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May 8, 1961

MEMORANDUM FOR THE PRESIDENT

Pursuant to your request for positive recommendations for placing this country on the way toward leadership in space, I have conducted a series of hearings with responsible and informed representatives of the Executive, the Legislature, and the public.

A major result of these consultations is the attached coordinated report prepared by the Department of Defense and the National Aeronautics and Space Administration. This report reveals an agreement between the two major agencies involved in the space picture and points up clearly what they consider should be done and how much funding is needed at this time. I am much impressed with the thoroughness and the sense of urgency reflected in this document.

Our evaluation and coordination will continue.

Lyndon B. Johnson

Enclosure

LBJ/ECW/nj

[redacted]

TAB B: U. S. SPACE PROGRAM

It is the purpose of this Section to outline some of the key features of U. S. undertakings in space. We may undertake space projects for any one of four principal reasons -- scientific; commercial/civilian; military; or national prestige -- although, clearly, these categories overlap. We have accomplished most in the scientific and military area. Our chief lag is, of course, in large scale undertakings chiefly aimed at the enhancement of national prestige. The projects outlined on the attached sheets will be described briefly under each of these headings:

1. Scientific.

The U. S. has accomplished considerably more than the Soviets in the utilization of space technology for the acquisition of new data of scientific importance and value. Our first satellite, EXPLORER I, made possible the initial discovery of the Van Allen radiation belts. Subsequent scientific satellites and probes of the PIONEER and EXPLORER series enabled us to map the Van Allen belts and yielded much additional data. We have learned, and through future experiments will learn a great deal more, about radiation from the sun, from the earth, about magnetic fields in space, the density of cosmic dust, the distribution of meteoric particles, about the size and shape of the earth, and even the size of the solar system by measuring more accurately the distance between space probes and the earth. We are engaged in an extensive program of international cooperation with scientists in numerous other countries and continue to make our scientific findings freely available to the world scientific community. Our program of international cooperation will grow in the years to come.

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The national program for the scientific exploration of space has four main approaches. A large number of small payloads are launched each year with sounding rockets. These payloads follow a ballistic trajectory and provide a variety of measurements, of the atmosphere and in space at altitudes to about 4000 miles. Some of these flights will also serve as flight development tests of instruments that are intended for later satellite and deep space probes. This sounding rocket program is expected to continue at a constant rate throughout the next decade.

The second part of the scientific exploration program is based upon measurements with earth satellites, as for example the already discussed PIONEER and EXPLORER series. In the next several years specialized satellites will be launched that will exploit the maximum capabilities of the current U. S. launching vehicles. By 1963, larger vehicles will be available and the scientific satellite program will, for the remainder of the decades, be substantially based on a series of large, general purpose observatory-type spacecraft. Developmental contracts have already been initiated for these observatories: (a) a solar observatory to provide a multiplicity of measurements of interacting sun-earth phenomena; (b) an astronomical observatory to provide an extension of man's observational powers to the whole range of spectra emitted from the universe; and (c) a geophysical observatory to permit simultaneous measurements of the physical quantities in space that are affected by the earth's properties (e.g., atmospheres, ionospheres, magnetic, electrical, and gravitational fields, energetic particles, cosmic rays, etc.). Each of the observatories will contain many individual experiments and will afford an opportunity for experimentation by co-operating scientists throughout the world. Other international experiments of a specialized nature will be conducted using the NASA Scout launch vehicle and NASA sounding rockets.

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A program of scientific exploration of the moon with instrumented, unmanned spacecraft will constitute the third phase of scientific exploration for the next decade. Within a few months, development flights will be made of a new lunar spacecraft called Ranger. Starting early in 1962 a series of seven of these spacecraft will be launched at the moon. Each will contain photographic equipment capable of recording and transmitting a series of increasingly detailed photographs of the lunar surface as the spacecraft approaches the moon. Shortly before impact, a portion of the spacecraft will be detached and slowed down so that it impacts the moon at a low enough speed to permit instruments to continue to operate on the moon's surface. Several survivable instruments will be included in the over-all program such as seismometers, to measure tremors; penetrometers, to measure the hardness of the surface layer; and, scanning TV to provide close-up details of topography in the vicinity of the impact point.

