NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

FOR RELEASE: JANUARY 1962

FACT SHEET

MANNED SPACE FLIGHT COMES OF AGE AS PROJECT MERCURY NEARS ITS END

Manned space flight comes of age as the NASA Manned Spacecraft Center's Project Mercury -- America's initial step into space -- approaches its end. Actively participating in this new age is Man, presently led by the Nation's seven astronauts, given the part by organization of NASA on October 1, 1958.

Project Mercury's passing will sadden many who dedicated themselves to its successful development. But that sentiment will pass quickly, for Project Apollo brings realization of man's ancient desire -- his feet upon the surface of the Moon.

Mercury has been a difficult but inspiring, vastly informing and rewarding task. In the short time since its official inception, the project has passed through stages of research, development, engineering, design, manufacture, and unmanned and manned ballistic flight tests.

Thus, the project nears its conclusion with the coming manned orbital flight. Man's capability in the once alien environment of space is being confirmed. More ambitious undertakings, including manned exploration of space and the distant planets, can now be performed.

Accomplishments to date, though, include more far reaching areas than just the Mercury spacecraft.

One of these areas is expanded, solid management capability for conduct of manned space flight research activity. The Manned Spacecraft Center -- with a large cooperative support organization composed of a sizeable segment of the Department of Defense, civilian industry, scientific and research organization, and elements of the entire NASA -- now represents a major management resource.

A second area includes developed and expanded industrial knowledge and capacity for design and manufacture of very complex spacecraft and related systems.

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Build-up of well underway flight operations is the third area. New launch capabilities and techniques have been checked and proven, while new ground rules on flight safety and crew protection have evolved.

A fourth area encompasses the Earth-girdling tracking, data collection and flight control network -- the Mercury world-wide tracking system.

The fifth of these areas concerns a developed pool of trained space pilots. The seven U.S. Project Mercury astronauts represent a vitally important resource upon which the Manned Spacecraft Center can build while supporting more ambitious flight plans.

As research proceeds, Manned Spacecraft Center will be selecting and training additional crew members, relying heavily upon the skill, knowledge, experience, and dedication of these seven pioneering men.

Experience and capability, now a reality, is already being called upon to meet the most complex challenge yet -- the national goal set by President Kennedy before Congress May 25, 1961, to send man to the Moon, landing him and then returning him to Earth before this decade ends.

Aggressive steps have already been taken to meet the Apollo challenge. These steps include accelerated research, expansion of management capability, expansion and creation of new resources, and acquisition of additional civilian industrial manufacturing capability.

Many other space research efforts are being conducted in support of this project. Effort by other NASA research facilities, the military, and supporting and educational institutions are of vital importance to the success of Apollo.

In addition, expanded Mercury space flight experience in the form of an interim step prior to a three-man Apollo mission is considered necessary. Following Mercury's increased-orbit flight -- probably including as many as 20 orbits -- a Gemini two-man rendezvous spacecraft is planned to carry two astronauts in orbit for a week or more and to be capable of rendezvous and docking with other vehicles in Earth orbit. This contract is already under negotiation with McDonnell Aircraft Corporation, manufacturer of the present Mercury craft.

Rendezvous in orbit is one way of carrying out later Apollo missions. Another possibility is the direct-flight approach using a multi-million-pound thrust booster of the Nova-class. Both methods will be explored in order to meet the national man-on-the-Moon goal.

This new two-man craft will assume the same Mercury shape but will be slightly larger and weigh two to three times as much as the one-ton Mercury spacecraft. It will be placed in orbit by Martin Marietta Corporation's Titan II.

Two-manned flights are slated for the 1963-64 period, starting with unmanned ballistic missions to test overall launch vehicle spacecraft compatibility and systems engineering. Several manned orbital flights will follow with rendezvous fly-bys and actual docking missions attempted in final flights.

This program provides the earliest means of experimenting with manned rendezvous techniques. At the same time, the two-man craft will complete orbital missions of a week or more to provide pilot training for future long-duration circumlunar and lunar landing flights. The Manned Spacecraft Center may phase in additional astronaut crew members during later stages of the program.

This interim activity will also give the Manned Spacecraft Center personnel more launch experience and more depth in knowledge about manned input into these systems.

This activity will be undertaken concurrently with and in support of Apollo work. The highly productive undertaking will require maximum advantage of Mercury experience and knowhow and will provide new experience and capabilities for application to the lunar program.

Apollo spacecraft design, determined partially by already completed industry design competition, will be more completely determined by NASA-North American Aviation detail design efforts. Basically, the Apollo design will consist of a three-man command module attached to advanced propulsion modules for lunar landing and takeoff.

Project Apollo began about two years ago when a small team was set up within Manned Spacecraft Center (formerly the Space Task Group) to determine working guideline for the effort. All NASA research and space flight Centers and resources have been brought into the program to insure sound basic research and availability of solid technological basis for the program. Intensive in-house design study was undertaken at the Center during 1960, and in November three industrial teams were brought into the effort to conduct feasibility studies.

These industrial studies resulted in an NASA-industry technical conference in Washington in July 1961 in which all American aerospace industry had the opportunity to learn principal results of these basic research and design efforts and to be brought up-to-date in preparation fo industry-wide competition for the Apollo spacecraft prime contract.

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North American Aviation, Inc., was named prime contractor on November 29, 1961 -- the day Enos made two Earth orbits in the Mercury-Atlas 5 spacecraft.

Primary propulsion systems for launching Apollo are under study. Saturn, predecessor of Nova-class rockets, entered its flight test phase with the first vehicle launched successfully from Cape Canaveral on October 27, 1961.

Concerning the present status of Project Apollo, much of the basic research has already been completed. Design studies have shown that the project is technically feasible. And of equal importance manned space flight -- specifically the Apollo manned lunar landing and return mission -- has been recognized by the President and Congress.

In pursuit of the established goal, NASA has provided a management structure for the project as a major part of the Space Agency and is in process of establishing a permanent home for Manned Spacecraft Center near Houston, Texas.

Related here, a $1,499,280.00 contract was awarded on December 11, 1961, to a Houston firm -- Brown and Root, Inc. -- for architect-engineer design work on a major portion of the Center by the Army Corps of Engineers. Award of the contract was made by Colonel R.P. West, Fort Worth District Engineer, who will supervise design of the facility based on criteria to be supplied by NASA.

Completion of initial engineering will take about six months; however, the first utilities construction contract is expected to be announced in February. Besides general site development, the initial architect-engineer contract includes master planning for the complete installation as well as design of the flight project facility and various utilities. Initial occupancy of these buildings should occur about mid-1963.

Concerning major Apollo technical advances, a multitude of complex problems are involved in the flight mission. For reentry dynamics, there is a problem of protection of both crew and spacecraft from searing heat of reentry at velocities of 36,000 feet per second. Here Manned Spacecraft Center personnel must dissipate a kinetic energy per-pound of weight that is far greater than chemical energy of any known compound. However, solutions are foreseen for this in extensions to the vast reentry technology built up during the past decade.

Earth landing capability problems include ability to avoid local hazards and to control the final and predetermined touchdown point. Some degree of lift ability in the vehicle itself plus adaptation of either steerable para-

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chutes or the Rogallo paraglider (a kite) may provide solution to this problem.

For lunar landings, NASA must achieve a genuinely "soft" controlled landing in a vacuum and on a surface about which we know almost nothing; here the Lunar Sciences Program -- with NASA's Ranger, Surveyor, and Prospector -- should provide many answers. However, a large engineering undertaking will be required in the final solution.

Finally, there are major problems in vehicle performance and reliability, including human crew participation.

The performance problem is basically related to size of the step to be taken. Project Mercury requires a launch vehicle capable of putting about one and one-half tons in low Earth orbit. For lunar landing and return, Apollo will require a basic launch vehicle capable of putting one hundred times that weight in low Earth orbit. For Moon and planet flights, the ratio of takeoff thrust spacecraft weight will approach 1,000 times that.

Because of the extremely large vehicles which might result, it may well be that orbital rendezvous techniques will provide the only means of accomplishing the mission with launch vehicles of considerably smaller proportions. It also seems clear that NASA will soon have to progress to more exotic forms of propulsion -- such as nuclear or nuclear-electric -- if it engages in planetary exploration with relatively reasonable thrust-to-weight ratios.

As for reliability, many factors tend to gather against large space-vehicle design. One factor -- Man -- requires extreme reliability. NASA must achieve magnanimous, failureless launch rates in its vehicles to approach required reliability necessary for manned flight away from the Earth. Possibly, desired reliability can be achieved by increases in previously used measures of simplicity, redundancy, quality control, and human input to control of the system. This is no easy task but one worthy of intense effort.

These Project Apollo problems cover a large part of what is now known as "Space Technology." Solutions will without doubt contribute markedly to the general store of technological information and capability, and their effects will be felt in many fields outside the realm of space projects.

Thus, with the United States standing on the threshold of the end of the beginning -- manned orbital flight through Project Mercury, exploration of space comes of age. Although this Mercury step was not well understood in some scientific and technical circles when born less than four years ago, more and more scientific people are believing that it was a wise move and that it has already paid many dividends.

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With manned lunar landings recognized by the President as a national goal, agreement in opinion within the scientific community is at a new high. Differing opinions regarding which steps to take first will naturally work for more healthful technical growth rather than for hindrance.

Another extremely important factor almost on the same level with technical competence is national will. In addition to backing the best that scientific minds can produce to carry out these programs effectively, each citizen shares the burden of developing and expressing national will.

Scientists naturally and necessarily look to the people -- as well as to the scientific, engineering and technical fraternity -- for support in their vital areas so that they can proceed at a pace limited only by their technical competence.

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS
FOR RELEASE: JANUARY 1962

FACT SHEET

LIQUID PROPELLANT ROCKET ENGINES

A semitechnical discussion of the design,
operation and performance of large liquid rockets

LIQUID PROPELLANT MOTORS

A rocket engine is a device to convert chemical energy into kinetic energy and thus produce a propulsive effect or thrust. Both the internal combustion engine in an automobile and the gas turbine in a jet aircraft actually meet these definitions.

In the automobile engine, however, air is taken into the cylinders and used to burn the fuel. The energy released is then transmitted through the transmission to the rear wheels as shaft power. In the gas turbine engine, air is again takenin to burn the fuel, but here the resultant gases are expelled in the form of a high velocity jet, and the propulsive effect is obtained by the reaction of this jet.

The rocket engine is similar to the gas turbine insofar as it is a reaction device, but it differs from both the gas turbine and the reciprocating engine in that it does not take in any atmospheric air, but instead carries all its means of propulsion within itself.

This then is the most important thing to know about a rocket engine. It not only carries its fuel, but in some form of chemical, it also carries the oxygen with which to burn the fuel. For this reason, a rocket engine is to all intents and purposes unaffected by its environment and can successfully operates at high altitudes where the air is very thin, or out in space where there is no air at all.

As an analogy, let us consider a man in a boat on a canal and assume that he is propelling the boat by throwing bricks backward over the stern. The bricks then correspond to the stream of gases being discharged from a gas turbine or rocket engine. Now the bricks could be distributed in a row along the edge of the canal with the man picking them up and throwing them backward as he goes along. This is like the gas turbine in which air, corresponding to the bricks, is taken in all the time. You will note that when the supply of bricks ends the man cannot propel the boat any further by this means.

