shorter time span, with a saving of money, and with equal safety to any other modes.

Therefore, we are now adopting this as a means of asking industry to give us proposals for building this lunar excursion vehicle. If these proposals meet the requirements of this mission, we will proceed to procurement of the vehicle. In the meantime, we will also be making very complete studies of a logistic support vehicle that will be capable of landing supplies on the moon in support of our operations there, and of the possiblity of a two-man direct flight mission using a new capsule and the C-5 booster.

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