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**"THE NATIONAL AND  
INTERNATIONAL SIGNIFICANCE OF  
THE LUNAR EXPLORATION PROGRAM"**

by

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# NEWS RELEASE

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## THE NATIONAL AND INTERNATIONAL SIGNIFICANCE OF THE LUNAR EXPLORATION PROGRAM

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(Banquet Address at Symposium on Manned Lunar Flight, American Astronautical Society Program at 128th meeting of the American Association for the Advancement of Science, Denver, Colorado, December 29, 1961)

### Introduction

The closing days of 1961 seem an appropriate time to review one of the boldest enterprises ever undertaken by any nation, the exploration, by man himself, of our nearest neighbor in space, the moon. Primarily a most difficult technological achievement, this task will require the resources and skills of scientists, engineers, technicians, business specialists and managers in government, industry, and education, and the marshalling of their knowledge now available and to be obtained within the next few years in almost every branch of science, engineering, technology, and management.

At the beginning of 1961 the national space program of the United States included Project Mercury, the first step in the manned exploration of space, the flight of a man in orbit around the earth for three circuits and his safe recovery. In January 1961 it was hoped to accomplish manned orbital flight by the early fall, but the failure of a programmer in the booster of MA-3 delayed further orbital flights until September and November. On these two flights, the latter with animal passenger, the recoveries were successful. Astronaut John H. Glenn, Jr., has been selected as pilot for the next flight, with Scott Carpenter as back-up.

In addition to the approved and funded Mercury project, future steps in the manned exploration of space were outlined in a ten-year plan. These included the development and testing of the prototype of a three-man capsule for the following Project Apollo, conceived as one element of an earth-orbiting laboratory and also as a basic vehicle for circumnavigation and manned exploration of the moon. Under the original plan the manned lunar landing mission was considered to lie beyond 1970, the end of the period covered by the plan. Although Project Apollo was included in NASA's planning, the budget prepared in the fall of 1960 limited the FY 1962 funding to studies without actual hardware development.

Following the election of President Kennedy, the policies underlying the national space program were re-examined. Following an action on March 27th to speed up large booster development, the President, on May 25th, announced major new goals for the nation in space, and new programs to achieve them, in a special message to the Congress on urgent national needs. He said, "Now is the time to act, to take longer strides . . . time for a great new American enterprise . . . time for this nation to take a clearly leading role in space achievement. . . . I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth."

Thus 1961 was a year of great national decision, Congress approving the funds substantially as requested by the President for the acceleration of the national space program, including other elements of the program as well as the manned exploration of the moon. I would like to review with you briefly the steps taken by NASA to implement the national decision.

#### Initial Planning of the Program

As early as January of 1961 the results of internal NASA studies of a program for manned lunar landing were reported to a meeting of senior NASA officials from headquarters and the field centers. The studies, which were made over a period of a few weeks, included both the direct ascent based on a single large Nova-type launch vehicle and the rendezvous method in earth orbit using a number of Saturn C-2's, the advanced version of Saturn then under study. You may be interested in the following listing of special problem areas: (1) launch vehicle development (at least 30 tons must be accelerated to escape velocity); (2) guidance and navigational systems to be developed; (3) heat-shield development for escape velocity; (4) landing technique for use on moon consistent with manned safety; (5) space physiology problems to be assessed (radiation and weightlessness); and (6) moon habitability and survival problems. Many of these were discussed during the day at this present symposium.

With the approval of the accelerated program by the President, the bases for more specific planning became available. An ad hoc task group was set up for intensive study of the many separate tasks which must be completed to accomplish the manned lunar landing mission and their time phasing. The main purpose was to size up the scope, schedule, and cost for realistic budgetary planning, to determine the main problems, the pacing items, and the major decisions required at various time periods. For this purpose the direct ascent mission was used in the intensive study with less detailed consideration of the rendezvous method.

