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SPACE, MISSILES, AND THE NATION

REPORT

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS
U.S. HOUSE OF REPRESENTATIVES

EIGHTY-SIXTH CONGRESS

SECOND SESSION

PURSUANT TO

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LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., May 18, 1960.

Hon. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics.

DEAR MR. CHAIRMAN: I am forwarding herewith for committee consideration a report, "Space, Missiles, and the Nation," based on 26 open and 6 executive hearings sessions of the committee between January 20 and March 7, 1960, and supplemented by statements filed for the record through May 10, 1960. Eighty-eight witnesses appeared before the committee for these hearings.

This report has been drafted for the committee by the staff, and acknowledgment for individual contributions is as follows: Spencer M. Beresford, section on the Navy; John A. Carstarphen, Jr., section on the Army; Richard P. Hines, section on Office of the Secretary of Defense; Dr. Charles S. Sheldon II, sections on Air Force, introduction, technical societies and related groups, and other witnesses; Raymond Wilcove, section on the National Aeronautics and Space Administration; and Philip B. Yeager, section on the Department of State and U.S. Information Agency.

It has been the purpose of this report to give a fair summary of the testimony taken in the hearings, and readers are referred to the complete record for further details.

CHARLES F. DUCANDER,
Executive Director and Chief Counsel.

LETTER OF SUBMITTAL

HOUSE OF REPRESENTATIES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., July 5, 1960.

Hon. SAM RAYBURN,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: By direction of the Committee on Science and Astronautics, I submit the following report on "Space, Missiles, and the Nation" for the consideration of the 86th Congress.

OVERTON BROOKS, *Chairman.*

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SPACE, MISSILES, AND THE NATION

JULY 5, 1960.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. BROOKS of Louisiana, from the Committee on Science and Astronautics, submitted the following

REPORT

[Pursuant to H. Res. 133]

SPACE, MISSILES, AND THE NATION

Introduction

During the months of January, February, and March, 1960, the Committee on Science and Astronautics conducted a detailed and thorough review of the national space program, and examined the related phases of missile research and development as well, for all of these matters interact to affect the national interest.

Although a large amount of ground was covered, the committee was required to turn its attention to immediate legislative matters before it was able to complete its survey of all elements of the national program. It had particularly wanted to hear from private industry, and accordingly held the record open, hoping that these witnesses could be scheduled later in the year. When this opportunity did not materialize, major companies were invited to submit statements for the record, which was closed May 10, and this report follows in sequence from that closing.

The issues which this report considers are ones of great importance to the national welfare and the national security. There is always a problem in preparing such a report in choosing words which convey this urgency and importance, when the public finds such words jaded from overuse. Looking back over previous reports of this committee, it is also worth noting that many of the things which have been said in the last 2 years are still valid today, and many of the predictions have come true. Earlier recommendations of the committee are still worthy of attention even though they may have passed from current headlines with the march of events.

It is inescapable that much of the testimony presented to the committee, regardless of the experience and the integrity of the witnesses, has been looked upon as political in its implications. This is to be expected, for the matters discussed have been of the highest importance; they deserve consideration by the people and by officials of both the executive branch and the legislative branch of Government for the insights which can be supplied to making policy.

At the same time, this committee has been nonpolitical in its committee actions. Most votes have been unanimous, and where there have been occasional differences of opinion, the split has not been on party lines. The reason for this nonpolitical approach to the work of the committee is that all the members recognize the importance of the issues at stake and have sought to find areas of agreement to create reports which would stress the need for action in solving these problems.

This report has attempted to summarize the highlights of testimony before the committee, together with those conclusions which developed as a consensus. Where views have differed, the report attempts to reflect these shades of opinion.

Department of State and U.S. Information Agency

The interval between the adjournment of the first session of the 86th Congress and the convening of the second session was a period of marked significance in the field of space exploration.

During that time the competition between nations tightened noticeably.

The Soviet Union introduced several spectacular new achievements into the space picture, including a "hard" rocket landing on the Moon and a surveillance of the far side of the Moon by photograph from a lunar probe.

Here in the United States, the American space effort was advancing methodically in certain phases of its program, expeditiously in others, but appeared to be lagging in certain very crucial phases including propulsion.

In spite of successful satellite launchings and missile advances, in spite of valuable data collection, reduction, and interpretation by U.S. science teams—an astronautic endeavor possibly unequaled elsewhere in the world—it was obvious that the American effort was beset with growing pains, doubts, and some indecision. This may have been a normal condition under the circumstances, but if so it was nonetheless a risky one in view of the apparent stakes involved.

It was in the hope of ascertaining the exact nature of these stakes that the committee opened hearings January 20, 1960, with major witnesses who had been asked to discuss the American space program in hitherto undefined terms.

Exactly how important *is* the space program when viewed in the total context of domestic and world conditions? Does it or does it not merit top priority? If so, on what basis?

Chairman Overton Brooks set the tone of the hearings by opening them with these words:

> Those of us on this committee would be indulging in fanciful thinking if we did not admit to ourselves that the U.S. space effort has reached neither the pace nor the proportions which we had hoped for when we passed the National Aeronautics and Space Act in July 1958. Perhaps we expected too much. But there are definite indications—these have existed some time—that a true sense of urgency has not constantly attended the American space program. * * *
>
> It is our intention here to make a thorough and careful review of the U.S. space program, to study the problems it presents with expert assistance, and to recommend to the Congress ways and means of shunting that program onto the fastest possible track.
>
> We are beginning these hearings in a way in which we believe will place them in their proper context. We will be hearing from crucial witnesses whom we have asked to give an appraisal of the importance of the American space effort from the point of view of their particular departments. It is our hope that in this way we will be able to measure the true significance of that effort as a force—both domestic and international—in the scheme of our affairs as it exists today.
>
> After establishing this broad view, we intend to investigate the details and specifics of the space program with subsequent witnesses and thus endeavor to locate its "soft spots" and find out what can be done about them.

Thus the committee arranged its hearings in a manner designed to focus attention, for the first time, on the specific *value* of the space program as a national asset.

Well in advance of hearings, lead witnesses were requested to be ready to give their appraisal of the space program in these terms and

in light of the objectives of their particular departments which included the Department of State, the U.S. Information Agency, the Department of Defense, and the Central Intelligence Agency, as well as the National Aeronautics and Space Administration.

When the heads of the agencies had completed their testimony, it was unmistakably clear that the American space program had become not only an integral and permanent part of the national scene, but an essential part, the successful prosecution of which is mandatory for the country's security, welfare, and standing in the international community.

The committee, in undertaking its subsequent study of the details of the space program, considered it most important to view that program against the background of these initial assessments which may be summarized as follows:

Livingston T. Merchant, Under Secretary of State for Political Affairs:

The exploration and use of outer space have introduced a new element into the complex of factors governing relations among nations. What we do in this new field and the manner in which we do it have both actual and symbolic significance.

Although the practical potentialities of outer space activities cannot now be fully foreseen, outer space clearly represents a field from which man may derive substantial benefits, into which man may strive to extend his power and influence, and about which conflicts may arise. All nations have an interest in the opportunities and problems thus presented.

Besides this fact, the achievements of a nation in outer space may be construed by other nations as dramatically symbolizing national capabilities and effectiveness. The challenge to the imagination has been great. Equally great have been the skills and resources needed to respond to this challenge. Consequently, achievements in outer space have been both startling and impressive.

The connotations of those achievements are inescapable. The sending of a manmade object into orbit around the Earth or beyond the claim of the Earth's gravity requires a very high order of scientific knowledge and skill supported by extensive technological and industrial capabilities. Furthermore, a flight into outer space which itself has no direct military importance may have military implications since the performance of space vehicles is indicative of missile capabilities in thrust and, to an extent, guidance. * * *

The performance of the United States and the Soviet Union in outer space will inevitably be compared by the rest of the world, and I wish to leave no doubt in the committee's mind that the Department of State fully supports a strong and vigorous outer space effort. As much as developments in any other area, the events in outer space of the past 2 years have made it clear to all that the Soviet threat is neither purely political nor short term. The Soviet accomplishments in this field are witness to strong scientific, technical, and industrial capabilities, organizational effectiveness in concentrated effort, and they reflect growing military strength. These are sobering facts. But the danger to ourselves would come not from recognition of these facts, but from refusal to recognize them.

The international power position of the United States by no means rests on activities in the field of outer space alone. They have, however, because of their dramatic impact, assumed a special significance.

George V. Allen, Director, U.S. Information Agency:

Probably the most significant result of the Soviet successes is a change in the overall impression of the people of the world about the Soviet Union. In public opinion parlance, we speak of this as the revised Soviet image. The change goes beyond the field of space technology. It covers all of Soviet science and technology, plus Soviet military power and general standing.

Before Sputnik I, few people of the free world believed the Soviet was currently in a position to challenge America in the broad fields of science, technology, and production. Now, the Sputniks and Luniks are taken as evidence

that the Soviet Union is able to challenge America successfully in all these fields, including even production.

It is hardly an overstatement to say that space has become for many people the primary symbol of world leadership in all areas of science and technology. * * *

The principal danger in the situation seems to me to be the cockiness which these successes have engendered in Soviet officials themselves. If it were a question merely of competition in scientific achievement, no one could properly begrudge the Soviets their magnificent successes, any more than we should begrudge their economic progress. Nor should one begrudge their new-found feeling of self-confidence. Most foreigners who visited America during the first half of the 19th century found our self-confidence showing on every side. However, if this new-found Soviet cockiness ("arrogance" is not too strong a word) translates itself into adventuresomeness in foreign affairs, the world is in for a good bit of trouble. * * *

All space activities are now seen within the framework of Soviet-American competition. Regardless of how Americans may feel about it, the world sees the United States in a space race with the U.S.S.R. * * *

In summary, I should like to respond to the committee's specific question on the importance our space program may have as a factor in international relations, world prestige, and in the minds of peoples of other countries by concluding that our space program has an importance far beyond the field of the activity itself, that it bears on almost every aspect of our relations with people of other countries and on their view of us as compared with the U.S.S.R. Our space program may be considered as a measure of our vitality and our ability to compete with a formidable rival, and as a criterion of our ability to maintain technological eminence worthy of emulation by other peoples.

As succeeding sections of this report will also reflect, the U.S. space program, then, is described emphatically as vital to America's future. It has been so described by those directly charged with the government of the Nation.

While the testimony of Allen W. Dulles, Director of Central Intelligence, was given in executive session for security reasons, it can be said that the information thus acquired by the committee lends added credence to the themes expressed in the foregoing.

Office of the Secretary of Defense

The intervening years from the end of World War II up to the present could be characterized as the most technologically dramatic period in history. This seems particularly true in reference to the development of the large rocket as a significant military weapon and as the only means by which space exploration has become feasible. Further, during those 15 years, we have witnessed under the stimulus of such programs as the International Geophysical Year the emergence of scientific achievement as a factor of great importance to world prestige and international influence. It has been in those areas of national interest that the Department of Defense, in terms of scope and funding, has played the major role, especially in the many programs associated with space exploration.

Following the close of World War II, the three military services separately conducted many rocket programs for experimental, operational, and scientific purposes. Early and invaluable experience on handling and launching large rockets was gained with German V–2's. At the same time, American capability in the development of large rockets was demonstrated by the Viking, a Navy project that enjoyed signal success. However, despite the variety of programs undertaken and missile types evolved, no integrated programs were initiated

during this early period to produce an effective intercontinental ballistic missile weapon system. The U.S.S.R. lost no time after the close of hostilities in establishing programs of large rocket research based on German achievements and captured enemy personnel, thereby gaining a 5-year lead in experience and know-how over the United States, as demonstrated by its Sputniks and Luniks.

It is obvious that during these relatively early years of advanced rocket technology, investigation into the problems of space flight and man's possible survival out beyond the Earth's atmosphere has been directly dependent upon large boosters developed by the Army and the Air Force for their IRBM and ICBM programs. The measure of success of these programs is most often the efficiency with which they have been managed—within the defined scope of service responsibility—and the rapidity with which decisions could be made and implemented.

One of the major complaints that have been directed toward the Department of Defense by authoritative individuals in and out of Government has been concerned with the bewildering array of policy-making groups and program review organizations through which requests for decisions on our missile programs have had to be channeled. It might be well, at this point, to review briefly the many major agencies of authority over guided missile development that have been created and abolished within the Department of Defense since the end of World War II.

HISTORY OF CONTROL OVER MISSILES IN DOD

The first organization dealing exclusively with guided missiles was established early in 1945 by the Joint Chiefs of Staff for the purpose of reviewing projects concerned with the developing of rockets comparable to the German V–1's and V–2's. This was called the Committee on Guided Missiles and existed to review programs and recommend action.

In 1946 the Joint Research and Development Board created another committee by the same name to coordinate and supervise the missile development programs. This group continued to operate until 1950, when the now defunct Munitions Board established its Joint Aircraft Committee to assist the Board in arranging for the industrial support of the military aircraft and missile programs; and the Secretary of Defense, Gen. George C. Marshall, created within his own office the position of Director of Guided Missiles. This relieved the Munitions Board and the Research and Development Board of their advisory and coordinating responsibilities and attempted to concentrate authority and control within the Department of Defense under Mr. K. T. Keller, former president of Chrysler Motors Corp., who is noted for his outstanding administrative abilities.

However, in 1953, Mr. Charles E. Wilson, the new Secretary of Defense, abolished the office of Director of Guided Missiles. The Munitions Board and the Research and Development Board were abolished and their functions were transferred to the Secretary of Defense. This was ostensibly an attempt again to centralize authority and define areas of research. The result was to place the responsibility for conducting the guided missile programs with the three

separate services and, in effect, to create three new research organizations within the Department of Defense.

Later, to establish centers of control for the programs as conducted by the services, the offices of Assistant Secretary of Defense for Research and Development and the Assistant Secretary of Defense for Applications Engineering were created. The respective authority of these two positions included control of the research and development programs for guided missiles and the industrial production of the missiles as they progressed toward operational status. Both Assistant Secretaries inherited existing subordinate committees to advise, study, and evaluate. These were consolidated into four distinct groups; their missions were defined and assigned to either the Assistant Secretary of Defense for Research and Development or to the Assistant Secretary of Defense for Applications Engineering.

Despite the earnest efforts of the Department of Defense under Secretary Wilson to organize proper channels of management for guided missile research, it was nevertheless necessary to redefine the areas of responsibilities of the two new Assistant Secretaries, once in late 1954 and again in mid-1956.

In 1953 was created the Gardiner Review Committee, which was intended to review the guided missile programs initiated under the previous Secretary of Defense, to eliminate possible duplication, and to standardize missiles for common use by the three services.

Meanwhile, in 1954, the Joint Coordinating Committee was created within the DOD to coordinate and integrate the guided missile projects and to facilitate the exchange of information between the armed services and their programs. The mission of this group, too, had to be clarified by directive in 1955.

Constituted at the same time as the Joint Coordinating Committee was the Technical Advisory Committee on Aeronautics. Despite its title, this committee had, among its responsibilities pertaining to aircraft, an advisory mission for guided missile structure development, design, and test.

Next came the Ballistic Missile Committee, established within OSD in late 1955, to monitor the management, organization, and functioning of the missile projects within the three separate services. At the same time, Secretary Wilson brought into being the Air Force Ballistic Missile Committee and the Joint Army-Navy Ballistic Missile Committee, whose plans were to be reviewed and approved by the Secretary's Ballistic Missile Committee.

Then, in March 1956, came the Office of Special Assistant for Guided Missiles within the Office of the Secretary of Defense to establish more centralized controls and assist in the guidance and coordination of the Army, Navy, and Air Force guided missile programs, including the development of Earth satellite vehicles for the International Geophysical Year.

In 1957, the Congress abolished the Offices of the Assistant Secretaries for Research and Development and for Applications Engineering. At the same time, it created the position of Assistant Secretary for Research and Engineering which included all the responsibilities of the previous assistant secretaries with regard to guided missiles. However, this position was destined to exist only for about 2 years, for in late 1958 it was replaced by the Office of the

Director of Defense Research and Engineering. Earlier that year, the Advanced Research Projects Agency had been created.

In February 1958, under the authority of the 1947 National Security Act, Secretary McElroy created the Advanced Research Projects Agency by directive. This action was sponsored by an increasingly evident need for high-level centralized control and direction of research and development activities concerned with areas of scientific interests that were either outside the assigned missions of the military services or had future military potential beyond the immediate requirements of the defense agencies. Thus, ICBM developments and the associated techniques were, logically, made part of ARPA's province. Actually, all advanced research conducted by the Department of Defense came under ARPA's scrutiny for review and authorization. ARPA had the authority to contract for services in support of its own programs as well as to fund contracts of the armed services. As an indication of the extent of ARPA's responsibility, it had jurisdiction over such projects such as Discoverer, Notus, Transit, Tribe, Suzano, Principia, Pontus, Longsight, and Defender.

The creation in 1958 of the Office of the Director of Defense Research and Engineering was intended to effect a tighter and more direct control over the conduct of DOD research and development programs, and over the engineering application of research and development products.

The Director is the principal adviser to the Secretary of Defense on scientific and technical affairs, and supervises, directs, and assigns all research and engineering within the Department of Defense. Thus, the position of Assistant Secretary of Defense for Research and Engineering was abolished and all personnel and responsibilities of that office were transferred to the Director.

TESTIMONY OF SECRETARY OF DEFENSE

On January 25, 1960, Secretary of Defense Thomas S. Gates, Jr., testified before this committee, providing us with some insights into his views on the space program. Highlights of his testimony are as follows:

We are very much aware of the importance to the welfare of the United States of a vigorous program in space flight and exploration, and of the need for bigger boosters for the space exploration program. In view of the potential military need for much larger boosters than are now available, we strongly endorse a vigorous NASA program. * * *

We intend to follow NASA progress in large boosters closely just as we follow other NASA projects—Tiros (meteorological satellite) and Mercury (man in space), for example—that have potential military applications.

*** * * when I described our rapid and solid accomplishments in the ballistic missile field, I did not desire to leave the impression that these represent the Department of Defense's only effort in the support of our space program. Ballistic missiles are by no means the only systems now under development. Earth satellites will provide us with new means of extending our present military capabilities. Perhaps the most important are the reconnaissance and early warning satellites which will contribute significantly to our deterrent posture. If warning of enemy missile launchings exceeds the reaction time of our own retaliatory forces, the enemy would be strongly deterred from launching an attack.**

We are pushing other programs that have direct military applications. These are communication and navigation satellites. In each of these areas we have important research and development projects well underway. All show promise.

