REVIEW OF THE SPACE PROGRAM

TUESDAY, FEBRUARY 9, 1960

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

The committee met at 10 a.m., Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will come to order. I think yesterday when we adjourned everybody had been sworn in except Admiral Pirie, who was not here. May I, Admiral?

Do you solemnly swear that the testimony you will give before this committee in matters now under consideration will be the truth, the whole truth, and nothing but the truth, so help you, God?

Admiral PIRIE. I do.

The CHAIRMAN. Have a seat, Admiral.

Now, before we get into the statements, I want to say that some time ago, while I was at home, Mr. Lankford, of Maryland, one of our colleagues, wrote us about a naval station here in Washington being used for missile purposes and I asked the staff to look into the matter and give Mr. Lankford, on behalf of the people of this area, a report.

Now, we have called Mr. Lankford and, if he is available and wishes to come here, I had proposed to the admiral if he has any report to make on that particular project, and if so, to give us the report this morning. But we won't bring it up until he is here, out of courtesy to him.

Now, Admiral Pirie, you have a statement, and Admiral Hayward has a statement. Admiral Hayward, shall we proceed with your statement?

Admiral HAYWARD. Mr. Chairman, if it is all right with you, I would have Admiral Pirie begin. His statement is relatively short on the operational side and my statement is pretty long and detailed.

The CHAIRMAN. Fine. Admiral Pirie, we are very happy to have you. I think this is the first time we have had you before our committee. We welcome you here.

Admiral PIRIE. Thank you, Mr. Chairman.

STATEMENT OF VICE ADM. ROBERT B. PIRIE, USN, DEPUTY CHIEF OF NAVAL OPERATIONS FOR AIR

Admiral PIRIE. I am Vice Adm. Robert B. Pirie, USN, Deputy Chief of Naval Operations for Air. As Admiral Burke's deputy for air, I have been given, in addition to my responsibilities in the aeronautical field, the responsibility for astronautics and space plans, programs and requirements—operational plans, programs and requirements as distinct from those in research and development.

While naval space activities in the field of research and development have been going on for a number of years, it became quite evident during this past year that there were aspects of the national and Defense Department space programs that would require considerable staff effort outside of the research and development field. These fell principally into two categories: First, the formulation of those requirements which the Navy might have for space vehicles or satellites which would enable us to better perform our missions and, second, the support of space operations, both national and Department of Defense, with resources, facilities, and forces of the Navy. These operational needs clearly pointed to a requirement for operational staff direction as distinct from those of research and development.

With attention focused on operations, I should like to present to you today some views on the naval uses of space which the Navy believes are pertinent to your consideration of the overall national space effort.

As previously stated by Secretary Gates, it is approved policy that the Navy will use space to accomplish naval objectives and prevent space from being used to the detriment of those objectives. Specifically, the Navy will pursue the necessary research and technological developments which will enhance its ability to conduct operations in space which are in support of the roles and missions presently assigned to the Navy. At the present time there are considered to be 10 areas wherein the Navy believes that its objectives may be accomplished more effectively by space systems. Ten operational requirements have been established in these areas. The systems involve improved navigation, communications, optical and electronic reconnaissance, weather surveillance, geodetics, and satellite detection. Some of these areas of naval interest may overlap those of the other services.

This chart on the bulkhead to my right shows this quite clearly (fig. 79).

In the left where the checkmarks are you see, opposite combat systems, where each of the services has an interest in those specific systems, and the circles to the right in red under the various reconnaissance systems shows those in which each of the services may have a distinct interest in the specific space system.

I think it is probably quite clear. We are trying to show here that each of the services has an interest in practically all of the space systems that we have today in the military.

This duality of interest does not in itself necessarily imply duplication. Compatibility with a specific weapon system may demand that a space system be designed by a particular service even though the system is in an area which parallels the interests of another service.

The aircraft designed by the Navy for use on its aircraft carriers is an example of development which has necessarily paralleled that of the other services. The reconnaissance satellite designed by the Army or Air Force for the close observation of specific land areas would not necessarily fulfill the requirements of the Navy for surveillance of shipping in the worldwide ocean areas.

The fact, however, that there are overlapping interests does point up the need for the closest coordination and joint effort between services in the development of their space systems.

SPACE SYSTEMS

COMBAT SYSTEMS	ARMY	NAVY	AIR FORCE	WEATHER	GEODETIC	COMMUNICATIONS	NAVIGATION	OPTICAL & INFRA RED RECONNAISSANCE	INFRA RED EARLY WARNING	PASSIVE ELECTRONIC COUNTERMEASURES	SPACE SURVEILLANCE
STRAC	✓			●		●		●	●	●	●
DEPLOYED ARMIES	✓			●		●		●	●	●	●
AMPHIB	✓	✓		●		●	●	●	●	●	●
CARRIER STRIKE		✓		●	●	●	●	●	●	●	●
POLARIS FBM		✓		●	●	●	●	●	●		●
ASW		✓		●		●	●	●	●	●	●
MINE WARFARE		✓	✓	●		●	●	●	●		●
AIR DEFENSE	✓	✓	✓	●		●		●	●		●
MISSILE DEFENSE	✓	✓	✓			●		●	●		●
TACTICAL AIR SUPPORT	✓	✓	✓	●		●		●	●	●	●
STRATEGIC AIR			✓	●	●	●	●	●	●	●	●
ICBM			✓	●	●	●		●	●		●
IRBM			✓	●	●	●		●	●		●

✓ COMBAT SYSTEM PECULIAR TO A SERVICE

● SPACE SYSTEM WHICH CAN BE EMPLOYED EFFECTIVELY BY THE INDIVIDUAL SPACE SYSTEM

FIGURE 79

The overlapping interests of the various military weapons systems is illustrated on this chart. The Navy view is 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.

A Navy space facility that is of significance at this time is the Navy space surveillance system, centered at Dahlgren, Va. This Navy facility has been detecting and cataloging all orbital objects passing over the United States since February, a year ago, whether or not they are emitting electronic signals.

The Navy's Space Surveillance Center at Dahlgren, Va., using a large computer regularly compiles and disseminates to the military and civilian users, orbital data on all satellites. The Navy considers space surveillance information vital to the security of our fleet forces when considered in the light of the demonstrated Soviet capability in space photography.

The surveillance center is, therefore, tied in with our forces afloat and regularly disseminates to them orbital data on foreign satellites. This permits fleet forces to develop effective countermeasures and evasive tactics, and to train our personnel in the military use of such information.

The space system that we believe will soon be operational is the navigation satellite, Project Transit. From an operational standpoint, we consider that this system will be in fleet use by 1962. Moreover, the research and development models to be placed in orbit this year may prove operationally useful. In anticipation of its operational status, we are planning to equip our ships and train personnel in its use. The operational effectiveness of the system should greatly improve the accuracy of the fleet ballistic missile. It will likewise contribute significantly to the effectiveness of our attack carrier and antisubmarine operations.

Now, in the field of space support functions, the Navy has resources, facilities, and forces to contribute:

1. Resources consist of:
   - (*a*) Trained personnel.
   - (*b*) Test, and evaluation activities:
     - (1) Naval Air Development Center.
     - (2) Naval Research Laboratory.
     - (3) Naval Ordnance Test Station.
     - (4) Naval Electronics Laboratory.
     - (5) Aviation School of Medicine.
     - (6) Research programs at various U.S. universities.
2. Facilities consist of:
   - (*a*) Pacific Missile Range.
   - (*b*) Navy space surveillance system.
   - (*c*) Communication facilities.
   - (*d*) Sound location sites.
3. Naval Forces consisting of ships and aircraft units.

The Navy has been actively involved in the recovery of space vehicles and has contributed heavily to space support operations of this type. Our contributions to recovery of the Nation's first space flight capsules of Project Mercury, bespeak of the growing importance of the sea for space operations. So far, the Navy's achievements in this regard include the recovery of a number of nose cones. Three of these recoveries included biomedical capsules containing primates.

The magnitude of the overall support problem is well illustrated by the support which the Navy is providing for Project Mercury. Project Mercury recovery responsibility is assigned Commander Atlantic Missile Range, and Commander in Chief, U.S. Atlantic Fleet, is assigned recovery operations for the Atlantic area.

During 1959, fleet units have developed recovery techniques, procedures and hardware and have provided ship and aircraft support for the solid rocket booster tests which have been conducted by NASA off Wallops Island, Va., as well as the Atlas-boosted tests on the Atlantic Missile Range.

In 1960, the Atlantic Fleet forces will continue development of recovery techniques and will provide ship and aircraft support for the recovery of Redstone-boosted ballistic shots, as well as for a number of Atlas-boosted ballistic shots which lead up to the first Project Mercury orbital shot in late 1960 or early 1961.

Certain Navy resources have contributed to Project Mercury in the form of biomedical equipments, and space simulation devices which the Navy has developed. In addition, the Navy was a source for three and Marines for one of the seven men who were selected as astronauts for Project Mercury.

The Navy has been requested to furnish certain facilities in the Pacific Missile Range to support Project Mercury. These include certain instrumentation for tracking, telemetry, communications, command control, and data reduction.

Additionally, Pacific Missile Range will provide an instrumentation ship to be stationed off the west coast of Mexico for tracking, telemetry, and command.

To assist NASA in the construction of facilities on Canton Island for telemetry in the western Pacific, the Navy is providing a Seabee construction team. The Navy is providing also real estate and local support for the location of a trucking station at the Naval Air Station in Corpus Christi, Tex.

The forces utilized in Project Mercury recovery operations include destroyers, dock-type landing ships, patrol aircraft, helicopters, and fleet oilers. The estimated Navy support force requirements for the entire project approximately 2,245 ship-days and 1,264 aircraft/helicopter-days. In consideration of the importance of the project, and the fact that the eyes of the world will be focused on it, the Navy considers the recovery operation or the astronauts to be of paramount national importance. The Navy is rendering maximum support.

With the increase in tempo of activity of the total national space effort, hard earned experience has shown a definite need for joint participation by the combatant services to support this national space effort.

The effort required to provide transportation, communications, logistic support, and operational facilities, in addition to boosters and payloads for various projects, necessitates the direct participation by

the combatant services in the development of military space technologies.

The CHAIRMAN. Thank you very much, Admiral, for a very fine statement.

Admiral Hayward, do you also have a statement?

Admiral HAYWARD. Yes, sir; I do, Mr. Chairman.

The CHAIRMAN. We would like to have it, Admiral, at this time.

Admiral HAYWARD. All right, sir.

STATEMENT OF VICE ADM. JOHN T. HAYWARD, DEPUTY CHIEF OF NAVAL OPERATIONS FOR DEVELOPMENT

Admiral HAYWARD. Good morning, gentlemen. I am Vice Admiral Hayward, the Deputy Chief of Naval Operations for Development. One of my responsibilities is to ensure that scientific developments are exploited for application in the Navy's conduct of its functions.

