STATEMENT BY DR. BROWN, DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING, TO THE SENATE COMMITTEE ON AERONAUTICS AND SPACE SCIENCES, JUNE 12, 1961.

Mr. Chairman and Members of the Committee, I am pleased to have this opportunity to appear before you again; this time to discuss the Department of Defense space interests, space programs and the relationship of these to the National space effort.

Secretary Gilpatric, during his testimony to this Committee on June 7, expressed the Department of Defense's full support of the recent policy changes in the space effort and spoke his belief that the United States, as the leader in the scientific aspects of space and in proposed commercial and military applications of space, should proceed with lunar exploration for its scientific interest, as well as for its symbolic effect.

I have with me Brigadier General David C. Lewis, USA, Director of Special Weapons, Office of the Chief of Research and Development, Department of the Army; Rear Admiral Kleber S. Masterson, USN, Assistant Chief of Naval Operations (Development), Department of the Navy; and Major General Victor R. Haugen, USAF, Assistant Deputy Chief of Staff, Development, Department of the Air Force. They join me in offering our wholehearted support to the achievement of the new National space objectives.

At the time of Dr. York's testimony to this Committee on March 30th of last year, a detailed review of the DOD space program was provided. In general, the nature and scope of the program remain unchanged. However, it may be helpful to the Committee if I summarize the objectives of this program, highlight the progress made since that review and indicate changes which have taken place.

The major DOD space programs currently under development are:

ADVENT	SAMOS
DISCOVERER	TRANSIT
MIDAS	VELA HOTEL
SAINT	

There are, in addition, programs which are space related rather than space programs oriented toward the development of orbiting spacecraft to perform a specific mission. These include the SPACETRACK and SPASUR tracking systems, the X-15 and DYNASOAR developments. There is also a launch vehicle development called BLUE SCOUT and an experiment called WESTFORD. I will describe these programs to you. You have in front of you a funding table which indicates prior funding for each of the programs and the proposed Fiscal Year 1962 budget which you may care to refer to as we discuss each program.

ADVENT - At the time of the testimony before this Committee last year, the military communications project was known as NOTUS. This included Project COURIER which had as its objective the feasibility demonstration of an active delayed repeater type satellite relay communication system, using micro-wave frequencies. It also included Project ADVENT, an active instantaneous repeater satellite system. The COURIER program consisted of two planned launches from the Atlantic Missile Range. The principle involved in the delayed repeater communications satellite is that as the satellite passes over a designated ground station, a message is transmitted to it and stored in a tape recorder. At the next ground station the satellite, upon command, transmits the message picked up at the previous station. The first COURIER launch attempt from the Atlantic Missile Range in August 1960 failed due to a booster malfunction. The second attempt on October 4, 1960, was successfully orbited and demonstrated feasibility of the technique. This project is now completed. The ADVENT concept provides for 3 satellites equally spaced around the earth in the so-called 24-hour synchronous altitude (19,200 n.m.) equatorial orbit. In this orbit the satellite remains stationary over a point on earth simplifying the ground tracking and communication problem. This system will provide an instantaneous global communications capability. There have been no launchings to date. Recent analyses of the payload capability indicate that the vehicle may not be able to carry the weight originally planned.

DISCOVERER - DISCOVERER is the basic research and development program, managed by the Air Force, directed toward developing a satellite vehicle (AGENA) and a variety of subsystems, including guidance and control, stabilization and physical recovery of a capsule from orbit. The basic AGENA vehicle and many engineering developments derived from the DISCOVERER program are being applied to other military as well as National Aeronautics and Space Administration space programs. Since last March there have been 10 successful orbits and 3 which failed to orbit. You may recall that DISCOVERER XIII, launched on 10 August 1960, resulted in the first successful recovery of a capsule from orbit. This one was recovered from the sea; it was followed shortly thereafter by DISCOVERER XIV, launched on 18 August, resulting in the first recovery by air snatch. DISCOVERERS XVII and XVIII were also successfully recovered by aircraft. The record is good, but obviously we would like the recovery rate to be much better. We would like to develop the degree of reliability which would enable us to recover capsules regularly.