Now let us consider the other case of the man having a pile of bricks in the boat with him instead of along the bank of the canal. Now he can propel the boat quite independently of his surrondings. This corresponds to the use of rocket propulsion, but you should note that in this case the boat initially is far m ore heavily loaded. By analogy, therefore, while it is independent of its surrondings, a rocket engine has to be fed with far more chemicals than the gas turbine has to be fed with fuel. This fact alone generally confines the use of rocket engines to rather short periods of operation.

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Thrust Generation

Let us now consider in more detail how the rocket engine produces its thrust. Consider a sealed pressure vessel such as a balloon, the neck of which has been securely tied. The pressure in the balloon acts uniformly in all directions, and consequently there is no force trying to make the balloon move one way or another. If we now suddenly open the neck of the balloon, we find that, as indeed one would expect, the air rushes out and propels the balloon in the opposite direction. This has been caused by the pressures inside the balloon being modified as the air rushes out, giving an unbalanced force.

There is another way of looking at the generation of this force by using Newton's Laws of Motion. As the air accelerates through the aperture, a force has to be applied to it to give it its increasing velocity. To every action we know, there must be an equal opposite reaction that propels the balloon. The balloon is indeed a very simple form of rocket engine combustion chamber, but as you can imagine it is too crude for any practical use. To begin with, the energy it contains is too small to produce any really worthwhile thrust. Secondly, the conversion of pressure energy of the air in the balloon to kinetic energy of the air leaving the balloon is very inefficient. Finally, there is no way of continuously recharging the balloon so that it goes on propelling itself for any length of time.

These limitations can be overcome in the combustion chamber of a rocket engine. To overcome the very short and relatively explosive nature of the balloon's behavior, chemicals can be continuously fed into the combustion chamber where they burn without interruption, generating a steady supply of gas. If the chemicals are liquids, they can conveniently be injected into the chamber under pressure, and as a great deal of the heat is generated in the combustion process a large amount of high temperature, high pressure gas is formed.

Liquid Propellants

The chemicals used are known as propellants, and these are generally divided into two sorts. There are oxidants which contain oxygen or an oxidizing component, and fuels which burn the oxidants, releasing energy in the process. There are a number of advantages in using liquid propellants in a rocket engine. To begin with, it makes it possible to vary the thrust by varying the flow of propellants into the chamber. Furthermore, by suitable design it is possible to cut the flow completely, so stopping the rocket engine, and then to restart it again later, perhaps a large number of times. In addition, one of the propellants can be used as a coolant to keep the combustion chamber at a reasonable temperature.

Modern liquid propellants will be needed for our more ambitious journeys into space because they are the only substances known to contain enough available chemical energy. Here, for the purposes of comparison, is a brief word about solid propellant rockets. Solids are generally much simpler than liquids and usually cost less to produce, but it is difficult to control and to terminate their thrust. Also, their burning time is short; therefore, less total thrust is produced and, generally speaking, the performance of solid propellants is less than that of the best liquids.

Let's now consider some of the chemicals used as propellants for liquid engines. These can be broadly divided into three categories. First, there are those which do not ignite spontaneously when they mix. Consequently, some sort of igniting device, such as a firework or a spark plug, has to be provided in the combustion chamber to initiate combustion. Once this is done, the propellants will go on burning together for as long as they are injected. In this category are the oxidants: liquid oxygen, nitric acid, or hydrogen peroxide, when burned, for example, with petrol or paraffin.

In the next category come the propellants which ignite spontaneously when they are brought together; for these, therefore, no igniting device is needed. These are called "hypergolics" and include nitric acid with analine or hydorgen peroxide with hydrazine. The Titan II, which will launch NASA's two-man spacecraft, uses hypergolic fuels. Self-igniting propellants simplify the combustion chamber and generally lead to smooth combustion, but they do impose the risk of fire should they accidentally mix outside the combustion chamber.

In the last category we have the monopropellants, chemicals which can be burned and decomposed on their own to form a sufficiently large quantity of gas. Hydrogen peroxide by decomposition comes into this category -- the chemical which, incidentally, is used in the reaction control system of the X-15 and Mercury spacecraft.

Generally speaking, of monopropellants are safe to store and handle, they do not contain enough energy to give them a worthwhile performance. On the other hand, if they are sufficiently energetic, they usually impose difficult safety problems.

The choice of propellants is invariably a matter of compromise to suit the particular application being considered. Of the oxidants, liquid oxygen is widely used for large space vehicles, mainly because it gives high performance, is cheap, and is fairly easy to handle. Nitric acid has been used for small vehicles, because like liquid oxygen it is cheap; although unlike liquid oxygen, it has a low boiling point, and therefore it cannot be stored for long periods of time even in sealed containers. Hydrogen peroxide has been used for rocket engines in manned aircraft mainly because it can be decomposed before injection into the combustion chamber; this feature leads to a safe system and facilitates the variable thrust requirement and the need for repeated use.

Of the fuels, petrol and paraffin are widely used because of their familiarity and availability. All the propellant combinations so far described burn at temperatures between 2,000° and 3,500° C, giving exhaust velocities varying from 6,000 to 8,000 feet per second.

There are, however, a number of other propellants which, because of the improved performance they give and other characteristics they possess, are also now in use. One which should receive particular note is the liquid hydrogen/liquid oxygen (LOX) combination. With the exception of fluorine and hydrogen, this combination gives the highest possible exhaust velocity, namely about 11,000 feet per second, and consequently is likely to be quite widely used in future space exploration. The 1.5 million-pound thrust F-1 -- to be used in the Saturn and NOVA programs -- is a hyrdogen-type engine.

The Nuclear Rocket Engine

Liquid hydrogen by itself has another interest. It is a very suitable propellant for a nuclear rocket engine which does not rely on the release of chemical energy, but instead heats all its working fluid using the energy of an atomic pile. Since no chemical reaction is involved, there is a greater freedom in choosing the working fluid; and since in the nuclear rocket, as well as in the chemical one, exhaust velocity depends on molecular weight, you will appreciate why hydrogen is a suitable propellant. Using it and heating it up to as high a temperature as we can imagine an atomic pile working, exhaust velocities can be obtained which are three or four times greater than those possible by the best chemical rockets. This really means that the nuclear rocket will consume far less propellant, and this will have a great effect on the practicability of many space missions. In fact, there are many such missions quite impossible with chemical rockets, which could only be accomplished using nuclear propulsion of this type.

In conclusion, it might be in order to list the broad requirements of a large liquid propellant engine and the particular difficulties which face the rocket engineer. To begin with, the rocket's pumps must be capable of instantly supplying propellant to the combustion chamber under pressure, and then continue to supply it without fluctuation or interruption. Next, the entire propulsion system, including the pumps and valves, must be completely leak proof, in spite of the high pressures and generally corrosive, often freezing cold. All the valves must be capable of instantaneous and positive action whenever they are called upon to do so.

Important also is the injector system which feeds propellants into the combustion chamber. It must permit a smooth start and insure that the propellants continue to burn steadily thereafter, for any propellant which leaves the combustion chamber unburned, is not making its full contribution to the efficiency of the engine. More important, a poorly designed injection system could set up pressure fluctuations in the chamber which could ultimately lead to complete failure.

Finally, the chamber must be kept sufficiently cool to allow the engine to perform its task. The temperature in the combustion chambers of most rocket engines runs 3,000° C, which is about 1,500° higher than the melting point of the materials from which it is made. Such temperatures can be tolerated only by continuous cooling of the chamber in rather the same way that water is used to cool the engine of a car. Water cooling would not be practical, however. In a rocket engine, it is necessary to use one of the propellants for cooling, circulating it around the outside of the combustion chamber before it is injected into the chamber and burned. The problem of heat balance through the chamber wall into the coolant is a critical one, the solution of which demands great care and ingenuity.

As you can see, the rocket engine contains a number of challenging problems. These have not yet been entirely solved, even for the present generation of engines; the use of more energetic chemicals necessitated by the need for improved performance will bring new problems in its train.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

IN REPLY REFER TO:

FOR RELEASE: JUNE 18, 1962

PRESS RELEASE

WEBB DISCUSSES GOVERNMENT'S ROLE IN SCIENTIFIC EXPLORATION

In an address to the second National Conference on the Peaceful Uses of Space, held recently in Seattle, Wash., James E. Webb, Administrator of the National Aeronautics and Space Administration, said that only the government was capable of marshalling the resources and finances required for major scientific efforts.

Discussing the government's role in scientific exploration, Webb noted that "major scientific advances today require group efforts, expensive equipment, and massive technological support, often over many years of sustained effort. Only the government can marshal the resources and finance such endeavors."

Webb pointed out, however, that the "question of science and public policy does not end with the recognition of Federal responsibility." In addition to this recognition, and of equal importance, is the "determination of how the government shall carry out its responsibilities; how it apportions the work between industry, government laboratories and educational institutions; how the views of the scientific community are taken into account; how the traditional independence of the university professor, researcher and student are to be safe-guarded; how national goals are to be established and achieved."

Webb described the complexity of coordinating the work of the government agencies themselves with industry, educational institutions and public service foundations. He emphasized the fact that only the national government could successfully blend together "this complex of individuals, groups and organizations."

Not all national scientific efforts are directly related to the military and national defense, Webb said. For instance, three of the primary objectives of the NASA deal specifically with areas of scientific development and human welfare, and only one of the objectives is concerned with defense.

Webb listed the four objectives established for NASA by the National Aeronautics and Space Act of 1958: "To conduct scientific exploration of space; to conduct manned exploration of space; to apply space science and technology to the development of earth satellites for peaceful purposes, to promote human welfare; and to develop space science and technology in the interests of the national defense."

The NASA administrator also described the problems of a national scientific effort. Because all finances for the program must be appropriated by Congress, anticipated expenditures must be filed with Congress a year in advance.

Webb explained that it is often difficult to accurately predict expenditures and plans in a program as rapidly changing as that of manned space exploration.

However, he said that Congress has been particularly understanding of NASA's difficulties in this area. He said he believes that the attitude of most members of Congress toward the space program is "akin to that once expressed by Teddy Roosevelt, speaking of the Panama Canal: 'Instead of debating a half-century before building the canal,' Roosevelt said, 'better to build the canal and debate me for a half-century afterward...Push the work rapidly and at the same time with safety and thoroughness.'"

"We like to feel," Webb concluded, "that these words would be applied as well to the program in which we are now engaged."

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

IN REPLY REFER TO:

FOR RELEASE: JUNE 18, 1962

PRESS RELEASE

WEBB DISCUSSES BENEFITS OF SPACE AGE TECHNOLOGY

James E. Webb, Administrator of the National Aeronautics and Space Administration, told a conference of the Oregon Department of Planning and Development in Portland recently that "it is the spirit of the frontier which is needed everywhere today to meet the problems which we all confront."

He emphasized the role of the Space Agency in combating these problems, not only in the field of space research but in areas of practical benefits to the nation as well.

Webb listed three major benefits which will come from space research.

"We will put satellites to work on a global basis to report the weather, transmit message and worldwide television programs and to serve as electronic lighthouses in the sky.