A second lunar exploration spacecraft, Surveyor, is now under development and a series of ten will be launched beginning in 1963. These will land softly on the moon's surface and will contain a variety of instruments for measuring lunar properties. One of the principal measurements will be a core-sampling through five feet of the moon's crust with on-board analysis of the samples. These results, together with radiation measurements, scanning television pictures, etc., will be transmitted back to the earth.

The last phase of the scientific exploration program is that involving studies of the near-by planets, Venus and Mars, and the intervening space. Spacecraft are now under construction for these missions called Mariner. The initial exploration attempts of the planets, which can only occur at definite intervals when the earth is favorably located, will involve fly-by measurements of the planetary properties. Such an attempt will be made at Venus in the summer of 1962, and again in 1964 n both Venus and Mars are attainable.

Studies are already underway of advanced planetary spacecraft

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that will be able to go into orbit about Venus and Mars. The planetary satellites will transmit long-term information similar to that now obtained near the earth.

2. Commercial/Civilian.

Vigorous programs are underway to use space for practical, commercial purposes. The outstanding success of the two U. S. meteorological satellites launched to date, TIROS I and TIROS II, has amply demonstrated the utility that space vehicles may be expected to contribute to this area of man's daily concern. The data obtained from these satellites has been used on a semi-operational base by the Weather Bureau, the Air Weather Services of the Department of Defense, and on a more limited basis by a number of participating foreign governments. Sufficient additional TIROS launchings are planned to maintain a continuous source of weather observations using this satellite until a more advanced spacecraft can be employed.

The present TIROS orbit is at a relatively low inclination to the equator, so that observations are only possible in the middle latitude from 50°N to 50°S. The recommended program provides for additional launches to be made on a continuing basis in orbits that will provide weather data over a larger percentage of the earth's surface.

TIROS has several limitations that make it too elementary for a truly operational meteorological system. It is spin-stabilized so that its axis always points in the same direction out into space. As a consequence, the cameras for photographing cloud cover only point at the earth during part of the orbit. In addition, the amount of instrumentation for making measurements of meteorological interest is limited.

These limitations will be eliminated in the next step in the meteorological satellite program which is already underway. A larger, non-spinning spacecraft, NIMBUS, is under development, which will be launched in a polar orbit and which will point at the earth at all times by means of an on-board stabilization system. The first of these

acecraft will be flown in 1962 and it is possible that sufficient reliability can be achieved to permit a fully operational system by 1963.

Satellite-based telecommunications systems are another application of space technology which will be of great commercial/civilian interest and value in future years. In fact, numerous U. S. commercial enterprises, both equipment manufacturers and common carriers, are greatly interested in this field. Both NASA and the DoD have undertaken projects for the development of communications satellites. Both agencies have studied the subject in depth.

Both agencies have worked closely with the FCC, the OCDM, the White House staff, and other agencies and officials concerned with this subject. Despite the interest evidenced by commercial companies, the technology is not in hand. It is likely that the major preliminary steps leading to the development of commercially feasible communication satellite technology, including the acquisition of environmental data needed to design the satellite vehicle for successful operation, must be done by the Government. Otherwise we must wait until the state-of-the-art generally has developed and deployed on a commercially economical basis.

Accordingly, we have recommended that the NASA Relay project already underway be expanded in FY 62. Within the next few years this country, which is already the world's leader in communications of all kinds, will be able to deploy a worldwide satellite-based communication capability which will enable our friends everywhere to talk with us and among themselves.

The TRANSIT project will permit ships at sea to use radio signals to determine their position within a fraction of a mile. Again, reliability and cost stand in the way of operational deployment. Within a few years this capability, too, will be operationally feasible and ships at sea, whether military or commercial, will be able to utilize the TRANSIT system to determine their position in any kind of weather, night or day.

Apart from the important technological byproducts of all phases of our space undertakings, these are the principal operational capabilities which today appear promising for commercial/civilian application during the first half of this decade. Our space effort must include rapid deployment and exploitation of satellites for these purposes.