Some have progressed to the point where they are now in the stage of applied development where we can test their feasibility on a systems basis. * * *

We have steadily increased expenditures and efforts for Defense space related programs. * * *

The present-day space programs of both NASA and the Department of Defense are, of course, largely outgrowths of missile programs. The technology, facilities, and components developed in the past for ballistic missiles are now used today for space projects. Similarly, today's missile development effort will no doubt find future application in both civil and military space activities.

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

A review of the management philosophy within the Department of Defense in handling the ever-increasing complexities of guided missile and rocket research and development reveals what appears to be a history of uncertainty and ill-defined responsibilities. One of the prime factors that influenced the progress of the technical achievement in rocketry, as exemplified by Redstone and Jupiter, was the early difficulty of making and executing decisions. Over the past 10 years there has been a myriad of committees, boards, liaison groups, review panels, and advisory councils through which problems of program direction and policy have had to be funneled. There has been concern over the appearance and departure of many people in and out of Government missile research and development policy levels, a condition that has, to put it mildly, led to considerable confusion as to authority and responsibility.

At this time, it seems astonishing that so much indecision existed within the Defense Department in placing rocket development in a proper perspective in relation to the overall weapon system research objectives to produce a broad-based, versatile and varied, high-quality military capability. But, it is easy to lose sight of the seemingly infinite number and variety of qualified, perplexing, and often contradictory factors that had to be considered and weighed in making executive decisions in what was then a field of science that had few sure management criteria. However, with the remarkable success that has been achieved to date by the armed services in placing effective IRBM and ICBM systems in operational status within a comparatively few years, has come increasing clarification and positive decision with regard to the roles of the Army, Navy, and Air Force in space.

It is possible that the creation of the National Aeronautics and Space Administration by the 85th Congress did much to assist the Department of Defense in hardening its approach to the management of its big booster projects and in the establishing of clear areas of responsibility for the support of nonmilitary space programs.

The national budget for fiscal year 1961 calls for the expenditure of almost $6 billion for research and development presently being conducted by the Department of Defense under the supervision of Dr. Herbert F. York (Director of Defense Research and Engineering) and his staff. This impressive sum represents a scope of activity that places great premium on management efficiency in establishing policy and budgetary emphasis for some 2,000 projects and 15,000 tasks. However, in terms of total research efforts, projects concerned with space under Dr. York's cognizance form a minor part of the total Defense research program.

Dr. York stated in his prepared statement before the committee on January 26, 1960, that—

> the funding for fiscal year 1959 for the separately identified space related programs (DOD-wide) amounted to $381 million. For fiscal year 1960 the funding is $414 million, and for fiscal year 1961 the funding is $481 million. These figures do not include Saturn or other programs which were earlier carried in the Defense budget but subsequently transferred to NASA.

Although there has been a steadily increasing allocation of funds to the development of DOD space systems over the past few years, nevertheless the amounts are rather modest in relation to the total R. & D. funding within the Department of Defense.

According to Secretary of Defense Gates, the Department of Defense is concerned directly with space and its associated technical requirements only to the extent that military systems will utilize that area. As stated by Dr. York in his appearance before the committee on January 26, the Department of Defense implements this position by—

> stressing that the objectives of the defense efforts in space are (1) the development, production, and operation of space systems where it can be demonstrated with reasonable certainty that the use of space flight will enhance the overall defense program, and (2) the development of components which would be needed in systems which cannot be clearly defined at this time, but which will develop as the future unfolds this new sphere of activity.

Dr. York further amplified Secretary Gates' statement by explaining that—

> in addition to these specifically identified space-related programs, the technology, facilities, and components developed and built for past and present missile programs have provided the major source of, and support for, today's space programs, and the future missile programs will continue to be a major source of support in all aspects to the future space programs, both military and civilian. The total research, development, test, and evaluation program for all missiles in 1961 will be approximately $2.14 billion. These figures include both the missile items in R.D.T. & E. appropriations, and the separately identified D.T. & E. items, principally for the ICBM's in the "procurement" appropriation.

The Department of Defense, and specifically Dr. York in his position as a "corporate manager," has the responsibility for assigning space research and development tasks to the military services. Such assignments are governed by a determination of either paramount interest or unique capability, or both. However, in instances when no one military service has an existing or foreseeable jurisdictional interest over a specific space research project that is nonetheless considered to be within the area of DOD responsibility, then that project is assigned to the service that has personnel competent in parallel or similar fields.

Transfer from the Army to NASA of the Jet Propulsion Laboratory at the California Institute of Technology and the Von Braun team and the Saturn program at Huntsville, Ala., followed the shift of major responsibility for the big military boosters to the Air Force. This shift is a logical result of not only the Air Force's current strategic mission assignment, but also the broad capabilities, the established facilities, and the experience that has been steadily developed within the Air Force, particularly with reference to large rockets over the years since the close of World War II. In this connection, the National Aeronautics and Space Administration has and

will continue to have for some time to come, a vital interest in the work in this field being carried on within the Air Force, since it is presently the military big boosters that make NASA space missions possible. Hence, cooperation between NASA personnel and Air Force people should be vigorous and productive. As Dr. York said—

> The DOD–NASA working relationships over the past year have become better coordinated, with many members of my staff, ARPA, and the services meeting frequently with their counterparts in NASA. These meetings are taking place at various working levels on a day-to-day basis. In addition to mutually supporting relationships on the related space projects of the Department of Defense and NASA, our national missile ranges have been supporting the research and development programs of both NASA and DOD. It is expected that integration of range support for both missiles and space vehicles will be given increasingly greater emphasis as both the missile and space efforts continue to grow.

Thus it can be seen that the positive steps that have been taken within the Department of Defense to create a single authority, a single agency of accountability, and a single source of policy can pay off in a tighter coordination of our overall space effort. And such coordination can have continued effectiveness through early decisions expressed from a position of centralized source of evaluation and responsibility.

The evolution of a proper management philosophy within the Department of Defense, as applied to research and development, with particular reference to the exploitation of space capabilities, has indeed been long and complex. As former Secretary of Defense Neil McElroy stated to the committee on March 2, 1959—

> As you know, one of the most important objectives of the recent reorganizations of the Defense Department was to insure that our research and engineering activities would have the integrated direction and leadership needed for our security now and in the future.

It is important to note that within the DOD there has been a continuous effort to achieve the proper and effective integration by rearrangement of organization and delineation of authority that has culminated in the present centralization of direction and control.

National Aeronautics and Space Administration

SENSE OF URGENCY

One of the things that have been troubling people is whether the space program is being pushed with a deep enough sense of urgency, or whether it is proceeding generally on a business-as-usual basis.

Three of the most important programs in America's space effort to catch up with and surpass the Soviet Union are Project Mercury, Project Saturn, and Nova.

The first would place a man in orbit about the Earth while the remaining projects would provide the Nation with the greatly increased propulsion necessary to put larger payloads into space.

Neither the testimony given this committee by NASA officials nor other facts available to it would indicate that the three programs were pushed with sufficient urgency in the view of most members of this committee. Other members, however, disagreed and felt that these programs were being pushed with sufficient urgency by NASA.

The Saturn program, which will cluster eight liquid-fueled engines to develop 1½ million pounds of thrust, was not given a top priority

until January 1960. In fact, it was almost killed entirely just a few months earlier. According to information furnished the committee by Roy W. Johnson, when the latter was Director of the Advanced Research Projects Agency he was advised by Dr. Herbert York, Director of Defense Research and Engineering, that he had decided to cancel the Saturn program. Mr. Johnson testified that Dr. York informed him of this decision in August 1959. Subsequently, however, it was decided to transfer the Saturn project from the Army to NASA.

The F–1 project, to develop a single chamber rocket engine of 1½ million pounds thrust, fundamental to the Nova concept, has never been given a top priority. According to Dr. T. Keith Glennan, Administrator of NASA, a DX priority is not needed. Dr. Glennan so testified before the committee on January 29.

He stated:

> The DX priority ought really to be reserved only for those of the greatest urgency. We, therefore, backed off, if you will, from the large engine, believing that with the assistance of the Department of Defense in some of our procurement matters, we would not be held up for any of the materials that we would require. Had we been held up, we would have gone back in there to request a DX priority again.

Yet prior to this Dr. Glennan and his advisers felt so strongly about getting a DX priority for the big engine project that after taking the matter up with the Defense Department on November 14, 1958, they carried their request for a top priority to the National Aeronautics and Space Council, which turned it down December 3, 1958.

Subsequently, on March 17, 1960, the NASA disclosed that the F–1 engine program was delayed because of difficulty in obtaining steel during the steel strike. A DX priority would perhaps have prevented this, since some steel was available during the strike for top priority programs.

The delay due to a shortage of steel supplies was disclosed by Dr. Glennan in his second semiannual report to the Congress on NASA's activities. In it, Dr. Glennan discussed the need for building new facilities at the Edwards Air Force Base to test the F–1 engine.

In this connection, he stated:

> Until the stands at Edwards are completed, the Rocketdyne test facilitiy is being utilized. The Rocketdyne stand can sustain test runs of only a few seconds at thrusts no greater than 1 million pounds. During early development, this limitation is not serious because most tests are on engine-starting. *However, difficulty in obtaining steel during the nationwide steel strike, along with other shortages, are delaying construction of the new Edwards test facilities. As a result, tests of the engine to full thrust and full deviation have also been delayed.* * * * [Emphasis added.]

Project Mercury fared somewhat better, although for some time its progress was comparatively slow. The project was launched by the Air Force in February 1958 as the man-in-space program under a directive from Roy W. Johnson, then head of the Defense Department's Advanced Research Projects Agency. On October 1, 1958, when NASA began operations, it was transferred to the new agency and became known as Project Mercury.

On November 14, 1958, NASA requested a DX priority for the project. The Space Council rejected the request on December 3, 1958,

at the same time it turned down the request for a top priority for the big engine (F–1) project.

On December 9, 1958, the Civilian-Military Liaison Committee recommended to NASA and the Department of Defense that Project Mercury be given top priority.

In the discussion which preceded this, it was pointed out by members of the Liaison Committee that many of the items which would be critical to the rate of progress of Project Mercury (including assignment of production boosters, use of test facilities, and operational services such as launching, tracking, etc.) were items required by several military projects already carrying a DX rating. It was the consensus that absence of a DX rating would thus almost certainly mean delay in getting a man into space.

Despite this, the Space Council took no affirmative action until April 27, 1959, when it approved a DX priority rating for Project Mercury. The Department of Defense was notified of this action on April 30 and Project Mercury was assigned a top priority by the Department of Defense on May 5, 1959, more than 5 months after it had been requested by the space agency.

One of the truly epochal events of the 20th century will be man's first landing upon the Moon. Its impact upon mankind will be sensational. The first man to set foot upon the Moon will apparently be an American or a Russian. But which will it be?

Richard E. Horner, Associate Administrator of the National Aeronautics and Space Administration, outlined to the committee a 10-year plan of program activity in space experiments in which he forecast a manned landing on the Moon "in the time period beyond 1970." When beyond 1970, he did not say.

Whether the Russians will wait until "beyond 1970" for manned exploration of the Moon is highly problematical. Almost 2 years ago, Dr. Herbert F. York, Director of Defense Research and Engineering, expressed the opinion that a manned exploration of the Moon was possible by 1968, and even by 1965, if pushed hard enough.

Dr. York so advised the House Select Committee on Astronautics and Space Exploration, the predecessor of the present standing committee. He stated:

> In the case of the Moon, a manned exploration could take place in just about 10 years (perhaps in as little as 7, if a very high priority were placed on this goal).

Dr. York's prediction bore the backing also of Roy W. Johnson, then head of the Defense Department's Advanced Research Projects Agency, and Rear Adm. John E. Clark, then Deputy Director of ARPA.

There were others who felt the same way. Among them was Lt. Gen. Bernard A. Schriever, Commander of the Air Force's Air Research and Development Command, who told the select committee that "it should be possible by 1968 to return to the Earth from the Moon a payload capable of carrying a crew of one to two men."

Brig. Gen. H. A. Boushey, Director of Advanced Technology, USAF, was another who thought a manned vehicle could land on the Moon and return by 1968. Boushey went further. He predicted that construction of a manned lunar base would begin in 1969.

Others who thought a manned expedition to the Moon was possible during the present decade include Dr. Wernher von Braun, the Army's top missile expert; Dr. James H. Doolittle; Dr. Walter R. Dornberger, Bell Aircraft Corp.; Donald W. Douglas, Douglas Aircraft Co.; Dr. Louis G. Dunn, Space Technology Laboratories; Krafft A. Ehricke, Convair; Alexander Karivelli, Republic Aviation Corp.; Dr. Glauco Partel, Italian Rocket Association; James A. Reid, Astrodyne; George H. Stoner, Boeing Airplane Co.; and George S. Trimble, the Martin Co.

Their views are set forth in the select committee's publication, "The Next Ten Years in Space, 1959–1969."

More recently, representatives of Vought Astronautics, a division of Chance Vought Corp., presented members and staff of the present committee with a program which they said could place a manned expedition upon the Moon in 8 years, by 1968, if the effort were begun immediately.

As recently as February 18 of this year, Maj. Gen. John B. Medaris, who retired as the Army's top missile manager January 31, told the committee that the Russians have boasted that they will celebrate the 50th anniversary of the Communist Revolution on the Moon in 1967.

General Medaris:

> My own personal feelings are very strongly in the direction that we should have begun some time back the necessary long-range preparation that would lead to our capability for a manned outpost on the Moon by 1966 or 1967. I don't know that we could now make those dates, but we could still come awfully close to them if we went about it.

These are the views of knowledgeable men, well versed in the art which may make space flight as commonplace someday as a flight from Washington to New York. Their views raise these questions: Is our space program being pushed hard enough? Are we doing all we can to place the United States in the forefront in this vital field? Or are we proceeding upon the theory that what another nation does is no concern of ours; that this is our program; we shall hew to it; eventually we shall get to the Moon; if the Russians get there first, well, that can't be helped. But will the American people be satisfied?

Indicative of NASA's attitude on this (or at least that of its Deputy Administrator) is the following statement made to the committee by Dr. Dryden:

> We have taken the view, as you know, on the Moon proposition that we keep trying with what we have, perhaps not putting an unduly large effort when the risks are high and the chances of success not too great. Some people said we would be better not to try at all rather than to try and fail.
>
> We have gone on the premise that we should try with what we have at hand, but work like everything to get better tools, more accurate tools, to do the job.

Some of the questions which went unanswered during the hearings on the Nation's space program were subsequently taken up again during the committee's consideration of the NASA authorization bill for fiscal year 1961, which proceeded for a time concurrently with those on the space program.

One of these concerned NASA's plans for landing a manned expedition on the Moon. Associate Administrator Horner reiterated that a manned expedition would not be accomplished this decade by the

United States. It could be accomplished in the 1970's, he stated, in one of three ways: (1) by using a nuclear rocket, (2) by using a Saturn-size vehicle and doing orbital refueling, or (3) by using a chemical engine such as the F–1, now under development. Several F–1's would be grouped together to produce 5 to 10 million pounds for launching the first stage from the ground in order to produce a sufficient payload at the Moon so that there would be enough propulsion available to return to Earth.

Mr. Horner testified that due to a cut by Congress last year in the funds authorized for NASA the development of the F–1 engine has been delayed 12 to 18 months and will now take possibly as long as 5½ years instead of the 42 to 48 months previously contemplated.

Mr. Horner said a cut of $18½ million in the research and development funds caused NASA to reduce the funds for the F–1 engine program by $6 million with a resultant loss in time of 12 to 18 months. This in turn could mean a similar delay in sending a manned expedition to the Moon.

Mr. Horner admitted that NASA traded a year or a year and a half on the development of the F–1 engine for $6 million. He said the earliest proposed experimental flight testing of the F–1 engine is not scheduled now until 1968 and a grouping of the F–1 engine into what is known as a Nova configuration will not be "really useful" in this decade. Mr. Horner said the Nova was still "only a concept."

Subsequently, NASA advised the committee that as a result of the delay in the F–1 program, it is estimated that an additional $8 million will be needed to complete the development program through preliminary flight rating tests. This will increase the total cost for the program from $105 million to $113 million.

Mr. Horner added that the funds being requested by NASA for fiscal year 1961 would not provide for the maximum development of the F–1 engine. But he said he did not favor making additional funds available in fiscal year 1961 for this program. To do so, he maintained, would unbalance the entire space program.

Important testimony was also given by several witnesses of the Atomic Energy Commission regarding the availability of nuclear propulsion this decade for a manned expedition to the Moon.

Brig. Gen. Irving L. Branch, USAF, AEC's Assistant Director for Aircraft Reactors, said a nuclear propulsion booster could be ready for space flight in the "mid-1960's, without any trouble."

The following information was then elicited from General Branch:

Question: "Is the state of the art sufficiently advanced so a nuclear-powered space vehicle could be prepared with sufficient power to land an expedition on the Moon in this decade?"

Answer: "The state of the art in the nuclear propulsion business, specifically the Rover device, is such that we feel confident we could provide the necessary power *if the vehicle were developed to use this power.*" [Emphasis added.]

Question: "Could you develop your propulsion sufficiently in time so that a vehicle could be prepared in time to land an expedition on the Moon this decade?"

Answer: "Yes, sir."

Question: "A manned expedition?"

Answer: "Yes, sir."

As already mentioned, NASA has no plans for a manned expedition to the Moon this decade. Associate Administrator Richard Horner told the committee this epochal event would perhaps occur in the next decade.

After the hearing, the AEC witnesses told newsmen that they had in mind a two-man expedition involving a total payload, including equipment, of 20,000 pounds.

They added that such an expedition to the Moon might be able to get off sooner if the Saturn 1,500,000-pound-thrust booster, now under development, were used as the initial stage for the flight, with an atomic booster as the second stage to carry the payload to the Moon and back.

General Branch told the committee that he is "not completely satisfied" with NASA's "requests for and uses of nuclear power." He added: "We can go faster than they want us to go right now."

NASA witnesses subsequently testified, however, that the program was being expedited to the fullest extent.