"In pushing our space program, we are making many technological advances which can be utilized to improve industrial processes and raise our standard of living.

"The money we spend on space activities stimulates business in general, and industrial pioneering in particular."

Webb said he feels certain that "the technological activity generated by the space program, the thinking devoted to new concepts and new ways of doing things, will permeate the entire economy."

The NASA Administrator said also that the greatest achievement in the space program is not a future landing on the moon but is the accomplished "creation of a truly national effort for mobilizing large resources of scientific knowledge and advanced technology to achieve clearly defined national goals."

However, before these goals can be reached, Webb explained, "our country needs greatly increased numbers of graduates in science and engineering."

Webb described NASA'S program to aid in the increase of trained technical personnel. "In the first year of this new program, each of the first ten universities selected will train ten students who are working toward their doctor's degrees. Students chosen will receive stipends of $2400 a year for 12 months' study, and expense allowances of up to $1000 a year. The universities will be reimbursed for tuition, fees and other expenses involved."

He said that NASA plans to expand this program in the future, after its value has been estimated.

Webb said that although NASA has initiated most of the work in America's space program, no one really knows what the impact of the space age will be on American life. He stressed that only through education can the nation keep abreast of the space age and be able to take full advantage of its technology and advancements.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

IN REPLY REFER TO:

PRESS RELEASE FOR RELEASE: June 28, 1962

WEBB SPEAKS AT SHIRO, INAUGURATION
IN NEW ORLEANS

James E. Webb, Administrator of the National Aeronautics and Space Administration, in an address at the inaugural dinner for New Orleans mayor Shiro, described the work of NASA in the space program and discussed the new NASA facilities in the New Orleans area.

Webb outlined the types and uses of the various rockets which NASA is employing as launch vehicles. He paid particular attention to the Advanced Saturn, which will be capable of placing a 100-ton payload in earth orbit, and the Nova, which will be able to launch a 75-ton payload to the moon.

Both of these heavy boosters will be under development in the new construction facilities at Michoud near New Orleans, and the Mississippi Test Facilities, about 35 miles northeast of New Orleans.

"The Advanced Saturn," Webb continued, "and possibly Nova, will be assembled at Michoud. Subsequently, the vehicles will receive their static testing at the Mississippi Test Facility, before being transported to Cape Canaveral for flight testing."

Webb explained that these new NASA sites, along with the Manned Spacecraft Center in Houston, were chosen with "the availability of water transportation in mind, since these very large vehicles cannot be satisfactorily transported by any other means."

Webb reminded his audience that, although the nation has certain specific goals in space exploration, "the overriding concept underlying this program is that of driving forward the advancing front of science and technology at the most rapid rate possible over the years ahead and making practical use of the results in space, and throughout our economy."

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

IN REPLY REFER TO

PRESS RELEASE FOR RELEASE: JUNE 28, 1962

NEWELL PRESENTS PAPER ON SPACE SCIENCE
AT CONFERENCE IN SEATTLE, WASH.

In a statement to the second National Conference on the Peaceful Uses of Space, in Seattle, Wash., Homer E. Newell, Director, Office of Space Sciences, National Aeronautics and Space Administration, discussed the importance of the various fields of science in relation to manned space flight.

He emphasized the fact that the science of space exploration is inseparable from the other scientific fields, such as astronomy, physics, chemistry and biosciences.

"Scientific disciplines," Newell explained, "that heretofore had gone their separate ways with only mild interaction, now tackle in close partnership the problem of understanding the phenomena and properties of outer space."

Using slides to illustrate his talk, Newell discussed the various areas of scientific study which provide information for manned space flight exploration. Satellite probes, he said, provide valuable information on the upper reaches of the atmosphere, the earth's magnetic field, and the Van Allen radiation belts.

Through satellite observation of the many types of radiations in space, much can be learned to make manned space flight safer, Newell explained.

Newell listed the various NASA projects for investigating outer space. Among these are the current Ranger and proposed Surveyor and Prospector for lunar study; the Mariner and Voyager to study the planets; the Explorers and orbiting geophysical observatories for investigation of the earth; and orbiting solar and astronomical observatories for study of the sun and stars

Newell explained that the "NASA program of space science is basic research. Its principal objective is the advancement of knowledge."

Newell continued, "The space science of today is needed to sow the seeds for the harvest of future applications of space knowledge and technology. The weather, communications and navigational satellites of today grew out of the scientific engineering of the past decades. Their perfection and the development of new applications, will rest upon the space science of today and the years to come."

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

IN REPLY REFER TO:

PRESS RELEASE FOR RELEASE: JUNE 28, 1962

WEBB TELLS WILKES COLLEGE GRADUATES
OF RAPID TECHNOLOGICAL ADVANCES

James E. Webb, Administrator of the National Aeronautics and Space Administration, in a recent address to the graduating class of Wilkes College, Wilkes-Barre, Penn., said that "We live in a period of scientific progress which is providing us with new knowledge, new processes and new materials at an unprecedented rate."

Webb noted that the scientific ideas and theories of only a few years ago have today become a reality. To illustrate this, he mentioned an address he gave in 1957, in which he quoted James S. McDonnell, president of McDonnell Aircraft Corporation, as saying that manned orbital space flight could be anticipated by 1990. Webb explained that at that time, McDonnell's estimate was considered fairly accurate.

"The geometric progression of accomplishment in scientific research and technology," Webb told the graduates, "will be the dominant feature of your lives. Unlike your forebears, you will never have the opportunity to become fully adjusted to the world as you know it before you have thrust upon you ... new methods and new products which will change the way you live."

Webb emphasized that space exploration is not the only scientific field undergoing rapid change and progression. He said that this is true of all areas of science as well as of all areas of knowledge

He also said that, while it is in
men and women for work in the space pr
concentrate on so-called "space scienc
basic educational efforts in both the

"Our space program," he continued
expense of progress in other research
a stimulus for them. This is as it sh
exploration must be an integral part c
fields of human knowledge."

WEBB, James E., NASA Administrator

GOVERNMENT'S ROLE IN SCIENTIFIC EXPLORATION

Press Release dated June 18, 1962

Webb explained, "Just as the non-science student should have a basic understanding of science and technology as they affect society, so should the science or engineering major be afforded the opportunity to develop an appreciation of the social sciences, arts and humanities."

Webb concluded his speech with a quotation from an ancient Chinese philosopher speaking to the young people of his time, "May you live in interesting times." He added, "May you also have the will to believe in yourselves, and the imagination and the initiative to benefit from and contribute to the age of science and technology in which we live."

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

FOR RELEASE: IMMEDIATE RELEASE
11 July 1962

NEWS CONFERENCE

NASA OUTLINES APOLLO PLANS

PARTICIPANTS:

MR. JAMES E. WEBB, Administrator, NASA.

DR. ROBERT C. SEAMANS, JR., Associate Administrator, NASA

DR. D. BRAINERD HOLMES, Director, Office of Manned Space Flight, NASA.

DR. JOSEPH F. SHEA, Deputy Director of Systems, Office of Manned Space Flight, NASA.

DR. C. H. ROADMAN, Director, Aerospace Medicine, Office of Manned Space Flight, NASA

MR. PAUL P. HANEY, Chief of News Division, Office of Public Services and Information, NASA.

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HANEY: Ladies and gentlemen, may we have your attention, please.

Mr. Webb.

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

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 remained 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.

SEAMANS: Before discussing the lunar-orbit Rendezvous with you a little bit, I would like to also bring --

WEBB: Let me break in one minute and say that I forgot something very important.

Dr. Seamans has just returned from a period of service with the Chairman of the Senate Committee on astronautical and space sciences and has served with the Chairman there to answer any questions that might be pro-pounded in the Senate. As a result of this very fine endeavor by Dr. Seamans and the Chairman and their associates we have a unanimous vote of the Senate approving the 1963 authorization bill for this Agency, just voted this afternoon. I think this is a worthwhile endeavor.

Dr. Seamans, it is interesting, comes right from that endeavor to meet with you.

SEAMANS: I want to refer our second release to your attention, namely, the new assignment for Major Deke Slayton. As you know, there has been a considerable question about Major Slayton's ability to carry out the orbital flights because of an arterial or atrial fibrillation. We felt that before making a final determination we wanted to have one of the great cardiologists in this country review the case in depth, namely, Dr. Paul White.

Dr. White has had available to him all of the medical information that we have, not only on Major Slayton but also on Astronauts Glenn and Carpenter, both before and during their flights. It is his considered judgment that we should not at this time consider Major Slayton for a flight in the Mercury program. However, because of Major Slayton's very great capabilities, and because of his interest in the program, because of his experience in the program, we are very gratified that he is interested in continuing with the Manned Spacecraft Center in this new assignment.

QUESTION: What are his new duties, Dr. Seamans?

SEAMANS: His new duties have to do with operational and planning responsibilities. The exact nature of his duties, as well as his new title, will be announced at a later date by Dr. Gilruth.

QUESTION: There are now six astronauts, then?

SEAMANS: There are now six astronauts in flying status.

Moving on to the Apollo program, I would like to say a few words and then turn the meeting over to those who will discuss the matter with you in depth.

I would like to first 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 that time, that is, in the following December and January months, NASA was carefully considering manned flight 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. Golovin and Kavanaugh, 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 earth-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 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 to at the same time 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.

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 and Dr. von Braun, and also utilizing the skills of Dr. Debus 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.

HOLMES: 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 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 everyone 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 Dr. Shea and his organization. The largest concentration of support from the NASA centers has been from Marshall Space Flight Center at 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 test this conslusion -- 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 you 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 operational and to offer the most 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 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 the 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 this 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 to the Nova, 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, there 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 penetration, for larger payloads in earth orbit, for larger payloads on the 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 all of them 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 -- 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.

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.

SHEA: 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, F-1C first stage, five J-2 engines, S-2 second stage, and the S-4-B 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-1C 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 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 confortable 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.

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. Bascially, 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.

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 re-entry 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 above to withstand entry Gs so that their normal position is in effect laying on their backs, as 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 then 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 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 moon landing gear? I missed it.

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 bring up propulsion and the long time of operation associated with the systems.

HOLMES: Show them the comparison of the size of the vehicle 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 here, 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 lunar landing vehicle. That should give you a feel for it.

SHEA: Another comparison which is worthwhile 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 talk 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 weighs 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.

In order to do the mission with the C-5 vehicle requires utilzing 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 estimated 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 X-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 then you 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 operating engines and scaling down the spacecraft, it could 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 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 2-½ 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 lunar landing vehicle, 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 lunar landing vehicle 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 lunar landing vehicle 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 excusion 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 and 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 earth 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.

WEBB: Wouldn't you add that it gives us a great deal of opportunity for experiencing environmental chambers on the earth with respect to the various items of equipment, so that we will know a great deal more about the equipment in these smaller units than if we were using the larger ones?

HOLMES: Yes.

QUESTION: Dr. Holmes, does the unanimity on 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.

Mr. Webb?

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 services 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 operations. 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 of 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 fact, 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 that Gemini-type vehicle for a direct ascent, and is there a possibility that this might even beat the lunar landing vehicle?

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: Can we return to Slayton for a minute?

