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REPORT TO THE

PRESIDENT-ELECT

OF THE AD HOC COMMITTEE ON SPACE

CLASSIFIED

VERSION

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I. Introduction

Activities in space now comprise six major categories:

1. Ballistic missiles.
2. Scientific observations from satellites.
3. The exploration of the solar system with instruments carried in deep space probes.
4. Military space systems.
5. Man in orbit and in space.
6. Non-military applications of space technology.

We rely on the first member of the list, ballistic missiles, for a large part of the retaliatory response to the Russian missile threat. (At any moment we can expect Russian missile developments which would permit them to state their threat in more powerful language by demonstration of ever more massive vehicles under more and more precise control).

It is the assumption of the American citizen that the largest national effort of the United States is the preparation of the ballistic counter-threat and the determined acceleration of research development and production to place on site missiles that will prevent the Russians from attempting to frighten us in the future. It is the assumption of the American citizen that what is being spent in all categories of space activity is being spent first of all to contribute to this defense, and it is for this reason that there is sympathetic support of the vast expenditure in the other domains on the list of space projects. The fact is, however, that the sense of excitement and creativity has moved away from the missile field to the other components of the list, and that missiles, long before they are in condition for us to depend upon them, are slowly being delegated to the category of routine management. Before we proceed in this report to discuss

and support the important activities in the other five categories we wish to emphasize the hazard of failing to complete and deploy on time the most important of all space programs, our intercontinental deterrent missiles.

In addition to the need to develop ballistic missiles to provide for our military security, there are five principal motivations for desiring a vital, effective space program. It is important to distinguish among them when attempting to evaluate our national space effort.

First, there is the factor of national prestige. Space exploration and exploits have captured the imagination of the peoples of the world. During the next few years the prestige of the United States will in part be determined by the leadership we demonstrate in space activities. It is within this context that we must consider man in space. Given time, a desire, considerable innovation, and sufficient effort and money, man can eventually explore our solar system. Given his enormous curiosity about the universe in which he lives and his compelling urge to go where no one has ever been before, this will be done.

Second, we belive that some space developments, in addition to missiles, can contribute much to our national security -- both in terms of military systems and of arms-limitation inspection and control systems.

Third, the development of space vehicles affords new opportunities for scientific observation and experiment -- adding to our knowledge and understanding of the earth, the solar system, and the universe. In the three years since serious space exploration was initiated the United States has been the outstanding contributor to space science. We should make every effort to continue and to improve this position.

Fourth, there are a number of important practical non-military applications of space technology -- among them satellite communications

and broadcasting; satellite navigation and geodesy; meteorological reconnaissance; and satellite mapping -- which can make important contributions to our civilian efforts and to our economy.

Finally, space activities, particularly in the fields of communications and in the exploration of our solar system, offer exciting possibilities for international cooperation with all the nations of the world. The very ambitious and long-range space projects would prosper if they could be carried out in an atmosphere of cooperation as projects of all mankind instead of in the present atmosphere of national competition.

The ad hoc panel has made a hasty review of the national space program, keeping in mind the objective -- to provide a survey of the program and to identify personnel, technical, or administrative problems which require the prompt attention of the Kennedy administration. We have identified a number of major problems in each of these categories, and they will be discussed in this report. It is obvious that there has been inadequate time to examine all facets of the program or to permit full consideration of the possible answers to many of the questions raised.

Because of the overriding necessity to provide more efficient and effective leadership for the program, the group has devoted a major portion of its time to this aspect of the space program. We will, however, indicate important scientific and technical problems which should be thoroughly examined as soon as possible. We have concluded that it is important to reassess thoroughly national objectives in the space effort -- particularly in regard to man in space; space science and exploration; and the non-military applications of space, in order to assure a proper division of effort among these activities. Space activities are so unbelievably expensive and people working in this field are so imaginative that the

space program could easily grow to cost many more billions of dollars per year.

While we are now compelled to criticize our space program and its management, we must first give adequate recognition to the dedication and talent which brought about very real progress in space during the last few years. Our scientific accomplishments to date are impressive, but unfortunately, against the background of Soviet accomplishments with large boosters, they have not been impressive enough.