Col. Jack L. Armstrong, USAF, Branch's deputy, expressed the opinion that "the nuclear systems offer us an opportunity to take a jump over the Russians."

He added:

> I think the * * * first peaceful use of nuclear energy in space is one of the big breakthroughs for which you will get as much international fame as the first satellite in space. I would like to see this one have the stars and stripes on it for a change.

Subsequently, Dr. Hugh L. Dryden, Deputy Administrator of NASA, was asked the same day, "Do you feel, Doctor, this country has a good chance to get to the Moon with a manned expedition before the Russians?"

He replied: "This depends on what the Russians decide to do * * *. I think there would be a sporting chance, but I don't know how to answer this positively."

Later, Dr. Dryden remarked that "We believe that space is going to be here a long time. There is an awful lot of room out there."

The committee also questioned two Defense Department witnesses concerning Project Orion. This project pertains to a method of future space propulsion which is based on a system in which a series of small nuclear explosions creates propulsion for huge space platforms.

Project Orion is now under study by the Advanced Research Projects Agency. A total of $2.4 million has been allocated for a feasibility study. However this work will terminate next August unless another $1 to $2 million is provided to carry out the work for another year. Neither the Defense Department nor NASA has any plans for continuing the study beyond August 1960.

SUMMARY OF THE TESTIMONY

Representatives of the National Aeronautics and Space Administration appeared before the committee on January 27, 28, 29, February 1, 2, 15, and 16. Those who testified for the space agency were Dr. T. Keith Glennan, Administrator; Dr. Hugh L. Dryden, Deputy Administrator; Richard E. Horner, Associate Administrator; Dr. Abe Silverstein, Director, Space Flight Programs; Ira H. Abbott, Director of Advanced Research Programs; Harold B. Finger, Chief, Nuclear Engine Division, Space Flight Development; Dr. Homer E. Newell, Jr., Deputy Director, Space Flight Programs; Dr. Morris

Tepper, Chief, Meteorological Satellite Program; Dr. Wernher von Braun, Director, Development Operations Division, Army Ballistic Missile Agency; Richard V. Rhode, Assistant Director of Advanced Research Programs; Maj. Victor Hammond, Technical Assistant to the Assistant Director of Space Flight Operations; Abraham Hyatt, Deputy Director, Launch Vehicle Programs; and George M. Low, Chief, Manned Space Flight Programs.

Dr. Glennan, the leadoff witness, discussed NASA's program and its request to Congress for $802 million in new funds for the 1961 fiscal year. While the hearings were underway, the President announced that an additional $113 million was being requested, bringing the overall 1961 fiscal year budget to $915 million.

Since $238 million of this amount is for the Saturn project, the remainder of the 1961 budget represents an increase of only $154 million over the 1960 budget of $500,575,000 plus the $23 million in supplemental funds for the current fiscal year.

According to Mr. Horner, the $802 million budget is divided as follows: research and development, $545,153,000; salaries and expenses, $167,560,000; and construction and equipment, $89,287,000.

Of the additional $113 million being requested, $98 million would be allocated for the Saturn program and $15 million for the F–1 engine.

Aside from the virtual doubling of NASA funds after less than 2 years of existence, the rapid increase in the size and activities of the space agency is vividly shown by the increase in NASA personnel.

Mr. Horner testified that the new space agency began with a nucleus of 8,040 staff members of the National Advisory Committee for Aeronautics. To these were added 400 members of the Vanguard team, transferred from the Naval Research Laboratory. Seven hundred new positions were provided in the agency's first fiscal year and an additional 700 in the current fiscal year. The proposed budget program would boost the total strength to 16,373, the greatest increase coming, of course, from the assimilation of the Von Braun team at Huntsville, Ala.

The committee questioned NASA witnesses at length on whether sufficient funds were being requested for the space program and were repeatedly assured that the new budget was adequate. The willingness of Congress to appropriate as much funds as were necessary was repeatedly stressed by the committee, which recalled that NASA witnesses similarly told the committee last year that sufficient funds were being requested for the current fiscal year, only to admit later that their estimates had been too low.

Horner predicted that—

> it is certainly likely that a natural growth of the developments now underway will lead to a budget request of more than $1 billion in the following year, with a growth to more than $1½ billion a few years later.

Dr. Glennan informed the committee that the Soviet Union "continues to hold a substantial space lead in the eyes of the world." He added that this lead is based—

> principally upon the possession by the Soviets of one or more reliable launch vehicle systems having perhaps twice the thrust of our own first-stage booster rockets * * *. In no other aspect of the space business do we appear to lag the Soviet Union.

The Atlas today provides the United States with a maximum thrust of about 380,000 pounds, compared to the 500,000 to 800,000 pounds of thrust which the Russians are believed to have had for more than a year, as used for the first 3 Sputniks and Luniks. The Soviet January 1960 Pacific tests and the May 15, 1960 satellite launching may very well represent the Soviet equivalent of our Saturn in the amount of thrust.

The importance of the Saturn and Nova engine programs are therefore self-apparent. It is doubtful whether the Saturn program, which would develop a thrust of 1½ million pounds, but may not be available for another 4 or 5 years, will catch up with, much less surpass, the Russians' achievements in propulsion. To think otherwise would be to assume the Russians are standing still.

However, Dr. Dryden expressed the view that it would. He testified:

We believe that in time, just as quickly as we can, we will overcome the present handicap that results from the size of boosters which are available to us. So far as we know, this is the only specific way in which we are behind. The Saturn project is the one which will remedy this, we feel * * *.

Dr. Glennan thought it would take the United States about 5 years to catch up with the Russians in rocket propulsion. Dr. Dryden told the committee that this forecast includes "some estimate of what he (Russia) will be doing in the meantime."

Subsequently, Dr. Glennan, in a speech February 15, predicted that—

within the next 12 to 18 months, we should begin launching rocket vehicle systems that will allow us to match and outmatch what the Soviet Union has done to date.

But he added that it was "not realistic" to think the Russians will not be making progress in the meantime. He said, "We know now that they have been testing more powerful rockets which could be used in launch vehicle systems for space exploration."

As suggested above, there are indications that the rockets the Russians tested in the Pacific and used for Sputnik IV have a thrust of 1 million pounds or more, and by 1964–65 the Russians will probably have developed greater thrust.

Thus, the main hope for the United States in this field may lie in the Nova, a cluster of F–1 engines which could provide a thrust of 9 million pounds or more. But the Nova is not slated for development testing until possibly 1968, according to Mr. Horner.

Dr. Glennan expressed the belief that the United States has made "excellent use" of the facilities at its disposal. He emphasized that the rocket engines employed for space projects were originally designed and developed for the armed services missile program and not for space missions.

Dr. Wernher von Braun, Director of the Development Operations Division of the Army Ballistic Missile Agency at Huntsville, Ala., whose team is being transferred to NASA, gave the committee an explanaion of the plans for the Saturn.

This rocket missile will cluster eight engines of 188,000 pounds thrust each as the first stage for an initial thrust of 1,504,000 pounds. The second booster will be powered by four engines of 20,000 pounds thrust each.

The Saturn's third stage will be powered by two liquid hydrogen-liquid oxygen engines which are almost identical with the engines used in the second stage. The third stage also will serve as the so-called Centaur vehicle in the Atlas-Centaur project.

The payload will ride on top of the third stage. The first version of the Saturn, known as the C–1 configuration, will provide an orbital payload capability of 23,000 to 25,000 pounds, "far more than anything available today," according to Dr. von Braun.

Another phase of the Saturn program (the C–2 configuration), said Dr. von Braun, will provide a second stage which will be powered by several engines of 200,000 pounds thrust, probably four of them. This new second stage would be placed between the C–1's second stage and the first stage. Thus, the C–1's second stage would become the third stage. For trips to the Moon and the planets, a four-stage Saturn would be used. The payload of the C–2 would be more than double that of the C–1 configuration. It would be sufficient, said Dr. von Braun, to carry two men around the Moon and back; to land a "very substantial payload" on the Moon in a soft landing; or to carry a "rather sizable" automatic radio relay station to the surface of Mars or Venus.

Dr. von Braun said the increase in funds for the Saturn program—from $70 to $71.5 million in the current 1960 fiscal year and from $140 to $230 million in the 1961 fiscal year—will make it possible to gain back 1 year in completing the research and development program on the Saturn. (Dr. Glennan, in his February 15 address, said the Saturn will enable the United States to place approximately 15 tons—30,000 pounds—in an orbit 300 miles above the surface of the Earth. But, he added, "this capability" will not be "before 1964, at the earliest." However, a two-stage Saturn of somewhat less capability will be available for use "in late 1963.")

Dr. von Braun told the committee that the Russians are "definitely several years ahead of us" in the field of very large rockets. Asked when the United States could expect to catch up, he remarked: "I do not think we should expect wonders." Dr. von Braun said that the Russians are probably working now on a new and larger rocket than any they have already flown. (And this now seems to have been borne out since he testified.)

When bluntly asked whether the United States "will ever catch up unless we do something much more drastic" Dr. von Braun replied cryptically, "We will just have to keep running."

"They are way ahead of us," said Dr. von Braun, "and still moving faster than we are."

Dr. von Braun said all indications point to the fact that the United States has not determined to go all-out to be first in space. But, he stressed, "I think we can catch up in any field where we really make an earnest effort, whether that field is space or bombs or anything."

Dr. Glennan reported that the astronauts will embark this year on ballistic training flights, using a Redstone booster. The plan is to propel them about 100 miles into space and recover their capsule about 100 miles downrange. The first manned, Atlas-boosted orbital flight should take place in 1961, according to Dr. Glennan. However, Dr. von Braun told the committee he would not be surprised if the Russians placed a man in orbit this year.

A highlight of the hearings was the presentation by Mr. Horner of NASA's 10-year plan of space exploration, which calls for approximately 260 launchings over the next decade, at a cost of possibly $12 to $15 billion.

The program is as follows:

NASA mission target dates

Calendar year	
1960	First launching of a meteorological satellite.
	First launching of a passive reflector communications satellite.
	First launching of a Scout vehicle.
	First launching of a Thor-Delta vehicle.
	First launching of an Atlas-Agena-B vehicle (by the Department of Defense).
	First suborbital flight of an astronaut.
1961	First launching of a lunar impact vehicle.
	First launching of an Atlas-Centaur vehicle.
	Attainment of manned space flight, Project Mercury.
1962	First launching to the vicinity of Venus and/or Mars.
1963	First launching of two-stage Saturn vehicle.
1963–64	First launching of unmanned vehicle for controlled landing on the Moon.
	First launching orbiting astronomical and radio astronomy observatory.
1964	First launching of unmanned lunar circumnavigation and return to Earth vehicle.
	First reconnaissance of Mars and/or Venus by an unmanned vehicle.
1965–67	First launching in a program leading to manned circumlunar flight and to permanent near-Earth space station.
Beyond 1970	Manned flight to the Moon.

Ira H. Abbott, Director of Advanced Research Programs, cautioned the committee that one of the problems still unsolved with respect to a manned lunar flight is that of guidance and reentry heat upon return to Earth.

"It is apparent," he stated, "that for the next few years much effort must be devoted to research to resolve these problems."

Harold B. Finger, Chief of the Nuclear Engines Division, Space Flight Development, outlined to the committee the work being done on various advanced types of propulsion still in the research stage, including the nuclear heat transfer rocket, the electric rocket, and a solar power system.

Mr. Finger said the 1961 fiscal year budget requests in the area of propulsion technology include $2.8 million for solid rockets; $40 million for liquid rockets; $10 million for nuclear systems technology, including both the nuclear electric generating systems and the nuclear rocket; and $8 million for space power technology, including electric thrust generators and nonnuclear electric power generating systems.

Dr. Homer E. Newell, Jr., Deputy Director of Space Flight Programs, told the committee that Mars and Venus are the solar planets, other than the Earth, "which appear to offer the greatest probability of the development of life."

Dr. Newell predicted that manned landings required for thorough exploration of these planets will not be possible "for many years to come." But in the meantime, he stressed, a progressive program of instrumented planetary exploration will be undertaken as rapidly as the necessarily sophisticated guidance, communications, and soft landing techniques become available.

Dr. Newell said NASA's space sciences program "over the next several years" will include approximately 100 sounding rockets per year, some 9 satellites and Scout probes, and approximately 4 deep space probes for lunar and planetary exploration. The latter will include, in fiscal year 1963, the first attempted orbit toward Venus and Mars.

Nearly half the requested funding in the space sciences area will be devoted to lunar and planetary explorations, while the sounding rocket program will require less than 10 percent of the total.

Dr. Morris Tepper, Chief of NASA's meteorological satellite program, assured the committee that the exploration of space has a practical as well as a scientific side and that results will flow which will benefit all individuals.

The three primary fields of satellite applications to which he referred were the meteorological, communications, and navigation satellites.

Dr. Tepper said objectives in these fields were to develop satellites capable of providing worldwide meteorological information, worldwide communications, and low-cost all-weather navigation.

The funds required to carry out the satellite applications program total $20,700,000 for the meteorological satellites program and $5,600,000 for the communications satellite program. The navigation satellite system is being developed by the Department of Defense.

Richard V. Rhode, Assistant Director of Advanced Research Programs, cautioned the committee that many problems in applied research and technology must be solved before more advanced space missions can be attempted.

Maj. Victor W. Hammond, Technical Assistant to the Assistant Director of Space Flight Operations, discussed the ground support instrumentation that was required for the successful exploration of space.

Major Hammond said four basic missions must be tracked; namely, the vertical probe, Earth satellites, the manned satellite (Project Mercury), and the deep space probes.

Three functions must be performed. First, "we must know where the vehicle is in space"; second, "we must know what is going on inside the vehicle"; third, command control must be exercised over the vehicle.

Major Hammond explained that satellites are tracked by three methods. First, the minitrack system, which must have an active transmitter in the satellite. Second, the Baker-Nunn cameras, which can track any type of satellite "so long as the camera is told where to look." Third, the Moon-watch teams. By next October, NASA will have some 14 minitrack stations. There are 12 Baker-Nunn locations. The Mercury network will consist of some 18 stations, including U.S. military equipment, Australian stations, and several installed specifically for the mission by NASA. The network will be operational early next year.

Abraham Hyatt, Deputy Director, Launch Vehicle Program, outlined for the committee the problems faced in the development of booster vehicles and the progress being made toward their solution.

Mr. Hyatt said the Scout, a four-stage solid propellant vehicle, will be capable of launching 200 pounds into an orbit at 300 nautical miles

above the Earth. This vehicle will be used for launching satellites, for high-altitude probes, and for aerodynamic testing of vehicles. The first launching was expected in "early 1960."

The witness said the Centaur, another vehicle now under development, will be capable of putting 8,500 pounds into a 300-nautical-mile orbit and 1,450 pounds into a planetary probe. The vehicle will be used for lunar and planetary explorations and possibly for a 24-hour communications satellite, as well as numerous other uses. The first launch is expected in mid-1961.

As for the Saturn, said Mr. Hyatt, it will lift 28,500 pounds into a 300-nautical-mile orbit and will be able to send some 9,000 pounds to the Moon or to a planet. This vehicle will be used for lunar and space probes and can be used for a 24-hour equatorial orbit, a communications satellite, and other kinds of satellites. Its first launching is expected as a three-stage vehicle in "early 1964."

Mr. Hyatt also discussed briefly the Nova program, which he termed "only a concept." This looks forward to the clustering of the F–1 engines, which are now under development, and which will provide a single engine thrust of up to 1½ million pounds.

Mr. Hyatt said that by clustering six of the engines in the first stage, two in the second, one in the third, etc., we would have a vehicle capable of putting some 290,000 pounds into a 300-mile orbit; approximately 60,000 pounds into a 24-hour orbit; and about 100,000 pounds to the Moon.

George M. Low, Chief of Manned Space Flight Programs, discussed Project Mercury, which aims at placing a man in orbit around the Earth in calendar year 1961.

When launched, it will attain an orbital speed of 17,500 miles an hour. Mr. Low explained that after three orbits, which will take 4½ hours, retrorockets will be fired which will slow the space capsule by 350 miles an hour. This will be sufficient to enable the Earth's gravity to pull the capsule down out of orbit. Upon its return to the atmosphere, the air will reduce the speed to 200 miles an hour. When it is about 10,000 feet from the Earth, a parachute will slow it down still further so that it will land on the water at a speed of about 20 miles an hour.

Before the astronauts go into orbit, the capsule will be tried out in manned flights using a Redstone missile. In these up-and-down flights, the Redstone will accelerate the capsule to a speed of 4,000 miles an hour, will carry it up to 125 miles and to a distance of 200 miles from Cape Canaveral. During this trajectory, the astronaut will experience 5½ minutes of weightlessness as well as 11 g's during reentry.

Department of the Air Force

Air Force witnesses before the committee included Secretary Dudley C. Sharp; Under Secretary Joseph V. Charyk; Gen. Thomas D. White, Chief of Staff; Lt. Gen. Roscoe C. Wilson, Deputy Chief of Staff, Development (accompanied by Brig. Gen. Homer A. Boushey, Director of Advanced Technology); Lt. Gen. Bernard A. Schriever, Commander, Research and Development Command (accompanied by Col. Beryl L. Boatman, executive officer of ARDC); and Maj. Gen. Donald N. Yates, Commander, Atlantic Missile Range. Sessions in-

cluded open hearings on February 3, 4, and 5, plus an executive session on February 3 whose transcript was released for publication after security review in the Department of Defense.

PREPARED STATEMENTS OF THE WITNESSES

Secretary Sharp

Secretary Sharp emphasized that the Air Force does not distinguish between aeronautic and astronautic systems, as there is no sharp line of demarcation, and its interest is in developing whatever weapon systems will perform military missions assigned with the greatest effectiveness and appropriate attention to cost. Space systems are viewed as complementary with airplane and missile systems. High immediate priorities are assigned to reconnaissance and early warning space systems because of the great contribution they make to protection against ICBM's. The ICBM is seen in a sense to be a space system, too, and in any event to be the basis of much of the national capability in space.

Secretary Sharp also endorsed the legislative proposals of the President for only minor changes in the National Aeronautics and Space Administration, alluding to the traditional relationship between the Air Force and the former NACA. He saw working level coordination on a host of individual projects, arranged by administrative agreement, as the best liaison device rather than relying on special institutions created by legislative action.