WEBB: Let me say Dr. Charles H. Roadman, Brigadier General of the Air Force, is here with us. He is in charge of these programs in NASA, on duty with us from the Air Force, if you have any specific questions that you want to ask on the medical side.

QUESTION: Not on the medical side. The press release directs the medical conclusions solely at a one-man solo space flight. It mentions nothing else. Is there some inference here that he might go along as part of a two or three-man -- I think in fairness this ought to be straightened out.

WEBB: We are not trying to cross every bridge in the future right now. We are saying that with respect to the one-man missions in Mercury we do not expect to fly Major Slayton, and he understands this. He has been consulted about his own future and about the assignment of duties to him -- he has made his own statement, which you see quoted here -- and he is happy to accept them.

QUESTION: Right. But he has not been ruled out of a two or three-man flight?

WEBB: No, not at this time.

QUESTION: There will be some other decision later on this?

WEBB: Yes.

QUESTION: Deke's status has been up in the air for months and I think in fairness to him we ought to get it as much out as we can.

WEBB: Certainly we are trying to do that just as rapidly as we can. We are proceeding in I think the best way to do it.

At the moment the study has been with respect to his own personal physical condition, and the requirements of the mission, including, as Dr. Seamans stated, the actual records of the Glenn and Carpenter flights. That is as far as we can go right at this time.

Bear in mind that after we get a number of missions safely accomplished, we will know a good deal more about the requirements on the astronauts.

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 forty 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 into 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 a 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 decision 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 American 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, no, 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 break throughs. 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 a redundancy such that if, for instance, in the first rendezvous, the lunar exploratory vehicle 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 lunar exploratory vehicle?

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.

That 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 on-board authorized program. We will try in this logistics vehicle to give a 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 record 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.

ROADMAN: 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 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 possibility of a two-man direct flight mission using a new capsule and the C-5 booster.

QUESTION: Would you make that statement now about Commander Slayton, Mr. Webb?

WEBB: Yes, I will be glad to.

After a very careful examination by authorities in the National Aeronautics and Space Administration, in the Air Force, and by Dr. Paul Dudley White, it has been determined that Major Slayton would not fly on one of the one-man Mercury flights. However, he has been requested to remain in the program in a planning, engineering and a support role. He has agreed to do so. We are very, very happy to have him continue in the program. I think the contributions he will make will be very great.

(Whereupon, at 5:52 p.m., the News Conference was adjourned.)

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

FOR RELEASE: July 11, 1962

NASA OUTLINES APOLLO PLANS

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 (configuration) to accomplish the initial manned lunar landing and recovery, using the lunar orbit rendezvous as the prime mission mode.

2. Request industrial proposals immediately for the development of a lunar landing vehicle spacecraft to be launched on the same launch vehicle 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 spacecraft now under development by the North American Aviation Company.

3. Employ a two-stage Saturn (configuration C-1B) using the present eight-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.

--more--

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 or 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 launch vehicle 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 ten to 15 per cent 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.

At 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-foot tall service module providing mid-course 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 spacecraft and service modules remain 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 spacecraft in lunar orbit. After crew transfer, the lunar landing vehicle would be jettisoned and the command craft 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 rentry.

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 service modules now under development, Earth orbital rendezvous would require the additional development of two propulsion modules weighing about 50 tons -- a lunar braking 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 launch 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 Nova vehicle with a 12 million pound thrust first stage and

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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, Virginia), Launch Operations Center (Cape Canaveral), and the Massachusetts Institute of Technology Instrumentation Laboratory, (Cambridge, Massachusetts).

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

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS
FOR RELEASE:

Talk Presented to The
Tenth Annual Aviation Day
Mason City Chamber of Commerce
July 14, 1962

by

Addison M. Rothrock
Associate Director
Plans and Program Evaluation
National Aeronautics and Space Administration

On July 29, 1958, President Eisenhower signed into law the National Aeronautics and Space Act, and by this action the United States adopted a National Space Policy and created an organization (NASA) to carry out this policy. Of this action Vice President (then Senator) Johnson stated "In the long view of History, possible the most important step that we took during this session (of the Congress) was to establish an Agency to guide America's effort in the exploration of outer space."

A study of the Space Act and the Executive and Congressional documents leading to and following the Act, shows the breadth of influence that both the President and the Congress feel that man's activities in space will have on the future welfare of our nation; and the need, therefore, of an active National Space Program.

I want to discuss this National Program with you, the importance we attribute to it, and what we hope to accomplish by it.

I will try to give you a perspective of the Program as a whole and the manner in which we are carrying out our Government's declaration - "---it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind."[1]

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[1]National Aeronautics and Space Act of 1958.

"What do we mean by Space?" The answer is fairly simple. We mean the universe beyond the atmosphere surrounding our own planet. Using this definition, the scope of space is infinite.

From the dawn of civilization, the answers to the unknowns of space have been sought by man. First, he sought to explain his superstitions and quiet his fears. As he became more knowledgable he sought to satisfy his curiosity, and then sought assistance - in navigation - and in agriculture.

Men have dreamed of going into Space, talked of going into Space, studied Space, and experimented toward Space since time immemorial. There is the biblical account of Elijah's ascent into the heavens -- "behold there appeared a chariot of fire, and horses of fire, --- --- and Elijah went up by a whirlwind into heaven." There are the accounts in Greek mythology of the flights of Daedalus and Icarius and of Phaeton's ill fated attempt to drive the chariot of the Sun.

There were the researches of the Greeks in Egypt and Asia Minor that led to close measurements of the earth's diameter, and the distance of the moon from the earth. There were the contributions from our own Western civilization that explained the travel of the planets in our solar system and added much to our knowledge of the universe beyond our planets.

But although man had learned much of space, man sent no objects into space until on October 4, 1957 the Russian Sputnik was launched into an earth orbit.

Since this first space flight nearly 100 spacecraft have launched into earth or solar orbit. Of these the United States has launch more than seventy and the Russians more than twenty. The total weight Russia has put into space is about twice the United State figure.

Spacecraft of Russian and of United States origin have flown and are flying over most nations of the world and it appears to be established that flight of manned or unmanned spacecraft over a country of different sovereignty than that of the craft does not of itself constitute an unfriendly act. In fact, space flight in earth orbit is impossible without flight over many countries. The situation appears to be evolving that flight in space is analagous to sailing on the high seas.

As of now, military uses of spacecraft appear more limited than military uses of sea or aircraft - in fact, limited to noncombat activities. I can assure you that it is the hope of the United States as expressed in the statements of the President and in the expressions of the Congress that this situation will not change. We must, nevertheless, be prepared to meet other eventualities.

In the present state-of-the-art the same techniques are required to develop space flight systems for (1) scientific research, (2) space exploration, (3) civil applications, and (4) military applications. Essentially, we want spacecraft that will permit us to travel in space with the same relative flexibility and reliability that we now have in our travel on land, sea, or air. We want to be able to do things in space and bring back things from space that will benefit mankind -- either by improving his well being or by protecting his well being, and this protection is from the hazards of nature or the hazards of man. Considering the cost of the program, it is well that this mutuality of requirements exist. They can best be met by a National Space Program.

Of the seventy some spacecraft the United States has launched, four are in orbit around the sun, the others were launched in orbits around the earth.[2] About forty are still in earth orbit. We are receiving information on our universe from a dozen of them. Two of these are transmitting continuous data on our weather. Of those no longer in orbit, more than fifteen were returned to earth on command. Of these the most famous are of course the Friendship VII, piloted by John Glenn, and the Aurora VII, piloted by Scott Carpenter, both of which orbited three times around the earth and were then landed by the pilots. It is a Space Program of which we, as Americans, can be proud.

These United States spacecraft were placed in flight to carry out our National Space Objectives as described in the Space Act. One can summarize these objectives as:

1. Development and operation of spacecraft for manned and unmanned flight into space.

2. Exploration in space with these manned and unmanned spacecraft to gain scientific and engineering knowledge.

3. Application of the results of this space exploration to the general welfare of mankind and to the protection of our national interests.

LEGISLATIVE PRECEDENTS TO THE SPACE ACT

Enactment by the United States government of legislation for governmental support of science and technology (of which space flight is a part) is not new; but creation of a governmental research and development organization of the size and scope of NASA is new.

Over previous years, these enactments of legislation supporting science and technology have been many. These acts are in line with the preamble to the

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[2]Spacecraft orbiting the earth are frequently referred as to "earth satellites" or simply "satellites."

Constitution of the United States. The preamble lists five objectives for which the Constitution is ordained. The third and fourth of these are to "provide for the common defense" and to "promote the general Welfare." Legislation relating to science and technology comes under these two provisions. And while the preamble to the Constitution does not provide a source of power for the Federal Government, it does, quoting from Joseph Story, "expound the nature and extent and application of (these) powers."

In carrying out these Federal powers in relation to science and engineering, we have, as an early example, the establishment of the National Academy of Sciences in 1863 which "--- --- shall, whenever called upon by --- --- the Government investigate, examine, experiment, and report on any subject of science or art --- ---." We have the establishment of the research bureaus in the various Government Departments. We have the establishment of the National Advisory Committee for Aeronautics (since absorbed into NASA) in 1915; the establishment of the National Institute of Health in 1930.

Following World War II we have the passage of the Atomic Energy Act of 1946 establishing the Atomic Energy Commission. The Atomic Energy Act was unique in that there was now created a government organization to develop a great natural resource - atomic energy - in which government funding and management was to be used because of (1) the general political implications, (2) the uniqueness of the military applications, and (3) because the general welfare uses were not sufficiently clear to justify development by private capital.

In 1950 the Act establishing the National Science Foundation was passed. The Foundation was set up "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the science" and "appraise the impact of research upon industrial development and upon the general welfare" and so advance the national health, prosperity and welfare, and secure the national defense.

We see through these Acts a general broadening of the sense of responsibility of the Federal Government in the fields of science and technology, first with emphasis on the "common defense" and as time proceeds and our general industrial growth as well as our national defense became increasingly dependent on science and technology an increased emphasis on the "general welfare" objectives.

The National Space Act presents therefore a continuation of an established government policy. However, activities in space require an additional consideration -- that is a broad coverage in regard to international cooperation. Space activities to be most effective require international cooperation in a sense not previously demanded in science and technology - in the fields of communicating with and issuing commands to our spacecraft. And as in all science, to be most effective in benefiting man, there must be international interchange of scientific information. The Space Act lists therefore as one of eight objectives "cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful applications of the results thereof."

OUR NATIONAL SPACE PROGRAM

Our Space Program to achieve our national space objectives can be divided into three parts:

1. Manned Space Flight

2. Scientific Investigations in Space

3. Applications Resulting From Space Investigations

In relation to manned space flight and applications from space investigation, President Kennedy in a Special Message to the Congress (May 25, 1961) recommended specific national goals:

1. To, within this decade, land a man on the moon and return him safely to earth.

2. To accelerate the development and use of space satellites for world communications.

3. To achieve at the earliest possible time a satellite system for worldwide weather observation.

Manned Space Flight

In exploration of space, dramatic "firsts" have been accomplished before it was possible to put man in space. For this reason the need of man in space was at first questioned. Since World War II our ability to measure and record by automation and remote control has increased at an unprecedented rate. However, no instrument or machine that man has developed or is developing approaches by orders of magnitude the ability of the human brain for on-the-spot interpretation of objects and events that respond to the human senses. One can read all information available on the Grand Canyon, Niagara Falls,, the Berlin Wall, but to get the full significance of each of them, one must go and see. No instrument could have discovered the Dead Sea Scrolls.