For this reason, I would like to direct your attention to the science part of your committee's interests. Although your present concern is primarily directed toward space and astronautics, a brief setting of the stage may help us realize a little better how it all started.

SCIENCE AND SPACE

"Science," which basically means "knowledge," has always been of great concern to the navies of the world. The inherent challenge of warfare at sea, over extended distances, against fleeting enemies has led our Navy to constantly explore new areas, develop new techniques, and pursue advanced research so that we might be able to accomplish our basic mission in new or more efficient ways.

The Navy has explored the Arctic regions, developed rockets, created artificial environments for human beings, investigated the upper atmosphere, searched the ocean's floor, frozen human tissue, explored the atom, and even analyzed the atmospheres of the other planets. This pursuit of science, this reaching for knowledge has been necessary for the development of the submarine, operations in the polar regions, transmission of naval communication, perfection of guided missiles, and conduct of antisubmarine warfare.

In this process of reaching out to new horizons, the Navy recognized very early the scientific challenge of outer space—that great unknown that surrounds us. The proposals in 1946 and 1955 for Earth-orbiting satellites were directed toward exploration of this new medium. The strato-lab carried by balloons to high altitudes, the rocket probes that sampled the upper atmosphere, or the radar signals bounced off the moon were all part of this reaching for knowledge, the pursuit of science.

Now this does not imply that the Navy laid claim to the upper atmosphere, to radar, or to space. We wanted to find out how we could exploit these techniques, these areas, or these media for Navy purposes, to better accomplish our job.

SUPPORT TO NATIONAL PROGRAM

Other activities and agencies were also so involved, and whenever a clear responsibility developed, the agency with primary cognizance naturally turned to the Navy for support or assistance.

The Atomic Energy Commission has used quite a bit of our research. With the creation of the National Aeronautics and Space Administration, the primary responsibility for space exploration logically developed on that organization.

The Vanguard project, being a scientific endeavor, was transferred to NASA from the Naval Research Laboratory, which had developed this IGY contribution. The benefits to all other space programs in the form of components, techniques, power sources, tracking facilities, and boosters have been numerous.

Although the post-sputnik furor confused the understanding both in its objectives and in its contributions to space programs. Similarly, the Navy has provided valuable support to NASA for development of solid boosters, passive communication satellites, and for the NASA weather satellite.

We do not consider these functions to be competitive to Navy functions, but rather feel that they are bonuses that have evolved from the Navy's basic search for better ways to do its job. At present we are not certain of the naval uses for a man in space, but are pleased to be able to support the civil program toward that goal which is so vital to national prestige.

As Admiral Pirie pointed out, these contributions to the national effort are largely unrecognized by the public because we do not publicize what we considered to be the fact of merely doing our job. In the NASA Mercury project, for example, of course, the Navy has contributed men, provided the suit they will wear, administered the contract for construction of the capsule, developed tracking stations, built facilities, provided liaison, provided personnel training, contributed environmental and acceleration research, determined recovery techniques, and provided some personnel for administration of the program. It is not a Navy program, though such a list may give that impression.

This is an example of how we gladly and willingly can support the civil programs if we are not restricted from doing so. This type of support to the national effort is one of the three ways in which the Navy participates in space activity.

PARTICIPATION IN DEFENSE PROGRAM

The second type of Navy activity in space is its participation with the other services in military space projects. This comprises not only supporting research sponsored by the Department of Defense, but includes participation in satellite programs designed to meet military requirements.

The Navy's contributions to the military space program have been a direct result of the research and development that was directed toward meeting naval needs. Our bureaus and laboratories have been working for many years on propellants, engines, rockets, radars, vehicle stabilization, guidance, sensors, atmospheric heating, missile detection, and similar problems. That research which can be used to support space technology is now contributing to, and frequently being supported by, the Department of Defense scientific effort.

NAVAL PURSUITS

We have not, however, ceased looking for new or better ways to do our job, and so the search includes investigation of space techniques.

This, then, is the third method of Navy participation in space—The pursuit of space techniques peculiar to naval needs. By analyzing and studying the advantages and threats posed by the advancing technology of space, we can determine which of these must, or should be, tailored to specific naval uses.

CURRENT PROGRAMS

Before discussing specific Navy programs, which you will note are neither large in number nor spectacular in the ordinary sense, I would like to explain an important point of view. The advent of space as an area of operations had not changed the basic naval missions which are all related to seapower and our control of the seas. We do not recognize at this time any space-based weapon system which can effectively accomplish the Navy task of destroying hostile naval elements—the surface, subsurface, and airborne forces.

Space techniques for the destruction of land-based threats to our fleets or to the Nation are also remote possibilities. We believe very strongly, however, that space-oriented support systems may soon augment existing weapon systems or alleviate major command problems. These support systems are in the field of satellite navigational systems, communications, and meteorology, and reconnaissance.

In these fields we have a keen interest; these systems comprise our immediate goals. In the future, we feel that technological developments can make possible the definition of space weapon systems which may revolutionize current concepts of war. As in the past, we will continue to develop future weapon systems for the support of our naval missions.

In the category of specific programs, I have available detailed presentations which I will be pleased to present if the committee desires. As a preliminary to this, however, I would like to cover the highlights of the various current programs.

TRANSIT

Our navigational satellite system, Transit, is being developed to provide initially a worldwide, all-weather navigation system capable of extremely high accuracy for use by submarines and surface ships. Extensions of the program are being considered to make the system also usable by aircraft.

Briefly, the operational system will consist of four satellites in circular orbits such that complete global coverage will result.

The orbital parameters of these satellites will be precisely determined by tracking stations which will feed the information to our computing center at Dahlgren, Va.

This project was started about a year ago under the sponsorship of the Advanced Research Projects Agency. Ultimately, however, the Navy must assume the responsibility for providing for both the payloads and the boosters which will be required to place the system into operation. Our present schedule calls for the system to be operational in fiscal year 1962.

Why are we pushing this program? Simply because ships at sea, particularly our Polaris-type submarines, require the best and most precise navigation that we can provide. Transit offers a means of

obtaining an improvement over existing navigational methods at lower cost and with greater coverage.

Additionally, it eliminates our dependence upon fixed transmitting stations located outside the United States which might be highly vulnerable in a war or emergency situation.

Now, I would like to make it clear that Transit wasn't started as a "space for space sake" project, but rather because a space-oriented system appears to offer the best means of obtaining an improvement over existing systems. An attractive gain in efficiency for doing a necessary job appears to be in the offing, and we intend to take full advantage of it; the fact that the system involves space does not mean that it is a glamour project for prestige. It must compete financially and in efficiency with other systems or we cannot justify its use.

SPASUR

Another "space" system developed by the Navy was the direct result of the Navy's creation of the minitrack network for Project Vanguard. After the Sputniks were launched, it was evident that the United States had no means of detecting noncooperating satellites, that is, those which did not transmit on the frequency of our tracking stations, or did not transmit at all.

In June of 1958 the Director of ARPA requested the Naval Research Laboratory to develop a space surveillance system which had the capability of detecting, tracking, identifying and determining the orbit of nonradiating space objects. In response to this request, the Naval Research Laboratory developed the Spasur system, sometimes called the Dark Fence. The system consisted of a data acquisition network, a Spasur operation center, and a computational facility. Feasibility was demonstrated in July 1958, and the complete facility system was placed in operation in August 1959. This system consists of six stations in two groups, eastern and western. Each complex consists of two receiver stations separated by 500 nautical miles with a CW transmitter located between the two which is an old physics means of determining velocities.

The performance to date has exceeded the original expectations by an appreciable margin. The reliability of the equipment has been such that the down-time per month is usually less than 1 hour. No Discoverer satellite has been able to pass through the detection barrier without being detected by one or more stations. The prediction accuracy has been demonstrated by predicting the position of Sputnik III as far as 25 days into the future with the actual observations agreeing within 5 seconds of the predicted positions.

The addition of a second detection zone, standing along a great circle from Miami to Nome, would improve the response time of the system so that after a single passage of a satellite through both detection lines, an orbit could be determined and a warning issued to operating forces in the predicted path of the satellite within 1 minute of the passage. Predictions of the sputnik orbits are now being regularly transmitted to the operating fleets to familiarize them with the plotting procedures, predication methods, and counter actions that are necessary against an unfriendly reconnaissance satellite.

Although this is a ground system, it has important space applications, as you can see.

The Department of Defense is currently considering the establishment of the third transmitter near Wichita Falls, Tex., to close the gap which now exists in the central part of the detection network. The 500-kilowatt transmitter requested will increase the range capability of the detection system to approximately triple the present altitude in addition to completing the coverage in the detection zone. This decision is being delayed pending policy decisions by the Secretary of Defense.

COMMUNICATIONS

In addition to Spasur and Transit, which the Navy is developing for the Defense Department, we are also vitally interested in the area of space communications. The advent of artificial satellites and associated space technology can revolutionize military long distance radio. Our communications of the future will be accomplished or supplemented by space relays—active satellite relays (delayed and real time); passive satellite reflectors (natural, such as the moon, and artificial); chaff belts, or any material orbiting in space which can serve as a reflector. Advantages which can be expected from the use of space technology for communications include broadening of the usable electromagnetic spectrum for radio communications over long distances; freedom from the vagaries of sky wave propagation of high frequency radio transmissions; worldwide coverage; less susceptibility to enemy jamming and intercept; and freedom from political implications of base rights.

Naval communications over long ranges which might be met by communication satellite relay systems are of several types: fixed point-to-point communications; communications between mobile units; communications between mobile units and shore facilities; and broadcast communications to water-borne units.

The Navy research and development program for communication satellites includes feasibility tests of high altitude satellites as relays between ship and shore stations; extension of the Navy's program of radio communications by Moon relay; investigation of systems for polar communication coverage; and concentrated efforts toward communications with submerged submarines.

As a participant in the current Department of Defense communications satellite programs, we have proposed that a Navy ship be instrumented with a complete receiving and transmitting terminal configured for experiments in communications by satellite relay. The experimental shipboard terminal is intended for use with the Department of Defense 24-hour satellite system. Further, it is planned that this installation be flexible enough to serve as a shipborne terminal for experiments with ship/shore moon relay, passive artificial satellites, or chaff in orbit. The 24-hour satellite system promises to meet many of the long range radio communications requirements of the Navy.

Since the development of the special shipboard antenna involved the longest leadtime, and must be meshed with the satellite time scale, ARPA has been requested to provide funding assistance initially with Navy research, development, test, and evaluation funding to follow in fiscal year 1961.

However, it should be mentioned that a satellite microwave radio relay system does not meet the very important requirement to im-

prove communications to a completely submerged submarine. This is an area wherein the Navy will have to pursue space research toward satisfying a need that is not common to the other services.