MIDAS - The MIDAS program is managed by the Air Force, and is directed toward the development of a capability to provide early warning against ballistic missile attack. Through the detection of infrared signals generated by the exhaust plume during powered ascent of the missiles, the satellite would report missile detection by direct readout through ground stations. Since last March there has been only one MIDAS launch attempt. On May 24 it was successfully orbited from the Atlantic Missile Range. However, 2 DISCOVERERS, XIX and XXI, launched successfully in December of 1960 and February 1961 also carried infrared detector payloads in support of MIDAS. All 3 shots provided useful data. Future MIDAS shots will be launched from the Pacific Missile Range into polar orbits.

SAINT - SAINT is a new development program manged by the Air Force and oriented toward the problem of intercepting and identifying uncooperative satellites. Secretary Gilpatric mentioned last Wednesday that the National Aeronautics and Space Administration is initiating development efforts in rendezvous techniques, oriented toward this problem of locating and coupling with uncooperative satellites, leading toward refueling and transfer operations. Even though the basic rendezvous applications, techniques and objectives are different, both will utilize some of the same engineering and scientific principles. Therefore, both agencies are working together to insure that there is a common flow of technology and that advance planning toward possible applications and missions is unified.

The SAINT system is being developed because we believe that we must have the capability to inspect any unidentified space object to determine its characteristics, capabilities or intent. We believe this might be done with unmanned satellites capable of maneuvering to intercept unidentified spacecraft. This inspection involves the use of sensors such as television. Results from the SAINT development flights will tell us the feasibility of this approach. However, it is possible that to perform the required mission, the use of more complex unmanned inspection schemes or manned inspection may be necessary.

In addition, there are many other potential military applications of the rendezvous technique such as logistics, maintenance, or transfer of manned crews, either as a routine or emergency measure. The NASA man in space programs will provide the basis for evaluation and analysis of requirements.

GAMOS - GAMOS is the observational satellite development program managed by the Air Force. There have been two launch attempts - one in October of 1960 which was unsuccessful and the other one which was successfully injected into orbit in January of this year.

TRANSIT - TRANSIT is the navigation satellite project managed by the Navy which has as its objective the development of a satellite system which will provide an accurate all-weather navigational capability. This system will not only assist military operations but will be of use to any ships and aircraft anywhere in the world. Satellites are equipped with special radio transmitters which provide coded information and a time signal. Use of this information, in conjunction with doppler techniques and published tables will permit ships and planes to determine their positions to an accuracy of within a fraction of a mile. Since last March there have been 4 launch attempts from the Atlantic Missile Range, three of which were successful. The TRANSIT program was the first to inject dual payloads into orbit from one launch vehicle. These included TRANSIT IV-A the Galactic Radiation Experiment Background, a separable payload launched on TRANSIT I-A. TRANSIT II-A also included a galactic noise receiver furnished by the Defense Research Telecommunications Establishment of Canada. TRANSIT III-B also carried a separable payload called LOFTI which was a very low frequency communications experiment. Unfortunately, the payload did not separate in orbit however, useful data were successfully obtained.

(3)LA NOTEL - VELA NOTEL is a new development project managed by the Advanced Research Projects Agency (ARPA) with the objective of obtaining information and experimental data for defining and evaluating the general effectiveness of an operational far-earth nuclear detection system which would be established in connection with United States policy commitments in Geneva. Many of the initial experimental payloads will be launched [illegible], for economy, on planned launches in other programs of both the National Aeronautics and Space Administration and the Department of Defense. Later in the program specific launches for VELA NOTEL will be made.

SPACETRACK and SPASUR - SPACETRACK (National Space Surveillance and Control Center) and SPASUR (Space Surveillance Detection Net) were developed to provide a capability to detect, track and assist in identifying silent or unexpected space satellites and to provide a center for data reduction, analyses, cataloging and dissemination of orbital information acquired from spacecraft. SPACETRACK and SPASUR were transferred to the Continental Air Command at Colorado Springs, Colorado in October of last year. They are being integrated into the Continental Defense System known as Space Detection and Tracking System (SPADATS) under the over-all operational control of the Commander-in-Chief of the North American Air Defense Command (NORAD).