Assistant Secretary Charyk

Dr. Charyk also developed the theme of harmonious relations between the Air Force and the NASA, using Project Mercury as an outstanding example. He, too, saw space not as a new medium, but an extension of previous horizons brought about by expanding technology. He dated Air Force interest in military use of satellites as beginning in 1946, even though successful exploitation waited upon the development of the ICBM begun in earnest in 1954.

Dr. Charyk drew certain differences between missiles or many civilian space exploration missions and the requirements of military astronautics. One of these important to military astronautics is the key importance of reliability of systems in long-life applications. A second difference is the need for low-cost boosters through the route of simplicity, ruggedness, and physical recovery for reuse. He also commented on the importance of complete operational systems which extend far beyond ordinary development work, such as personnel training, operational facilities, spare parts, and so forth. The development of a useful operational system involves a great variety of expensive and long leadtime activities which must be undertaken concurrently with the development of the satellite system per se. Because all such advanced programs involve uncertainties, there is inherent in making decisions on them a risk which must be weighed in arriving at correct judgments as to what lines to pursue, considering the military threat, the military potential, the military function to be performed, and the demands of all other phases of the total military program.

General White

General White in his statement made early reference to the medium of "aerospace," a term of growing popularity both in the Air Force and the aircraft industry which is switching its work more and more into missiles and spacecraft. General White lauded the peaceful objectives of the National Aeronautics and Space Act, viewing the Air Force as making its contribution to these objectives by guarding the peace. He viewed immediate military interests as being fairly close to Earth at the outset. He viewed as a logical arrangement the use of Air Force missile and base experience as the means for launching the space vehicles of NASA as well as for itself. He saw the X–15 and Dyna-Soar not as true space vehicles, but an extension of existing techniques which might lead later to true maneuverable manned spaceships. He, too, put great stress on the importance of the Midas infrared detection satellite and the Samos reconnaissance satellite because of the growing ICBM threat against this country.

Lieutenant General Wilson

General Wilson emphasized that space is a location, not a function or military program; further, he identified space as being part of a larger location he called aerospace, related in such a way that no meaningful line can be drawn between the atmosphere and true space. He saw space systems as called for whenever it was the only way to do a job, the best way, or the most economical way. He also noted that the Air Force research and development program could not be identified as to what part was space related in a meaningful way because so much applied both to activities within and outside the atmosphere.

He gave special praise to far ranging study programs undertaken by the Air Force which cost comparatively little yet provide guidelines to future research and development. Current studies range from low orbit Dyna-Soar type vehicles to systems dispersed and hidden 100,000 miles and more from Earth. These offensive system studies are matched by defensive studies for the inspection of satellites and space-based defenses against ICBM's. Others involve recoverable boosters, reconnaissance, space logistics, maintenance, and rescue. The Air Force is also working on many space components and subsystems, as for example space power sources, and propulsion techniques. He noted that the already developed Thor, Jupiter, Atlas, and Titan boosters are not adequate for all the systems the Air Force anticipates needing. Finally the Air Force is working on complete space systems. Because of the present ascendancy of offensive systems, a particular effort is being made on defensive systems against the ICBM. The high cost of putting payload into orbit is being attacked with the hope of cutting this to only 10 or 20 percent of the present level. Of particular interest are booster recovery plans. It is expected that both civilian and military space efforts will require much larger boosters. However, it is anticipated that a larger number of such military boosters will be required, and therefore cost reduction becomes of greater moment to the Air Force. Quicker checkout time will be required too. This seems to point inevitably to a new program of large military boosters, as distinct from the NASA effort.

Lieutenant General Schriever

General Schriever developed in greater detail what our military requirements in space comprise. Now that we are moving into a period when intercontinental missiles make their flight in 30 minutes, an unprecedented importance attaches to intelligence, early warning of launchings, and reliable, rapid communications. Our problems are heightened by the lack of easy access to military installations in the homelands of potential rivals as contrasted with the relative ease which attaches to observing our own operations by other powers. Space satellite systems afford one of the most promising techniques for repairing our relative disadvantages in some of these respects. For example, the locations of our missile launchers can readily be determined; good reconnaissance from space in the future may reveal to us where the presently unidentified launch pads abroad which threaten us are located. The public interest in the U-2 aircraft in May, 1960, only underlines the importance of this space system. General Schriever feels the ballistic missile poses the greatest threat to the security of the Nation in its history. If we are to insure it is not used against us, we must have a combination of hardened, dispersed, and mobile ballistic missiles in combination with other types of weapons, plus the space-based surveillance, alarm, and communications systems referred to above.

General Schriever reminded the committee that as long ago as February 1957 he had pointed out that 90 percent of the technology of ballistic missiles could be applied to astronautics. He views the developments in space sytems as a normal transition from ballistic missiles. He views this new program as being both civilian and military although derived from military systems, and as important to the Nation for both security and prestige. He favors continued close cooperation between the civilian and military space operations, following from the exisitng pattern of organization, not the creation of a new superorganization. He added parenthetically that all military services have an interest in space, not just the Air Force, and that it is his purpose to cooperate with and assist the other services in this regard.

General Schriever then turned to a more detailed review of the purposes and status of the principal military space systems under development by the Air Force. At the time of his testimony there had been nine Discoverer engineering test satellites attempted, of which six went into orbit. This series is providing information on polar orbits, on vehicle stabilization, on capsule recovery techniques, and later on biological support systems.

Midas, the infrared detection satellite is expected in the future to give up to 30 minutes warning of any ballistic missile launchings, giving a guarantee of effective retaliation and better warning to civil defense authorities. As Midas is successful, the chances are reduced that any enemy would attempt such a ballistic weapon attack against us.

Samos, also a passive, nonaggressive satellite system, will some day give us early warning of advance military preparations deep inside the borders of any country, in many respects even more important than finding out through Midas that an attack had already been launched.

Dyna-Soar is a boost glide manned vehicle lifted by an ICBM, able to circle the world one or more times. The ultimate operational system could attack mobile targets, would have a recall capability unlike most missiles, and be kept aloft in times of emergency.

The Air Force also is supporting in various ways such other projects as Transit, the Navy navigational satellite, Tiros, the NASA meteorological satellite, Explorer VI, and the Pioneer V scientific space vehicles of NASA. The Air Force has major roles in the work for Project Mercury and the X–15 research vehicle under the general control of NASA.

Major General Yates

General Yates explained that he wears two hats—that of Commander, Atlantic Missile Range, one of three national ranges, and that of Department of Defense representative for Project Mercury support operations. The Atlantic Missile Range is administered by the Air Force Missile Test Center of the Air Research and Development Command, while the Pacific Missile Range is administered by the Navy and the White Sands Missile Range by the Army. The Atlantic Range has been developed as a research and development facility, with instrumentation added to meet the expanding needs of each new system assigned there for testing. It now extends just east of the Caribbean past the string of islands with range instruments down into the Atlantic to the vicinity of Ascension about 5,000 miles from Cape Canaveral. It will need additional improvements to meet the new demands of Mercury, Dyna-Soar, and Centaur as they come to the test stage. Project Mercury will include launchings from Cape Canaveral, and after orbital flight, recovery in the Atlantic. It will be necessary to tie together all three national ranges to support Mercury, and additional temporary tracking stations will have to be supplied to fill the gaps in a worldwide support system. Overall control will rest at Cape Canaveral. A detailed analysis of further needs for the coordination of development, procurement, and utilization of range and ground support equipment by NASA and DOD has been undertaken by Mr. Walker Cisler, and his recommendations are pending now.

FURTHER POINTS DEVELOPED BY COMMITTEE QUESTIONS

The committee inquired into the adequacy of funding for Air Force space programs. Secretary Sharp and Dr. Charyk stated that requests for funds were approved by the budget authorities 100 percent. In response to a somewhat similar question, General White indicated that he could recall no year in which any service chief was satisfied with what funds he received, but that he accepted the decisions which had been made for fiscal 1961. He expressed specific disappointment that the B–70 mach 3 bomber was not being pursued with better support. He also hoped that a review currently underway on Midas would make it possible to add substantially to the funding of that program. General Wilson also viewed Midas as a program which might need more funds following a fresh evaluation of recent progress. He felt that the overall level of R. & D. funding was adequate, but that reprograming might be required, such as shifting money temporarily from Dyna-Soar to Midas. But on being pressed further, General Wilson explained that an R. & D. man can always think of

additional projects which he would like to see pursued if the funds were available. He agreed to supply later a list of such projects, and in answer to questions agreed that the new nozzle configuration for rocket engines illustrated one example of a breakthrough which might require a return for additional funds beyond mere reprograming.

The committee explored questions bearing on the division of labor between NASA and the Air Force. One related to the matter of boosters. Dr. Charyk said the Air Force had no current claim on very large boosters like the F–1 because there was no military requirement for that much thrust. But he did indicate many individuals in the Air Force were disappointed in the transfer of the Centaur high energy upper stage to NASA, but they were following its progress closely to insure the protection of the military interest in this vehicle. General White foresaw the ultimate need for a very large military booster but thought the more immediate problem was for numbers of present size boosters. General Wilson was more positive that the existing boosters will not be adequate for the systems already anticipated by the Air Force, and that the boosters designed for NASA would not have all the characteristics required by the Air Force. General Schriever confirmed that there is no current requirement for the very large boosters, but specifically mentioned the 24-hour communications satellite as one which would require a big booster to put it into orbit.

The committee questioned the Air Force on its reaction to the President's proposal for amending the National Aeronautics and Space Act of 1958, which had been endorsed in the formal statements of some of the witnesses. Dr. Charyk said he had participated in discussions on the proposed legislation and was satisfied with the language, referring specifically to section 309 covering coordination and cooperation between the Department of Defense and NASA, but later Secretary Sharp while agreeing with the intent of section 309 allowed there was room for refinement of the language to insure carrying out the intent of the section, and that suggestions to the committee from the Air Force would be forthcoming.

The committee spent considerable time eliciting an analysis of the current military posture of the United States from the Air Force point of view. Secretary Sharp agreed in principle with General Power on the importance of an airborne alert, said this was also the Administration point of view, but that there was involved the question of timing and extent. He also accepted the estimate that there would be a missile gap in 1961 and 1962, but felt there was no gap in our overall deterrent capability considering all weapons and defenses. He felt that General Power was viewing his problem narrowly from the SAC point of view and not taking into account our progress on BMEWS radar warning, and on such other retaliatory forces as our naval carriers. He did not quarrel with the mathematical correctness of General Power's calculation as to what a salvo of 300 enemy ballistic missiles would do to our SAC retaliatory capability. Secretary Sharp in response to a question agreed that the civil defense preparations of the country are inadequate to meet a sudden attack, but stressed that our major goal is deterrence so there will be no strike against us.

General White was asked similar questions. He responded by saying that BMEWS would give us 15 minutes warning of an ICBM attack, only marginally enough to launch our own small number of ICBM's. This is what leads to General Power's call for an airborne alert for SAC bombers. But General White pointed out that General Power was taking a hypothetical illustration, and that a certain leadtime was required to mount an effective airborne alert. He saw this as a possible need in the future, not an immediate thing, and said steps were being taken now to acquire that future capability. He stressed the continuing importance of manned bombers in maintaining our deterrent power for at least the near future, and denied there was any complacency in the Pentagon over the problems which are faced in maintaining an adequate defense. He reiterated that General Power's views were quite proper for a SAC commander, but that as one moved to higher echelons, judgments shifted as more and more elements came into the assessment, both of conflicting needs and of alternative solutions. When General Wilson was questioned on these points, he stressed that as one responsible for R. & D., he was more directly concerned with where we might stand in 1965, considering leadtimes. He also felt if present programs were executed there was "considerable assurance" that no technical gap would open up in the 1965 period and beyond.

General Schriever was also asked to comment on these matters. He too credited as important a mix of missiles and manned bombers with bomber launched missiles extending the useful life of the manned aircraft. In response to a question, he could see no place for a preventive war, and to all intents and purposes for a preemptive strike either, considering its almost certain costs to both sides. In the nuclear rocket age, as he labeled it, reducing the element of surprise is exceedingly important, and that is why he would accord the highest priority to Midas and Samos, for example, just as was given to the ICBM earlier, even though it means taking some calculated risks because of unsolved technical problems at the time the weapons system is adopted as a program to be pushed. He noted the ICBM had achieved its technical goals a year or two earlier than predicted by the Von Neumann Committee in 1954. General Schriever also views 1961 and 1962 as extremely critical years. However, because of the leadtime problems involved, he sees little that can be done about any current missile gap now through an increase of funds. As a matter of record, he indicated, during the past several years he did call for more funds which would have given us more missiles on launchers now. He did not feel in a position to side with General Power's call for an immediate, substantial airborne alert, as contrasted with General White's suggestion we should be preparing for one, but not necessarily order it right away.

Some Air Force witnesses used the term "aerospace" again this year, a term which is also gaining currency in the aircraft industry and technical press. On being questioned, more than one witness indicated the Air Force did not expect even a military monopoly in the use of space. This coined expression is viewed simply as a way of stressing the technical continuity of activities and environment extending from the normal atmosphere on out to space.

Near the end of the Air Force testimony, General Schriever was asked about the relative position of the United States and the Soviet Union in the space race, with particular reference to progress in the last year. He acknowledged the Soviet lead in bigger boosters, allowing some spectacular firsts in space, but was not of the opinion that the U.S.S.R. is necessarily ahead overall. In contrast, he indicated there will be a missile gap in ICBM's opening up in the next couple of years, a matter not of research but of production decisions.

Department of the Navy

THE NAVY'S INTEREST IN OUTER SPACE

All Navy witnesses agreed on the Navy's interest in outer space as a medium of operations. Secretary Franke stated that the Navy intends "first and always" to use space to carry out its assigned missions. The Navy's immediate space objectives are navigation and communications satellites, and the Navy has "additional requirements for satellites to perform surveillance, weather observation and surveying, plus systems to afford detection of space vehicles" (Admiral Burke). Its immediate research and development objectives, on the other hand, include weather and reconnaissance as well as navigation and communications satellites (Vice Admiral Hayward).

The Secretary of the Navy confirmed that there is a military interest in space at the present time.

However, Admiral Burke foresaw no naval need for a superbooster such as Saturn. Vice Admiral Hayward said there is no current naval requirement for man in space though there is one for a weather satellite and there is an anticipated requirement for a maneuverable space vehicle (manned or unmanned).

To date the Navy has established 10 operational space requirements involving improved navigation, communications, optical and electronic reconnaissance, weather surveillance, geodetics, and satellite detection. It should be noted, however, that each military space system, regardless of the service to which it is assigned, will be modified to meet the requirements of the other services.

ORGANIZATION OF THE MILITARY AND CIVILIAN SPACE PROGRAMS

In general, Navy witnesses testified in favor of entirely separate military and civilian space programs. They thus supported the President's bill, although Navy representatives did not see the bill before it was introduced. (Assistant Secretary Wakelin apparently had some prior informal conferences with Dr. Glennan and Mr. Horner of NASA.)

The establishment of NASA as the civilian space agency was called highly desirable since it facilitates the mobilization of scientific and technical manpower. As for interagency rivalry, there is more than enough needed space research for all the civilian and military groups interested in the field. In the Secretary's opinion, the present division of responsibility between NASA and DOD can be fairly clear-cut and will work well. If DOD had overall responsibility, he said, it might give too much emphasis to defense needs; and NASA, conversely, might give too much emphasis to civilian needs.

The organization established by the National Aeronautics and Space Act (including the Space Council and the CMLC) is satisfactory but has not been used effectively. (Vice Admiral Pirie.)

At the same time, Vice Admirals Pirie and Hayward recommended some kind of liaison committee between NASA and DOD. Vice Admiral Hayward suggested that it might resemble the Military Liaison Committee, which reviews the entire atomic energy program and consists exclusively of military personnel. These witnesses also recommended a joint command within the Department of Defense for missile and space operations. Certain aspects of the NASA and DOD space programs already require considerable staff effort by the Navy apart from research and development—principally in requirements and operational support. Hence, the Navy believes that an organization is needed to provide effective participation by all combatant services in the military effort to include operational planning, launching, tracking, data handling, and read-out, and where necessary, the recovery of the various space systems. Such an organization must be able to insure that the specialized operational requirements of each of the combatant services are fulfilled. It could insure that duplication of effort is minimized, and that the overall military space effort is performed in the most efficient manner. When pressed, Vice Admiral Hayward expressed his personal view that the military should control the whole space effort.

There is great concern in the Navy that NASA will emphasize space to the neglect of aeronautical research. Vice Admirals Pirie and Hayward confirmed this point.

Secretary Franke said he approved of section 309 (of H.R. 9675) as written, and thought it did not restrict the space activities of DOD or the armed services. He admitted, however, that there might be desirable "changes in individual words here and there." He also stated specifically that he had no objection to striking out the word "supporting" before the word "research" in section 309.

NAVY SPACE ORGANIZATION

The Navy space organization consists of—

(*a*) The Assistant Secretary of the Navy for Research and Development (Dr. Wakelin) and his office.

(*b*) The DCNO for Development (Vice Admiral Hayward) and his office.

(*c*) The Astronautics Operations Division in the office of the DCNO for Air (Vice Admiral Pirie).

(*d*) The Assistant Director for Astronautics of the Bureau of Weapons (Rear Admiral Connolly) and his office, including the Pacific Missile Range.

(*e*) The Office of Naval Research (Rear Admiral Bennett).

NAVY BUDGET FOR RESEARCH AND DEVELOPMENT

In general, the Navy research and development budget will be tighter in fiscal year 1961 than in fiscal year 1960.

The Navy requirement for research and development funds in fiscal year 1961 was $1,543,584. Of this amount, the President's budget provided only $1,169,000—a difference of about $375,000.

Furthermore, test and evaluation items which were formerly bought with appropriations for "procurement" are now included for the first time under "research, development, test, and engineering." Total comparative figures for Navy research, development, test, and engineering are as follows.

Fiscal year 1959	$1,172,482,000
Fiscal year 1960	1,255,437,000
Fiscal year 1961	1,169,000,000

Comparative figures for ONR (roughly speaking, for basic and supporting research alone) are as follows:

Fiscal year 1960	$99,030,000
Fiscal year 1961	92,162,000

Expenditure limitations are as much of a problem as appropriations. For fiscal year 1960 DOD imposed an expenditure ceiling of $1,130,000,000 on Navy research, development, test, and engineering, and has raised it only slightly for fiscal year 1961 to $1,266,000,000.