WEATHER SATELLITE

The need for improved weather information, on the other hand, is common to the military and civil agencies. The weather satellite requirements of the various departments have recently been consolidated to provide guidance to NASA in the execution of its Tiros project. It is not an easy task to satisfy the many diverse needs of the various customers, even though they are all in favor of better weather information.

The Weather Bureau may be looking for long-term weather information for scientific study; some military services are seeking leads to better forecasting for land areas; and the Navy is primarily seeking operation weather information in places where no one else is particularly interested. We believe that a weather satellite can help us obtain weather information in such areas of the world which are either very remote or which could be devoid of information in wartime. We stress the importance of rapid availability of the data from such a satellite, because we feel that naval forces must use weather tactically to maximum advantage.

One very important future application is the use of cloud cover information, from a satellite, as a defense against an unfriendly reconnaissance satellite.

The Navy is participating in Project Tiros, the weather satellite project originally established in the Department of Defense. Since the transfer of this project to NASA, the Navy is continuing its support through the Naval Photographic Interpretation Center which will perform the precision development and photogrammetric analysis of the master photographic record taken by the satellite. Although the Tiros project of two satellites will probably be succeeded by a follow-in program, Nimbus, the total number of weather satellites will still be relatively few.

PROBES

The Navy has tried another technique for obtaining local weather information by means of rockets which are fired in an almost vertical path above the earth's surface. Project Huga has demonstrated the feasibility of obtaining photographs over an area of about 3 million square miles by recovering the payload from such a vertical probe.

Of course, rockets of this sort have been used for many years to sample the upper atmosphere, to determine intensity of cosmic radiation, and to conduct numerous scientific experiments. There are further applications of mapping or communications relay and reconnaissance, which are under study to afford tactical vehicles to perform, at very low cost, some of the tasks envisioned for satellites.

SUPPORTING RESEARCH

This type of vehicle, and the others I have mentioned, can be rather easily identified as space systems which will assist the Navy in accom-

plishing its mission. They are the eventual results of the basic research, or the "pursuit of science," that the Navy supports.

Between that basic research and the development of systems lies an area which we can call supporting research. It is the area in which we pursue with definite intent the results that basic research has generated.

Though not identified as systems, supporting research is directed toward improvement of our space technology. Areas such as solid propellants, materials, biomedical research, and boosters will certainly yield benefits in many fields in addition to space. They are being pursued vigorously because demands of space techniques require that the greatest advancements possible be made in the state of the art in these areas.

Our efforts in astrophysics, radio astronomy, investigation of cosmic radiation, and high altitude rocket soundings of the upper atmosphere are being undertaken in order to learn more of the nature of outer space. These are necessary preludes, not only for manned space travel, but also for the more immediate applications of unmanned space vehicles. In addition to research for satellite applications of communications, navigation, reconnaissance and antisubmarine warfare, we are also attempting improvement of satellite payloads to afford greater efficiency, smaller size, and greater reliability. Supporting research covers a broad area; even such undertakings as improvement of mathematical computers or facilities for data handling are very closely related to our ability to use the information we get from satellites.

Space vehicles, of course, are not the only way we can use space, because other phenomena such as ionization in the upper atmosphere or entrapment of free electrons may possibly be used for detection of ballistic missiles or the jamming of radio transmissions. These are also space applications, and are typical of the diverse areas that our supporting research investigates.

In our approach we have kept in close touch with the space research and development efforts of other agencies. We have contributed to them where we could, we have sought to learn from others wherever possible, and we have done our best to avoid expensive duplication of the efforts of others.

We are, therefore, confident that the Navy has given this Nation the very most in actual space progress for every space dollar expended. We are confident that we can continue to do so, because that is how we are trained and organized to conduct our business.

FUTURE PLANS

Operational space systems are truly the responsibility of the military services, and if we want to use these advanced systems, we must make preparations now. We have great hopes for Transit, of course, and are prepared to assume the operating costs of this system for the advantages that it will afford.

We also plan to extend the Spasur system both in coverage and in speed of data transmission to the fleets so that we can minimize any threat from an enemy reconnaissance satellite. We wish to extend our present capabilities for surveillance through use of tactical probes and satellites. The first Earth orbiting vehicles capable of yielding worth-

while military information will probably be large, complex, and, unfortunately, costly.

They also will require extensive and complex systems for making available to the user the data they have acquired. We envision that refinements of payloads and improvements in propellants can afford us reduction in satellite size so that we can gain true flexibility in satellite operations.

Scout, which is under consideration as a booster for Transit, points the way for inexpensive boosters that could be launched from ships at sea anywhere in the world.

One type of launching that very obviously should be accomplished at sea is that of launching the super boosters which will be required for space travel. The complex launching platform for such vehicles is not consistent with the Navy's desire for mobility and speed.

The technology, however, is one in which the Navy excels. If the Nation is to realize the many advantages of sea launch, the Navy is willing to provide to NASA the know-how for launching the superboosters. Their size will necessitate all the familiar techniques of construction movement and support that the Navy has provided for ships.

If we develop a fully nuclear booster, the sea will afford the only safe launching area.

Beyond these foreseeable applications of space lies a great area of promise which is filled with many unknowns. We feel that NASA's exploration of space will yield many answers that are now uncertain. Manned space platforms, lunar bases, and military forces on Mars are subjects for interesting conjecture, but we prefer to be cautious in our dreaming with dollars at this time.

The Navy is certainly visionary, but we do not have the hallucinations of some space addicts.

Desire or hopes does not necessarily mean that an avid pursuit of a dream is always justified. Basic research is essential. Investigation of discoveries is mandatory. Development of systems must be accomplished after these vital steps have justified the further pursuit of a promising technique. This the Navy believes. We will do our homework, set our goals, and exploit space for the benefit of the Navy and the Nation. This is the underlying theme of the Navy's effort in space.

Mr. Chairman, I would like to show the committee here—we have what is known as the Spascore. It is an essential step in trying to get the human mind to comprehend the space situation when the population in space is large. Now, this concept is developed as an essential step for operational people, of course. The system can show the past, present and future position or paths of any satellite, group of satellites, or all satellites contained in the space catalog. It can also show the predictive reentry point of any satellite approaching the final phases of its life.

The Spascore system can also be programed to show the impact point of a satellite subject to a predetermined reentry maneuver as planned in the Mercury program.

Now, this system works on relatively small frame rate. It is a very small scale portrayal of the earth's surface. The apparent motion of the satellites between the frames of this scale is quite small. As

soon as the operational use of this concept has been determined, changes undoubtedly will appear. It is very likely that the scale is too small, the frame rate may have to be increased, it is probable its specific areas should be viewed at an expanded scale.

It is also probable that an instantaneous presentation rather than a delayed presentation using advanced satellite predictions may be required.

As soon as the operational user becomes used to this system, I am sure new ideas will be brought into the development.

As the committee, I am sure, is familiar with the number of satellites in orbit right at the moment, Captain Berg, here, will give you a short rundown on this system, Mr. Chairman.

STATEMENT OF CAPT. WINFRED E. BERG, USN, PROJECT OFFICER, NAVY SPACE SURVEILLANCE SYSTEM

Captain BERG. I think if you turn the light out, you might be able to see it a little bit better.

Each one of these dots shows the present position of one of our existing satellites. I am sure you can't see it from over there, but when you come a little closer later on, there is a line of dots trailing each one of the main dots. This represents the past position of each satellite or rather, a track, the way it is proceeding.

Now, the next shot you will see that the spot moves just a little bit. In one minute, one of these satellites will move approximately 300 miles. So you can see that on this small-scale map it represents a very small distance.

Now down here we have the instantaneous altitude of each one of the satellites which changes with each frame. And then we give the exact time of this particular presentation.

Do you want to turn it on, please? This speeds it up which will show you exactly the track these satellites are meeting. This is speeded up to a speed of 240 times as fast as the real motion. Do you see the motion here [indicating]?

Admiral HAYWARD. You can see, Mr. Chairman, when the space gets full of a lot of these things, you have quite a problem.

I have, Mr. Chairman, with me Captain Berg, and also Dr. Kershner on a presentation of these other systems, but I would rather give those systems in closed session.

In open session we have sanitized versions of it, but I think it would be better for the committee to do this at a later date.

The CHAIRMAN. Admiral, we want to thank you very much for your statement.

Now, before going into the questioning, the Chair would like to bring up this request which our staff made of the Navy regarding the use of the naval weapons plant. Mr. Lankford, from Maryland, who asked us to make the request, is here. Do you have any statement, Admiral, that you would care to make at this time in reference to the future use of that plant?

Admiral HAYWARD. Mr. Chairman, I don't have a statement to make on it. I know this is under consideration. We have gone to NASA. Admiral Stroup, who is the Chief of the Bureau of Weapons, is following this particular subject and would be available to discuss it, I am sure.

I am sorry you didn't get into it with the Secretary yesterday. It has been handled at the Secretary's level with the Chief of the Bureau of Naval Weapons and both sides, the House and the Senate, have asked about it. I know we are doing some NASA work there, not an awful lot. But they are preparing to answer these questions.

The CHAIRMAN. Mr. Lankford is here. Do you care to make a short statement, Mr. Lankford?

Mr. LANKFORD. Thank you very much, Mr. Chairman.

STATEMENT OF HON. RICHARD E. LANKFORD, REPRESENTATIVE IN CONGRESS, STATE OF MARYLAND

Mr. LANKFORD. Thank you very much, Mr. Chairman. I appreciate this opportunity greatly. In your statement, Admiral, you were talking about areas such as solid propellants and materials, then a little further down, greater reliability. I suppose you were talking of materials there.

It seems to me that we have skills at the naval weapons plant that are hard to find, and it has been my firm conviction, and until I am proved wrong, it is still my conviction, that these skills and this great plant we have there can be put to good use in these programs of yours.

I would certainly hope that the Navy Department, in conjunction with NASA, would investigate this to the fullest and I would hope that these skills which we have there will not be lost to the defense system, to the defense of the country.

I am convinced that they can be utilized and can be utilized economically. You said that you had no particular knowledge of this other than a general knowledge that Admiral Stroup and the Secretary had this under advisement. So I don't believe, Mr. Chairman, that any purpose would be served by pursuing it further at this time.

The CHAIRMAN. Thank you, Mr. Lankford.

Mr. LANKFORD. Thank you very much, sir.

The CHAIRMAN. Now, the Chair will state this, that when we do get a report, if the matter requires further committee effort, why it is our purpose to send it to a subcommittee to handle the matter. But the Navy, like all of the services in all parts of the country, is reducing installations, and it is difficult—as I am sure the people in the District area know—to find a need for everything that was built in prior times and has been useful in war efforts or in times of semi-war.

May I ask you, Admiral Hayward, a question or two in reference to your statement? I thought your statement was an excellent statement. It had vision to it and it had imagination to it and yet was thoroughly practical.