X-15 - The X-15 is a research aircraft. The objective of the X-15 project is to develop the capability of manned flight at hypersonic speeds and at very high altitudes. The project is a joint Air Force, Navy and National Aeronautics and Space Administration effort. The Air Force has the management responsibility and the NASA has the responsibility for technical direction. The project is supplying fundamental research data on temperature effects, stability and control, and physiological problems in flight of a manned aircraft at high speeds and high altitudes under quasi-equivalent space flight conditions. Two of the three X-15 aircraft constructed for this program have been test flown by pilots of the contractor and the government agencies participating in the program. The flight test program which was begun in 1959 was recently highlighted by the maximum speed and altitude to date achieved by a manned aircraft. The X-15 reached [illegible] on a March 30th flight. On May 25th a speed of Mach 5 was achieved. The speed and altitude regimes will be further expanded as the flight program continues.

In addition to the NASA funds shown on the funding table, it is estimated that the X-15 logistics support provided by the NASA amounted to approximately [illegible] million in Fiscal Year 1961 and $5 million in Fiscal Year 1962. Air Force logistics support is estimated at $4 million for each of the two years.

DYNASOAR - DYNASOAR is a space-related rather than a pure space program. That is to say, the vehicle is not programmed to go into orbit in the currently approved phase. DYNASOAR is a Air Force/NASA project to develop a vehicle which will expand the speed-altitude regime of manned hypersonic flight exploration. It will make use of the data obtained from the X-15 and will develop the

technology necessary for future manned orbital vehicles which will be capable of orbital maneuvers, controlled atmospheric reentry from orbit and landing on conventional runways. The current approved phase includes applied research into the technical problems involved in maneuvering within the atmosphere from near-orbital velocities, maneuvering within the atmosphere and culminating in a controlled landing on a conventional runway. In the program currently approved both unmanned and manned vehicles will be boosted by modified TITAN II boosters. Follow-on phases now under study have the objective of achieving orbital velocity and the deployment of subsystems in orbit. These phases will require the availability of more powerful boosters.

BLUE SCOUT - BLUE SCOUT was a project to develop a versatile, reliable, and economical small solid propellant vehicle in several configurations for a variety of payload applications and experiments. The program is jointly coordinated with NASA and makes use of NASA SCOUT components, with such modifications as are required to adapt it to military requirements. It has a capability for use as a vertical probe, having a wide range of payload weights for scientific and can be used for experiments requiring ballistic missile trajectories or unmanned boosted high-speed reentry vehicles, as well as for boosting small payloads into orbit. There have been [illegible] successful development flights.

WEST FORD - WESTFORD is an experiment, rather than a project, and is being conducted by the Department of Defense by agreement with the National Aeronautics and Space Administration. WESTFORD is a passive communications experiment and responsibility for this area of effort is the responsibility of the NASA. The objective is to place into orbit several pounds of very small dipoles to permit a reliance that they will spread into a complete belt around the world. This belt can be visualized as a fleecy cloud, shaped somewhat like a doughnut encircling the globe. It will be used as a reflector of radio signals to provide communications from one spot on the earth to another. It would be used in much the same manner as was the large NASA balloon called ECHO, except that it is a continuous reflector belt rather than a discreet balloon which must be maintained by a pressurized system.

You will note that there is very little change in the DOD space programs from the figures provided to you last year. A logical question is: What about [illegible] military space programs? This Committee is very familiar with the National Aeronautics and Space Act of 1958 which assigns the responsibility to the Department of Defense for only those activities in space which are peculiar to or primarily associated with, the development of military operations or the defense of the United States. Consequently, since space efforts are not an objective in themselves, we are undertaking only those applications which appear to hold promise of meeting specific military requirements or enhancing our over-all defense capability. We cannot continually assess our space development programs and accomplishments in the light of their contribution to our defense needs and they can compete favorably on a cost effectiveness basis with other more conventional means of performing specific military functions or missions.