Our review of the United States' space program has disclosed a number of organizational and management deficiencies as well as problems of staffing and direction which should receive prompt attention from the new administration. These include serious problems within NASA, within the military establishment, and at the executive and other policy-making levels of government. These matters are discussed in the sections which follow.

II. The Ballistic Missile Program

The nation's ballistic missile program is lagging. The development of the missiles and of the associated control systems, the base construction, and missile procurement must all be accelerated if we are to have the secure missile deterrent force soon that the country has been led to expect.

While additional funds will undoubtedly be required to accomplish this, we believe that re-establishing an effective, efficient, technically competent management for the program is the overriding necessity.

Though the missile program is not ordinarily regarded as part of the space program, it is important to recognize that for the near future the achievement of an adequate deterrent force is much more important

for the nation's security than are most of the space objectives, and that at least part of the difficulty in the management and execution of the program stems from the distraction within the Defense Department and in industry caused by vast new space projects. However, we have no alternative but to press forward, with space developments.

III. Organization and Management

There is an urgent need to establish more effective management and coordination of the United States space effort. The new administration has promised to move our country into a position of preeminence in the broad range of military, cultural, scientific and civilian applications of satellite and other space vehicles. This cannot be done without major improvements in the planning and direction of the program. Neither NASA as presently operated nor the fractionated military space program nor the long-dormant space council have been adequate to meet the challenge that the Soviet thrust into space has posed to our military security and to our position of leadership in the world.

In addition to the difficulties and delays which the program has endured because of the lack of sufficient planning and direction, it has also been handicapped because too few of the country's outstanding scientists and engineers have been deeply committed to the development and research programs in the space field. In changing the management structure and in selecting the administrators for the effort, the need to make space activities attractive to a larger group of competent scientists and engineers should be a guiding principle.

The new administration has announced that it plans to use the National Aeronautics and Space Council for coordinating government space

activities, for advising the President on policy on plans and on the implementation of programs. We believe that the space council can fulfill this role only if it is technically well-informed and, moreover, seriously accepts the responsibility for directing the conduct of a coherent national space effort. Particular care should be taken to insure the selection of a very competent and experienced staff to assist the Council.

Not only must we provide more vigor, competence and integration in the space field, but we must also relate our space requirements to other vital programs which support our national policy. We refer particularly to the missile needs, already mentioned, and to the continuing need for development and research in the field of aeronautics.

Each of the military services has begun to create its own independent space program. This presents the problem of overlapping programs and duplication of the work of NASA. If the responsibility of all military space developments were to be assigned to one agency or military service within the Department of Defense, the Secretary of Defense would then be able to maintain control of the scope and direction of the program and the Space Council would have the responsibility for settling conflicts of interest between NASA and the Department of Defense.

With its present organizational structure and with the lack of strong technical and scientific personalities in the top echelons, it is highly unlikely that NASA space activities can be greatly improved by vitalization of the Space Council.

We are also concerned by the NASA preoccupation with the development of an in-house research establishment. We feel that too large a fraction of the NASA program, particularly in the scientific fields, is being

channeled into NASA-operated facilities. NASA's staff has had to expand much too rapidly and without adequate selectivity, so that many inexperienced people have been placed in positions of major responsibility. This has, in turn, made NASA less willing than would a more mature and competent organization to solicit and accept the advice of competent non-government scientists. This situation appears to be improving at the present time.

One important responsibility of NASA given little attention now in the organization, is that of providing for basic research and advanced development in the field of aeronautics. There is a general belief in the aviation industry that the national preoccupation with space developments has all but halted any advance in the theory and technology of aerodynamic flight. There is ample evidence to support the contention that the Russians and possibly the British, are surpassing us in this field and consequently in the development of supersonic commercial aircraft. We should make a substantial effort to correct this situation, possibly by getting some of NASA's aeronautical and aerodynamic experts back into the field of advanced aircraft research and development. Possibly, after careful investigation, the Space Council would prefer to stimulate this work by non-governmental arrangements, or by placing it entirely in another agency.