You testified last year, Admiral, that the Navy needed more money for basic research and for component development.

Under the fiscal 1961 budget, will this situation be improved?

Admiral HAYWARD. No, sir; it will not be improved, Mr. Chairman.

The CHAIRMAN. What are the dollar amounts for 1960 and 1961?

Admiral HAYWARD. I can furnish—roughly in 1961 the money for the Office of Naval Research is about $92 million, versus $104 million in 1960. I can furnish the exact numbers into the record, Mr. Chairman. It is down in the research and development area.

The CHAIRMAN. You can give us the exact amount for the record.

Admiral HAYWARD. Yes, sir; I can. Our funding for fiscal year 1960, $99,030,000; fiscal year 1961, $92,162,000.

The CHAIRMAN. Now, Admiral, I would like to ask you this: You are a member of the NASA civilian-military liaison committee. In your opinion, has that committee worked effectively?

Admiral HAYWARD. Mr. Chairman, I started out as a member of that and then we appointed Admiral Pirie. He was appointed as the member with Admiral Masterson as the alternate.

Admiral Masterson is our Director of Guided Missiles, who works in the research and development area.

The CHAIRMAN. Maybe Admiral Pirie can answer that question.

Admiral HAYWARD. Yes.

Admiral PIRIE. Yes, Mr. Chairman.

I would say that the civilian-military liaison committee of NASA has not been as effective as it might have been. I don't think that it was used either by the Department of Defense or the National Aeronautics and Space Administration as much as it should have been used.

The CHAIRMAN. Do you think the coordination of the civilian and military space programs would be improved if they left it to ordinary interagency cooperation?

Admiral PIRIE. It is my opinion that you need a coordinating machinery between NASA and the Department of Defense in the space area to really have an effective interchange of information and to prevent duplication. I do not think that it can be as effectively accomplished without a body and the machinery to do it as it would be if such a body existed.

The CHAIRMAN. What are the weaknesses of the present system?

Admiral PIRIE. I presume you mean the National Aeronautics and Space Act as it is now written?

The CHAIRMAN. That is right; yes, sir.

Admiral PIRIE. I don't think there are really any weaknesses to the system. I think it depends on the way it is operated.

The CHAIRMAN. Well, do you mean the law is good but the execution is bad? Is that in effect what you mean?

Admiral PIRIE. Well, in effect; yes, sir.

The CHAIRMAN. Well, in what respect has it fallen down?

Admiral PIRIE. Well, there are two bodies that have not been used effectively that were set up within the law. One is the Space Council, and the other is the Civilian-Military Liaison Committee.

The CHAIRMAN. You feel that the Space Council should have been used and it has been overlooked?

Admiral PIRIE. Well I think that is a little out of my purview and not a part of my particular business.

The CHAIRMAN. Well, is the other——

Admiral PIRIE. The CMLC; I, as a member, sat on that from its inception.

The CHAIRMAN. And what——

Admiral PIRIE. And it has not been used to any great extent. Very few problems were presented to us to solve. It was used as an information agency, principally, and I think that it could have been used more effectively. I would like to say, however, that there were a great many things done at the member level between the National

Aeronautics and Space Administration and the Department of Defense members that did not appear on the surface, such as problems in personnel coordination and in obtaining personnel for the agency—the support for Project Mercury, as an example, where we went to work and were actually picking up the capsules and learning that art within a week or two of the time that we were told that they wanted us to do it, without any fanfare or fuss. In these areas we have been effective.

The CHAIRMAN. We have lost a good deal by not using it, then; is that your answer?

Admiral PIRIE. In my opinion, it could have been used more effectively if used in practically all areas at the top.

I do not think you can, by just words of "advise and consult," make a really effective system. I think that you have to have a machinery setup within the law that is effective and will work in order to get proper coordination.

The CHAIRMAN. Mr. McCormack?

Mr. MCCORMACK. Well, what you are telling us is that the human aspects of it have not been doing the functioning they are capable of doing under the law.

Admiral PIRIE. That is right; yes, sir.

Mr. MCCORMACK. Would you recommend that this Committee be retained in the law in the hope that its significance might be recognized?

Admiral PIRIE. It is my own opinion, Mr. McCormack, that some coordinating machinery at this level would be much more effective than not having it.

Mr. MCCORMACK. You are a member representing the Navy—I do not want to get into the critical stage; in fact, we just want to see how we can improve. Would you say that as an official member you are in a much better position than if the Committee did not exist because you can make some inquiry which you might hesitate to do if you did not have this Committee?

Admiral PIRIE. I might say that there must be some point of contact within the Department of Defense, certainly, if you abolish the Committee for the National Aeronautics and Space Administration, to work.

Mr. MCCORMACK. And also for NASA, too?

Admiral PIRIE. For a mutual exchange of information and technical details, and the machinery set up to exchange this information and technical detail and to prevent duplication.

Mr. MCCORMACK. In other words, such a committee would be of vital importance in connection with the maximum contribution both to the defense of our country and to the pursuits on the peaceful side, and at the same time prevent unnecessary expenditures of money, duplication, and so forth.

Admiral PIRIE. I would say so; yes.

Mr. MCCORMACK. Admiral Hayward, on page 13 of your statement you were referring to the space system, you said about data transmission to fleets, "so that we can minimize any threat from any enemy reconnaissance satellite." Would you give the committee some information about what those satellites could be?

Admiral HAYWARD. For instance, if you had a satellite up there that wanted to get electronic intelligence from you, it is interested

in pulse width, repetition rate, things of this kind, and if you knew where it was and when it was coming, if you shut everything off, why you might take active countermeasures to give him the wrong information, too. But the ability to know where these things are is of vital importance to all of us, really. This is what we are thinking of.

Admittedly the sensor, the state of the art of sensors of looking down and seeing things or getting this information is at a point now where you cannot get all you want. I mean you could not today put something up and really get the resolution that you require to get the information. You can get electromagnetic spectrum and you can get the infrared spectrum, but to take real fine pictures or things of this kind, this would be real difficult.

Mr. McCormack. I imagine, I would assume that great importance is attached to this activity?

Admiral Hayward. Yes, sir; which brings in another type of satellite. You see, everybody gets real interested in going into deep space and all that, but we have something which is known as a satelloid, which is something that returns to the Earth. It goes around a couple of times and comes back.

Now, if you can recover it, then you can really process pictures and things of this kind. This technique means that maybe you will go around only 100 miles high and only go around for a definite orbit, but this would permit you to do better work in this particular field, rather than trying to convert something to an electronic image, transmitting it, reconverting it back to a picture. You probably saw the photographs of the Moon and how they were touched up and things of this kind. The resolution is a tremendous problem in any of these devices. But this is where the military has a very prime interest which is to use, let us say, close-in space to get all the information we can. We feel it would be very useful to a shipboard or fleet commander to be able to air-launch a satellite or satelloid that goes around the Earth a couple of times but goes over areas he wants to know about either for weather or reconnaissance and that he gets it back.

Now this is one of those questions of what the state of the art is. If you get it back, as you have seen the pictures of the separation of the Thor, things of this kind, these were all photographs that were recovered, you see. And this is why they were as good as they were.

Mr. McCormack. Were you talking about any enemy reconnaissance satellite?

Admiral Hayward. Yes, sir.

Mr. McCormack. Give us an idea of what an enemy reconnaissance satellite——

Admiral Hayward. I feel they would be much more inclined to go after communication intelligence and electronic intelligence rather than take photographs of the United States. You can buy Aviation Week and anything else. We do not have any secrets.

Mr. McCormack. We will strike out the word "reconnaissance" and let us confine it to satellites. Would you include in that the possibility of satellites, say, within 200 or 300 miles of the Earth's orbit that might be able to fire, discharge with precision a powerful weapon?

Admiral Hayward. No, sir; I think this is in the realm of pretty good space dreams at the moment.

Mr. McCormack. You mean what I just asked you?

Admiral Hayward. Yes, sir.

This is a real difficult problem. As you know, Newton's law of celestial mechanics, it would be real difficult to do this and it would be the hard way to do it. You can go from any point on the Earth to any other point on the Earth relatively easy rather than putting something up in orbit and then trying to shoot it back down at the Earth. There are easier ways to do it. Before the enemy would do something like that, he has competition in his systems, I am sure, and the Russians always seem to take the simple approach—he would use a simpler way of doing it than that. Their satellites could be used to try and get the distribution of where our forces were, trying to get all sorts of communication intelligence and electronic intelligence, as the primary use of this. I do not know whether he would put up a warning satellite such as the Midas. He might, I do not know.

Mr. McCORMACK. You have less money next fiscal year than you have this year?

Admiral HAYWARD. Oh; yes, sir.

Mr. McCORMACK. Does that mean you have to scrap some—that among those projects, both research and development, that you consider to occupy a preferential status you have to lay some on the table?

Admiral HAYWARD. That is true, we have. All of our areas and systems are down this year from what we had last year. The total—I can give you some examples. In 1960 we had $33 million for instance in electronics system. This year we have $31 million, in 1961.

Mr. McCORMACK. At an increased cost?

Admiral HAYWARD. That is right. The effort is down, Mr. McCormack. There is no sense arguing about that. Even if you kept it at a level dollar it would be down, but actually it is down in dollar effect in a lot of the areas.

Mr. McCORMACK. I will not ask you the next question that I might be prompted to ask you about your opinion as to the policy. So I will not press you.

Admiral HAYWARD. Well, as you know, Mr. McCormack, I do not make the policy.

Mr. McCORMACK. About the wisdom of it.

Admiral HAYWARD. Oh, the wisdom of it?

Mr. McCORMACK. I will not ask you that question. [Laughter.]

Admiral HAYWARD. I will not take the fifth amendment.

The CHAIRMAN. Will the gentleman yield?

Mr. McCORMACK. I am through. I will yield to you; yes.

The CHAIRMAN. Could you place in the record the other instances? I notice you were——

Admiral HAYWARD. Yes, sir; I will place the comparison of the 1959, 1960, 1961 budgets for the research and development programs in the record. The comparative research, development, test, and evaluation—new obligational authority—figures are for fiscal year 1959, $1,172,482,000; fiscal year 1960, $1,255,437,000; fiscal year 1961, $1.169 million.

The CHAIRMAN. On the individual items. You started out with one example there but you had some other examples?

Admiral HAYWARD. I do; yes, sir. I have communications down from $6 million to $5 million, and these are in systems; I will place those in the record, Mr. Chairman.

The CHAIRMAN. All right. And the amount that they are down.

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. Mr. Fulton?

Mr. FULTON. I am glad to have both Admiral Pirie and Admiral Hayward here with us because we know they are doing an excellent job, and being a Navy Reserve officer I am glad to be part of the group.

The question comes up, what did the Navy ask for on research and development, overall, compared to what you were allowed by the Bureau of the Budget for the coming fiscal year 1961.