We know that man's current standard of living could not have been approached by orders of magnitude had he not developed transportation systems to explore, utilize, and occupy the surface of the earth and the atmosphere above the earth. Until the various places had been occupied by man and adequate travel to and from them developed, it was impossible to predict or realize their benefits. We presume the same is true of space. Of the NASA program, about two-thirds the effort is in manned space flight.

Our National Manned Space Flight Program consists currently of four phases:

1. Project Mercury and one-day manned flight to determine man's ability to function in space for periods up to one day and to develop manned spacecraft technology.

2. Project Gemini - to develop spacecraft rendezvous techniques and to extend man's functioning in space to periods of one or two weeks.

3. Project Dyna-Soar - to develop a manned spacecraft suitable for maneuverable reentry into the earth's atmosphere and suitable for controlled landing at an air field selected by the pilot.

4. Project Apollo - to develop and operate a manned space flight system suitable for landing men and supplies on the moon and returning them to the earth.

Mercury, Gemini, and Apollo are NASA programs. Dyna-Soar is a joint USAF-NASA program financed and administered by the Air Force. In all four phases,NASA or Department of Defense facilities are used as appropriate.

The most ambitious of these phases is of course the Apollo program to land men on the moon. In rèlation to landing man on the moon, President Kennedy stated: "No single space project in this period will be more exciting, or more impressive, or more important for the long range exploration of space; ---".[3] In passing the appropriate authorization and appropriation legislation the Congress accepted the President's recommendation.

In preparing for the actual moon landings, the Apollo crew will pilot sections of the spacecraft in earth orbital flights and exploratory flights to the vicinity of the moon including circumlunar flights and flights into lunar orbit. In these flights the crew will perfect their techniques for deep space navigation and spacecraft operation.

Our schedule calls for the earth orbital flights in the 1964-65 period, the circumlunar and lunar orbital flights about 1966, and the manned moon landing before 1970.

(Beyond Project Apollo)

If we are successful in these plans we will have developed by 1970 space flight systems and space flight techniques to permit the use of manned spacecraft to:

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[3]Special Message to Congress, May 25, 1961.

1. Remain in earth or lunar orbit for considerable periods of time.

2. Rendezvous and dock in orbit and so provide logistic support for earth or lunar orbiting spacecraft.

3. Return to earth for a normal landing at a choice of air fields.

4. Fly to the moon, land, and return to earth.

In the next decade or towards the end of this decade we will start the manned exploration and use of the moon and the use of manned spacecraft to further our science programs and our application programs (civil or military). Does this seem unreal? Four and a half years ago man had sent nothing into space other than light and radio waves.

Scientific Investigations in Space

Much has been said on the reasons for and the advantages that will accrue from our use of spacecraft o increase our knowledge - knowledge in the basic sciences - physical and life - those studies we conduct to increase our understanding of the universe and of life itself. Certainly, this understanding is one measure of our culture. And man's advance in this culture is a major factor in determining his general welfare.

By sending instruments aloft in spacecraft we accomplish three things. (1)We need not make our measurements through the veil of the earth's atmosphere. (2) We place our instruments at the place the phenomena is occurring as was done in the discovery of the Van Allen belt. (3) We can conduct experiments in zero gravity and "perfect" vacuum, and under radiation bombardments not available on earth.

It is in this field of scientific spacecraft that results have appeared most rapidly as we entered the space race. As examples: There is the discovery of the Van Allen radiation belt surrounding much of the earth at altitudes above 300 miles; there is the mapping of the earth's magnetic fields; the discovery of the slightly pear shape of the earth; new insights into the earth's heat balance; determination of effects of the sun on our atmosphere.

We have recently launched an earth Orbiting Solar Observatory (OSO). The instruments it carries are pointed at the Center of the sun, and for four months continuously recorded for us more than a dozen sets of sun measurements. The information collected was "played back" on ground command as the craft flew over our ground stations. During this year (1962) and next (1963) we hope to launch six of these observatories as well as two earth observatories to help us determine the sun-earth relationship.

We have hit the moon with the Ranger spacecraft. We hope this year to lanch a second instrumented Ranger on the moon. This experiment is scheduled to be followed in 1964 by the Surveyor Spacecraft which will soft land several hundred pounds of instruments (including TV cameras) on the moon and which will also be flown into low altitude orbits around the moon. These exploration are a prelude to the manned moon landings.

We will send our science spacecraft to the planets, first to Venus and Mars to circle and then to land, then to the more distant planets and finally to leave our solar system.

Our exploration of the planets is scheduled to start this year with a Venus fly-by. The spacecraft is scheduled to be launched into a solar orbit so as to pass within 25,000 miles of Venus, focus its instruments on Venus and radio the information back to earth. By 1964 we hope to fly a craft to Mars and discharge a small capsule into the Martian atmosphere.

In these science flights we will search for extra-terrestrial life -- the most exciting of our knowledge quests.

If our abilities in manned flight increase sufficiently, we will extend man's direct participation to these planetary explorations.

International Cooperation

In our space science programs we draw extensively on scientific talent from home and abroad. Several foreign countries are supplying instruments and spacecraft which we are launching. Many nations are taking part in operating the world-wide ground stations which receive our Space information and track our spacecraft.

Applications

By Applications Spacecraft, I refer to satellites that play a direct part in our daily lives. We have launched and will launch satellites for activities in meteorology, communications, navigation, and geodetic survey.

(Meteorological Spacecraft)

The NASA meteorological satellites, Tiros I through V, have played and are playing an immediate part in our daily lives. Tiros I was launched on April 1, 1960, and for the first time we were able to look at the weather from outer space, to determine on a gross scale the location and interrelation of cloud systems, the nature of the cloud patterns, how storms so located are moving, and in what manner they are changing.

The Tiros spacecraft represent early development meteorological satellites flown to perfect instruments and techniques rather than to provide actual weather forecasting data. For instance Tiros points its camera at the earth for only part of each orbit. Nevertheless the results obtained with Tiros have proved so useful that they are fed into our weather forecasting system and the schedule of Tiros launchings has been increased to provide continuous operation of Tiros spacecraft for weather information.

Tiros satellites will be succeeded by the Nimbus series which we hope to have in operation by 1963. Nimbus is an improvement over Tiros in that Nimbus will always point its camera earthward, giving continous recordings on the weather. Since Nimbus will be launched in an approximately polar orbit, it will give complete global coverage. Our data to date indicate that had Nimbus been operational there would have been advanced warnings of the weather and seas that devastated the East Coast last March (1962).

(Communications Spacecraft)

We come now to communications spacecraft. In a sense all the spacecraft that we have launched to date have been communications spacecraft. They received information from space and transmitted this information to earth. The information has come from the sun, from the outer reaches of our galactic system, from the planets and from the earth itself. The information is received by the spacecraft in the form of electromagentic radiations (that is light or radio waves). With three spacecraft, Score, Echo, and Courier the radiations received were man generated originating from voice or photographs or TV. The Score spacecraft, launched December 19, 1958, received from a ground station and on command transmitted to ground receiving stations a Christmas message from President Eisenhower. With Echo I, launched August 12, 1960, "messages" consisting of voice, photographs, and TV have been transmitted from earth stations to Echo reflected off the spacecraft and so transmitted to ground receiving stations. These spacecraft are the forerunners of world-wide telephone and television spacecraft communications systems. We term these Communication Satellites.

What is the requirement for such systems? Every country in Europe has TV service. India has TV service and television is the fastest growing industry in Japan. All bust three countries in South America have TV. TV services are available in Nigeria, Iraq, Cyprus, and Lebanon. The average number of viewers in Hong Kong is 20 per set, in Portugal, 25.

Looking to economic expansion in the underdeveloped countries as a whole, trans-world communications by spacecraft will give an expansion through flexibility that is not possible with undersea cables. Of the political-social-economic results from world-wide television I will not comment other than to say that such television is coming and we must use it to benefit the cause of freedom.

A single communications satellite could provide five times the present telephone voice capacity between the United States and Europe plus three TV channels. The NASA is conducting research in support of this kind of satellite world-wide communications system.

The first active communications spacecraft launched by the United States will be Telstar, a private development venture of the American Telegraph and Telephone Company. Two launchings are scheduled for 1962 with the spacecraft placed in a 500 to 3000 mile orbit. The NASA will be responsible for the launching, tracking, and certain data reception and processing (with reimbursement of costs by AT&T). England and France will take part in this program. With the first Telstar launched we hope to demonstrate experimentally trans-Atlantic live TV.

The NASA will conduct tests with two active system, Relay and Syncom. Relay is a medium altitude research and development system to be flown in tests during 1962 and 1963. It will have capacity for one TV channel. The experiment will involve United States, Great Britain, Germany, Brazil, France, and Italy.

Syncom (schedule for a late 1963 launching) is an advance over Telstar and Relay in that it is to be launched into a so called "24 hour" orbit -- that is an orbit at such an altitude and such an angle that the satellite appears stationary from the earth's surface and can therefore be used for continuous 24 hour service.

Based on the results from these various programs we will proceed with the development of operational systems for trans-world telephone and television. We hope to have a system in operation within the next five years. The extent of the first operations will depend on the success we have with Telstar, Relay, and Syncom.

(Navigational and Geodetic Survey Spacecraft)

Development of navigational spacecraft is being conducted by the Department of Defense and by NASA. The Department of Defense navigation system (Transit) is progressing on a schedule calling for world-wide fleet operational use by the end of this year (1962). Three development navigational spacecraft were launched in 1961.

Use of spacecraft for geodetic surveys is being investigated by the Department of Defense in Project ANNA which has recently been declassified. The ANNA spacecraft is scheduled to be launched in the near future. International cooperation is being sought on this project which will permit more precise determinations of the shape of the earth and of locations of places on the earth.

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CLOSE

In accepting the gauntlet of the space race we are undertaking a great national effort -- an effort which will improve the technological capabilities of a large sector of our population. Men cannot effectively work on the space challenge without developing their intellects and their capabilities to the limit. And as a result of this development we will develop many things that will inevitably better our lives and so better us. And as a result our Space effort will improve our standards of life as well as our standards of living.

This, then, is our space program -- our objectives and our goals -- our accomplishments and our hopes. Quoting again from the President -----

> "This is a new ocean and I believe the United States must sail on it and be in a position second to none."

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NEWS RELEASE

NASA MANNED SPACECRAFT CENTER

Houston 1, Texas

FOR RELEASE: July 17, 1962

Address by D. Brainerd Holmes, Director
Office of Manned Space Flight
National Aeronautics and Space Administration
Before the American Rocket Society
Cleveland, Ohio
July 17, 1962

LUNAR ORBITAL RENDEZVOUS FOR APOLLO

I'm sure that everyone in this audience has a keen interest in our recent decision to use the lunar orbital rendezvous approach as the method for accomplishing the first manned landing on the moon and subsequent return to earth. My purpose today, therefore, is to review the technical considerations which led to our selection of the lunar orbital rendezvous mode (LOR), and to describe briefly the mission profile. In such a distinguished gathering I may be hard-pressed to tell you anything you haven't surmised from the stories that have appeared. Nevertheless, I will try to be as informative as possible.