The ad hoc task group reported on June 16, 1961. It was concluded that the manned lunar landing mission was feasible within the decade, that a strong management organization was needed, and that information on solar flare radiation protection and lunar surface characteristics were needed at an early date. The pacing items in meeting the time schedule were the development contracts for the new first-stage boosters required, the static test stands for these boosters, and the launch facilities. The overall schedule would be determined by the schedule for launch vehicle rather than spacecraft development.

On May 25th NASA established a second group to survey possible launch vehicles and their schedules, which reported on June 10th.

On July 20th, following an exchange of letters between the Administrator of NASA and the Secretary of Defense, a joint study was undertaken to determine the national large launch vehicle needs for the next decade, considering the requirements of both NASA and DOD. This study was more comprehensive and detailed than previous studies, and its results have recently been presented to both agencies.

On June 23, 1961, a joint study was undertaken by NASA and DOD to make recommendations of the launch site to be used for the manned lunar exploration missions. The report of this study was completed in July.

#### Initial Decisions

Between November 1960 and May 1961, complete systems studies were made of the Apollo spacecraft system by three industrial contractors. Even before this period it had been decided that the requirements of several missions could be met by a "building block" or modular design of the spacecraft, utilizing three or more components. One will be the "command center" housing the three-man crew. The second will house fuel, electrical power supplies, and propulsion units needed for lunar take-off. This unit is also available to furnish propulsion if necessary to terminate a mission for safe return to earth, to make mid-course connections, and to enter or

leave an orbit around the moon. The third component will contain decelerating rockets intended to slow up the spacecraft for landing on the surface of the moon. Other modules could be used for some missions, i.e., for an earth-orbiting laboratory.

In July of this year, 16 firms were invited to submit proposals, and on November 28th announcement was made of the selection of North American Aviation to be responsible for the design and development of the command center and the propulsion unit. The Instrumentation Laboratory of the Massachusetts Institute of Technology had previously been selected as an associate contractor for development of the Apollo guidance and control system. Other industrial firms will join the team as subcontractors to North American.

As previously noted, facilities are the pacing items. The first decision which had to be made was that of launch site. On August 24th announcement was made of the decision to expand the facilities at Cape Canaveral by the acquisition of approximately 80,000 acres north and west of the presently used launch site to be administered by the Air Force, as agent for NASA, as part of the Atlantic Missile Range. This site was selected on the basis of the joint NASA-DOD study previously mentioned.

It became clear during all of the studies previously mentioned that provision should be made in all facility planning for very large launch vehicles, so large that water transportation is necessary and close proximity of facilities is highly desirable. Following the selection of the launch site there followed announcements on September 7th of the selection of the government-owned Michoud Ordnance Plant, near New Orleans, Louisiana, as the site where the large launch vehicle stages would be fabricated; on September 19th of the selection of a site in Houston, Texas, made available to the Government by Rice University, as the location of the Manned Spacecraft Center, with responsibility for the design, development, evaluation, and testing of spacecraft and their subsystems for manned space exploration, and the training of flight crews; and on October 25th of the selection of the Mississippi facility for static tests of Saturn and larger launch vehicles.

The second pacing item was the development of new large launch vehicles. During the last three months most of the necessary decisions have been made with the help of the numerous studies previously mentioned. On September 11th, contract negotiations for the S-II stage, the second stage for an advanced Saturn launch vehicle, were announced to be undertaken by the Space and Information Systems Division of North American Aviation. This stage makes use of four Rocketdyne J-2 liquid oxygen-hydrogen engines with total thrust of 800,000 pounds. On November 17th Chrysler Corporation was selected to build, check out, test, and launch the first stage of the Saturn

C-1 launch vehicle following the 10 prototypes being built at NASA's Marshall Space Flight Center. On December 15th Boeing was selected to develop the first stage of the advanced Saturn launch vehicle powered by a cluster of four or five 1.5-million-pound-thrust F-1 engines. On December 20th it was announced that Douglas Aircraft Company would build modified S-IV stages for advanced Saturn missions, using a single 200,000-pound-thrust Rocketdyne J-2 liquid hydrogen-oxygen engine.