Admiral HAYWARD. Actually, my requirements were $1,543,584,000.

Mr. FULTON. And what did you get?

Admiral HAYWARD. $1,169 million.

Mr. FULTON. And what percent of that that you received from the Bureau of Budget in allowance is that of what you asked?

Admiral HAYWARD. Well, actually, I cannot say the Bureau of the Budget cut this down, Mr. Fulton. The guidelines that were given us and the picture is confused in that they transferred test and evaluation items, such as missiles that come out of the research and development budget now. So it is hard, a direct comparison of the sums is difficult to arrive at.

Before those missiles—for instance when we shot a Polaris or when we shot a Corvus or one of those missiles, those missiles were bought under procurement appropriations. Now they have placed that money in the "Research, development, test, and evaluation" appropriation.

Mr. FULTON. But you are actually short on dollars, $374 million for the year 1961?

Admiral HAYWARD. Yes, sir.

Mr. FULTON. And would you have in mind asking for supplemental appropriations as you went or would this be your final figure? Would you not ask for any further funds?

Admiral HAYWARD. Well, I would ask—in the normal course of business I go to Dr. York for emergency funds.

Mr. FULTON. And last year in the fiscal year 1960, how much extra did you get above the regular budget?

Admiral HAYWARD. Well, they were very kind to me on the last day of the fiscal year, they gave me $30 million, but I could not spend it, of course, on the 30th of June. So it is added to the 1960 program.

Mr. FULTON. 1961 program?

Admiral HAYWARD. No. You see that was on June 30 last year he gave it to us—the emergency funds to the Services—but of course, naturally, I could not spend it. My real problem is in expenditure limitations as much as in the actual new obligational authority. We have an expenditure limitation in 1960 of $1,130 million and I have in 1961 $1,266 million expenditures, a limitation.

Mr. FULTON. Is that on a guideline basis?

Admiral HAYWARD. Yes, sir. That is given us, overall expenditures that the services are allowed to have, and this is what I got out of the pot.

Mr. FULTON. Rather than take the time at this particular point, would you put in the record a statement of what you would like to have for this current fiscal year coming up, beginning July 1, 1960, in addition to what you have already had from the Bureau of the Budget? If you will give me the amount now, you can fill out the various projects later, because I am sure this committee would like to help you.

Admiral HAYWARD. Yes, sir; I will furnish that, Mr. Fulton, with a breakdown showing you the test and evaluation transfers that were made.

Mr. FULTON. That is what I would like.

Admiral HAYWARD. All right, sir.

Comparison of Navy fiscal year 1961 research, development, test, and evaluation requirements budget with congressional submission

	Requirements budget	Congressional budget
Basic research, development, test, and evaluation	$849,974,000	$603,000,000
Polaris	283,800,000	273,800,000
Pacific Missile Range	88,010,000	68,794,000
Comparative test and evaluation transfers	321,800,000	223,406,000
Total	1,543,584,000	1,169,000,000
Difference		−374,584,000

Mr. FULTON. Now, in each of your statements you have emphasized the Mercury program and the part that the Navy is playing in the Mercury program. For example, Admiral Hayward, on page 3 of your statement, you say, you are not certain of the naval use for a man in space but are pleased to be able to support the civil program toward that goal which is so vital to national prestige. And then in Admiral Pirie's statement, page 7, in view of the importance of the project, meaning Mercury, and the fact that the eyes of the world will be focused on it, the Navy considers the recovery operation for the astronauts to be of paramount national importance. The Navy is rendering maximum support. Now, it has been proposed that the Mercury project target dates be postponed 3 to 5 years on the basis that this was not the kind of a project that should be given a DX, or the highest national priority. Do you agree, and if not, why not?

Admiral HAYWARD. I think the Mercury project is very important, Mr. Fulton.

Mr. FULTON. You do not think the target date should be postponed? I certainly do not.

Admiral HAYWARD. I do not know who said this.

Mr. FULTON. But you disagree with that position?

Admiral HAYWARD. If anybody says it should be postponed, I do not believe this myself.

Mr. FULTON. Do you not think that Project Mercury is a necessary step in space for both the civilian and the military or security approach to space? I do and I am very sincere in wanting the Mercury project pushed at every speed and that is why I call attention to your two statements

Admiral HAYWARD. My point is that I cannot tell you any military system that it will be used in, but it has great military potential. So certainly we would be foolish not to explore it. Of course the big problem always comes: Where is space? The F–4H at 90,000 feet, is that space or does he go to 500,000? Now the X–15 is going to be the same sort of a problem. I think we have got to find out all we can about this.

Mr. FULTON. I do, too. Admiral Pirie, would you comment.

Admiral PIRIE. I would say any delay in the program set out by the NASA is a problem within their purview and they know more about it than anyone else.

Mr. FULTON. But you feel that man in space and maneuverable instruments or vehicles in space are certainly of great military potential and should not be postponed?

Admiral PIRIE. Most important to us.

Mr. FULTON. Now I want to compliment you. The Air Force had come in with a word "aerospace," which is their jurisdiction. I want to compliment you on not coming in with "mari-aerospace." [Laughter.]

You are saying that you do not claim any particular field in space but will be glad to cooperate with both the civil and the military agencies in the national effort in space; that really is a rewarding and very satisfying comment to make.

Now another thing I would like to ask about is on page 3 of the statement of Admiral Pirie. The Navy view is that an organization is needed to provide effective organization by all combat and services in the military. And of course that means space effort.

Now the question then is: Would that be a military joint command for this military purpose; and secondly, it would not be in the sense that General Medaris wants an overall military command for all space; and thirdly, it would be a combination of the various services, such as the Army, the Navy, the Air Corps, the Marine Corps, rather than on the Department of Defense level; and, lastly, would it supersede ARPA, or would it be an additional thing at DOD or the service level? You see, where do you put that in your concept? And that is all, I am through then.

Admiral PIRIE. My comment was made about the organization within the Department of Defense.

Mr. FULTON. At that level?

Admiral PIRIE. At that level, not a national organization as you referred to General Medaris' statement.

Mr. FULTON. So you disagree with General Medaris on that?

Admiral PIRIE. Yes, I think I do, that military should control the whole space effort.

Mr. FULTON. Does this supersede ARPA in your view?

Admiral PIRIE. No. ARPA is now a part of the Office of Defense Department Research and Engineering.

Mr. FULTON. So this is more an operational joint command on planning and carrying out space functions that you would add on rather than replace anything that is there now?

Admiral PIRIE. That is correct. Now this organization, I might say, is up to the Secretary of Defense. He will determine what organization is proper. I do believe that we must, as we go along, have an organization for two reasons: I think that it is necessary that our plans, programs and requirements be coordinated so that we are not duplicating effort, that we know what we are doing in this area and I think that it is also going to be very necessary that we have an organization that coordinates the support effort and that can take charge and run the support effort because we have the resources, facilities and forces to do the job.

Mr. FULTON. But you do not mean to supersede in any way the policy-forming function of the Joint Chiefs nor their directional and operational function, do you?

Admiral PIRIE. No, sir.

Now, this might be a body, whether it is a joint command or agency, it might be under the Joint Chiefs, because a great many of these functions cut across the lines of the unified and specified commanders in the performance of their missions and involves a good many of their forces.

The CHAIRMAN. Thank you, Admiral.

Mr. FULTON. That is all.

The CHAIRMAN. Mr. Anfuso? May I say at this time that Admiral Hayward suggested he had some things to tell the committee in executive session. This afternoon we have two witnesses that we scheduled especially, is that not right?

Mr. BERESFORD. Yes, Mr. Chairman.

The CHAIRMAN. So we would have to hear the Admiral this morning. About how much time would you require in executive session?

Admiral HAYWARD. About 30 minutes.

The CHAIRMAN. If there is no objection, then, I suggest that we hear him in executive session beginning at 11:30 and we take the questions as they come and then, if we have time, we meet at lunch hour to finish up. That would be the only way.

Admiral HAYWARD. All right, sir.

The CHAIRMAN. I think at 2 o'clock we ought to meet with the other witnesses and then we have a special program following the hearing of the other witnesses this afternoon. We have got a rather full schedule.

Mr. BASS. Mr. Chairman, in view of that may I suggest that each one of us from here on have one question to ask.

The CHAIRMAN. What is the pleasure of the committee?

Mr. MOELLER. Move along.

The CHAIRMAN. It has been moved that we go into executive session at 11:30. Is there any objection to that?

Mr. FULTON. Whatever you want.

The CHAIRMAN. I think we should do that. I think in the meantime, Mr. Anfuso, I have already recognized you. From thenceforth every member will be limited to one question.

Mr. ANFUSO. I will try to make it brief.

Mr. FULTON. May I have a unanimous request. I would like to have the chart put in the record following my questioning.

The CHAIRMAN. If there is no objection, it is so ordered.

Mr. ANFUSO. First of all I would like to congratulate Admiral Hayward and to thank him for the wonderful assistance which he gave to this committee at the London Conference and also to take this occasion to thank Captain Berg for his invaluable assistance to me personally on my trip to Moscow; although he got very sick on that trip, he carried on and refused to be bedded.

You said that the effort is down, Admiral Hayward. Can you justify that in the light of information that the Russians are spending a tremendous amount of money on research and development?

Admiral HAYWARD. Well, Mr. Anfuso, you know my position. As we say in Washington there are only two types of people, chiefs and

Indians, and I am an Indian. And we are given guidelines on the budget. I do not know whether you heard the Secretary yesterday and Admiral Burke, but I was given a guideline. There were two of them, there was the 1960 budget plus 10 percent and the 1960 budget less 10 percent. And this was what we had to adhere to.

Mr. ANFUSO. In other words, Admiral Hayward, our military needs are measured in this fashion, you are given a top figure and say: "This is all we are going to spend, now you boys get under that figure." Is that it?

Admiral HAYWARD. Well I do not know who tells the Secretary of Defense, but the Secretary of Defense puts out these guidelines to the budget for us.

Mr. ANFUSO. You do not justify that, though, in view of our national emergency, do you?

Admiral HAYWARD. Personally?

Mr. ANFUSO. Your personal view.

Admiral HAYWARD. No, sir, not at all.

Mr. ANFUSO. Do you have any agreements, Admiral Hayward, with any other countries or are you contemplating any agreements with any other countries that can help you bring about these programs a lot faster? In other words, cooperate with you in these different projects?

Admiral HAYWARD. Well, our mutual weapons development program which has been taken over to the Department of Defense, with General Palmer now, with the MAP, we have 19 projects for instance in Western Europe. We certainly are going to use any of the Western European scientists that we can. Now there are a lot of things that they do in electronics and other basic physical sciences that can help you in space and on the ground and any place, and they are doing real good work for us in all of these fields and they have come along. Our center in Italy at La Spezia is in operation. It is working successfully. Dr. Booth has done a very good job. We certainly intend to pursue that.