When the Program Office of Manned Space Flight was established last fall, one of the very first problems to which we turned our attention was the selection of a mission mode. It is true that a primary mode, earth orbital rendezvous (EOR), had been tentatively selected, with a direct mission back-up capability in the program. Fortunately, the development work that has been done since then could be handled in such a way as to be consistent not only with this tentative selection, but also with any of the other modes under consideration. However, a firm decision obviously became more and more important with the passing months.

We recognized this need to re-affirm the EOR mode, or select another as quickly as possible, as soon as the Office of Manned Space Flight was established. We also knew, however, that it was absolutely essential to go back and examine in great depth each possibility. We, therefore, assigned this as a priority task to our Office of Systems.

The ensuing study has since occupied a great deal of time and effort in the Office of Manned Space Flight, as well as at the Marshall Space Flight Center in Huntsville and the Manned Spacecraft Center in Houston. Other governmental activities, and a number of industrial concerns, have also contributed time, money, and brainpower. The three proposed Apollo modes which were finally considered in detail were: the direct flight mode, using the Nova launch vehicle; the earth orbital rendezvous mode, requiring separate Saturn launches of a tanker and a manned spacecraft; and the lunar orbital rendezvous mode, requiring Saturn launch of the manned spacecraft and the lunar excursion module.

In the direct flight mode, a three-stage launch vehicle would place a 150,000 pound spacecraft into a $2\frac{1}{2}$ day earth-to-moon trajectory from which the spacecraft would deboost to a lunar orbit for descent to the lunar surface with a touchdown weight of approximately 50,000 pounds. On completion of the lunar stay, the return spacecraft would be launched for injection into a moon-to-earth trajectory designed to permit re-entry of the command module such that landing would occur at a pre-selected point on the earth's surface.

The earth orbital rendezvous, or EOR, mode was studied in several versions. It was evident fairly quickly that a connecting mode, in which the spacecraft and a fueled escape vehicle would separately be put into orbit and then joined, could not be accomplished with a logical split in payload because of the weight of the injection stage. The second alternative, the tanking mode, differed from the direct flight mode principally in its concept of fueling the injection stage while in earth orbit. This maneuver would require rendezvous in earth orbit between an unmanned tanker and a manned Apollo spacecraft, including an unfueled injection stage. Thus the lift-off weight of the manned spacecraft would be reduced by several thousand pounds of cryogenic fuel. After the refueling operation, the injected weight of the manned spacecraft could be the same as for the direct flight mode. Using this mode, the mission could be accomplished with a Saturn-class three-stage launch vehicle, thus avoiding the delays incident to the development of a larger Nova launch vehicle required for the direct flight mode.

In the LOR mode, the injected spacecraft weight would be reduced from 150,000 pounds to approximately 80,000 pounds by eliminating the requirement for the propulsion needed to soft-land the entire spacecraft on the lunar surface. A small lunar landing vehicle would be detached after attaining lunar orbit. The lunar landing vehicle would carry two of the three-man Apollo crew to a soft landing on the moon and would subsequently be launched from the moon to rendezvous with the third crew member in the "mother ship." The entire crew would then return to earth aboard the command module in a manner similar to that described for the direct flight mode.

The choice between these three contenders was not an easy one, nor lightly taken. Each offered substantial benefits which were thoroughly analyzed and carefully weighed. We concluded that LOR offered the greatest assurance of successful accomplishment of the Apollo objectives at the earliest practicable date. In reaching this decision, we studied all available facts, and received the considered judements of many interested groups.

To provide the basis for final selection, we compared the three modes (including five variations of the direct flight mode) in as much detail as our current knowledge of component and subsystem performance would permit. We considered a substantial number of launch vehicle and spacecraft combinations representing a spread of injected spacecraft weights ranging from about 60,000 to 240,000 pounds. The launch vehicles considered were:

a. The Saturn C-5, both with and without engine-out capability and with either two or three burns to orbit;

b. The Saturn C-8 with similar variation in pre-injection profile;

c. The liquid Nova launch vehicle; and

d. The solid Nova.

Spacecraft in-flight propulsion systems considered included various combinations of hypergolic and cryogenic fueled stages, both pump-fed and pressure-fed, to provide the required propulsion for mid-course correction maneuvers, deboost to lunar orbit, descent to and launch from the lunar surface, and escape from the lunar parking orbit for return to earth.

Feasible combinations from this matrix of launch vehicles and spacecraft, supplemented by required systems for guidance, control, communications, tracking, abort operations, and life support, were measured against carefully selected criteria which had evolved from our experience to date and from our analysis of as-yet-unknown factors which might influence the choice. The following order of mode comparison criteria is not necessarily indicative of the criteria discussed.

The capability of each of the three modes for accomplishing the Apollo mission was analyzed, including consideration of the number of men to be placed on the moon, the length of their stay, and the scope and extent of possible lunar surface operations. Under this criterion, EOR and direct flight modes have a slight edge, although there is little difference in he capability of any of the modes to accomplish the gross mission objectives -- to land United States astronauts on the moon and return them safely to earth.

Careful analysis was made of the performance margins offered by each of the modes as currently conceived. This was primarily an analysis of the capability of the proposed propulsion systems to accommodate the conceivable increase in component and system weights as development and testing proceeded. EOR offers the least performance margin, with LOR and direct flight following in that order. This analysis, of course, was quite sensitive to our present ability to estimate component weights, which vary widely at this stage of system design.

The guidance accuracy required of each of the three modes was compared with the general conclusion that presently foreseen technology can readily meet the stringent accuracy requirements of EOR for its earth orbital operations and LOR for its lunar orbital operations. Direct flight requires less precision and, therefore, guidance systems for the direct flight mode would be the simplest.

The communications and tracking requirements were analyzed with a similar conclusion that the direct flight requirements were the simplest to meet, but that communications and tracking for both EOR and LOR are well within projected ground operational support systems capabilities.

The development complexity associated with each of the modes was carefully weighed. EOR requires development of the tanker system, LOX transfer techniques, operation of cryogenic stages in space, rendezvous between manned and unmanned spacecraft, and development of a large lunar touchdown module. LOR uniquely requires the development of rendezvous techniques in lunar orbit, and the development of an additional manned spacecraft, both light in weight and with adequate protection from environmental hazards such as solar radiation and micrometeorite flux. The direct mode requires major launch vehicle development, as well as the use of a cryogenic stage in space, and the large lunar touchdown vehicle as indicated for EOR. The LOR mode appears to offer a sizeable advantage under the criterion of development complexity for the overall system.

A major selection criterion was the probability of mission success, and mission safety. This analysis required a detailed assessment of the reliability of each subsystems as well as of the overall system at each step along the mission profile. While extremely important, it is obviously very difficult to predict reliability for the multiplicity of required subsystems in view of the paucity of statistical data. It is impossible, therefore, to place much credence in the absolute values resulting from such a numbers game, but the relative ratings of the various modes can be assessed. Contrary to most instinctive first impressions, we found that the mission success probability of LOR and direct flight were approximately the same. EOR has only two-thirds the probability of the other modes because of the requirement for multiple C-5 launches. The mission safety probability for all modes was nearly equal, the rendezvous requirements in LOR being roughly equivalent to the problem of landing a larger stage and using cryogenics in space as required for EOR and direct flight.

The over-all mission schedule, both for systems development and operation was, of course, an important consideration. Using a conservative approach, we concluded that LOR can accomplish the lunar landing some months earlier than either EOR or direct flight.

Also of fundamental importance is a relative comparison of Apollo costs as predicted for each of the three modes. Again using conservative forecasts, it appears that costs of the three modes, from design through first successful mission, will be quite close, but that LOR costs will probably be some ten percent less than for either EOR or direct ascent. This results primarily from the less expensive hardware developments involved, and because LOR will require fewer launch vehicles to accomplish the same amount of pre-mission training.

Finally, we considered carefully the growth potential of each of the three modes. We concluded that each would probably require development of a lunar logistic vehicle for full exploitation of the moon's potential benefits. Each mode would result in significant advances in space technology for such areas as earth orbit operations, manned planetary programs, and military applications.

In summary, the schedule advantages, cost advantages, and developmental simplicity of LOR led to its selection as the prime mode. In other areas the technical factors considered did not dictate the selection of one mode over another.

The Apollo objective, using the LOR mode, is to land two of a three-man crew on the moon; sustain them there for at least one day (possibly up to seven) and return them; together with the third crew member, safely to earth. To accomplish this objective will require a spacecraft launch vehicle configuration which will dwarf any we have seen to date. The three-stage Advanced Saturn booster will reach to a height of some 280 feet and will be topped by the spacecraft and ejection tower which reach an additional 75 feet above the booster. The total lift-off weight will be approximately 6 million pounds, for which the Saturn S-IC first stage will provide $7\frac{1}{2}$ million pounds of thrust from five F-1 engines. The S-II second stage will develop 1 million pounds of thrust from five J-2 engines, and a single J-2 engine in the S-IVB stage will provide 200,000 pounds of thrust to place the 80,000 pound spacecraft into the trajectory which will carry it to the moon.

The spacecraft itself will consist of three major elements: the Command, Service, and Lunar Excursion Modules which respectively will weigh approximately 10,000, 42,000, and 25,000 pounds. The Command Module will carry the three-man crew together with guidance, communications, and life support systems. The Service Module will contain propulsion systems for mid-course maneuvers as well as for deboost into, and escape from, lunar orbit. Finally, the lunar landing vehicle will carry two of the crew members to the surface of the moon, along with scientific instruments, communications and guidance systems, and propulsion required to return them to the orbiting Command Module.

We plan to launch the Apollo from Cape Canaveral into an inclined earth orbit. During the first revolution around the earth, the spacecraft will be injected into its earth-to-moon trajectory. In the first few minutes after injection, the Command and Service Modules will be reoriented to mate the lunar landing vehicle with the Command Module in a nose-to-nose manner. This can be done either by "flying" the Command Module to its reoriented position, or by transferring the lunar landing vehicle by mechanical means. Further study will determine which alternative is best.

Approximately 45 minutes after injection, the first mid-course correction maneuver will be accomplished, using the Service Module propulsion system. The magnitude and direction of the mid-course maneuver will be determined by computer calculations, backed up by calculations from the crew and from the ground support systems, which will maintain communications with the spacecraft throughout the mission via the Deep Space Instrumentation Facilities (DSIF). A number of midcourse maneuvers may be required to place the spacecraft into position for entry into a precise, circular lunar orbit approximately 100 nautical miles above the lunar surface.

While the spacecraft is coasting in its predetermined lunar orbit, the crew will prepare the lunar landing vehicle for descent to the lunar surface. The two lunar explorers will transfer to the vehicle through the hatch at the connection point between the two vehicles. The vehicle will then be separated from the Command and Service Modules, which will remain in lunar orbit.