3. Military

The existence of the Iron Curtain creates an asymmetry in military needs between the U. S. and the Soviet Union which compels us to undertake a number of military missions utilizing space technology that would appear to be unneeded by the USSR. We have in the past and are likely in the future to continue to feel the need for reconnaissance. The SAMOS project is intended to fill this need. We have also felt the necessity to provide ourselves with the earliest possible warning of ballistic missile attack. The MIDAS system is being undertaken in an effort to develop a satellite-based early warning capability. [redacted] Even here, at least with respect to MIDAS, the military value of additional warning, which MIDAS might provide, is being strongly questioned; nor is it certain by any means that the MIDAS concept will prove to be technically feasible without altogether unwarranted complexity and expenditures.

Communication satellites look very promising from a military point of view. Some of the characteristics most useful to the military, such as cryptological security, are not necessary and are not economical from a commercial point of view. The Department of Defense has undertaken the development of the ADVENT communication satellite system which may become operational in about 1965.

Space technology, however, is in its infancy. The U. S. conspicuously lacks the capability to place large payloads into orbit. The military applications of such capabilities are not clearly discernable but

hat does not mean that they will not exist. For this reason, the Department of Defense will undertake the development of large scale segmented solid propellant booster motors. This development will be conducted to meet the requirements of the NASA man-in-space program. The possession of this capacity is considered an important item of insurance for the future from a military point of view.

4. Prestige

A number of U. S. programs, although they are primarily being undertaken for reasons such as scientific knowledge or commercial/civilian values, will have a major worldwide prestige effect. The Ranger and Surveyor projects are designed to give us information about the space near the moon and of the nature and character of the moon surface and interior. Although the Russians have impacted the moon with an object they have not as yet landed instruments on the moon or taken close up pictures of the moon. Our first flights with the Ranger spacecraft are scheduled for calendar 1961. Should we succeed before the Russians substantial prestige value will be ours. The information from the Ranger and Surveyor programs is also an essential prerequisite to manned lunar flights.

Of all the programs planned, perhaps the greatest unsurpassed prestige will accrue to the nation which first sends man to the moon and returns him to earth. The technological advance that will result from the manned lunar landing effort may ultimately overshadow the prestige that will be gained.

The exploration of space will not be complete until man directly participates as an explorer. The national program for manned flight is directed at the earliest accomplishment of this role for man. Project Mercury has already achieved the first milestone of limited, short-duration ballistic flight. By the end of this calendar year it is expected that a four-and-one-half hour flight three times around the earth will have been accomplished.

The next major milestone of unsurpassed achievement is the landing of man on the moon. This program, to be known as Project Apollo, has been considered as an active part of NASA planning for the past several years. While the manned lunar landing is an ultimate objective, significant intermediate steps must be undertaken. Information must be acquired in the nature and effect of space radiation on man, man's existence in the hard vacuum of space, and the effects of extended periods of weightlessness on man's performance. Much of the scientific program is geared to the acquisition of this data. Laboratory research has been underway in the nature of and the solution for the intense heating problem during re-entry. The lunar characteristics as a landing site must be understood. The lunar scientific experiments are designed to acquire this information. Finally, adequate launch vehicles must be developed, not only for the final landing mission, but for the intermediate developmental steps. These will include manned orbital flight around the earth for extended periods, and manned circumlunar flight.

The extended orbital flight will be accomplished for periods up to 27 hours (18-orbits) using modified Mercury capsules. The necessary longer duration (2 weeks) flights will utilize the Saturn C-1 launch vehicle and a version of the final lunar landing capsule. Prior to these flights, it will be necessary to fly primates for extended periods. They will be done with modified Mercury capsules.

The manned circullunar flight must have a greater launch vehicle capability than the earth orbital flights. This may be provided by the Saturn C-2 vehicle. The final lunar landing will require a launching vehicle from earth that is about six times as big as Saturn. NASA has the 1.5 million lb. thrust F-1 engine under development. This engine is expected to power a Nova vehicle. At the same time a parallel development leading towards large launch vehicles based on solid propellants will be undertaken. As one or the other approach proves superior that approach will be selected for the NOVA vehicle. The DoD will carry out the solid [illegible] development with full responsiveness to NASA requirements.