These decisions initiate the work on the pacing items of a manned lunar landing mission by the rendezvous method. NASA has decided to also begin work on the longest lead-time items for the direct ascent method, and is now giving consideration to the procurement of a large one-million-pound or more thrust liquid hydrogen-oxygen engine needed as a building block for the Nova vehicle, which is needed for direct ascent and for later manned missions to the planets. NASA is also following the development of large solid-propellant engines by the Department of Defense which may be used for the lunar mission. In this manner, considerable flexibility can be maintained for the next two or three years to permit change in plans should unexpected obstacles occur.

In order to permit an earlier exploration of the rendezvous technique, as announced on December 7th, the Project Mercury effort is being extended to produce a two-man spacecraft capable of docking with another vehicle in earth orbit, to be boosted into orbit by a Martin Titan II booster. NASA expects to cooperate with the Department of Defense in the practical study and demonstration of the rendezvous technique.

The NASA ad hoc study groups who have analyzed the manned lunar landing mission listed more than 2,000 component tasks in the overall mission. I have listed for you the decisions already made and actions taken on several of the more important long lead-time items. On November 1st NASA announced major organizational changes, including the appointment of D. Brainerd Holmes as Director of the Office of Manned Space Flight Programs. This office has the responsibility for overall systems engineering and evaluation and is rapidly taking up the load of the many detailed technical decisions needed to implement the program. The major decisions on policy matters and on large contracts will continue to be made by the Administrator, in consultation with the Deputy Administrator and the Associate Administrator and with the advice of the Director of the Office of Manned Space Flight Programs.

It will be appreciated by this audience that manned lunar exploration requires the accomplishment of many tasks in spacecraft design, launch vehicles and propulsion, ground support, life sciences, space sciences, and in several areas of advanced research and technology. Contributions to the program come from all parts of NASA,

from other government agencies, particularly the Department of Defense; from industry research and development groups, and from universities. Some appreciation of the contribution of all groups in all areas is essential to understand the national and international significance of the lunar exploration program.

### National Significance of Program

The space program represents an important milestone with respect to the role of the Government in the development of science and technology and their utilization as instruments of governmental policy.

Past scientific and technological developments, beginning with the Industrial Revolution of the last century, have had a profound impact on every aspect of human affairs, including government itself. At the turn of the century we had reached the automotive age, to be followed by the air age and the nuclear age. Each of these developments provided in essence a mere change in the tools which man had at his disposal to change his physical environment, but each had important and direct effects on the economic development of the Nation, on national defense, on education, on law and religion, and on governmental policy in every field.

During these developments the role of government changed profoundly. Through the automotive age, scientific and technological development were accomplished mainly by private initiation with little direct governmental participation. As aviation progressed, largely because of national defense needs but partly because of the desire to actively promote the civil use of aircraft, the Government established a civilian research agency to advance the scientific and engineering bases of aeronautics at government expense for the benefit of all. This wise decision soon established the United States in a leading position in both military and civil aviation. Through ad hoc commissions at first, but ultimately by special governmental agencies, the Government established policies for the promotion of civil aviation. The Government thus played a more active role.

The nuclear age began wholly as a Government-sponsored activity, first by a secret military agency for weapons development. Following World War II and after extensive debate, the civil uses of nuclear energy were formally recognized and a civilian agency was established to carry on both weapons development in secrecy and civil or "peacetime" applications with wider dissemination of information. The Government began to use nuclear science and technology as instruments of policy, particularly in the international field. Within the Nation, steps were taken to promote widespread research in universities, industrial laboratories, and in centralized national laboratories, and to foster medical and other applications, including the

private development of nuclear power plants. There remains in this field some opportunity for private initiative subject to various controls related to public safety.