The main engine of the lunar landing vehicle's landing stage will decelerate the vehicle. Then through a carefully blended combination of manual control and automatic system operation, the vehicle will be lowered nearly to the surface, will hover and, if necessary, move laterally so that the crew can select the touchdown point. They will be aided by maps, reconnaissance data and, possibly, a previously landed beacon. At any time during descent the crew can return to the mother ship. It appears that the first landing should be made in the vicinity of the lunar equator and preferably on the leading edge of the moon's surface -- between 270° and 360° longitude.

Descent to the surface is probably the most critical phase of the entire operation. Fortunately, the vehicle will be small and will be designed specifically for landing, rather than for both landing and recovery.

Once on the moon, and before taking any other action, the two explorers will prepare for re-launching. In addition to their own inspection and checking, they will be instructed and guided in this activity by the third crew member in the mother ship, and by information transmitted from earth. This done, the exploration phase of the mission will begin.

As presently conceived, the lunar landing vehicle will carry approximately 200 pounds of equipment for scientific exploration and experiments during the crew's stay on the moon.

Photographs and surface samples will be obtained. Probably apparatus will be left on the moon for continued operation and transmission of scientific data back to earth.

When it becomes time to re-launch the vehicle, the crew will fire the launching engine at a precisely determined instant while the mother ship is within line of sight. The vehicle will enter a transfer ellipse calculated to rendezvous with the mother ship after traveling part of the way around the moon. The docking of the mother ship and the lunar vehicle, controlled by the crew of the smaller vehicle will be a critical operation - I want to stress here however that this maneuver can earlier be practiced extensively in earth orbit.

After docking, the crew of the lunar vehicle will transfer back into the Command Module, and the lunar landing vehicle will probably be left in lunar orbit to save weight on the return trip.

After the Command and Service Modules are thoroughly checked out and all calculations are confirmed, the Apollo spacecraft will be fired into its return trajectory. After mid-course corrections, and just before entering the earth's atmosphere, the Service Module will be jettisoned and the Command Module will be oriented for re-entry. At an altitude of approximately 50,000 feet a drogue parachute will deploy to stabilize the vehicle. This will be followed shortly by the main parachute system, which will gently lower the Command Module to earth -- probably on land rather than at sea.

The mission I have described has been widely reported in the newspapers and technical journals, with a liberal use of superlatives in assessing its magnitude and complexity. In this case, resort to superlatives is well-advised -- this is truly a staggering undertaking. Entirely new concepts of component and system reliability must be developed and proven. Extensive tests must be carefully planned and conducted, and results must be exhaustively studied. Crew capabilities must be developed and meshed with proven automatic systems so that the two work together with Swiss watch precision.

It is a challenging task, studded throughout with difficult decisions which must be soundly based and promptly made. The list of participants will be large, including scientists, engineers, administrators, industrial workers, aerospace medicine experts, and the astronauts themselves.

With the decision made as to the method by which we will go to the moon we think we have taken a giant step forward. Essentially, we have now "lifted off" and are on our way.

Let me conclude, then, by reiterating a few of our basic concepts.

We believe it was necessary to carefully evaluate all feasible mission modes and select the best of these upon which to concentrate our efforts.

We believe that the lunar orbit rendezvous mode is best.

We believe that we must obtain the very best efforts of the very best people we can find, both in Government and industry, if we are to achieve our national goal.

We Believe that our organizational concepts and management techniques must be no less excellent than our technical efforts.

We believe that with constant attention to these concepts, and with the hard work and dedication of the people involved, we will be able to carry out our responsibility to our country to be second to none in man's conquest of space.

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

FOR RELEASE:

MAN'S ROLE IN THE NATIONAL SPACE PROGRAM

National Academy of Sciences
Space Science Board
2101 Constitution Avenue, N.W.
Washington 25, D.C.

August 1961

With the recent announcement by President Kennedy that manned landing on the Moon constituted a national objective of the space program during the present decade, public discussion has been concerned with the values of such an effort. For three years the Space Science Board of the National Academy of Sciences has been studying scientific aspects of space, including the role of man. On this topic the Board adopted a formal position at its February 10-11, 1961 meeting, which it submitted to the government on March 31, 1961.

The Board recommended that scientific exploration of the moon and planets should be clearly stated as the ultimate objective of the U.S. space program for the foreseeable future. This objective should be promtply adopted as the official goal of the United States space program and clearly announced, discussed and supported. In addition, it should be stressed that the United States will continue to press toward a thorough scientific understanding of space, of solving problems of manned space exploration, and of development of applications of space science for man's welfare.

The Board concluded that it is not now possible to decide whether man will be able to accompany early expeditions to the Moon and planets; many intermediate problems remain to be solved. However, the Board strongly emphasized that planning for scientific exploration of the Moon and planets must at once be developed on the premise that man will be included. Failure to adopt and develop our national program upon this premise will inevitably prevent man's inclusion, and every effort should be made to establish the feasibility of manned space flight at the earliest opportunity.

From a scientific standpoint, there seems little room for dissent that man's participation in the exploration of the Moon and planets will be essential, if and when it becomes technologically feasible to include him. Man

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can contribute critical elements of scientific judgment and discrimination in conducting the scientific exploration of these bodies which can never be fully supplied by his instruments, however complex and sophisticated they may become. Thus, carefully planned and executed manned scientific expeditions will inevitably by the more fruitful. Moreover, the very technical problems of control at very great distances, involving substantial time delays in command signal reception, may make perfection of planetary experiments impossible without manned controls on the vehicles.

There is also another aspect of planning this country's program for scientific exploration of the Moon and planets which is not widely appreciated. In the Board's view, the scale of effort and the spacecraft size and complexity required for manned scientific exploration of those bodies is unlikely to be greatly different from that required to carry out the program by instruments alone. In broad terms, the primary scientific goals of this program are immense: a better understanding of the origins of the solar system and the universe, the investigation of the existence of life on other planets and, potentially, an understanding of the origin of life itself. In terms of conducting this program a great variety of very intricate instruments (including large amounts of auxiliary equipment, such as high-powered transmitters, long-lived power supplies, electronics for remote control of instruments and, at least, partial data processing) will be required. It seems obvious that the ultimate investigations will involve spacecraft whether manned or unmanned, ranging to the order or hundreds of tons so that the scale of the vehicle program in either case will differ little in its magnitude.

Important supporting considerations are essential to realization of these concepts:

(a) Development of new generations of space vehicles, uniquely designed for use in space research and not adaptations of military rockets, must proceed with sufficient priority to ensure that reliable vehicles of adequate thrust are available for lunar and planetary research. This program should also include development of nuclear stages as rapidly as possible.

(b) Broad programs designed to determine man's physiological and psychological ability to adapt to space flight must likewise be pushed as rapidly as possible. However, planning for "manned" scientific exploration of the Moon and the planets should be consummated only as fast as possible consistent with the development of all relevant information. The program should not be undertaken on a crash basis which fails to give reasonable attention to assurance of success or tries to by-pass the orderly study of all relevant problems.

(c) Consideration should be given soon to the training of scientific specialists for spacecraft flights so that they can conduct or accompany manned expeditions to the Moon and planets.

The Board strongly urges official adoption and public announcement of the foregoing policy and concepts by the U.S. government. Furthermore, while the Board has here stressed the importance of this policy as a scientific goal, it is not unaware of the great importance of other factors associated with a United States man in space program. One of these factors is, of course, the sense of national leadership emergent from bold and imaginative U.S. space activity. Second, the members of the Board as individuals regard man's exploration of the Moon and planets as potentially the greatest inspirational venture of this centry and one in which the entire world can share; inherent here are great and fundamental philosophical and spiritual values which find a response in man's questing spirit and his intellectual self-realization. Elaboration of these factors is not the purpose of this document. Nevertheless, the members of the Board fully recognize their parallel importance with the scientific goals and believe that they should not be neglected in seeking public appreciation and acceptance of the program.

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

FOR RELEASE: BACKGROUND MATERIAL

NOTE: The following is an abstract of a presentation by Dr. Robert B. Voas, Assistant to the Director of NASA Manned Spacecraft Center for Human Factors, at a meeting of the Santa Monica Chamber of Commerce.

August 17, 1962

MAN AS A PART OF A SPACECRAFT SYSTEM

Man must be made an integral part of a spacecraft system so that he may improve the reliability and flexibility of our spaceflight activities. Mercury experience to date has indicated that he can do this. This talk explains how man is made an integral part of the system and how the type of man needed as a part of a system such as Mercury is determined. The selection criteria for the Mercury astronauts will be listed. The criteria for future Gemini astronauts will be similar except that the age limit will be five years lower.

The training program for the Mercury astronauts covered six areas:

1. Training in the basic sciences which underlie space flight. The astronauts received lectures in such areas as propulsion, orbital mechanics, astronomy, and meterology.

2. The second major area of training was in the operation of the vehicle itself. This included learning to control the attitude of the spacecraft, learning to operate the environmental control system which provides oxygen and cooling to the man in space, operating the communication system by which he keeps in touch with stations on the ground, and operating his electrical power system which supplies power to all of the spacecraft instruments and controls.

3. The third major area of the training concerns familiarization with the unique environment which man enters in space flight. This included actual centrifuge training, training in pressure of the Mercury cabin, and training to familiarize the man with the Mercury full-pressure suit. It included familiarization with increased levels of carbon dioxide with noise and vibration, and with weightlessness for a more limited time than the flights themselves allow. All of these environmental conditions were simulated during training to the same extent that man would meet them during space flight.

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4. The fourth major area of training concerned the maintaining of flying proficiency. This involved flying supersonic aircraft and an individualized program of physical activity.

5. They also received considerable training in tasks to be performed while on the ground. Among these were preparing themselves for the flight and taking part in the countdown of the vehicle before launch. Another area of ground tasks for which training was given was on the other end of the flight -- the recovery operation, where they learned to get out of the capsule, deploy the raft and other survival equipment, and take care of themselves following the flight. Another area of ground activity was to act as voice communicators from the ground to the astronauts in space. Members of the Mercury astronaut team who are not involved in the flight act as communicators to the astronaut in the Mercury capsule in orbit.

6. A sixth area of training was familiarization with equipment used for research. In lectures from operators in the U.S. Weather Bureau they were familiarized with those areas scientists would like to have information on which could be brought back from space flight. On the flights to date they have made a number of observations of interest to meteorologists and astronomers.

Following the training program in these six basic areas, a special program was developed to be used during the sixty days just prior to each flight. During this time the man and spacecraft participated in a joint checkout program where they both went through many tests together to demonstrate that the man and the spacecraft are compatible and can work together as a smoothly functioning unit. The program during this period was described and some of the preparations listed for the flight.

Following this period of preparation came the flight itself. The observations of the astronauts during the flights were described and a number of pictures were taken from the spacecraft during flight -- both by automatic camera and the astronaut's hand-held camera. The physical characteristics of the spacecraft environment were described and some of the information which has been brought back from these early flights will be discussed.

As a overall summary of our results to date, we have been successful in Mercury in integrating the man and the machine into one system. It has been proved that man can augment the reliability and the flexibility of our missions by taking over when automatic malfunction occurs. Experience to date strengthens our belief that man will be an important component of future space flight programs.

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS
FOR RELEASE: September 16, 1962

NASA Headquarters
Release No. 62-199

NASA OUTLINES ASTRONAUT POLICY
FOR NEW SPACE FLIGHT TRAINEES

A new policy aimed at assuring equal access by all news media to the astronauts' stories of their space flight mission was announced tonight by the National Aeronautics and Space Administration.