Mr. ANFUSO. Admiral Hayward, would you recommend the building of more Polaris submarines?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. The Chair will recognize Mr. McDonough.

Mr. MCDONOUGH. Will more money correct the failures we have had in our missile and rocket program or is it manpower and brain power that we need more than money?

Admiral HAYWARD. I am just as sensitive as General Schriever. I do not think we have a missile mess or that there are lots of failures. I am real proud of the work that the United States has done and I get real upset when we degrade our performance. I think it is disgraceful to do this, too. When you look at what has been accomplished—most people do not look. Of course, even with due respect to my press friends here, this makes the front page, like last week when the Titan blew up, where was it? It was on the front page. The Polaris went. Where was it? On page 8 with a little paragraph about this big [indicating]. So you do not tell the American people of your accomplishments. We are good. I hate to see us degrade our accomplishments. We have a long way to go, but the Russian is not 10 feet tall and he puts his pants on one leg at a time just like I do and

I get really upset when people say that it is a failure and a mess; it is not. When you look at the satellites right now, what is the satellite that is still broadcasting? It is Vanguard I. Who pioneered the solar batteries? Vanguard I. Where did the spectrograph come from in Sputnik III? Out of the Vanguard. Here we go around with our tail between our legs saying how lousy we are. We are not. They are going to have to come and get me before I say they are as good as they say they are. I get very upset about it.

Mr. McDonough. I think that is a very significant statement. I appreciate it. I hope that makes some of the headlines that you talk about. [Laughter.]

The Chairman. Mr. Karth?

Mr. Karth. Admiral, we are good, but we could be a lot better if the guidelines were absent; is that what you are saying?

Admiral Hayward. No; I am not saying that. I am sure the administration will make guidelines. We will always have guidelines. Mere money is not the answer to it. You need good people, it gets down to people, it gets down to people like Mr. Hechler was talking about yesterday, educating the young people. It is meeting the challenge. The challenge is not how many ICBM's we have or how many ICBM's they have. The challenge is political, economic, psychological, and military, and it is in peace as well as war and we have to recognize it and we cannot go on saying, "Well, they have 300, we have 200." We assume the Russians can shoot all of these things in a salvo, they all work and they are all going to hit the target. I mean I just feel that we have done ourselves a disservice this way. We can be a lot better and we are going to be better.

Mr. Karth. I was not referring to that, Admiral. I was referring to the proposition of research and development, I think, which is educational, as Mr. Hechler suggested. If you did not have the guidelines there you could do a better job.

Mr. Fulton. I move we make the admiral an honorary member of this committee.

The Chairman. We already have a captain on the committee. That is enough brass. [Laughter.]

Mr. Fulton. Touché. We have it on the staff, too.

The Chairman. Mr. Chenoweth.

Mr. Chenoweth. Admiral, I also want to commend you for the attitude which you take. I wish all of our people would take that attitude. I deplore this tendency to degrade everything that we have done, to say we have accomplished nothing, and always to hold up in headlines here what the Russians have accomplished. I take it from your remarks that you are not fully satisfied that the Russians are as far ahead of us as they would have us believe in the space and missile program; is that correct?

Admiral Hayward. That is correct. I am convinced we are ahead of them in many fields. They are ahead of us in rocket boosters; I have said that here; but because of this we have degraded the rest of our performance. Our technical people are better. Benny Schriever has done an outstanding job; Admiral Raborn has done a tremendous job. Here we have the submarine at sea going and look what Schriever has done. Yet you get all of this playback; I agree we are better than they say we are.

Mr. Chenoweth. And we are going to stay better.

Admiral HAYWARD. We are going to stay better; yes, sir.

The CHAIRMAN. Mr. Hechler?

Mr. HECHLER. Admiral, just about a year ago when you testified before this committee you were concerned about spelling out the responsiveness of the new space agency to military requirements and you gave the example of the Atomic Energy Commission with the Division of Military Applications as the best way to make sure that military requirements were given adequate attention. In view of what Admiral Pirie has testified about the ineffectiveness of the CMLC I wonder quite seriously what we could do now to make sure that military requirements under the current administrative arrangement are protected.

Admiral HAYWARD. Yes, sir. It was Mr. McCormack over 2 years ago when I brought this up before the legislation was passed. He permitted me to write to him what I thought should be done. That had to do with the Military Liaison Committee. The difference between the Military Liaison Committee and the Atomic Energy and what was set up in legislation here was the fact that under the law the Atomic Energy Commission was required to give its program to the MLC and the Chairman of that body also had the ability to go to the Joint Committee on Atomic Energy. The CMLC—incidentally, the MLC was the Military Liaison Committee. They did not put members of the AEC on that. They just put military people with the Chairman. He could review the entire program of the Atomic Energy Commission. If he did not like it he could do something.

Now we have had no difficulty with duplication with the ordnance side of the business for the AEC, and it was the way the law was written that permitted this to happen. I am convinced in my own mind that we in the Department of Defense are going to have to set up some sort of a Military Liaison Committee, just as General Loper does for the atom, to make sure that not only do we known what their program is, but that we do not get the Bureau of the Budget treatment that I am getting now on a real good example. I can give you a good example on a wind tunnel. This shows you what goes on—now I have a hypervelocity wind tunnel that I want to build out at NOL. We have Dr. Kurzweg, one of the outstanding German scientists. Now I justified this all the way through the military construction program. I had the NASA people come over and say yes, this made good technical sense. It went all the way up to the Bureau of the Budget, then the Bureau of the Budget arbitrarily, when the bill was forwarded to Congress, deleted this on the basis I was duplicating the functions and facilities of NASA.

Now it did not go forward. Now what do I have to do? I had to call and I have to get Mr. Gates to write the Bureau of the Budget. But here is a case where we had thought we had it all the way up and you put the Bureau of the Budget then in the referee business, and he probably will be in the referee business anyway, but technically he tells me I am duplicating the functions. Now if you had had a workable organization at the time in the military and NASA such as the MLC and the AEC, I do not think this would have occurred.

Admiral PIRIE. May I amplify the answer to that question?

The CHAIRMAN. All right, Admiral, and then we are going into executive session.

Admiral PIRIE. The question of getting aeronautical research and development done under the National Aeronautics and Space Administration Act is of some concern to us. Before the act was passed I was a member of the Advisory Committee, National Advisory Committee on Aeronautics which had been in existence for some 40 years. The military fully supported that and we got aeronautical research done by the National Aeronautics and Space Administration to the great benefit of all of the services and of industry and civilization.

There was great concern that because space is so glamorous that a great amount of the effort of this agency would be put on space and that aeronautical research would be neglected. I expressed this at both of the last two meetings of the National Advisory Committee on Aeronautics.

We are more concerned today that that is happening and I would plead with you that if the law is changed that there be some requirements in the law to see that the military requirements in the field of aeronautical research are insured.

Mr. MCCORMACK. May I ask, would you see that appropriate language is submitted for the consideration of the committee.

Admiral HAYWARD. Yes, sir; I will.

The CHAIRMAN. The committee will go into executive session.

(Whereupon, at 11:35 a.m., the committee recessed, to reconvene in executive session.)

(The committee reconvened in open session at 2:04 p.m.)

AFTERNOON SESSION

(The executive session is classified and will not appear here.)

Mr. HECHLER (presiding). The committee will be in order. This afternoon we are going to hear testimony on Project Wagmight. Admiral Coates and Captain Bright of the Navy are ready to testify.

Will you please rise, gentlemen?

Do you solemnly swear that the testimony you will give before this committee on the matters now under consideration will be the truth, the whole truth, and nothing but the truth, so help you God?

Captain BRIGHT. I do.

Admiral COATES. I do.

Mr. HECHLER. Do you have a prepared statement, Captain Bright?

Captain BRIGHT. I do not have a prepared statement. I have a prepared presentation which is "Secret" in classification. I would like to have the opportunity to give it. It describes the Wagmight concept in great detail.

Mr. HECHLER. Is the pleasure of the committee then that we proceed immediately into executive session?

Mr. FULTON. Do you have a sanitized version that you could give us the general picture without getting into any classified or secret material?

Admiral HAYWARD. Maybe I could answer. Of course, I have Mr. Pearson's column on this particular thing. I want to make sure the committee knows——

Mr. FULTON. Is that authoritative?

Admiral HAYWARD. Pretty—well, no comment on that one.

I want to make sure that it is not snarled in redtape. I mean as the program for development for the Navy, it was our decision as to what we did.

Mr. FULTON. I think there should be some public statement.

Admiral HAYWARD. Yes. My statement is that frankly, from a structural point of view, it looked good, but this is an exact example of the things that I told this committee before of trying to go from a concept to a full-blown system.

The proposal that came to me I didn't accept. It was an airfoil proposal. It had to do with something that I didn't feel was going to pay us the dividend we wanted. I felt that this particular material could be used in places, structurally and that we should investigate it as a material, rather than trying to make a complete airplane or anything else out of it at the moment.

Mr. FULTON. So the Navy has an interest in this particular material.

Admiral HAYWARD. Certainly we have an interest in any material.

Mr. FULTON. But not a program?

Admiral HAYWARD. No, we have a material program totaling about $6 million worth, but for this we don't have a program specifically. I would point out that in making this decision, I think it was correct, we are still available to talk about any material proposals to study this, to look to see where we could use it.

Mr. Pearson says, the loudest objections have come from the carrier admirals.

That is standard routine for this column anyway. The objection hasn't come from them; it has come from me and on a technical basis.

Mr. FULTON. And not on a budgetary basis?

Admiral HAYWARD. No. If this had to be competitive, it would have to come a long way before I would put more money in what was my material side of fiscal year 1960, and some of the other material problems I have had prior to this. The Goodyear Co. has a contract with us for the Subroc missile. I would be very interested to see if it is called for in that missile.

I don't think it will be, because I don't think it is in a position to be spelled out for a system. But that doesn't say we don't have interest in it as a material.

Mr. FULTON. But the Navy is open minded on a research and development program on this particular Wagmight and if it is shown to be feasible in the future, you would certainly give it consideration, would you not?

Admiral HAYWARD. I would, Mr. Fulton. One of the biggest problems that always faces me, I have lots of people come in with a lot of ideas. They have ideas, but to go from ideas to put numbers on their ideas usually costs me many millions of dollars.

When a man comes in with an idea and he wants to put numbers on it, then we want to see exactly what we are trying to get out of the program. What are we trying to accomplish?

And I felt in this case that from a selectivity point of view, which we always have in the budgetary process, this would have dropped out. I wouldn't spend my money on it.

Mr. FULTON. That is all.

Mr. HECHLER. Mr. King, do you have any questions?

Mr. KING. No.

Mr. HECHLER. Mr. Moeller, do you have any questions?

Captain BRIGHT. Could I make an unclassified statement at this time?