In particular, the Navy needs more money for research and development on missile systems, especially surface-to-air, and on ASW (Vice Admiral Hayward).

PARTICULAR NAVY PROGRAMS

Polaris

Secretary Franke stated that the Polaris system is very close to being operational. On February 15, 1960 there had been 51 Polaris test flights. Of these, according to Rear Admiral Raborn, 36 were successful, 14 partly successful, and 2 unsuccessful. Development of the missile is now about 3 years ahead of the original schedule, although this speedup has been achieved at the cost of reducing the range from 1,500 to 1,200 miles. A 1,200-mile missile can reach about 97 percent of the targets that could be hit with a 1,500-mile missile. Vice Admiral Hayward predicted that the range can eventually be extended to 2,500 miles. He added that a Polaris missile could put about 180 pounds in orbit, and that its specific impulse is about 240-pound seconds at sea level.

Polaris submarines are becoming increasingly important because of their mobility and concealment. So are aircraft carriers; but, in Admiral Burke's opinion, Polaris submarines (a strategic deterrent force) will not reduce the need for carriers (in limited war).

More Polaris submarines will be needed (about 45 in all) than the budget provides for. On Feburary 15 construction had been started on nine Polaris submarines; four of these had been launched and one (the *George Washington*) had been commissioned. The full Navy request (for four more) was denied this year on the ground that the Polaris system was not yet fully operational. The Navy nevertheless anticipates that it may be permitted to submit a supplementary request for funds to build more Polaris submarines. (Shortly after this testimony was given, the Navy announced that it would request a supplemental appropriation for six additional Polaris submarines, making a total of 18.)

The present building rate of Polaris submarines is three a year. According to Rear Admiral Raborn an urgent building rate, with present facilities, would be about 12 a year. This rate of production

could be reached in 1963, and 15 Polaris submarines would then be available in that year. (The estimated cost is $150 million more for fiscal year 1961 and about a billion dollars more each year thereafter.) The limiting factor is a 46-month leadtime for nuclear powerplants.

Since its inception, the Polaris program has been managed by a Manhattan type of organization within the Navy Bureau of Weapons.

Satellite research and development

Admiral Burke mentioned that the details of the Midas program are being developed in Navy laboratories.

According to present plans, the Navy's navigation satellite (Transit) will become operational by 1962. Research and development models are scheduled to be put in orbit this year. (One has been put into orbit since this testimony was given.) The complete system will consist of four satellites in near circular orbits, transmitting radio signals. Transit information will be freely available to everyone in the world. (Some Transit information, however, will be sent in code or cipher known only to the Armed Forces of the United States.)

Space surveillance system

The Navy's space surveillance system (SPASUR) consists of six stations in two groups, eastern and western, for detecting nonradiating objects in near outer space. It is often called "the dark fence."

In order to complete the coverage of the space surveillance system, Vice Admiral Hayward stated, a second detection zone will be needed, extending along a great circle route from Miami to Nome. Even without such an extension, the gap in the present detection zone could be closed and the detection range trebled by adding a 500-watt transmitter near Wichita Falls, Tex.

Department of the Army

The committee heard witnesses from the Department of the Army including the Honorable Wilber M. Brucker, Secretary of the Army; Gen. Lyman L. Lemnitzer, Chief of Staff; Lt. Gen. Arthur G. Trudeau, Chief of Research and Development; Maj. Gen. W. W. Dick, Jr., Director of Special Weapons; Maj. Gen. August Schomburg, commanding general, Army Ordnance Missile Command. The committee also heard Maj. Gen. John B. Medaris, U.S. Army (retired), former commanding general, Army Ordnance Missile Command. A brief and concise summary of their prepared statements is furnished herein.

TESTIMONY OF SECRETARY BRUCKER

The contributions of the Army in broad and general terms, together with the policies and views of the Army with respect to its continued role and participation in the space program, were outlined by Secretary Wilber M. Brucker. He pointed out the salient fact that it is most difficult, if not impossible, to separate in a technical sense peaceful accomplishments from military capabilities in space. It is the responsibility of the military to insure that advantage is taken of every opportunty in space exploration in order to strengthen the Nation's defenses and at the same time to assure ourselves that mili-

tary use of space by a potential enemy will not endanger our national security.

The Army's efforts in space have had two primary objectives: First, the development of Army capabilities that will better enable the Army to accomplish its assigned missions of land combat and air defense; and second, the contribution to the overall advancement of the country's national space program, both civilian and military.

Since World War II there has been some thinking which has led to the unwarranted conclusion that the traditional and conventional methods of warfare, and particularly the basic mission of the Army in land warfare, have become obsolete. Fortunately for our national security, neither the Congress nor other responsible officials have been deluded by such a superficial approach to the problem. On the contrary, it is becoming more evident that the ability of the Army to engage successfully in ground combat is more important to our security than ever before. Despite the glamorous challenges presented by the possibilities of space exploration, sight must not be lost of the fact that man's home and life are here on the land and man is capable of existing outside his natural environment only to the extent that he is able to create an artificial environment for a short period of time. Man cannot exist indefinitely either in the sea or in the atmosphere or outside the atmosphere, and he must therefore have control of the land to which he must return.

In accordance with the national policy to reduce duplication of effort, all the Army's efforts in the satellite and space vehicle fields have been conducted as a part of the integrated Department of Defense military program directed by ARPA, or in support of the civilian scientific space program under the direction of NASA. At the same time, the Army has been assigned the responsibility for the development of Nike-Zeus to provide an antimissile defense for the United States.

The Army was the first agency in the free world to penetrate outer space, to develop large multistage missiles, and to orbit an artificial Earth satellite. During the past year the Army added other "firsts" to this list of accomplishments. On March 3, 1959, the Army launched the free world's first artificial satellite of the sun, Pioneer IV, and on May 28, 1959, successfully recovered in a Jupiter nosecone the first primates to have been transported so far outside the atmosphere and successfully recovered. During the same period the Nike-Zeus antimissile development program has proceeded on schedule. The Army has made improvements not only in the missile itself but in its control system that will enable the Nike-Zeus to achieve its original design objectives.

In September 1959, the Secretary of Defense assigned the Air Force the responsibility for the development, producton, and launching of space boosters, and the integration into such systems the payloads which might be developed by it or the other services. At the same time the Secretary of Defense indicated his intention of transferring to the Air Force the responsibility for the development of two major satellite programs, the Samos reconnaissance satellite, and the Midas early warning satellite. The Secretary of Defense also indicated that assignment of the Transit navigational satellite to the Navy and the Notus interim communications satellite to the Army, respectively, had been approved but that the transfer dates would be determined later.

These latter transfers have not yet been implemented although the Navy is developing for ARPA the Transit payload and the Army is developing for ARPA the Courier communication payload (first step in the Notus program).

On October 21, 1959, the President decided to transfer the Development Operations Division of the Army Ballistic Missile Agency to NASA, and with it the responsibility for Saturn, the million-and-a-half-pound-thrust booster. The Army recognizes that these events have reduced its capabilities and responsibilities for developing and launching integrated space vehicle systems, but nevertheless the Army still retains many and varied capabilities in its seven technical services which are contributing and will continue to contribute significantly to space developments. The Army's efforts in this field complement and benefit all other Army programs, since many hardware items, as for example, in communications electronics, have wide application.

The Secretary of Defense is considering assignment to the Army of the responsibility for the development of the principal communications satellite systems. This program will be directed toward a 24-hour global communications system involving satellites at altitudes of thousands of miles and a network of ground stations. Existence of such a system will assure reliable, adequate, and rapid communications for critical military operations in any part of the world. The Army will accept this task with enthusiasm and confidence. In addition to the communications satellite program, the Army Signal Corps is conducting other satellite programs for ARPA and NASA. This represents the contribution and the potential for still further contribution by only one of the seven Army technical services.

The Army is very proud of its inhouse development capabilities system, of which the Von Braun team has been an integral part. To quote Secretary Brucker in this regard:

> All of these Army technical services have the inhouse scientific and technological capability and widespread contact with American industry to represent, in the aggregate, an organized and coordinated Army resource which can be rapidly oriented toward the accomplishment of almost any space project or program in the national interest.

The Army has extensive capabilities in diverse fields of propulsion, mapping, geodesy, and selenodesy, ground-based engineering and logistic support systems, nuclear power systems, transportation, medicine, communications, and many other related areas of competence.

The Army proposes during the coming year to press forward at the maximum practical rate of speed consistent with available funds the space and antimissile defense projects, and more particularly it will continue the vigorous development of the vital Nike-Zeus antimissile missile system. The Army has long been convinced that the Nike-Zeus will provide a successful defense against intercontinental ballistic missiles, and proposes to press this development with the urgency it deserves and with the top national priority which it enjoys.

TESTIMONY OF GENERAL LEMNITZER

General Lemnitzer addressed himself particularly to the Army's interest in space, its capabilities, and its role. Presently space must be looked upon as an entirely new medium, a medium with untold possibilities in a relatively unknown area. This new medium is bring-

ing about new technological discoveries and almost daily developments which have a broad application in both the civilian and military areas of interest.

Although the military use of space may ultimately produce new concepts of combat, space systems will be used initially to support terrestrial operations. Space systems can, therefore, complement and extend present Earth-based capabilities. Offensive and defensive weapons in space are not clearly defined at this stage, but are primarily a matter for study and research. The extent to which actual military operations might be conducted in space (including the land mass of the Moon or other celestial bodies) is still somewhat conjectural. However, this possibility must be recognized and the military space program should reflect these long-range considerations. It must be kept in mind that space, because of its potential use for all of the military services, transcends the exclusive interest of any one of them. The Army's role and interest in space are initially directed toward the application of space to modern terrestrial warfare and, more specifically, to its application in the accomplishment of the Army's principal assigned missions in this environment. These principal missions are threefold—(1) to provide and support forces for land combat; (2) to provide and support forces for air and missile defense; and (3) to provide a number of related services, not only for the Army, but in support of the other armed services as well, including intelligence, communication, mapping, and geodesy.

The accomplishment of each of the foregoing missions will be greatly facilitated by space systems—systems which can be visualized at the present time. For example, land combat forces urgently require surveillance and reconnaissance of hostile territory, which a reconnaissance satellite would be able to provide. Secondly, communications satellites will greatly increase the security and reliability of our worldwide Army command and administrative net, which provides communications service for many agencies in addition to the Army. Thirdly, air and missile defense services are concerned with the early detection, identification, and location of hostile missile and space vehicles, which could be provided by a space surveillance system.

The Army's ultimate role and interest in outer space will be determined by strategic, tactical, and technological considerations that are still very far in the future. However, it is reasonable to assume that there will be an important role for the Army in this area at such time as we may be able to effect human lodgments on habitable celestial bodies. The Army has developed unique capabilities as assets to apply against its requirements in space. These are largely a natural outgrowth of the Army's pioneering efforts in missiles, communications electronics, geodesy, construction, and survival operations in extreme environments. Even after the transfer of the Development Operations Division of ABMA to NASA, the Army will still have a substantial capability to participate in space activities. This capability is not restricted to Army requirements, but will continue to contribute to the overall national space program.

General Lemnitzer stressed the fact that the Army's capabilities and its present work in certain fields should not go unnoticed. Particularly did he call attention to the fact that the Army is especially experienced in geodesy and that it is making the first topographic map

of the Moon. Similarly, the Army has a great deal of experience in construction of missile bases, launching and space-tracking sites, and in developing and operating simulated environment facilities. The Army is also engaged in the biomedical aspects of the Army missile programs, in the development of nonperishable foods and tablets, and in the utilization of algae for food production, and the development of special clothing, shelters, and handling equipment.

General Lemnitzer stressed the importance of the Army capability to contribute materially to the overall space program in both military and nonmilitary fields, reiterating the Army's interest in developing communications satellites, mapping and geodesy satellites, a space surveillance system, and antisatellite and antimissile defense systems.

TESTIMONY OF LIEUTENANT GENERAL TRUDEAU

General Trudeau appeared before the committee with a prepared statement, to outline the philosophy of the Army research and development program and to relate it to the national military space program as an extension of the Army's experience, capabilities, and resources. From the Army's assigned combat functions there are computed the research and development requirements, which are influenced by three major factors: (1) The future threat to our national security; (2) the scope, nature, and shape of tactical organization; and (3) the sum of the advances in science and technology which can be made available.

Over the past 185 years the Army has constructed a solid foundation in competence and capabilities that has steadily expanded as the demands of warfare have progressed "from muskets and mules to rockets and missiles and now to space technology." (General Trudeau.) The broad base of research and development in the Army is operated by the seven Army technical services. The Army presently owns and operates approximately $1 billion worth of research and development facilities. These resources include approximately 40,000 personnel, with a high percentage of scientific and engineering talent. These personnel and facilities represent an annual operating expense of $400 million and are supported by an approximately three-quarter billion dollar effort from industry and private institutions.

The objective of the research and development program of the Army is to provide on a continuing basis and as far as budgetary limitations permit, the most effective weapons system and materiel for the Army, for the other services as may be required, and for our allies. This program proceeds in two broad areas. The first is basic or fundamental research, and the second applied research and development that ultimately results in hardware for the troops in the field.

Basic research looks to the future for a period of about 12 to 20 years, as, for example, toward the battlefield of 1975. Today the Army is engaged in almost 2,600 research tasks that cut across 16 major scientific disciplines and 74 subfields. This work is conducted at 52 Army locations, at 21 other Government agencies, and by over 550 colleges, universities, and research institutions.

Applied research and development, on the other hand, is concerned with the classic military fields of mobility, communication, and firepower. Here is an effort to seek to fashion machines of war necessary to combat the potential enemy of a given time frame.

Research and development programs in the fields of Army interest have provided an unusual amount of experience for investigating and designing operational systems that utilize the medium of space while contributing to the Army's land combat mission. Rocketry grew out of artillery; missiles followed rockets; data and computing techniques for the science of ballistics began with the adding machine. These are a few examples of the benefits of experience combined with high motivation so important to continued success in vital programs for the future.

Space systems are based on rocket technology. The Army's pioneering in this field is recognized to be highly successful. In the words of General Trudeau:

> Despite claims to the contrary, it has been the Army that vigorously pioneered rocket-missile technology for 10 crucial years after World War II. We used rockets in the Mexican War and in World War II, too. We fired our first test ballistic missile in December of 1944 and 10 years later we had two guided missile systems in production and on station ready for employment by Army soldiers.

General Trudeau went on to say that in 1955 the Redstone inertially guided ballistic missile was successfully fired. These milestones are meaningful, for with additional accomplishments they were cumulated in the Jupiter IRBM. At the time of the launching of the Sputnik in October 1957 there was no rocket or missile capability in existence in the United States that could launch an Earth satellite except that of the Army.

Last year NASA programed five Moon probes. One of the Army's two probes passed relatively close to the Moon and is now in solar orbit, being the first U.S. probe to do so.

These examples lend weight to the argument that experience is an important contributor to success. From the vantage point of hindsight it appears that Army research and development and organization have made major contributions to the national space effort. Since 1958, however, the Army has conducted all of its space effort under NASA or ARPA. Since the large rocket boosters for the programs which require space flight are now the responsibility of the Air Force or NASA, the Army is at present concerned primarily with the payloads. These are the "payoff" of satellite and space programs, and some of them that are presently programed may become integral parts of an assigned Army mission such as geodesy or communications.

The Army has supported NASA in many fields of endeavor since the latter's inception. These include space probes, satellites, large thrust boosters such as Saturn, biological experiments, and support of the Mercury program. In fiscal year 1959, NASA placed $28.5 million of requests or purchase orders with the Army, and in fiscal year 1960 to date $10 million.

January 31 marked the second anniversary of the launching of Explorer I, which is estimated to have made more than 9,000 trips around the Earth for a total of 280 million miles. Since that original effort the Army has done considerable work for NASA on satellite and space probe launchings and the development of payloads. This includes the Pioneer IV lunar probe, which passed the Moon and went into orbit around the Sun, and Explorer VII, the Earth satellite placed into orbit last October. NASA has requested the Army Ord-

nance Corps to launch five more scientific satellites this year. This task calls for the provision of the payloads as well as the launching. Another NASA-sponsored satellite program is the payload for the Tiros meteorological satellite. This payload is being worked out by the Army Signal Corps, with the assistance of Radio Corp. of America. The Army is contributing to Project Mercury in that eight Redstone missiles are being provided for launching capsules into ballistic trajectories. The first manned flight will be launched with a Redstone missile.

In addition, the White Sands Missile Range in New Mexico is to man three tracking stations in this program, and the Army Ordnance Corps is to provide for the participation of its downrange measurements ship.

With respect to programs for ARPA, the Army was supported by over $83 million in projects in fiscal year 1959 and over $90 million in fiscal year 1960 to date. These general program areas include the Notus family of communications satellites, including the Army's Courier communications satellite.

The Army's research and development program has a broad and comprehensive scope to produce the kind of weapons and materiel that land combat forces of the future will need to protect our national interest. With such a diversified program the Army has contributed substantially to the national space program. Although it is difficult to lose any part of an efficient and dynamic organization, the Army has repeatedly announced that it does not intend to allow the transfer to NASA of the Development Operations Division of ABMA to hinder the accomplishment of any new defense programs. General Trudeau announced that the Army stands ready, confidently, to accept responsibility for additional tasks in the challenging space field. The Army realizes that the immediate future cannot but uncover new discoveries, and bring benefits and military advantages in this new and challenging dimension of our civilization.

In the words of General Trudeau:

> Our basic mission is still to maintain ascendancy in land combat; in any area that man can operate, anything in any medium that will further this task is of immediate and continuing concern. The utilization of space is definitely included in this category.

TESTIMONY OF MAJOR GENERAL SCHOMBURG

Maj. Gen. August Schomburg, recently named to replace Maj. Gen. John B. Medaris (now retired) as the commander of the Army Ordnance Missile Command, spoke briefly before the committee, explaining the fundamental mission and the many unique features of the organization, and describing briefly some of the weapons systems being developed at Redstone Arsenal.