The space activity is at present wholly financed by the Government, and from the beginning overall governmental policy considerations have determined the nature, scope, and rate of advance of space science and technology and of their application to fulfill various national needs. A positive decision was made to entrust the development of space science and technology and their civil applications to a civilian agency while reserving applications to national defense as the responsibility of the Department of Defense. It becomes apparent that the Government has full power to set the national goals in space. In fact, it already has established goals which motivate large elements of the Nation to expand the new science and technology as rapidly as possible. It is also clear that the wise direction of the space effort may be used as an instrument of social change in many areas of economic and social development of the Nation, if so desired. Finally, it is clear that such policy decisions are established through the cooperation of the legislative and executive branches of the Government and must ultimately receive the support of the public. Thus the primary significance of the national space program is that it is a powerful instrument of governmental policy, such that the social and economic impact of the new technology can be channeled to desirable ends.

The sheer magnitude of the manned lunar exploration program, amounting as it will to three billion dollars or more, represents a significant application of the Nation's resources. These billions of dollars will be spent in the laboratories, workshops, and factories of the Nation and thus constitute a significant factor in the Nation's employment and economy generally. The personnel in the space program are not all scientists and engineers but come from every walk of life.

The ultimate and practical purpose of these large expenditures is twofold: (1) insurance of the Nation against scientific and technological obsolescence in a time of explosive advances in science and technology; and (2) insurance against the hazard of military surprise in space.

The first result can be accomplished because of the technical nature of the program and the demonstrated transferability of scientific and engineering knowledge to other industrial applications. Manned exploration of the moon requires the most advanced engineering and technological developments at the very frontiers of knowledge. Major advances are occurring in electronics and communications, new materials, energy sources, and energy-conversion devices, data collection and handling, computers, knowledge of the behavior of

the human body under stress, protective equipment for man in hostile environments, and many other areas.

These developments at the frontiers of science and technology are transferable to other applications in industry. Because of the newness of the space age it is difficult to give specific examples at this early date. It is easier to recognize this process in relation to the automotive age, the air age, and the nuclear age. For example, the development of the automobile has brought us the concept of simplification for the operator through complication of design, a concept now widely applied in the operation of a modern steel mill or oil refinery and in such modern consumer products as automatic washers and ovens, where automatic controls program the entire operation. The automobile is largely responsible for the development of alloy steels, new fuels, synthetic rubber, quick drying finishes, and other new materials.

Similarly the air age brought us great supplies of aluminum and the basis for building light-weight structures, not only for airplanes but also for trains, buses, and ships. The nuclear age brought applications of isotopes in medicine and in the inspection of materials. Nuclear developments brought remote manipulators and sealed pumps for hazardous liquids and gases. The space age has brought to maturity the concept of systems analysis and optimization of designs involving many branches of science and engineering. In addition the space age has given us high-temperature ceramics, ablating materials for heat protection, pressure-stabilized light-weight tanks, computers handling large amounts of data, and many other developments which are finding applications throughout industry.

While the technological developments offer the earliest contributions to economic development, in the long run the contributions from the scientific knowledge obtained in the great unknown environment of the celestial bodies and interplanetary space may bring much greater returns. Today not only the prestige of a nation but also its true greatness and strength depend upon mastery and control of man's physical environment; and the extension and perfection of scientific knowledge is fundamental to that mastery and control. What benefits the new knowledge of the universe may ultimately bring to mankind no one today can predict. Judging from past experience, advances in scientific knowledge are the foundation of advances in technology and advances in technology are a key factor in economic development.

The manned lunar exploration program constitutes essential insurance against finding ourselves with a position in the new technology inferior to that of a possible enemy. The freedom of space combined with the great power of nuclear energy for destruction forecasts the future development of weapons systems now only dimly understood. There are many defense applications already evident and

under way as a responsibility of the Department of Defense. The components, vehicles, techniques, and knowledge developed in the civil program are constantly available for defense applications.