Mr. HECHLER. Proceed, Captain Bright.

STATEMENT OF CAPT. COOPER B. BRIGHT, OFFICE, CHIEF OF NAVAL OPERATIONS

Captain BRIGHT. I was instructed when I came over here to advise the committee that I could answer any questions and give any information that they desired.

However, I would be speaking for myself and not the Navy, as Admiral Hayward would speak officially for the Navy. But I would like to point out that what I say will not be my opinion, it will be based on the very extensive study done in the Navy and by the Navy and not by the Goodyear Aircraft Co. I feel very strongly, and I have for over 2 years, that this program offers a real opportunity to increase our defense posture to utilize the ships that we have today in our Navy to greater advantage in increasing the offensive and defensive capabilities of our fleet.

I don't think I should say any more now until we get into the presentation, but I think I can satisfy the committee that due diligence has been exercised and the procedures that are legal and orderly have been followed and that their time will be well spent to hear the presentation.

Mr. FULTON. Could I have some comment from you on practicality? You have talked on policy. Now, the question comes of how practical such a research and development program is and whether it would have a substantial chance of having a breakthrough or a moderate increase in our capabilities?

Would you comment on that?

Captain BRIGHT. Mr. Fulton, I have an engineering background, graduating from Rutgers University, 1931. I have served two tours in research and development in the Navy. I am familiar with, I think, the word "feasibility," and all the connotation it carries.

I think we have carried this study much further than others that I have been in that were funded and it is to a point now where unless we make another definite step to test this vehicle, we can go no further in establishing, not its practicality, but its ability to be produced in numbers for use on all the ships of the Navy.

Mr. FULTON. Of course, we are talking about a collapsible aircraft and a low-level aircraft with certain flight characteristics. The question is as to the competition of this particular craft with what you already have, and, secondly, as to the gain that might be obtained through the compressibility. Would you comment on that? They don't compress engines, they don't compress a lot of your radar equipment; they don't compress a lot of components that are on this plane.

Would you then comment as to what gain there would be, as well as the other factor I spoke about?

Captain BRIGHT. The gain as our study shows, is primarily, in major part, the foldability, sir, not so much—the foldability that is apparent.

Mr. FULTON. Of the wings or body structure?

Captain BRIGHT. Both, sir, it is inherent in fabric construction. It is the foldability that is the big and major factor that is making this advantageous to use as a weapon with ships at sea.

We don't fold the equipment, but we provide for it to be packaged as the wings and fuselage fold down into its plastic base or package.

Mr. FULTON. What gain do you have on this particular Wagmight model over a folded-wing version? I might say, incidentally, I have been a carrier bridge officer myself in World War II.

I would wonder just how much gain you would have over that type that you already have.

Captain BRIGHT. A considerable gain, sir. I was the Air Operations Officer on the U.S.S. *Yorktown*, the Fighting Lady; maybe we met out there on the Pacific. I was out there for 34 months.

Mr. FULTON. I was on a jeep carrier. You were the department store type?

Captain BRIGHT. I was the hangar-deck officer. I am familiar with those operations and I would say it gives us a chance to get back to what you remembered, where we had a mission aircraft to divebomb, we had aircraft to fight, and we had aircraft to drop torpedoes. It would give us a chance to go back to a mission aircraft which would mean the minimum amount of equipment to be folded.

Mr. FULTON. All you are going to do is fold the tail up?

Captain BRIGHT. No, sir; we are going to, as you will see later on, we are going to fold a considerable part of the fuselage structure, tail and wings.

Mr. FULTON. Of course, the wings I have already said, you fold in another model, but all you do is shorten the tail up and wrap the canvas up and put it in the driver's seat.

Captain BRIGHT. Compared to the way that you and I worked in World War II, with folding wings back, you will see there is quite an advance in the volume you consume when you fold them the way Wagmight folds them as compared to the hinged wings that we had in World War II.

Mr. HECHLER. Admiral Hayward, do you have a comment?

Admiral HAYWARD. Only I have the responsibility to assign the operations requirement. I wouldn't sign an operation requirement for this, Mr. Chairman. I still adhere to my decision, Mr. Chairman, and I am very anxious that you see the presentation and I will be the loyal opposition, let me say.

Captain Bright and I have discussed this. He knows my feeling on it. This isn't the only, let me say, item that I have turned down when it came to going along this way. There are a lot of other good things.

The one thing that I have always to remember, there are going to be many good things that I don't have the funds to pursue in A.S.W. in missiles, in aircraft, in ships, its submarines, and this is way down the list as far as I am concerned. Under the general ground rules that I have right now, it wouldn't survive.

Mr. FULTON. And for the past 30 years that has been the case right straight through on funds, no matter what administration has controlled the Federal Government, is that not right?

Admiral HAYWARD. That is true; yes, sir.

Mr. HECHLER. Captain Bright?

Captain BRIGHT. Mr. Chairman, as we go through the Navy and plot our career, I guess it is like navigating a ship, you look out for the old lighthouse at night and point of land during the day.

Admiral Hayward has been that to me since I have known him, particularly during this tour. One reason I have been persistent in keeping on with Wagmight, when discouragement was my lot, was because I always felt that I had Admiral Hayward behind me 100 percent, both in his expressions of confidence to keep going, and I think when you see this presentation, you will find that I—I like him a lot personally, and professionally, I think he is a tremendous man and he doesn't make out my fitness report, Mr. Chairman.

Mr. HECHLER. We hope you will continue to avoid the rocks and shoals.

Mr. FULTON. Could I ask you this just in closing? When doctors disagree, the patient prays. What happens when you engineers disagree?

Admiral HAYWARD. Well, if we have the money, Mr. Fulton, we usually build two models.

Mr. HECHLER. Admiral Coates, do you have anything to add to this in open session?

STATEMENT OF REAR ADM. L. D. COATES, BUREAU OF AERONAUTICS, DEPARTMENT OF THE NAVY

Admiral COATES. Sir, I believe I am the spearhead of the opposition or was at the time. I conducted the evaluation in Bureau of Aeronautics. I was at that time Assistant Chief of the Bureau of Aeronautics for Research and Development. And I do have some comments to make on the proposal, but I think that they would be easier to understand if you would see the presentation first.

Mr. HECHLER. Would it be agreeable to the Navy witnesses here if we do this: I think it would make for a more orderly procedure to proceed in open session with testimony by the Goodyear representative after which we could go into executive session.

Admiral HAYWARD. Yes, sir.

Mr. FULTON. In that case, Mr. Chairman, I would like to have in public the evaluation of the Admiral, that he had spoken about. I think we need your comment when you were head of BuAER.

Admiral COATES. I was not head of it; I was Assistant Chief.

Mr. FULTON. You were in charge of the program. I think we should have your evaluation at that time. If you have any further comments, let us have them.

Admiral COATES. Yes, sir. Do you want that now?

Mr. FULTON. Yes, sir; before Goodyear.

Admiral COATES. No, sir; I can't quote from this letter in open session.

Mr. FULTON. What is your evaluation currently?

Admiral COATES. If I may just discuss this in an unclassified way, when this was presented to me, it was claimed to have certain advantages, one of which was foldability and another one was cheapness of construction.

Now, interesting as it might be to an engineer, we would certainly not want to put the taxpayers' money into a different way of doing something just to see if we could do it.

It must offer some clear advantage. With my experience in airplane design and from looking at modern airplanes, they are packed full of things that don't fold, engines and engine ducts, electronics, the ejection seat that the pilot sits in, his instrument panel, the cockpit enclosure, the landing gear, the controls, not only the wing and tail movable surface controls, but engine controls, controls for his armament. The whole airplane, fuselage and wing are jammed full of equipment, components, and plumbing.

It seemed obvious to me that even if the shell of the airframe, by itself, could be folded, that we could not hope to fold a modern airplane made of flexible fabric because of the unfoldable things in the airplane.

Now, as to the advantage, the supposed advantage in cheapness of construction, it was represented to us that because this fabric would be made on a loom designed especially for the design of the particular airplane, that once the looms were made and set up, it could duplicate a large number of pieces quite inexpensively.

I am willing to grant that, but we saw so many unknowns and so many difficulties in developing this new technique adequately for high performance airplanes, that we thought that the time and money consumed in the development would more than eat up any possible savings in a fairly large number of subsequent production aircraft.

Now, one more point on cheapness. There was a time when the airframe was all there was to the airplane and a major part of the cost. That time has long gone. The mere shell of an airplane now, not counting all of the equipments, the components that go into it, and the attachments for those things, which you must have regardless of the structural material, the just plain shell of the airframe is quite a small part of its cost.

So that even a major saving in just the shell or the skin of the airframe, as you might call it, would not be a substantial saving in the overall cost of the airplane.

Mr. FULTON. Is there increased vulnerability, because of this type structure to say antiaircraft guns——

Admiral COATES. No, sir; I don't think so. It is continuously inflated in flight and it would be easy to provide for an excess of air supply so that you could have a fair number of holes punched in it and the air supply would keep up with the loss through those holes.

I wouldn't expect any great difference in vulnerability. Certainly, I have never doubted the feasibility of building and flying such a machine. In fact, there is a contract for 10 inflataplanes. They have been built and flown. These were low performance airplanes, quite low performance, puddlejumpers, with an absolute minimum of equipment.

Their foldability was achieved.

Mr. FULTON. That is all.

Mr. HECHLER. Any further questions of the Navy witness?

Mr. ANFUSO. May I ask the Admiral a question? I am sorry I was not here earlier, Admiral. This is a collapsible plane, is that right?

Admiral COATES. Yes, sir.

Mr. ANFUSO. For one or more passengers?

Admiral COATES. It could be made into anything, in fact, the name, Wagmight, doesn't refer to a design of a particular airplane, but to a concept of construction.

Mr. ANFUSO. It could also be unmanned, is that right?

Admiral COATES. Yes, sir.

Mr. ANFUSO. For special missions?

Admiral COATES. Yes, sir. Of course, that means putting in more equipment. You would have to replace the man with control and guidance equipment.

Mr. ANFUSO. How long would it take you to put it together?

Admiral COATES. You mean from its stowed or collapsed form?

Mr. ANFUSO. Yes, from its stowed and collapsed position.

Admiral COATES. It was represented to us that it might be set up ready to fly in 30 minutes, but I was never quite clear in my mind just what kind of a machine would be set up to fly in 30 minutes. I can readily imagine that a simple machine could be set up to fly in less than that. I don't know what the record is on the Inflataplane.

The Goodyear representative here can tell you that, but I am sure it is less than 30 minutes.

Mr. ANFUSO. Is it a Goodyear project?

Admiral COATES. Yes, sir.

Mr. ANFUSO. The Government is not at all involved?

Admiral COATES. No, sir. The Government is involved in a contract for the Inflataplanes, which are not identified with the name, Wagmight, although they use a similar method of construction.