Specific guide-lines were spelled out covering sale by the astronauts of stories of their personal experiences and those of their families. However, the new policy contains sharp prohibitions against such stories containing, or purporting to contain official information concerning the astronauts' training or flight activities not previously available to the public.

Provision for sale of the stories on this basis was endorsed in the belief it would make available to the public personal aspects of the astronauts' lives that might otherwise not be available.

Further, it was noted that many individuals in the service of the government -- either because of their official duties or personal experiences -- have enjoyed similar opportunity.

Major changes from present policy as embodied in the new guide-lines include:

1. A requirement for a second post-flight news conference in which selected representatives of various news media would have opportunity to question the Astronaut in depth on all phases of his flight mission.

2. A specific prohibition against any publication advertising as "exclusive" stories purchased from the astronauts when the stories are not exclusive or are exclusive only in part. The policy further requires that the contracting publication must provide a method, acceptable to NASA, for avoiding this inference.

3. All such agreements are subject to approval by the Administrator of the National Aeronautics and Space Administration.

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The new policy applies equally to civilian Astronauts or those detailed to NASA from their respective military departments.

The basic policy requirement is contained that "all information reported by the Astronauts in the course of their official duties, which is not classified to protect the national security will be promptly made available to the public...."

Astronauts have also been advised that it is NASA policy that "no investment will be made which might create the impression that any participant in this program is placed in a position of benefiting from the activities or decisions of NASA itself."

The new policy stemmed from study by a special group within NASA that embraced both operational and policy levels, and final recommendations represented total concurrence of this committee.

Additionally, expressions of opinion were also received from representatives of various media,.and from the astronauts.

Implementation of these policies will be made through detailed arrangements with the present astronauts as they continue their duties and with new flight personnel as they come into the program.

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

FOR RELEASE:

Remarks by

STUART CLARKE
DIRECTOR OF PERSONNEL
MANNED SPACECRAFT CENTER

September 17, 1962

In April 1962, the Manned Spacecraft Center asked for volunteers for its forthcoming Flight Crew Training Program. The following minimum qualification standards were published and distributed to the press, aircraft companies, Government agencies -- civilian and military, and The Society of Experimental Test Pilots.

a. The candidate must be an experienced jet test pilot and preferably be presently engaged in flying high-performance aircraft.

b. He must have attained experimental flight test status through the military services, the aircraft industry or NASA, or must have graduated from a military test pilot school.

c. He must have earned a degree in physical or biological sciences or in engineering.

d. He must be a United States citizen under 35 years of age at the time of selection, and 6 feet or less in height.

e. He must be recommended by his present organization.

Over 200 applications were submitted to NASA. A preliminary selection committee met in June to consider 63 of the most highly-qualified applicants. The preliminary selection committee was composed of MSC Management, including representatives from the present group of Astronauts. Various quantitative criteria concerning the applicants were studied, such as flight test experience, academic achievement, and their present supervisor's evaluation. Thirty-two applicants were selected to continue in the selection program. During

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July and August, they were given medical examinations, and one was eliminated as being "too tall." During the week of August 12, the 31 applicants reported to Houston for four days of examinations and interviews. The next few weeks, the selection committee carefully reviewed and evaluated the tests and interviews. Nine were selected to participate as Flight Test Personnel. From these nine and our present Astronauts will come flight crews for future space flight missions. It is planned that in late stages of Apollo spacecraft development a third group of Flight Test Personnel will be selected to join those then available as the pool from which Apollo flight crews will be chosen.

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

FOR RELEASE:

Remarks by

WALTER C. WILLIAMS
ASSOCIATE DIRECTOR
MANNED SPACECRAFT CENTER

FLIGHT CREW TRAINING PROGRAM

September 17, 1962

The new flight crew personnel will report for duty in Houston on October 1. An intensive training program will be implemented in mid-October. The early phases of this training program will familiarize the men with the Mercury spacecraft, launch vehicle, and operational techniques. They will then receive spacecraft and launch vehicle briefings on Gemini and Apollo. As they become more familiar with Gemini and Apollo, they will be assigned, together with the current Mercury pilots, to help establish design and operational concepts.

Concurrent with the project-oriented aspects of the training program, the men will attend basic science lectures two days per week. Because of their previous academic and occupational experience, most of the basic science courses will be of the refresher type. The basic science program will place special emphasis on space navigation, computer theory, flight mechanics, astronomy, physics of the upper atmosphere and space, bioastronautics, advanced propulsion systems, aerodynamics, guidance and control, space communications, global meteorology, and selenology.

During later phases of the training program, the pilots will work with static and dynamic simulators to establish detailed flight operational procedures.

NASA has established a special aircraft operations group in Houston to provide proficiency flying for the pilots. T-33 and F-102 type aircraft have been assigned.

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The new pilots will be integrated with the Mercury pilots immediately, and although the early phases of this training program were tailored primarily for the new men, all will train together insofar as practical.

To help expedite the training and the integration in the engineering development programs of this expanded pool of potential flight crew members, Astronaut Deke Slayton will assume the position of Coordinator of Astronaut Activities. In this position, Major Slayton will be responsible for assignments of flight test personnel to training activities and engineering assignments, and will act as personal advisor to Dr. Gilruth and myself on flight crew affairs. As you all know, Astronaut Slayton participated in all aspects of our Mercury astronaut training program and has been actively following the Gemini and Apollo programs. I believe he will be a great asset to our space program in this new role.

NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON 1, TEXAS

FOR RELEASE:

FACT SHEET
October 1962

CAPE CANAVERAL

Halfway down Florida's east coast, between Jacksonville and Miami, is America's most complete space testing area-- Cape Canaveral, power point of the Atlantic Missile Range. The NASA Manned Spacecraft Center, one of several agencies using Cape facilities, launches from there its spacecraft -- manned Mercury spacecraft now with Gemini and Apollo spacecraft to follow.

Much of the Cape Canaveral terrain consists of thick undergrowth and palmetto scrubs, not unlike the earlier days when Indians and the early settlers made their homes on this arrow-shaped, sandy spit jutting, into the blue Atlantic Ocean. New growth started with the signing of a bill, on May 11, 1949, authorizing a launching range at the Cape. On June 13, 1950, the Department of Defense assigned the responsibility for the operation of this Long-Range Proving Ground at Banana River, Florida, to the U.S. Air Force. The Atlantic Missile Range presently extends from Cape Canaveral across the South Atlantic and into the Indian Ocean beyond Africa. However, it might now -- since NASA arrived there -- be more aptly said to have its ending not just in the Indian Ocean but in infinite space.

Land acquisition by NASA will increase the Cape Canaveral area from its present acreage to approximately 95,000 acres by mid-1963. This increase in land mass is required to carry out the program for the peaceful exploration of space as outlined by Congress.

The present Cape Canaveral boundaries are Port Canaveral to the south, the Atlantic Ocean to the east, and -- with the acquisition of land on neighboring Merritt Island -- the Indian River will form the western terminus. The area will connect to the Florida mainland in the north.

Since the Atlantic Missile Range was established 12 years ago, it has been a research and development test facility. Design work now under way will alter this mission to one which is primarily operational, capable of routine, rapid launching of large payloads. Physical appearances of the launch pads will change along with mission characters. The skyline will be dominated by massive assembly sheds where the huge Saturn C-5 and Nova launch vehicles can be prepared for launch simultaneously.

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The first vehicle launching at the Cape took place on July 24, 1950. Bumper No. 8, as it was termed, was a combination V-2 and WAC Corporal that attained an altitude of 25 miles in the horizontal distance test. From this early launching and many hundreds that followed, came the technology that has enabled this Nation to undertake the challenging program of building large vehicles with the objective of landing a crew of astronauts on the moon before the end of this decade.

The Cape is presently served by a channel from the Florida inland waterway, with docking facilities for Saturn barges and other craft. Road and air are other means of direct transportation. The airfield, known as "skid strip," handles air traffic, while a network of over 65 miles of paved roads within the Cape provides land access to the areas already developed.

Total employees at the Atlantic Missile Range number approximately 23,000. By the summer of 1963, this number is expected to increase to some 33,000 persons. NASA employees at Cape Canaveral by mid-1962 numbered about 2,000, including contractor and construction personnel; the personnel projection through 1966 indicates a rapid growth to more than 16,000. This large influx of people will have a noticeable impact on the local county -- Brevard, which had already attained the status of the fastest growing county in the United States during the 1950's.

Cape Canaveral has an average temperature of 72.5 degrees. August is the warmest month. A rainy season exists from May through October. High humidity is prevalent through most of the year. The average rainfall is 41 inches, and the water table varies from two to six feet. The highest point of natural elevation is ten feet on the Cape.

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Space Suits

File Apollo
Space Suits

NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
~~MANNED SPACECRAFT CENTER~~, News Release, dated
HOUSTON 1, TEXAS

FOR RELEASE: Monday A.M.
November 26, 1962

PROJECT APOLLO SPACE SUITS

The space suits and portable life support systems being developed for Project Apollo will serve as virtual one-man space ships for the American astronauts. The suits will be worn by the astronauts for four-hour expeditions on the moon's surface and for outside the Apollo spacecraft in space.

This was disclosed today by the National Aeronautics and Space Administration's Manned Spacecraft Center, Houston, Texas, as it released additional information about the integrated space suit systems. The space agency has selected the Hamilton Standard division of United Aircraft Corporation as prime contractor to manage and integrate the space suit program and also design and manufacture the life support backpacks. International Latex Corporation, as principal subcontractor, will develop and fabricate the suits.

The combined space suit and portable life support system will supply oxygen and pressurization, and will control temperature, humidity and air contaminants in the suit. It will protect the astronaut against the moon's harsh temperature extremes (plus 250 to minus 250 degrees Fahrenheit) and solar radiation that could blind or burn him.

The space suit, designed by International Latex, will give the astronaut a high degree of mobility. He will be able to walk, climb ladders and bend over with a minimum of effort while the suit is pressurized.

In the helmet will be an airlock feeding device to permit the astronaut to drink water and eat specially prepared foods when the suit is pressurized. The helmet's face plate will have provisions for protecting the eyes from intense solar glare. It will also be defogged and defrosted for good visibility in cold temperatures.

The complete assembly will contain a separate emergency oxygen supply. A two-way radio will provide communication with the Apollo spacecraft and other extra vehicular crewmen. A telemetry suit and sensing devices will relay to the vehicle the astronaut's physiological functions as well as the suit's pressure, oxygen and temperature conditions.

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The life support pack, carried on the back of the wearer, will contain the oxygen supply necessary to pressurize and ventilate the astronaut's pressure suit, and the mechanical systems required to cool the ventilating gases, remove contaminants, and insure adequate gaseous flow. The astronaut will be able to carry tools, a light, and containers to hold the specimens he collects on the lunar surface.

The space suit and life support system is designed to permit an astronaut to put it on or take it off in five minutes, unassisted.

Republic Aviation, as subcontractor to International Latex, will do medical and environmental testing for the program.

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SPACE SUITS

PROJECT APOLLO SPACE SUITS

NASA-MSC News Release dated November 26, 1962