Time is not available to discuss the national significance to modern education and to human thought and aspirations. At this meeting of the American Association for the Advancement of Science I do wish to say a few words about the significance of the lunar exploration program to science itself. Some scientists have feared that space activities may be exploited at the cost of other scientific work of higher priority and have questioned specifically the role of man in space exploration. These fears emphasize the fact that activities in space have other objectives as already described in addition to the increase of scientific knowledge. The space program, in my opinion, will greatly benefit science by stimulating popular interest in the frontiers of science and by bringing broader support for the advancement of all science and technology. In the past the nuclear developments have been charged with undue distortion of research and education in physics, but I am convinced that in the presence of both nuclear and space activities all branches of science receive greater support than they would have received had these activities been absent.

#### International Significance of Program

Space exploration is a significant factor in international policy. From the beginning space activities have had an impact on the climate of world opinion with respect to national strength and prestige. As stated by the President's Science Advisory Committee in March 1958: "To be strong and bold in space technology will enhance the prestige of the United States among the peoples of the world and create added confidence in our scientific, technological, industrial, and military strength."

There are no short cuts to the attainment of the desired position of strength. We have made great progress, and our policies of openness and sharing with other nations are bringing growing appreciation of the significance of our program to the free world.

In March 1959 the United States offered through the Committee on Space Research of the International Council of Scientific Unions to cooperate with other nations in making available launching vehicles, spacecraft, technical guidance, and laboratory support for orbiting individual experiments for complete satellite payloads developed in other countries. The first satellites under this international program are being prepared by the United Kingdom and Canada and will be launched in the first half of calendar year 1962. Discussions are in progress with several other governments which have expressed interest in cooperative satellite projects.

In his recent speech before the United Nations, President Kennedy said: "We shall urge proposals extending the United Nations Charter to the limit of man's exploration in the universe, preserving outer space for peaceful use; prohibiting weapons of mass destruction in space and on celestial bodies, and opening the mysteries and benefits of space to every nation. We shall propose further cooperative efforts between all nations in weather prediction and eventually in weather control. We shall propose, finally, a global system of communication satellites linking the whole world in telegraph and telephone, and radio and television." At its current session, the United Nations adopted a resolution which represents a forward step in cooperation along the lines recommended by the President.

Some social scientists have speculated that the exploration of space might become in time a substitute for war. Hope would be that the absorption of energies, resources, imagination, and aggressiveness in the exploration of space might contribute to the maintenance of peace. Whether or not this speculation is warranted, I am sure from personal experience that international cooperation in the exploration of space does contribute to friendship and understanding among nations.

The international impact of the United States space program appears in unexpected ways. Thus Russell Howe reported in a dispatch from Kaduna, Northern Nigeria, appearing in the Washington Post for December 3rd, 1961, as follows:

"[The Sardauna of Sokoto and Premier of Northern Nigeria] has welcomed on his soil Black Africa's only space tracking station. A few miles outside Kano, in a spot only visited until recently by camel trains and woodchoppers on their mules, NASA's Tracking Station Five now stands with aluminum brightness in the savannah."

\* \* \*

"Even Tracking Station Five has helped to enhance the Sardauna's great, semi-spiritual prestige. Said the Hausa driver who took me out to the station, when he had finally understood what my destination was: 'Ah, you mean the place the Sardauna built to get the message from the stars!'"

#### Conclusion

We must not underestimate the significance of space exploration to the ordinary citizen in every country. You recall the complaint of the Russian workman in the U.S.S.R., who asked, "What do Sputniks give to a person like me?" To this question frequently asked by men

in many countries, including our own, we can of course reply with discussions of practical benefits from weather and communication satellites and from technological developments as described in the earlier part of this paper. But perhaps a better reply would be: "The exploration of space can give you new interests and new motivations arising from an expansion of your intellectual and spiritual horizons as you take a longer view of man's role in time and space at this point in the history of the human race."

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