Mr. ANFUSO. Which one are you espousing?

Admiral COATES. I am not espousing either.

Mr. ANFUSO. Neither one?

Admiral COATES. That is right.

Mr. ANFUSO. Are you opposed to this Goodyear project?

Admiral COATES. Yes, sir.

Mr. ANFUSO. And why?

Admiral COATES. For the reasons I just stated, sir, that to me the supposed advantages are not realizable, neither the foldability nor the cheapness.

Mr. ANFUSO. Is this your personal opinion or is it the opinion of the Navy?

Admiral COATES. Both, sir.

Mr. ANFUSO. Thank you.

Mr. HECHLER. Captain Bright, did you care to add anything?

Captain BRIGHT. Admiral Coates said this was a Goodyear product and not the Navy's and I noticed in the newspapers when this broke out into the print, that they said that Goodyear had conducted a study and submitted it to the Navy for evaluation and I would like to set the record straight, that this is not the case.

The Navy did the study and I was the project officer and the people on this committee were naval officers, civil service people and engineering talent from the Goodyear Aircraft Co.

We asked them to come in on a voluntary basis as we needed them to be part of a Navy study group.

When we finished the study, they were not in any way paid for their efforts. They haven't been to date and the findings of the Navy study were that we should ask them for a cost estimate which they submitted to our group in the Chief of Naval Operations, and we submitted this to the Bureau of Aeronautics.

At no time did they submit any proposal nor have they to date. It has been through the group in the Office of the Chief of Naval

Operations who did this study and who had the proposals presented to the Bureau of Aeronautics and the corps will bring this out.

Mr. HECHLER. I think at this time we ought to proceed to hear the representative of Goodyear, so that we would not detain Admiral Hayward, Admiral Coates, and Captain Bright too long in executive session. They have work to do. They will make a presentation in executive session, of course, after the Goodyear presentation.

So if the representative from Goodyear will come forward, I will swear him. Raise your right hand.

Mr. Pipitone, you do solemly swear the testimony you will give before this committee in the matters now under consideration will be the truth, the whole truth, and nothing but the truth, so help you God?

Mr. PIPITONE. I do.

Mr. HECHLER. Could you give your full name and position for the record?

STATEMENT OF S. JOSEPH PIPITONE, MANAGER, AIRCRAFT ANALYSIS GROUP, GOODYEAR AIRCRAFT CO.

Mr. PIPITONE. S. Joseph Pipitone. I am a manager of the aircraft analysis and development group at Goodyear Aircraft.

Mr. HECHLER. Could you give us a brief estimate of the time of your presentation?

Mr. PIPITONE. I wasn't prepared to give a presentation here today, sir. I was going to answer any technical questions that the committee felt they would like answers to.

Mr. HECHLER. Do any members of the committee have questions? Mr. Anfuso?

Mr. ANFUSO. Mr. Pipitone, will you please describe for the committee how this thing works and what you think about it?

Mr. PIPITONE. Yes, I would be very happy to. It is a little difficult, of course, to do this without some drawings and what-not.

Mr. ANFUSO. Do you have any drawings with you?

Mr. PIPITONE. No.

Admiral HAYWARD. Here is a picture of an inflataplane.

Mr. PIPITONE. Yes.

Admiral HAYWARD. That has been built, actually.

Admiral COATES. Yes, sir, built and flown.

Mr. ANFUSO. What is this made of, Mr. Pipitone?

Mr. PIPITONE. It consists of a fabric structure which actually is a membrane, which is prestressed and it is made of an orthotropic type of material. That is, the strain in each of the directions is not the same as it would be in a metal structure.

What it does consist of is the fabric here [indicating] and the engines, the wing coming out here, and the fabric tail surfaces.

When the pressure is on, in the vehicle, the fabric is pretensioned. This is not unusual in a structure. For instance, reinforced concrete, you have heard of prestressed concrete, wherein concrete is weak in tension and, therefore, they prestress it in compression, so it can carry tension loads. This is just the reverse. This material is—I prefer not to call it a material, because really it isn't, it is a structural concept, and it is based on the fact that when it is pretensioned, it

then can carry compression load, just the reverse of a pretension concrete.

Mr. ANFUSO. What kind of fuel do you use?

Mr. PIPITONE. This is JP–4, it is a regular jet engine. The air is supplied from the compressors or the last stage of the jet engine. Of course, this air would then have to go through a heat exchanger to cool off because it is around 600 degrees.

Mr. ANFUSO. Has this plane been flown?

Mr. PIPITONE. No, this is purely in a conceptual stage, a very preliminary conceptual stage. The only airplane that has been flown of this type of structure is the one-place and two-place Inflataplanes, the one that you have in your mind.

Mr. ANFUSO. Has this been flown?

Mr. PIPITONE. That has been flown, yes, sir.

Mr. ANFUSO. This is not your product?

Mr. PIPITON. Yes, sir, it is our product.

Mr. ANFUSO. This is also a Goodyear product?

Mr. PIPITONE. Yes, sir.

Mr. FULTON. Where is the landing gear?

Mr. PIPITONE. On this, this was designed with the concept that it would be zero launched and that it would land in the water on its return flight, if it was a manned aircraft.

If it was an unmanned aircraft, then, of course, it is a one-way trip.

Mr. ANFUSO. Why do you—have you known about the Navy's opposition to it?

Mr. PIPITONE. Well, formally, sir, we have not known—most of our dealings have been with the CNO in the design of this aircraft. We were lending technical assistance purely. We were approached as to whether or not we could technically accomplish this type of mission with this structural concept. We did furnish the technical information and we thoroughly believe that it is feasible, we know that it is feasible and we feel that it is well within the present state of the art, for the speed range wherein this vehicle's mission was to be accomplished.

Mr. ANFUSO. And what is the speed range?

Mr. PIPITONE. We know that we can do this up to around 400 knots. That is, I would like to clarify that a little bit, in that we have been asked many times why did we select 400 knots? When we were approached on this, and, of course, the people who were making this study would like as great a speed as they could possibly get. This allows a greater probability of penetration, and so on. So we put the limit—we did not feel that we could take the next logical step at a speed in excess of 400 knots. This is primarily due to the fact that above these speeds, when you put in the limiting dive speed of an aircraft with this cruise speed, that you are just below the speed range or mach number, wherein you would get the compressibility effects of the air and the attendant aeroelastic problems.

Mr. ANFUSO. You said you were asked whether you could put up this kind of a plane. Who asked you?

Mr. PIPITONE. What was the question?

Mr. ANFUSO. You said that you were asked whether or not you could put up this kind of a plane.

Mr. PIPITONE. Yes. We were asked by the people at Chief of Naval Operations, Captain Bright's people.

Mr. ANFUSO. Have you testified, Captain Bright?

Captain BRIGHT. Yes, sir.

Mr. ANFUSO. What have you said, have you said it is feasible?

Captain BRIGHT. Yes, sir, our study showed it was technically feasible.

Mr. ANFUSO. All right.

Mr. FULTON. Could somebody give us an engineering estimate of the percentage of compressibility when you are doing the folding? What space do you save and how valuable is that and then relate this price to something in this particular usability range?

Mr. PIPITONE. First, to answer the question, Mr. Fulton, if I understand you correctly, you wanted to know what volume reduction there was by folding.

Mr. FULTON. And also the configuration on a carrier deck? What do you save there?

Mr. PIPITONE. Well, on the hangar deck or in the hangar deck, if you take the distance from the floor to the upper deck, with the clearance that is provided there, you can stack these in their folded shape in capsule form. This means that you could put them, then, on racks, which would then take the volume that is projected by the normal aircraft. We can put 20 of these in the space, say, of an A4D.

Mr. FULTON. On a flight deck?

Mr. PIPITONE. No, that would be in the hangar deck I am referring to.

Mr. FULTON. Yes. Now on the flight deck.

Mr. PIPITONE. On the flight deck in its flight configuration, that is its regular inflated shape, it will then take exactly the same shape as another airplane of the same dimensions. That is, there is no difference when it is in its flight configuration than a normal airplane.

Mr. FULTON. So once you get it up to the level of the flight deck there is no difference whatever from an ordinary conformation?

Mr. PIPITONE. When you inflate it, it is a normal size airplane; that is right.

Mr. FULTON. And it is then chiefly in the storage at the hangar deck level, it is not in an operational status nor in a repair status, but for storage that you save this amount?

Mr. PIPITONE. Precisely right, from a logistics and handling and that sort of point.

Mr. FULTON. On the handling of it, how do you handle it differently on the hangar deck from the ordinary type plane?

Mr. PIPITONE. Well, you could have this capsule, or the container which holds it, on a dolly of some type and you can roll it around without having the objections of the damage that usually is imposed on aircraft being handled on the hangar deck. That is wing tips get dented, they meet obstructions, one airplane hits another. I am sure from your experience on a carrier you know what I am talking about here.

Mr. FULTON. Has there been an estimate on the difference in vulnerability of this type conformation from the ordinary plane on, say, enemy fire? Have you made any estimates on that?

Mr. PIPITONE. We did fire shells, I must qualify that: We fired 30 caliber bullets into our present Inflataplane and I think this was in

the neighborhood of half a dozen bullets, when the pump, which is a very small compressor on the Inflataplane, was able to keep up with this fire. One very fine feature about this is that when it is pierced by shrapnel or a bullet, the hole is a ragged one, which means that the orifice coefficient is quite high. That is the resistance to airflow is quite high. Therefore, with the abundant supply of compressor air from a jet-type engine, we are quite certain that we can sustain quite a bit of damage. In fact, it is very possible that we could sustain the type of damage that a metal aircraft could.

Mr. FULTON. Admiral Hayward, you seem to have a comment.

Admiral HAYWARD. Yes, sir. I go right back: I do not want the committee to get the idea that there is not promise in the small Inflataplane. I mean we and the Chief of the Bureau of Aeronautics, discussing it with me, say that the technique of packaging and inflating may have attractive possibilities in connection with the small ship packing and using of this for airdrops. The Army was interested in this. This is where it is packaged and actually dropped to somebody in the field. You can blow that up and fly it. But that is a 9-pound-per-square-inch machine, good for about 80 miles an hour, something of that kind. It is useful in this field. The argument was that it is actually—the decision was that it is not in the 400-knot field and it did not make good technical sense nor program sense for me to spell out a system employing this. I mean Admiral Coates covered in detail as to why that decision was made and I think you put your finger on it, from the electronics, the jet engine, actual controls, things of this kind is what our problem has been on that.

Mr. FULTON. Thank you.

Mr. HECHLER. I will say for the benefit of the members of the committee that the Navy has an executive session presentation of this project which perhaps we ought to move toward. Do other members of the committee have questions they would like to ask in open session?

If not, we will proceed in executive session.

(Whereupon, at 2:40 p.m., the committee proceeded in executive session.)

(The executive session is classified and will not appear here.)