General Schomburg stated that the transfer of the Von Braun group may restrict one area of the missile development capability of the Army; however, the fundamental mission of the Army Ordnance Missile Command of providing weapons for defense remains unchanged. The Army Ordnance Missile Command organization has several unique features. The headquarters staff includes representation from the combat arms. Through the Office of Military Applications and Training the requirements of the user are integrated into the

day-by-day work of the command. A missile system is a composite development of many technologies, and, therefore, there are representatives from the Army Corps of Engineers, the Signal Corps, Transportation Corps, and Quartermaster Corps serving on the AOMC staff. These staff people perform a vital function in tying the other Army technical services into ordnance weapons systems development. An example of this is found in the fact that AOMC contracts for the communications equipment which is an integral part of the missile weapon system, yet the Signal Corps exercises technical supervision over the execution of that portion of the missile system contract. The AOMC depends upon the Signal Corps for basic advances in electronic components. It depends on the Corps of Engineers for the development of generators, air compressors, and other power equipment, and for the construction of facilities as well.

The Army Engineers are now engaged in construction of Nike-Zeus facilities at White Sands Missile Range, Johnston Island, Kwajalein Island, Point Mugu, and Ascension Island.

Likewise, the Transportation Corps is responsible for all aspects of transportability during development and test, and in the final weapons system.

The AOMC is also supported by the many ordnance districts and agencies, including Frankford, Watertown, Aberdeen Proving Ground, and the Ordnance Tank and Automotive Command, to mention a few.

Among the "weapons for defense," the AOMC is now providing and supporting both the Corporal and the Redstone systems, which are now being deployed overseas. The command has under development two solid propellant ballistic missiles: the Sergeant system with a nuclear warhead capability, and the Pershing, a longer range ballistic missile which will in the future succeed the liquid propellant Redstone.

In the surface-to-surface rocket system categories, there is the Honest John, deployed since 1953, and the Little John, which will provide the airborne forces with a "Sunday punch."

The command is also developing an individual air defense weapon for use by the individual combat soldier. This is called the Redeye. It is a shoulder-fired antiaircraft missile which homes on its target. It resembles the bazooka in size and appearance, although it is much lighter in weight and gives frontline and support troops a low-altitude antiaircraft defense capability.

The Nike-Zeus antimissile missile system provides a striking example of the continuing growth of the Army's missile technology. At the outset of the Nike-Ajax project in 1945, an Army evaluation suggested the subsonic high-altitude piloted bomber as the primary 1955 offensive threat. The Ajax system, designed to detect this threat, provided the free world with an effective antiaircraft guided-missile. Ajax has repeatedly demonstrated its capability to destroy even the fastest jet aircraft.

The Nike-Hercules program began in mid-1953 as the second generation air defense system. This system with its solid propellant rocket motor was calculated to meet the threat of supersonic aircraft and air-breathing missiles. The Hercules surface-to-air guided missile, with either conventional or atomic warhead, is capable of destroying single or multiple targets. The system has destroyed the highest performance targets and is now deployed.

In 1956 the Army staff approved a program for the development of the third generation system now known as Nike-Zeus. The Zeus will provide a workable solution of the problem of IRBM and ICBM defense. Our knowledge of Soviet offensive capabilities is convincing evidence that the Zeus development must be pursued as expeditiously as the country's resources will allow.

General Schomburg summed up the future program as follows:

> In addition to the current weapons programs, a comprehensive consideration of AOMC activities must give due weight to our need for planning beyond the more immediate defense preparations. Unless we anticipate tomorrow's requirements and orient our research accordingly, we shall be unable to fulfill those requirements when they are expressed * * *. We must further explore the advantage of missiles in new techniques of warfare. For example, the speed and assurance with which high-priority cargo could be delivered by missiles to isolated combat units make such a concept attractive. The economic ramifications of this are especially compelling when one considers the attrition rate of aircraft in supplying isolated units in combat—an attrition rate which will be prohibitive in future warfare.

ADDITIONAL COMMENTS ON NIKE-ZEUS

One of the more interesting aspects of the Army portion of the hearings brought out by the question session was the discussion of the Nike-Zeus program. Appropriated for the fiscal year 1960 for the Nike-Zeus program was the sum of $137 million for preproduction purposes. Although these funds had been appropriated, the testimony disclosed that they had not been released. Secretary Brucker testified that the decision of the Department of Defense in the fall of 1959 was that these funds would be placed in which was called a reserve for 1961.

Secretary Brucker stated that although the funds had not been forthcoming, nevertheless they did not feel that they had been completely estopped, for the Army at the time of the hearings was urging that there be reconsideration for a release of a portion of the funds.

This particular question of funding led to a more complete discussion of the program itself. General Lemnitzer stated that he considered the Nike-Zeus absolutely vital to the security of the country in this oncoming ICBM age.

General Dick reported to the committee on the status of the Nike-Zeus antimissile missile. This missile is designed to defend against a ballistic missile threat, including both the ICBM and the shorter range intermediate and submarine-launched ballistic missiles. This is the only weapons system of its type under development in the country today.

In 1955, the Army initiated feasibility studies at the Bell Telephone Laboratories, followed in 1956 by component development and experimental work that marked the beginning of active effort on the Nike-Zeus. Since that time the development of Nike-Zeus has been conducted in accordance with a logical and orderly plan consistent with the urgency and priority assigned to the project. The program calls for early systems testing, to be conducted at White Sands Missile Range, and full systems tests later at Kwajalein Island against actual IRBM and ICBM targets. The development program milestones established some 2 years ago are being met on schedule. Construction of the prototype installation at White Sands is nearly completed, early missile performance flight tests are underway and several successful test missiles have been fired to date.

The Zeus is the pioneer defensive weapon development project of the ballistic missile age. It has no immediate competitors. At the present time there are several projects and programs designed to contribute toward an effective ballistic missile defense. These consist of warning networks and tracking systems. For instance, the BMEWS radar warning network and the Midas detection satellite will furnish valuable information in the future so that we may prepare ourselves for possible missile attack. However, these systems contribute no active defense against an ICBM, as they only give the alarm.

The only active defense system under development now is the Nike-Zeus. The Army is vitally interested in pursuing what it believes to be the only active antimissile defense system which can give a reasonably early capability to meet the recognized Soviet ICBM threat.

In answer to a direct inquiry, General Lemnitzer stated that to date we have developed nothing better than the Nike-Zeus. He stated, however, that there were those who felt that the program had not yet reached a stage that warranted production, and that there was considerable difference of opinion on this point, but that the Army had had the opportunity to present its case.

Dr. Richard S. Morse, Director of Research and Development, Department of the Army, also discussed the Nike-Zeus weapons system, stating that the problem of defense against an ICBM represents one of the most formidable technical problems facing the country. Dr. Morse stated that he was very much impressed with the potentials which have been demonstrated in Nike-Zeus and with the rapid progress which had been made in the sense of technological breakthroughs, all of which he stated confirmed the fact that the research and development of this system should proceed as rapidly as possible.

Dr. Morse stated that there are problems still to be solved, but that in his opinion they could be solved and Nike-Zeus today is the only answer that anyone has been able to come up with to solve the very dire situation that we have in this country with regard to defense against the ICBM.

In answer to a direct inquiry, Dr. Morse stated as follows:

Nike-Zeus, as far as I am concerned, is the only conceivable answer which we have to shooting down an ICBM in the next 5 years.

Secretary Brucker was asked the same question, and he answered:

I answer it exactly the same way. I know of nothing else that we have, or will have in the immediate or foreseeable future, and when we have gone over the whole gamut of it, what other than the Nike-Zeus? While there are studies going on in other fields, this in my opinion—is exactly as Dr. Morse said—is the only one.

The entire problem of the release of funds for the Nike-Zeus program centered around the question of preproduction facilities. The research and development program for the Nike-Zeus, within certain limitations, is proceeding satisfactorily.

However, Secretary Brucker did not state categorically that the research and development was proceeding as rapidly as possible. Even though the Army has been given $287 million of new obligational authority for full-scale "go ahead," only $200 million of this has been made available.

Planned utilization of the $137 million (referred to above as blocked funds for preproduction purposes), based on the assumption that

Nike-Zeus full production will be approved for funding in fiscal year 1961, is as follows:

	Million
Engineering	$17.595
Material	36.110
Special tooling	25.447
Pilot production lines	57.478
Quality assurance	.370
Total	137.000

This preproduction program was initiated with $27.51 million of fiscal year 1959 funds including: a $19.9 million production planning contract, $3 million for manual production of semiconductors, $4.26 million for initiating an industrial preparedness measure for mechanization of semiconductor production, $50,000 to initiate planning for warheads, and $300,000 for industrial engineering and management.

These components consist of transistors and other electronic devices, highly miniaturized, which actually can be made in advance of system production. The purpose of the Army in requesting these funds was to enable certain preproduction work to be done simultaneously with the research and development. The so-called preproduction work would have relation not only to the Nike-Zeus program but also to many other space and missile programs where there is a need for miniaturized electronic components. The work would not be duplicated and would not be lost, but rather the Army saw a saving of time by the utilization of these funds for this purpose.

This problem of whether or not to press ahead with the Nike-Zeus is not a new one, but rather has existed since the inception of the program in 1957. Despite the Army's eagerness to proceed with Nike-Zeus production, there has been a lack of decision and funds to permit the program to proceed more rapidly.

Research and development of Nike-Zeus has already progressed much further than had many of the other complicated missile systems when approved and funded for production.

Reference was made to those who oppose the program simply on the ground that the ICBM threat poses insoluble problems. General Lemnitzer stated that in his opinion this is a defeatist attitude. Recent newspaper writings have quoted Government officials in the executive branch as saying that deterrent strength in missiles is adequate. But General Lemnitzer stressed the fact that while a military force could win only with an offensive system and could not win by taking the defensive alone, that throughout the history of warfare it has been proved that a certain amount of defense is absolutely necessary if the offensive system is to be utilized. General Lemnitzer said that this is particularly true since this country does not plan to launch a surprise attack or strike the first blow. Accordingly the only alternative is to have sufficient defense to insure that we will not be wide open to a surprise attack which could crush our offensive system.

Present defenses provide substantial defense against manned aircraft, but were we unable to put up an air defense we would be wide open to bomber attack. Such a situation would be even more serious if we were unable to devise an antimissile missile of the Nike-Zeus type. While the antimissile-missile system is regarded with a sense of urgency, nevertheless it should not be considered on the basis of a

crash program. It is regarded, however, as one of the highest priority development programs in the country and has been so designated by the National Security Council. This gives an indication of the importance of the development of the system.

Secretary Brucker said overall national security would be improved if we were able to go into production on the antimissile missile at the earliest practicable date. He conceded that the Army had requested the preproduction funds, that it had been overruled. The Army was told that until the system was proven, such funds would not be authorized. He stated, however, that he did not consider this ruling as final, in that the Army could reapply from time to time for any or all of these preproduction funds. In his opinion the country's interest required that this program be reevaluated month by month.

In speaking of the same point, General Trudeau stated that an active defense such as that possible with the Zeus system will create a greatly added deterrent as far as the Soviet Union is concerned, and would have very considerable ability to stop such attack if one were launched. He stated that although the Zeus missile has not been brought to a point where it is as complete or as near the finished product as either the Polaris or the Titan, nevertheless it is such an important weapons system that we cannot afford not to develop it.

With regard to the so-called missile gap, General Trudeau stated that in his opinion we ought also to be concerned with the "muscle gap," as he termed the Army's concern with the hard core for sustained fighting.

The problem of a proper mixture of offensive capability with some defensive capability, as stressed by General Trudeau, means in effect that if we are going to maintain our deterrent offensive capability the most important thing is to maintain our determination as a people that we can meet any challenge and this cannot be done if we are exposed and without defensive protective measures.

General Dick stated that the Army had requested $323 million for Nike-Zeus and the budget carried only $287 million. The difference in the moneys is that which would be required to develop training devices and publications, maintenance provisions and allied items which would accompany a decision to produce, that these extra moneys are not needed if the system is not to be placed in the field in the hands of the troops. The $287 million was, in his opinion, sufficient to fully fund a system to demonstrate a capability, and, further, that the difference in funds at this time was not an adverse factor to development since there is now no decision to produce.

One final point should be mentioned with regard to Nike-Zeus, and that is the fact that it has, in the opinion of Army experts, a growth potential into an anti-satellite-missile system. Nike-Zeus has not been fired full scale. At the time of the testimony, there had been four successful firings, attaining the limited objectives sought. Each test firing proves out new components and this test firing will continue until the final package and system are proved.

ADDITIONAL COMMENTS ON TRANSFER OF THE VON BRAUN GROUP

It is interesting to note that although the committee had heard witnesses on House Joint Resolution 567 and favorably reported this resolution, nevertheless the committee showed a continued interest

in the Von Braun team and the Saturn project with relation to the continuing Army capabilities. While there is little doubt that the transfer of the Von Braun team has reduced the capability of the Army in the space vehicle system field, the question resolves itself into one of relativity. Secretary Brucker expressed it by stating that in the Von Braun team the Army had an inhouse capability that was unique in that it was the best scientific team in the world and that the Army felt that with this team it had both the capability and the potential for developing missiles as well as space vehicles. The Army felt that this was the place where they could "score and continue to score," had not other things occurred.

Secretary Brucker had reference to two decisions, the first of which was a decision of the Department of Defense in September 1959, that the Air Force would take over the development, procurement, and launching of large space boosters for the Department of Defense. The second was that the Saturn project should be transferred to the NASA. Although the Army personnel who had worked with the Von Braun team since its inception were unanimous in their feeling that they disliked seeing it transferred from the Army province, nevertheless they expressed unanimity that this decision would be supported in the Nation's best interest. As expressed by Secretary Brucker, after referring to the two decisions mentioned—

> Under those circumstances, of course, it became untenable for the Army to take any position other than to say we will keep this team together as a national asset, rather than have it divided, part for the Army and part for NASA.

Under the transfer arrangements the Von Braun team will be under the management of NASA. Notwithstanding, it will be at the same location with the same people doing the same things. The team will be available to the Army, but primarily it will be a NASA operation.

General Trudeau stated, when asked for his personal opinion, that he was not in favor of the transfer of the Von Braun team, but nevertheless the decision had been made and the Army is doing all that it can to see that the transfer is conducted in the most effective manner so as to minimize any delays or setbacks in the national program.

Throughout the hearings there was considerable testimony from various Department of Defense witnesses to the effect that they were never at any time pressing for the transfer of the Von Braun team; nevertheless the decision had been made, it was accepted, and full cooperation was being given to this transfer.

It should be recalled that the Saturn program was the Army's answer to the popular present-day query as to whether or not there is a military application for large space boosters. General Trudeau stated that Saturn is definitely necessary to establish a 24-hour communications satellite. The extension of the present combat missions of the Army can be accomplished through the development of such large booster capabilities. Although General Trudeau stated that there was a present military need for superbooster engines, he did not necessarily mean that he disapproved of the other services making a contrary statement. He further stated that the necessity for the communications satellite as a meaningful adjunct to the defense system is obvious.

It was brought out that the transfer of the Saturn program to NASA will not speed up the project from a technical standpoint.

However, General Trudeau did state that NASA could put a lot more money into the program than had heretofore been made available. It was possible however that the transfer might cost more money. General Trudeau based this statement on the fact that NASA would have to set up an administrative and logistic organization to do the servicing required for the project. The present organization is in the inhouse capability of the Army through its technical services. The Von Braun team of scientists should not have to divert its efforts to perform administrative functions such as the procurement of necessary hardware. Under Army cognizance, the team was able to concentrate on the scientific effort. The Army, through the Ordnance Corps, Corps of Engineers, and Signal Corps and the other technical services, did the necessary procurement to see that the team had what it wanted, when it wanted it, and where it was needed.

The testimony throughout stressed the fact that the Army wanted to make sure that the Von Braun team would not be dissipated, for they considered it the greatest national asset that we have with respect to space. While, as General Trudeau said, it was not a happy moment when the Army "surrendered" the Von Braun team, this nevertheless was offset by the fact that the team would be retained as a single working unit.

There has been considerable speculation as to the reason for the transfer of the Von Braun team. Undoubtedly there were certain jealousies stimulated by the Army's success in the space field. Also there were many honest doubts in the minds of some people as to whether the Army should be in the space field. There was some thinking to the effect that one service or one agency should have control of everything that has to do with space. Further, there are probably psychological and psychopolitical reasons as to why we should accent the civilian aspects of the space effort and play down the military applications.

TESTIMONY OF MAJOR GENERAL MEDARIS

In addition to the Army witnesses, the committee heard Maj. Gen. John B. Medaris, USA (retired), formerly commanding general of the Army Ordnance Missile Command. In a prepared statement before the committee, General Medaris directed his remarks toward two phases of the space program. The first was an expression of his views with respect to the national missile and space effort, and second and more specifically, he dealt with the urgency of an operational antiballistic missile system.

By way of introduction, General Medaris said the space race between the United States and the Soviet Union has ideological overtones. The field of conflict is so broad that it encompasses every element of national power—military, economic, diplomatic, political, psychological, and spiritual. He expressed his personal conviction that for psychological reasons alone the free world must attain and maintain at least parity, and preferably a margin of superiority, in the field of space exploration and space exploitation. He expressed this opinion as follows:

> I consider the decision to achieve this parity, and eventually superiority, one of the most critical and fundamental decisions of our day. If the "space race" is not a valid one, then I would suggest that we are already spending too much money and too much effort on it.

He examined two possible solutions—(1) to spend more money in dollars and effort, or (2) substantially increase the efficiency of the effort.

General Medaris discussed briefly the recent directive of the Secretary of Defense which revised the missions of the respective services, which had previously been discussed by Army witnesses. His comment concerning these assignments of missions was that perhaps on the surface this decision pretended to settle old issues, but, actually it served only to create dissension. For example, the Army and the Navy are directed to buy their space vehicles from the Air Force, but there is no immediate authority responsible for the overall mission. The problem of placing the payload with the vehicle must be settled by such "anemic devices" as committees, coordination offices and other inadequate administrative devices. Presently there is no technically competent authority to give the vehicle program and the payload program the joint program status that success demands. The theory is that systems coordination has been assigned to the Air Force. However, if this theory is authoritatively exploited, it denies to the responsible service full control over its assigned space mission. As a result, since no one authority is totally responsbile for the complete mission, what is everybody's business is nobody's business.