We believe that the work of NASA would be facilitated and the task of recruiting the needed staff made possible if an outstanding expert was placed in charge of the direction and management of each of the following important areas of work:

a. Propulsion and vehicle design and development
b. The space sciences
c. Non-military exploitation of space technology
d. Aeronautical sciences and aircraft development

IV. The Booster Program

The inability of our rockets to lift large payloads into space is the key to the serious limitations of our space program. It is the reason for the current Russian advantage in undertaking manned space flight and a variety of ambitious unmanned missions. As a consequence, the rapid development of boosters with a greater weight-lifting capacity is a matter of national urgency.

Payload weight is currently limited by our dependence on modified military rockets as the primary boosters (THOR, JUPITER, ATLAS). Current plans call for the first substantial increase in payload with the addition of the CENTAUR upper stage to the ATLAS in 1962, followed by a second big step with the SATURN booster in 1965.

It is likely that a variety of new booster programs will be proposed in the near future, particularly for military projects. There are no fundamental differences in civilian and military requirements which are foreseeable now. If the national effort is to be focused and the very large expenditures are not to be distributed among an excessive number of booster programs, it is important that we maintain and strengthen the concept of a National Booster Program.

A number of problems may well arise in the National Booster Program. The present MERCURY program, based on the ATLAS, is marginal and if the ATLAS proves inadequate for the job it may be necessary to push alternatives vigorously. The first possibility appears to be the TITAN, although it has not yet demonstrated the reliability which is required. We should study the desirability of carrying out a TITAN-boosted MERCURY program in the event ATLAS should prove to be inadequate.

The CENTAUR rocket involves an entirely new technology and is still

untested. If difficulties develop in this program within the next three or four months we must act promptly to initiate an alternate.

Development of the SATURN-booster -- a cluster of eight ATLAS engines -- should continue to be prosecuted vigorously. However, it would be dangerous to rely on SATURN alone for the solution to our problems, either in the long or short term, for two reasons:

(a) It is intrinsically so complex that there is a real question whether it can be made to function reliably.

(b) It represents a maximum elaboration of present technology and provides no route to further development.

Therefore, the development of a very large single engine should proceed as fast as possible, so that it may be a back-up for the SATURN cluster and a base for future larger vehicle development. The present F-1 (1.5 million lb. thrust) engine development should be studied to be sure it is progressing fast enough and has enough promise of success to fill this role. If the technological step in going from the present 180,000 lb. thrust engines to 1.5 million lbs. is so big as to make success marginal, a parallel development of a somewhat smaller engine should be started.

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Above all we must encourage entirely new ideas which might lead to real breakthroughs. [redacted] This proposal should receive careful study with a realization of the international problems associated with such a venture.

V. Military Space Programs

We have a large military space program in being and continuing to grow. In addition, each of the three major military services plus the Advanced Research Projects Agency (ARPA) is clamoring for a major role in space. The organizational hiatus posed by these conditions is treated elsewhere in this paper.

There are important and unique uses of space for national security and in support of our treaty alliances throughout the world. There are also important uses of space systems for arms-control purposes.

There are also many uses of space for military purposes which are now in the planning or study stage which, if allowed to continue, will jeopardize the value we can derive from valid military space programs. It is necessary that these projects and concepts be eliminated at an early date.

In absence of treaties preventing all nations from exploiting space for military advantage, the United States' policy on this matter must be that we take no new action which will foreclose development of

space systems in support of our legitimate military needs.

The most urgent and immediate use of space systems for military purposes is for surveillance and target reconnaissance over the land masses of the world with particular emphasis on the Sino-Soviet bloc of nations. The technical progress we have made in this area will be discussed separately. This program is presently organized with a special security organization in such a manner that our other military space programs and plans are subordinated and to an extent interfered with. This can and must be corrected.

Perhaps the most disturbing and potentially dangerous part of the space program is the international aspect of the SAMOS and MIDAS programs. Our present policy concerning the use of these devices is criticized in an article by G. Zhukov - "Space-Espionage Plans and International Law" - published in the English edition of "International Affairs" in October of 1960. This publication originates with the Soviet Society for the Popularization of Political and Scientific Knowledge. It is suggested that members of the incoming administration read this article and seriously consider taking emergency steps to salvage the SAMOS program from destruction by international political action on the part of the Soviets. Many suggestions have been advanced in this connection. One such suggestion is that we unilaterally announce the SAMOS flights to the U.N., invite U.N. inspection (technical details of inspection to be defined by the U.S.), and that we make available the data obtained from the SAMOS to all the nations of the U.N. The urgency of arriving at a new solution to the SAMOS international relations problem is of the highest order of priority for our national security.