For these reasons we cannot define in detail the military space programs of the future in specific terms of systems, numbers of vehicles, schedules and costs. The force structure of the future is dependent upon the results of currently programmed research and development of space projects as well as new-space efforts and the relative cost effectiveness that emerges as we progress down the technological path.

In broad terms, we see navigation, communications, meteorological information gathering, navigation, communications, inspection and defensive satellite systems. At the moment, with the exception of DYNASOAR, our projects are based upon unmanned systems. This, of course, is subject to change as a function of the results of the DYNASOAR program as well as the manned programs of NASA. We are asked frequently why we do not have a detailed plan for military use of man in space, for space stations and for logistics support of space stations. The answer is that we do have many studies, examining concepts and investigating applications in these areas. We certainly do not want to duplicate NASA efforts although we must be in a position to exploit for military purposes any applicable results of NASA programs. I feel that out of the MERCURY, DYNASOAR and APOLLO programs will come the answers needed to determine, on a sounder basis than theory and hypothesis, what practical applications of manned space vehicles there may be for both military and civilian use.

The DOD is not responsible for space exploration, whether manned or unmanned; however, we support these NASA programs vigorously and we recognize moreover that fundamental data produced from these programs will be useful to our current military programs and may well form a foundation for advanced military space systems of tomorrow.

I commented to you, on the 2nd of June, our conviction that the Aeronautics and Astronautics Coordinating Board provides an effective medium for the necessary exchange of information between the NASA and the DOD. This is considered important because it is essential that we have a close working relationship with the National Aeronautics and Space Administration if we are to pursue an effective national space program.

In this connection, you will note that the funding table, provided to you, shows $62 million for the development initiation of a large solid propellant booster and $15 million for initiating the development of an upper stage for use with the TITAN II booster. We are working with the National Aeronautics and Space Administration to support the national space effort by undertaking the development of large solid propellant motors and to modify the TITAN missile for space application together with a new upper stage for use on the TITAN II booster. You are probably aware, or can readily guess, that there have been internally dozens of proposals for expanding the national space efforts. A large proportion of these proposals dealt with expanding, or increasing, our payload lift capability

[illegible] can be taken in terms of [illegible] and vehicles, and the [illegible] have under way studies [illegible] we are going to take in the solid propellant program. [illegible] determine the course of action which will give [illegible] with the desired growth potential.

[illegible] of solid propellant motors such as simplicity, higher reliability and [illegible] time are some of the reasons for the decision to [illegible] as a parallel approach to the liquid fuel [illegible] that this development will be pursued to a [illegible] between the solid and liquid choice.

The [illegible] subject to further refinement, is to develop a segmented solid propellant motor weighing approximately 750,000 pounds which will provide [illegible] pounds of thrust. This basic motor can then be used [illegible] building block to provide stages of varying thrust by clustering the [illegible] of motors. Facilities will have to be provided for the [illegible] of segments, the full-scale motor and clustered assemblies.

[illegible] are under way on [illegible] nozzles, thrust vector control [illegible] high strength cases. Nozzle cooling is also being [illegible] in the event that it should be required for the longer burning [illegible].

For the [illegible] upper stage the choice has to be made between a number of liquid fuel combinations. [illegible] is a function of the fuel selected. [illegible], cryogenic fuels have the advantage of higher specific impulse but are more difficult to handle. Storable fuels have the advantage of ease of handling and [illegible] advantages but provide lower specific impulse. [illegible] must be analyzed in terms of performance, weight, reliability and development time [illegible].

We recognize the [illegible] with the earliest possible decisions and actions but at the same time we are convinced that we will make progress [illegible] at this point, with deliberation before selecting the details of the [illegible] approach. I should like to close with the [illegible] for FY 1962 are a down payment on [illegible] we will provide data in concerning not only the [illegible] of these funds but an indication of what the total program might cost and what the development schedule will look like in terms of milestones [illegible] finished our overall analyses and determined the best [illegible] approach.

Thank you, Mr. Chairman. I will be happy to attempt to provide answers to any questions which you or the Members of the Committee may have.