The National Aeronautics and Space Administration was created on the presumption that the borderline between scientific space exploration and military space requirements can be clearly and effectively defined. In General Medaris' opinion, this presumption is totally incorrect. From a technical viewpoint there is little difference between civilian and military space programs, and certainly there is no justification for a division with the resulting duplication. For example, in the field of powerplants, both programs are concerned with the reaction type engine. Their development and operation stem from identical technologies, and this is a fundamental characteristic of every vehicle whether it be a short-range ballistic missile used by the troops in the field or the more ambitious vehicle used in an interplanetary probe.

In addition to the power sources being identical, likewise the control methods come from the same principles. From the standpoint of pure science, then, these programs are interrelated. Scientific exploration is in no way inconsistent with military objectives. In the opinion of General Medaris, the principle, stated briefly and simply, is that we are trying to divide the indivisible. In this regard General Medaris stressed the fact that both the military objectives and the civilian programs are derived from the same physical and manpower resources. The exploration and exploitation of space will continue to demand the use of the same facilities and the same brainpower that is now being used in the development of space weapons.

General Medaris addressed himself to the transfer of the Von Braun team as follows:

> In the area of political competition for control of resources, the Army has done the only thing it could do. When one is forced into making a choice from a bundle of bad choices, he must take the least objectionable one. The transfer of the Von Braun group to NASA is the unfortunate culmination of a long series of such dilemmas. At the end, the Army faced a Solomon's choice: First, by the assignment of the space vehicle development, production, and launching mission to the Air Force, and secondly, the Army's total inability to secure from

the Department of Defense sufficient money or responsibility to do the Saturn job properly, we found ourselves then in the position of either agreeing with the transfer of the team, or watching it be destroyed by starvation and frustration.

Although General Medaris recognized the fact that the transfer of the Von Braun team is now academic, he still believes that the present trend represented by the transfer to be illogical and undesirable. In analyzing this statement he further stated that the Von Braun group has been supported extensively by a nationwide Army organization which will continue for the performance of Army missions regardless of whether it still has the Von Braun group or not. This will require the creation of a new and separate system to support the Von Braun group in terms of finance, accounting, purchasing, contracting for services, and general logistics, and this, of course, could not be done without spending additional money. Under the existing organizational concepts and operational responsibilities placed on NASA, it must necessarily create its own system to accomplish these things, a system already in existence in the three services.

General Medaris went on to say that there must be a unified missile and space program. In view of the past performance in certain areas of purely civilian activities, as for example, in the work of the Corps of Engineers in rivers, harbors and flood control, the administration by the Army of the Panama Canal and many other activities, there is nothing fundamentally inconsistent in assigning civilian scientific efforts in the space field to the Department of Defense. General Medaris concluded:

Thus, in view of the fundamental inconsistency involved in taking the responsibility for weapons development out of the Department of Defense, we are forced to conclude that the space effort, if it is to be unified, must be unified within the Department of Defense.

It was General Medaris' conclusion that the Defense Atomic Support Agency offers a tested pattern for the problem here. There is nothing to prevent the creation of a joint command to assume undivided responsibility for our major missile and space activities. Each service being fully represented within this command would necessarily feel obligated to support its representatives. This would be coupled with the fact that there would be available various support elements of the services to reinforce joint efforts. Further, in order to assure adequate attention to the scientific side of space exploration, the scientific community should be represented at the command level. He stated we should get about 20 percent greater capability for our dollar in the space program under such an organizational arrangement.

In speaking of the antiballistic missile system, General Medaris addressed his remarks first to the school of thought that argues against the need for such a system. He stated in effect that when offensive capabilities are equal, the best offense is a good defense and we have a positive deterrent only when we can do something that the aggressor cannot do. For a deterrent force to be fully effective, it must be powerful enough to inflict damage that would be wholly unacceptable to the aggressor. Secondly, it must be supported by the unquestioned public will to use it without delay whenever necessary, and thirdly, the potential aggressor must know that the two foregoing conditions do exist. Passive defense is limited by economic circumstances, for it is unrealistic even to consider "adequate hardening" as a protec-

tion for the physical resources from whence stem our industrial and economic strength.

The Nike-Zeus missile system now in development is, in the words of General Medaris, our only conceivable positive defense for the next decade. While it is admitted that there are development problems still to be solved—for this is true in all development programs—these technical problems are proportionately no greater in the Nike-Zeus system than they are in any other weapons system of great cost and importance. The enthusiasm of General Medaris for the Nike-Zeus may be summed up in the following quotation:

> In essence I believe that the question is not whether we have yet completely demonstrated the full effectiveness of the Zeus system but rather whether we are to make any effort to defend the major centers of the United States against atomic annihilation by ballistic missiles during the next 10 years. I feel very strongly that we cannot afford not to initiate immediate action looking to the prompt production and deployment of the Zeus system.

General Medaris concluded with a strong recommendation that there be considered the means for the creation of a unified responsible authority for the future direction of the national missile and space effort, and that there be immediate preparation for the production and deployment of the only visible means for the protection of our population against atomic ballistic missile destruction that is represented today by the Zeus antimissile missile system.

When asked his position concerning the preproduction funds of the Nike-Zeus program, General Medaris stated there was very definite justification for the release of these funds and that he had so recommended months ago. He added they should have been released immediately when made available through the action of Congress.

It is interesting to note that in answer to the query as to whether or not he would be as positive in his views if he were still in uniform, General Medaris replied that he had been equally positive in his views as expressed in conferences inside the Department of Defense, and that he had made recommendations that had come to naught.

Technical Societies and Related Groups

In the past, notable contributions to national thinking on space needs and programs have been furnished by such groups as the American Rocket Society and the National Academy of Sciences (for example, in connection with the International Geophysical Year). Accordingly, the committee extended an invitation to the presidents of the American Rocket Society, the American Astronautical Society, the Institute of the Aeronautical Sciences, and the National Rocket Club, and to the Chairman of the Space Science Board of the National Academy of Sciences, to deliver prepared statements to the committee, and meet as a panel before the committee to discuss their current reactions to the status and progress of the national space effort, together with any recommendations for improvement.

Four of the five groups listed above responded with direct participation in the panel before the committee and filed longer statements for the record. These four organizations went to considerable trouble to poll their directors on various recommendations and to collect comments which would be useful to the committee. At the same time, each speaker indicated that in some degree he was representing personal

views, as any formal ratification of a position by memberships running into the tens of thousands was not practical within the time available.

AMERICAN ROCKET SOCIETY

Dr. Howard S. Seifert, president of the American Rocket Society, raised a number of points of concern to himself and to individual members of his board of directors. He stated that several members of the board felt that present planning of the American space program could be improved, and that its weakness lies in the absence of a clearly defined national policy on space.

> One day space is regarded as the key to the Nation's survival, the next as an expensive gamble which is largely irrelevant to our national destinies. Achievements in space are considered to be a revealing index of a country's technology and hence its position in the world; but they are also deprecated as mere propaganda, valuable only for swaying the have-not nations. The planning and funding of space projects are affected critically by these oscillations of opinion, often in a damaging fashion.
>
> We as a Nation should decide, first of all, how important we feel space to be, and then be prepared to act upon the consequences of our decision.

He proceeded to examine the problems of funding, to demonstrate that annual reconsideration of space expenditures hurts the continuity of projects which require stability of support over a span of at least 5 years if they are to proceed in an orderly fashion.

Among technical goals which were singled out for special urgency: Emphasis should be given to high-performance vehicles and powerplants which require a 5- to 10-year leadtime, including million-pound-thrust class recoverable boosters, medium scale rockets using new energetic propellants, nuclear rockets of 100,000 pounds of thrust and up, and electrical propulsion rockets. He also called for increased studies of bioastronautics, astronomy, astrophysics, metallurgy, and solid state physics. He outlined the needs for satellite research to provide engineering laboratories in orbit, at the same time providing global communications and weather prediction, as well as basic research. Instrumented vehicles to the vicinity of the Moon could determine the feasibility of its use as a base or station for interplanetary explorations. A few of the directors also warned against any artificial separation between the scientific and military potential of space.

AMERICAN ASTRONAUTICAL SOCIETY

Dr. George R. Arthur, president of the American Astronautical Society, viewed manned space flight as a logical progression from today's technology. He stated that the program of scientific satellites appeared to be well in hand, but that more work could be done on planetary probes. By contrast, he viewed as a definite gap the absence of a substantial follow-on program to Project Mercury to put a man into orbit. He also indicated there is room for a stronger program of applications of present knowledge in meteorological, communications, and navigation satellites. Their potential would be worth exploiting quite independently of any Soviet accomplishments.

He also developed the needs for a stronger information program to allow easier communication among engineers and scientists in the space program to minimize unnecessary duplication of effort. He also called for a more realistic public information program by

agencies of Government so that the public at large will have a better appreciation of how much can be done how soon and at what cost. Although the American Astronautical Society takes no position on the question of Government organization of the space program, Dr. Arthur wanted to make sure that the military implications are not overlooked. He also stressed (quoting from a RAND report) that—

> A good development program will insure that those in technical charge of a program have the authority to take quick advantage of new information gained during development. Such a policy will guard against the tendency for technical decisions to be made at the upper echelons of the military services, or higher. Technically trained contractor and service personnel who are in close touch with a program are in the best position to translate new knowledge into concrete plans for the next stage of development.

In closing, he called attention to the continuing need for adequately trained and educated manpower if we are to keep up with the expanding demand for qualified people to implement the programs of which we are capable.

INSTITUTE OF THE AERONAUTICAL SCIENCES

Dr. H. Guyford Stever of MIT appeared in behalf of the Institute of the Aeronautical Sciences. The position of the institute is that goals for the space program are a matter of national policy not within the purview of the institute, but the institute is prepared to cooperate in the attainment of whatever goals are set and to supply from its membership the technical talent required. This is not to say that individual members of the institute do not have strong personal views which they often freely express. He did state that the United States has a responsibility for world leadership, compounded of many factors, not the least of which is a strong capability in science and technology.

NATIONAL ROCKET CLUB

Mr. Nelson P. Jackson, president of the National Rocket Club, spoke to reflect some of the opinions offered at the recent 1960 National Missile/Space Conference held in Washington, at which a number of recognized authorities gave papers. His interpretation was that the space program does deserve a higher priority, and indeed he recommended an annual rate of current expenditure about $4 billion more than is presently programed. He also was quite concerned about the creation of incentives for industry which would spur greater progress. One official recommendation of the National Rocket Club which he brought was a request that Congress set aside March 16 each year as Goddard Day, in honor of Dr. Robert H. Goddard who pioneered American research in rocketry.

OTHER WITNESSES

DR. WILLIAM H. PICKERING

The committee spent the morning of February 24 taking testimony from Dr. William H. Pickering, director of the Jet Propulsion Laboratory of the California Institute of Technology in Pasadena, Calif. The Jet Propulsion Laboratory, transferred from its former relation-

ship with the Army, is the largest contractual group giving its time to the National Aeronautics and Space Administration. Dr. Pickering, who had appeared before the committee on previous occasions, has played a key role in the preparation of the Explorer I satellite, first in the free world, and the Pioneer IV planetoid, first in the free world, as well as other important vehicles and experiments.

Dr. Pickering had been invited to address himself to the whole range of problems relating to the space program under consideration by the committee. He reminded the committee that virtually everyone, including scientists, had little notion as recently as 1955 and even later that the space program would change from a slowly evolving, low pressure effort into the tremendous activity which is underway today, less than 5 years later. He said that by hindsight we can now recognize that even 2 years ago there was insufficient acknowledgment of the most important immediate objective; that is, that the United States should equal or exceed the achievements of the Soviet Union in space.

In other words, we should frankly admit what the rest of the world knows—that we are indeed in a race with the U.S.S.R. in space. One can come to no other conclusion.

He pointed out that the consequences of this competition are numerous and far reaching. Quite aside from the propaganda value of the Soviet achievements, which are important, Russian technological abilities are so much better recognized that countries the world over invite Soviet help for many projects outside the area of space research. Indeed, even the United States has begun to import Soviet automobiles, something which was commercially unthinkable 5 years ago.

Dr. Pickering, pointing to the confusion and indecision over what the exploration of space really means, and what motivation should apply, drew a line between the missile program and the space program. He recognized that the space program still depends upon military rockets to serve as launch vehicles, but in most other respects he viewed the two programs as involving different objectives. He recognized the high priority which must be accorded military missiles, and viewed as legitimate, military development of these missiles at the fastest possible rate. He further stated, the space program, by contrast, is important to establishing our technological leadership in the world. A real danger is that military applications may come to dominate the space effort to the detriment of our general mastery of space technology by trying to do too much too soon before there is a firm foundation of knowledge and capability. The vast sums of money required to pursue these military goals in space may tend to cut off the necessary work in the nonmilitary field which is the basis of real advance for both peaceful and military defensive use of space.

Although in general he supported the recommendations for the revision of the Space Act of 1958, he noted that lack of any provision for keeping in balance the military and the civilian efforts in this field. Indeed, he came to the general conclusion that a completely unified national space program is required, and that the National Aeronautics and Space Administration could well be made responsible for the execution of the entire national effort in this field.

These views were presented with the cogency and effectiveness that Dr. Pickering has always shown before the committee. But the

members of the committee questioned him quite closely on the recommendation that NASA manage the entire national space effort. Some members of the committee stated that in the world of today, they felt the military should be given a relatively free hand to pursue space research because survival of the Nation was at stake. Dr. Pickering did not disagree with the needs for adequate national defense, but he was concerned with the high cost of the program, and the necessity for speed of accomplishment. He felt that this would be greatest under a unified program stressing fundamentals, and that diversion of manpower and resources prematurely to military end items would slow down the attainment not only of total technological goals, but of a military capability as well. He seemed convinced that military ballistic missiles are ready for high priority military development, but that an equal effort on military communications satellites and reconnaissance satellites was premature, and would not attain these ends at the earliest dates.

In response to other questions, Dr. Pickering set forth as the long-term objective evolving from the program, not a mere duplication of Soviet accomplishments, but manned return flights to other planets, with the Moon as an intermediate goal. In answer to questions about level of funding, he put emphasis upon a steady buildup which is maintained consistently as well as a more rapid effort than is presently funded.

THOMAS G. LANPHIER, JR.

On March 7, the committee received testimony from Mr. Thomas G. Lanphier, Jr., who a few days previously had announced his resignation as a vice president of Convair (a division of General Dynamics Corp.) in order to give full time to pushing his personal views on the missile and space program without implicating his employer.

Although Mr. Lanphier's training academically was not in engineering or the physical sciences, he pointed out that for the last 20 years he has been actively engaged in work related to national defense, whether in Government or in private industry. Mr. Lanphier's statements were very forceful, and brought a strong if mixed reaction from many members of the committee. He listed a variety of conditions and policies which he believes prove the inadequacy of our defense posture, and in response to questions, told what he would do to rectify the situation. In his view, this country is losing the deterrent phase of "World War III" as he termed it. He believed the starting place must be a change in the national attitude toward the peril we face. He would step up military defense expenditures to meet as soon as possible these threats. This would include funding for an immediate airborne alert of a significant portion of the Strategic Air Command, and the ordering of more KC–135 tankers to support the alert and other SAC operations. He would accelerate both the Atlas and Titan programs, to strengthen our position a couple of years hence. He would accelerate the Polaris and Minuteman programs to give us a better mobile defense at some point later in time, but sooner than is now likely (he said). He would accelerate the work on the Midas and Samos military satellites. He expected that more B–52's and B–58's will be required, too, for the need for bombers is likely to still exist when the present fleet wears out. He would go ahead with

the B–70 program, and the improved B–58. He would buy airlift for the Army and Marines. He would start a "sensible civil defense shelter program as a significant element in our deterrent" posture.

Mr. Lanphier made much of General Power's estimate that about 300 missiles would be sufficient to destroy the approximately 100 bases of our strategic retaliatory power. He noted that whatever the official estimates may be of current Soviet ballistic missile strength, the only reasonable basis for national planning must be on the assumption that they are capable of building and emplacing missiles as fast as we are. Since Mr. Lanphier ascribes an operational date to Soviet ICBM's in 1957, it follows from a comparison with our capabilities, he said, that they should already have more than 300 ICBM's in place. There was some committee disagreement that this capability should be accorded to the Soviet Union at the present time, although there is no lack of concern over the problems which Mr. Lanphier discussed. Mr. Lanphier felt very strongly that the next 2 or 3 years represent the critical ones when the risk to our deterrent power is greatest, and hardest to correct with missiles because of the leadtimes involved in production and emplacement of total systems. Overall, he would step up defense expenditures by $4 or $5 billion a year.

In response to questions about the organization of the national space program, he indicated that it looked fairly good in level of funding if the budget is not chipped away over the next several years. He would like to see coordination of NASA and military efforts at the National Security Council level by some individual with a small staff. In response to further questions, he agreed strongly that there is a military application possible and probable in space. Looking beyond the immediate needs for reconnaissance and communications, he could foresee antisatellites and other space interceptors.

During the course of this session of the hearings, there were a number of ancillary issues brought up and much lively discussion, the details of which are carried in the printed record.

INDUSTRY TESTIMONY

Although in the end it was not possible to conduct planned hearings with private industry witnesses, because of pressures on committee time to proceed with the legislative program, an invitation was extended by the committee to these witnesses to file statements for the record. Two of the six companies originally scheduled supplied brief statements for the record.

Mr. Courtlandt S. Gross, president of Lockheed Aircraft Corp., directed his attention to the problems of indemnification against unusual hazards in space programs, a matter which is before the Congress in the revision of the Space Act of 1958. He is of the opinion that the draft legislation on this point, which parallels authority given to the Department of Defense, would do no more than meet minimum needs. He urged consideration of broader legislation to be available to nonresearch and development activities. If such coverage were provided NASA and the Department of Defense, it would match certain precedents in the Atomic Energy Commission and the Maritime Administration.

Mr. W. B. Bergen, of the Martin Co., reviewed in his letter to the committee the contributions of Martin to the missile and space program. These include Viking research rockets, a proposed satellite system offered in 1947, the Matador pilotless airplane, the Vanguard satellite, the Pershing solid-fuel Army missile, the Lacrosse tactical missile, the Bullpup Navy air-to-surface missile, the GAM 83-B follow-on to Bullpup for the Air Force, the Mace successor to Matador, the Titan ICBM, and the booster for Dyna-Soar. Martin has also been working in the field of space medicine for several years.