The U.S.A.F. provides 90 percent or more of the resources and

physical support required by the space programs of other agencies and is the nation's principal resource for the development and operation of future space systems, except those of a purely scientific nature assigned by law to NASA.

In view of the likely need of large boosters for military purposes, the military establishments have a vital interest in the development of such boosters. This emphasizes again the necessity of a really effective national effort for the development of larger boosters. The question should be re-examined whether this program should or should not be carried out entirely by a civilian agency.

The Chief of Staff of the A.F. through the Commander for Research and Development Command (ARDC) has recognized this dilemma and expressed his concern for the disorder in the space program. He has established a special Space Study Committee of 15 members chairmanned by Mr. Trevor Gardner, which has been at work since October 10, 1960 on the technical objectives and organizational needs of the military space program. This committee, consisting of some of the nation's outstanding and eminent scientists and industrialists has established a full-time task force which is working as a supporting technical group and is housed at the Los Alamos Scientific Laboratory in New Mexico. This support group is known as the Los Alamos Study Group. The report of the Gardner Committee, reflecting the output of the Los Alamos Study Group, will be available on February 15th. It has been designed to provide, in the military space field, the same quality of technical and organizational innovation and validation which the Von Neumann Committee provided the ballistic missile program in 1953.

The central problems of the military space program for which recommendations will be forthcoming from the Gardner Committee are:

1. The technical military objectives and critique of existing military space program.
2. International implications of the military space program.
3. Expanded booster program including an examination of nuclear propulsion.
4. Organization of the national booster program.
5. Organization of the military departments to fully exploit military space developments to avoid duplication between services and to prevent interference with the intercontinental ballistic missile programs.

Only a few short years ago we could not perceive meaningful space programs of value to the U.S. and the world. We can now see with some clarity communication, navigational, meteorological, television, military intelligence - surveillance, as well as geodetic requirements of considerable urgency in space. Most of these requirements have civilian as well as military implications. Tomorrow's future in space is quite obscure, but the feeling prevails that it holds great promise as yet undefined. The combination of nuclear energy plus the freedom of space utilization promises future realities of both great danger and great benefit to mankind.

Large bombs in orbit, manned space stations, early manned lunar landing and return, giant 100-200 megaton ICBMS, communications blackouts caused by space nuclear bursts may all be part of this future.

Of most immediate concern is a crash program to destroy or neutralize satellites.

The Gardner Committee will do its best to define the technically possible of today and the technically probable of tomorrow and recommend a program for accomplishment.

We dare not foreclose or prejudice the attainment of this future until we fully understand its meaning. We must manage this future instead of being managed by it. Only a virile and unique national space organization and the stimulation of the greatest possible intellectual quality will cause this to occur.

VI. Science in Space and Space Exploration

In the three years since space exploration began, experiments with satellites and deep space probes have provided a wealth of new scientific results of great significance. In spite of the limitations in our capability of lifting heavy payloads, we now hold a position of leadership in space science. American scientists have discovered the great belt of radiation, trapped within the earth's magnetic field. American scientists have revealed the existence of a system of electric currents that circle our planet. Our space vehicles have probed the interplanetary space to distances of tens of millions of miles from the earth. They have shown that the earth is not moving through an empty space but through an exceedingly thin magnetized plasma. They have intercepted streams of fast-moving plasma ejected from the sun which, upon reaching our planet, produce magnetic storms, trigger off auroral displays and disrupt radio communications.

From these and other experiments, there is gradually emerging an entirely novel picture of the conditions of space around our planet

and of the sun-earth relations. One of the important tasks of space science in the next few years will be a full exploration of the new field revealed by the early experiments. There is little doubt that such exploration will lead to further important discoveries.

Another scientific field, where space science promises an early and major break-through is that of astronomy. Until a few years ago, visible light from celestial objects, reaching our telescopes through the atmospheric blanket, had been the only source of astronomical information available to man. The only other portion of the spectrum capable of penetrating the atmosphere and the ionosphere is that corresponding to short-wave radio signals. In recent years, the development of radio telescopes has made it possible to detect these signals. Radio astronomy has enormously advanced our knowledge of the universe. By means of radio telescopes we can now "see" not only the stars, but also the great masses of gas between the stars; we can detect the high-energy electrons produced by cosmic accelerators located thousands or millions of light years away from the earth.

We are entitled to expect a similar and even perhaps a more spectacular advance the day that we shall have telescopes installed aboard satellites circling the earth above the atmosphere and the ionosphere. These instruments will be capable of detecting the whole of the electro-magnetic spectrum - from long-wave radio signals to gamma-rays.

A third major task of space science in the years to come will be the exploration of the moon and the planets. Scientists are planning to fly instruments to the vicinity of these celestial objects, and eventually to land them upon their surface. From the data supplied by

these instruments they expect to obtain information of decisive importance concerning the origin and the evolution of the solar system. Moreover, there is the distinct possibility that planetary exploration may lead to the discovery of extra-terrestrial forms of life. This clearly would be one of the greatest human achievements of all times.

Our present leadership in space science is due to a large extent to the early participation of some of our ablest scientists in our space program - primarily as part of the International Geophysical Year - and to the fact that these scientists were in a position to influence this program. Another important factor was our initial advantage in instrumentation, which helped to offset our disadvantage in propulsion.

We must not delude ourselves into thinking that it will be easy for the U.S.A. to maintain in the future a prominent position in space science. The USSR has a number of competent scientists. It will be easier for them to catch up with us in instrument development than for our engineers to catch up with the Russians in the technique of propulsion. Thus we must push forward in space science as effectively and as forcefully as we can.

Our scientific program in space appears to be basically sound. However, to insure its success, the following requirements must be met.

1. In the planning of our space activities, scientific objectives must be assigned a prominent place.
2. Our space agency must insure a wide participation in its program by scientists from universities and industrial laboratories, where our greatest scientific strength lies.

3. It must provide adequate financial support for the development and construction of scientific payloads.

4. It must exert the greatest wisdom and foresight in the selection of the scientific missions and of the scientists assigned to carry them out.

5. It must initiate immediately a research program in advanced instrumentation, so that we may be ready to exploit fully the capability of flying heavier and more complex payloads that we shall possess several years from now. Problems of automation, processing and transmission of information must be tackled by competent and imaginative research teams.

NASA has not fulfilled all of the above requirements satisfactorily. We believe, as previously stated, that the main obstacle here has been the lack of a strong scientific personality in the top echelons of its organization.

VII. Man in Space

We are rapidly approaching the time when the state of technology will make it possible for man to go out into space. It is sure that, as soon as this possibility exists, man will be compelled to make use of it, by the same motives that have compelled him to travel to the poles and to climb the highest mountains of the earth. There are also dimly perceived military and scientific missions in space which may prove to be very important.

Thus, manned exploration of space will certainly come to pass and we believe that the United States must play a vigorous role in this venture. However, in order to achieve an effective and sound program in this field, a number of facts must be clearly understood.

1. Because of our lag in the development of large boosters, it is very unlikely that we shall be first in placing a man into orbit around the earth.
2. While the successful orbiting of a man about the earth is not an end unto itself, it will provide a necessary stepping stone toward the establishment of a space station and for the eventual manned exploration of the moon and the planets. The ultimate goal of this kind of endeavor would, of course, be an actual landing of man on the moon or a planet, followed by his return to the earth. It is not possible to accomplish such a mission with any vehicles that are presently under development.
3. Some day, it may be possible for man in space to accomplish important scientific or technical tasks. For the time being, however, it appears that space exploration must rely on unmanned vehicles. Therefore, a crash program aimed at placing a man into an orbit at the earliest possible time cannot be justified solely on scientific or technical grounds. Indeed, it may hinder the development of our scientific and technical program and even the future manned space program by diverting manpower, vehicles and funds.

4. The acquisition of new knowledge and the enrichment of human life through technological advances are solid, durable, and worthwhile goals of space activities. There is general lack of appreciation of this simple truism, both at home and abroad. Indeed, by having placed highest national priority on the MERCURY program we have strengthened the popular belief that man in space is the most important aim of our non-military space effort. The manner in which this program has been publicized in our press has further crystallized such belief. It exaggerates the value of that aspect of space activity where we are less likely to achieve success, and discounts those aspects in which we have already achieved great success and will probably reap further successes in the future.