In general, Mr. Bergen endorses the revisions of the Space Act of 1958 as reported by this committee. He particularly hoped that the revisions of the patent clause as contained in the bill would overcome objections of the last 2 years. He also viewed the indemnification provision as a step in the right direction.

Conclusions

SPACE AND FOREIGN POLICY

It is difficult to escape the conclusion that the Soviet Union in the last several years has demonstrated a great skill in coordinating its progress in missilery, its success in space missions, and its foreign policy and world image. Shots seem to have been timed to maximize the effects of visits of Soviet leaders and to punctuate Soviet statements and positions in international negotiations. This is not to equate their space activities with hollow propaganda. Empty claims do not have a positive effect for long. Nor is there any firm evidence that it has been possible for political policymakers to call the time for shots at times inconsistent with good scientific and technical needs. The conclusion is rather that the many elements of scientific, technical, military, political, and psychological policy are all weighed, and tests which make a full contribution to such a combined strategy are carried out and supported with appropriate publicity.

Along this same line it is now clear that meaningful space exploration is becoming a major component in the stature accorded the big powers by the 20th century international community. We cannot state the case for this thought more cogently than George V. Allen, Director, U.S. Information Agency, has done before the committee—

> Our space program may be considered as a measure of our vitality and our ability to compete with a formidable rival, and as a criterion of our ability to maintain technological eminence worthy of emulation by other peoples.

In view of the foregoing, which means that the U.S. space program is joining the ranks of its defense program, foreign trade policy, mutual assistance, etc., as a prime force in world affairs, the committee expresses the strong belief that this and future administrations must emphasize and accelerate space research as a necessary element to the continued leadership of the United States.

OFFICE OF THE SECRETARY OF DEFENSE

In the year or more that has passed since the creation of Director of Defense Research and Engineering, several positive steps have been taken that augur well for increased efficiency and the elimination of

duplication within the DOD administration of research and development for our military space programs. To quote Secretary Gates—

> * * * a plan for the progressive and orderly transfer of space projects from ARPA to the military departments was initiated. This plan assigns to the Air Force responsibilities for the development, production, and launching of military space boosters; and for the separate assignment to the military departments, on the basis of primary interest or special competence, of the development responsibilities for payloads and specialized, ground-support equipment for space and satellite systems.
>
> Specific assignments for the development of payloads have been made on Midas (early warning satellite), Samos (reconnaissance satellite), and Discoverer (engineering research satellite) to the Air Force. Transfer of the Transit (navigation satellite) and the Notus (communication satellite) projects to the designated military departments is anticipated some time during the present fiscal year.
>
> Another important organizational improvement has been the strengthening of the position of Director of Defense Research and Engineering. We have recently placed the Advanced Research Projects Agency under his supervision. ARPA continues to be responsible for certain basic research programs. In particular that in the field of solid propellant chemistry will contribute to our future rocket development programs for use in missiles and space flight.

The successful management of missile research and development must be based upon clear-cut authority and the judicious application of sufficient funds. Since NASA has been assigned the urgent requirement to promote the national posture in the field of space exploration in the shortest feasible time, and since at present our space exploration effort is dependent upon the military research development and engineering program as conducted under the Director's supervision, in making available the necessary space boosters, it follows logically that the success of the Office of the Director of Defense Research and Engineering will have direct and material effect on the future success of our national space program.

However, it appears evident that sufficient care must be taken by the Secretary of Defense to insure that the evils that can come from overcentralization of authority do not occur within the Office of the Director of Defense Research and Engineering. The increasing scope of responsibility being assigned to the Director who is already charged with supervising the translation of almost $6 billion into productive research and development effort could force him to take figuratively an elevated supervisory position in order to maintain a necessary overall view of his expanding administrative domain. This result could possibly remove him from familiar contact with the sublevels of research activity, thereby significantly limiting his ability to evaluate fully many necessary technical and scientific factors that must be considered in making correct decisions. The Director is assisted by various scientists and engineers fully informed on their respective areas of interest and responsibility who give him advice and guidance. But the real responsibility, nevertheless, for making final recommendations to the Secretary of Defense on overall policy and action critical to our future defense posture and space exploration programs is his alone. And unless the Director is able to maintain on a current basis a working intimacy with the projects over which he must exercise supervision, then his ability to evaluate specific technical problems brought before him will be considerably less than that of the responsible subordinates. Therefore, he would either have to make the judgments of his subordinates his own, or would have to make decisions

that would tend to be arbitrary and based on something less than adequately comprehensive knowledge.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

a. NASA's 10-year program in space is a good program, as far as it goes, but it does not go far enough. Furthermore the space program is not being pushed with sufficient urgency. Especially lagging is NASA's program for the utilization of a nuclear powerplant and the development of the F–1 engine. In perfect candor, however, it may be said that this view is not unanimously shared by every member of the committee.

Tied in with these two programs is the bigger problem of getting a manned expedition to the Moon. NASA's 10-year program makes no provision for this, other than the forecast that a manned landing on the Moon may take place "in the time period beyond 1970."

b. Project Orion, a future method of space propulsion based on a system in which a series of small nuclear explosions creates propulsion for huge space platforms, will be terminated in August 1960 unless additional funds are provided for this important work.

This program has been underway, in one form or another, for 12 years. NASA has refused to take it over and the Advanced Research Projects Agency, which is in charge of the program, has no plans for continuing it beyond August.

Recommendations

(*a*) The F–1 development program should be expedited in line with other priorities so as to make available as early as possible a 1½-million-pound-thrust, single-chamber rocket engine which will supply a backup powerplant to the Saturn, and even more important, the opportunity to cluster engines to higher levels of thrust as a followon to Saturn. (The Nova concept.)

(*b*) Before substantial funds are committed on the Nova "concept," however, consideration should be given by NASA to determining whether a nuclear engine either by itself or in combination with the more conventional engines now in use or contemplated, does not offer a faster and more economical method of achieving a breakthrough that would enable the United States to leap-frog the Soviet Union in the field of space propulsion.

(*c*) A high priority program should be undertaken to place a manned expedition on the Moon this decade. A firm plan with this goal in view should be drawn up and submitted to the Congress by NASA. Such a plan, however, should be completely integrated with other goals, to minimize total costs. The modular construction approach deserves close study. Particular attention should be paid immediately to long leadtime phases of such a program. Fortunately, some of these are inexpensive of dollars now, but as the committee has pointed out previously, time is difficult if not impossible to buy in later phases of such an effort.

(*d*) The committee is happy to learn that the Air Force, which has been in active control of the program, plans to continue Project Orion by transferring from another project the $1 to $2 million

required to continue it for the 1961 fiscal year. However, the committee feels that this is the type of project that should be administered by NASA and recommends that it be turned over to the civilian space agency.

The committee further recommends that a gradual transfer from the Air Force to NASA be negotiated so that NASA may take over the project by the end of August. This will tend to prevent any loss of time on this important program.

DEPARTMENT OF THE AIR FORCE

The Air Force presented a strong case for its having a military mission in space, but not an exclusive one. It also seemed implicit that the military witnesses would like some increases in funding for their programs, but they were not in revolt against their superiors in the command structure.

The best available estimates seemed to make fairly conclusive there would be a missile gap during the next 2 years or so whatever is done today. However, as enthusiastic as the Air Force is for the new ballistic weapons, it has not by any means written off the manned bomber, and is pursuing a number of courses to keep bombers effective, and indeed, the main part of our nuclear deterrent against big war for the next 2 years at least. There was no statement from any Air Force witnesses that the United States has moved into a position of weakness, but there was no hiding the fact that they view the dangers in the period ahead of us as grave.

As to the space program itself, attention centered upon the need to progress as rapidly as possible with Midas and Samos. Communications satellites were also viewed as very important, but this was not developed in detail, perhaps so as not to become involved in the uncertainties of ultimate control over these projects which still rest in ARPA. (Communications satellites are viewed as important by the committee, too, not only for military purposes but peaceful as well.) No claim was made that there is a current military requirement for the large booster programs which have been transferred to NASA, but there was a very definite indication that the Air Force was building a case for a parallel program of its own which would be required to meet the needs of future space systems still at the study level. This could be considered consistent with the assignment of launch vehicle responsibility within the Department of Defense to the Air Force, although broader questions of national policy remain. On the whole, the statements were designed to give the impression that the Air Force was generally satisfied with the present organizational structure of our national space effort, and endorsed the changes recommended by the President which would eliminate the Space Council and the CMLC. Committee questions on the rewording of the declaration of purpose assigning parts of the space program to NASA and parts to DOD may have raised some doubts that the language in the original version of the bill amending the Space Act of 1958 was in the best interest of the Air Force and the Department of Defense. (This language has since been revised by the committee.)

DEPARTMENT OF THE NAVY

I. The Navy's interest in space

In the past year, the Navy has come a long way toward recognizing the value of near outer space as a medium of naval operations.

The Navy has now established 10 operational space requirements, including satellites for navigation, communications, optical and electronic reconnaissance, weather surveillance, geodetics, and the detection of other space vehicles. Of these, however, only the navigation and communications satellites are regarded as immediate objectives.

The development of communications satellites has been assigned to the Army. Yet the Navy (doubtless the Air Force, too) asserts an interest. What will the Navy be permitted to do? How should the work be divided?

In spite of its new-found interest in space, the Navy still foresees no need for superboosters or a man-in-space program. Admittedly, these developments lie some years away. In view of their probable application to naval warfare, however, as well as the long leadtimes required, not only for their technical development but for their evolution as operational systems, it would seem wise to begin work on them now.

It is true that space is still largely unknown as an operating medium. Operational concepts may, therefore, lag behind technology. The need can nevertheless be foreseen for a manned sea-based system to intercept other space vehicles. Superboosters will be required for that purpose and for many others, including space platforms, lunar and interplanetary missions and space rendezvous.

II. Navy views on space organization

In general, Navy testimony supported the present division of the national space program between NASA and the Department of Defense. However, Navy witnesses expressed a need for some kind of liaison committee. In view of the later testimony of Deputy Secretary of Defense Douglas, it seems likely that the Navy would be satisfied with a nonstatutory "Activities Coordinating Board" jointly chaired by the Deputy Administrator of NASA and the Director of Defense Research and Engineering.

The Navy witnesses thus took the administration line, and supported the President's bill (H.R. 9675).

At the same time, they strongly recommended a joint command within the Department of Defense for missile and space operations.

There is little doubt that the national space organization supported by Navy testimony would be workable. It might even represent an improvement over the present organization. But it fails to provide for policy coordination and overall management. No one but the President could set national space goals or priorities. There would be no *national* space program, no method for defining the military as distinguished from the civilian uses of space, no assurance that NASA would meet military needs, no reliable safeguards against wasteful duplication, no provision for relating the budgetary allocation of resources to national space plans and policies.

By implication, the Navy witnesses in general opposed the various suggestions that have been made for the overall management of the

national space program. These suggestions include the assignment of overall responsibility to NASA on the one hand or the Defense Department on the other, and the creation of a Space Commission, a "Manhattan Project" for space or an Office of Space Management in the White House. When pressed, one Navy witness (Vice Admiral Hayward) expressed his personal view that the military should control the whole space effort. Although he had recommended a Space Commission 2 years ago, he stated that the commission form of organization would no longer be appropriate at this late date, and he also opposed a Manhattan Project for missiles as well as space, though he said it might still be suitable for the civilian exploration of space alone.

Presumably, the Navy would not oppose a full-time staff adviser to the President on space and missile matters (whether reporting to the President directly or through the Science Adviser).

Navy resistance to any single, national space organization probably reflects a strong concern with insuring that the Navy remains free to pursue the naval applications of space science and for that purpose to do whatever it considers necessary to carry out its roles and missions. In Navy eyes, this objective naturally seems to loom larger than integrated national policy or effective coordination.

III. NASA aeronautical research

Two Navy witnesses (Vice Admirals Pirie and Hayward) expressed concern that NASA in its preoccupation with space may neglect aeronautical research.

Their concern is natural and deserves consideration. Under pressure, NASA may well be tempted to shift funds from aeronautics to specific urgent space programs.

On the other hand, admonitions written into the Space Act, as the witnesses suggested, would not be likely to guarantee an adequate aeronautical research effort.

The Navy witnesses did not say that NASA *has* neglected aeronautical research. Whether it has or not, the committee could properly inquire from time to time what level of effort (in terms of money and people) NASA is maintaining, and whether the user agencies are satisfied with the results.

IV. Navy budget for research and development

The Navy budget for research and development in fiscal year 1961 shows a continuation of the "level funding" that has prevailed over the past several years. In fact, research and development funds are slightly down, from $1,255 million in fiscal year 1960 to $1,169 million in fiscal year 1961. The policy of essentially level funding has continued in the face of rising costs and the growing complexity and diversity of weapon systems.

To make matters worse, funds for test and evaluation of major weapon systems and components, previously carried in "procurement" accounts, have been largely transferred to "research, development, test, and evaluation." The change took place under a rearrangement of the Defense budget adopted last year. As a result, the figures for "research, development, test, and evaluation" for fiscal year 1961 are not comparable to those of earlier years unless they are substantially deflated (apparently by about 20 percent).

In September of 1959, this committee recommended that Navy funds for research, development, test, and evaluation be raised to 10 percent or more of the total Navy budget, and that half or more of such funds be provided for basic and supporting research. The committee observed that comparable percentages for research and development in the Army and the Air Force are 10 percent or more. (See "Basic Scientific and Astronautic Research in the Department of Defense," H. Rept. No. 1182, 86th Cong., 1st sess., p. 26.) Since the total Navy budget for fiscal year 1961 is $12,013 million, it is evident that this recommendation has not been followed. Under the fiscal year 1961 budget, an increase of $323 million in Navy funds for research, development, test, and evaluation would be indicated by the committee recommendation. It is significant, therefore, that the Navy request for such funds in fiscal year 1961 was about $375 million more than the budget provides.

Unquestionably, the allocation of funds within the present Defense budget is difficult and painful. Sacrifices must be made somewhere; but the tendency has been to spread them across the board, in order to avoid perplexing choices. Is it sound policy to skimp on research and development, in an age of rapid and profound technological change?

V. Particular space and missile programs

An obvious question as to particular Navy space and missile programs, although beyond the scope of the hearings, is whether Polaris submarines are being produced at a sufficient rate. The present rate is three a year. Only two Polaris submarines will be operational by the end of 1960. In all, 9 have been built or are now under construction, and 12 are authorized. According to Admiral Burke, about 45 will be needed to provide a strategic deterrent force.

There are good grounds for withholding final judgment on the Polaris system until it has been fully tested. In particular, a Polaris missile has not yet been launched from a submerged submarine.

When and if the tests are successfully completed, however, a drastic increase in Polaris production will be indicated by the need for additional deterrent forces over the next 5 years.

Another crucial Navy program is the space surveillance system or "dark fence." The tardy discovery in early 1960 of a mysterious satellite in polar orbit dramatized the need for completing the coverage of the system. The Navy has proposed a second detection zone extending along a great circle route from Miami to Nome. Even without such an extension, the gap in the present detection zone could be closed and the detection range trebled by merely adding a 500-watt transmitter.

DEPARTMENT OF THE ARMY

Transfer of the Development Operations Division of the Army Ballistic Missile Agency known as the Von Braun Group

The transfer of the Von Braun team to NASA will undoubtedly curtail the capabilities of the Army in space and missile fields. The Army Ballistic Missile Agency, of which this highly competent team was an integral part, must be reorganized and restaffed with scientific personnel that will produce the standard of work required. Although at this time limitations on the Army's capabilities cannot be

determined, suffice it to say that the transfer of the team to NASA is acceptable if for no other reason than that it allows the team to be kept intact as a working unit. Attention should also be directed to the fact that restricted capabilities brought about by the loss of the team are offset to some degree by the inhouse capability that exists in the seven technical services of the Army.

NASA faces a problem in securing the utilization of the Von Braun team to its full extent since NASA does not have the nationwide complex of ordnance districts, arsenals, signal depots, and other installations of the technical services that have heretofore provided a high degree of administrative assistance to the work of the Von Braun team. Any organization to provide comparable services to NASA will prove costly to establish and cumbersome to manage.

There is little doubt that the transfer is the result of two factors—namely, the assignment of development, production, and launching of space boosters to the Department of the Air Force and the transfer of the Saturn program to the National Aeronautics and Space Administration. This, in effect, reduces the role of the Army "space," despite the fact that the Army has a continuing interest in space in such things as space communications, mapping, geodesy, and reconnaissance, which are in effect an extension of present roles and missions of the Army in modern warfare.

Nike-Zeus funds

It is the thinking of some observers that the withholding of $137 million from the preproduction funds of the Nike-Zeus antimissile-missile system is not only unreasonable but likewise tends to establish a dubious precedent in defense spending. This is particularly true in view of the fact that research and development of the Nike-Zeus has progressed further than certain other missile systems when they had been approved and funded for production. This withholding of funds is unwarranted when considered in the light of the overall missile program, for such funds were designated for engineering, special tooling, and pilot production lines for semiconductors and miniaturization generally which crosses all lines of space vehicle and missile research, development, and production. Nike-Zeus opponents do not take into consideration the potential of the system as an antisatellite defense system. The system is without current competitors and is the only system under active development today with a possibility of providing a defense against the ICBM threat. Failing to develop in a timely fashion may result in a future defense gap that could prove insurmountable. Successive tests have proven successful components development and encourage the belief that the system will accomplish the assigned mission.

In perfect fairness it may be said that this position was not a unanimous position with the members of the committee.

The Army's inhouse capabilities

The accomplishment of the principal missions of the Army will be greatly facilitated by space systems. Reconnaissance satellites would provide the surveillance and reconnaissance of hostile territory required by land combat forces. Reliability and flexibility of the Army command and administrative network would be greatly increased by means of communications satellites. The Army therefore has a positive interest in the space program.

The Army's continuing interest in space is a logical extension of the Army's mission, capabilities and resources. The research and development program of the Army conducted through the seven Army technical services has resulted in an outstanding inhouse capability. The technical services own and operate approximately $1 billion worth of research and development facilities, with an annual operating expense of approximately $400 million, supported by approximately three-quarters of a billion dollar effort from industry and private institutions. The contributions of the technical services to the space program lead to the conclusion that failure to use the inhouse facilities to their fullest capability is an unwarranted waste of a unique organization.

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