5. A failure in our first attempt to place a man into orbit, resulting in the death of an astronaut, would create a situation of serious national embarrassment. An even more serious situation would result if we fail to safely recover a man from orbit.

On the basis of these facts we would like to submit the following recommendations:

1. By allowing the present MERCURY program to continue unchanged for more than a very few months, the new Administration would effectively endorse this program and take the blame for its possible failures. A

thorough and impartial appraisal of the MERCURY program should be urgently made. The objectives of the various phases of this program (including the proposed physiological tests) should be critically examined. The margins of safety should be realistically estimated. If our present man-in-space program appears unsound, we must be prepared to modify it drastically or even to cancel it. It is important that a decision on these matters be reached at the earliest possible date.

2. Whatever we decide to actually do about the man-in-space program, we should stop advertising MERCURY as our major objective in space activities. Indeed we should make an effort to diminish the significance of this program to its proper proportion before the public, both at home and abroad. We should find effective means to make people appreciate the cultural, public service and military importance of space activities other than space travel.

VIII. Non-military Applications of Space Technology - An Industry-Government Space Program

As the technical feasibility and reliability of man-made satellites was demonstrated, many possible civilian uses for satellites emerged. With no government support, various groups in private industry have examined the field for areas of study and development and a few substantial projects are already under way.

Industrial and governmental communications satellites appear practical and economically sound. Communication satellites will provide high quality and inexpensive telephone and general communication service between most parts of the earth. A by-product of a communication satellite will almost surely be an international television relay system linking all the nations of the world. On a longer time scale it should be feasible to provide radio and television broadcasting service via satellite-mounted transmitters. Such systems would give the quality broadcast reception now only available in and near urban areas to most of the inhabitants of the earth.

Satellites containing reliable beacons can be used to provide improved means of navigation for aircraft and ships at sea and can greatly advance the field of geodetics.

Proper use of the information gathered by meteorological satellites should greatly increase our understanding of meteorology. With more knowledge of meteorology and with world-wide data frequently available from the satellites, longer-range and more reliable weather predictions should be possible. These projects, dreams a decade ago, bridge areas of technical speciality in which this nation is unexcelled. The United States has the most advanced communication system in the world, with a vast scientific and technological base supporting the communication industry. We are preeminent in the development of our electronic skills in radio, television, telephone and telegraphy. This entire industrial-scientific base is available to apply its art through satellite systems to the civilian needs of the world.

The exploitation of a new area of industrial opportunity for civilian use is normally left by our government to private enterprise.

However, in the case of these important space systems, the development investment required is so large that it is beyond the financial resources of even our largest private industry. Furthermore, the use of commercial space satellites will require physical support of government installations as well as financial support.

All of the civilian satellite projects listed here will have direct or indirect military usefulness as well. Furthermore, communication and navigation systems of the type envisaged would be extremely useful in implementing an inspection system which might accompany a disarmament agreement. For these reasons projects of the type proposed might well be undertaken in cooperation with the military services.

We recommend that a vigorous program to exploit the potentialities of practical space systems. The government, through NASA or the Department of Defense, should make available the required physical facilities as well as any extraordinary financial support required to make the undertakings successful.

Organizational machinery is needed within the executive branch of the government to carry out this civilian space program.

SUMMARY OF RECOMMENDATIONS

1. Make the Space Council an effective agency for managing the national space program.

2. Establish a single responsibility within the military establishments for managing the military portion of the space program.

3. Provide a vigorous, imaginative, and technically competent top management for NASA, including:
   (a) Administrator and deputy administrator
   (b)
      i A technical director for propulsion and vehicles
      ii A technical director for the scientific program
      iii A technical director for the non-military space applications
      iv A technical director for aerodynamic and aircraft programs.

4. Review the national space program and redefine the objectives in view of the experience gained during the past two years. Particular attention should be given the booster program, manned space technology, military use of space to the civilian activities of the country.

5. Establish the organizational machinery within the government to administer an industry-government civilian space program.