MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Wednesday, February 4, 1959.

The committee met at 10 a.m., in room 356, Old House Office Building, Hon. Overton Brooks, chairman, presiding.

The CHAIRMAN. Let us come to order.

This morning we have the Navy in open session and before we begin I want to publicly thank the chairman of the Veterans' Affairs Committee, who is a member of this committee, for lending us the use of this committee room for the purpose of having our picture made and also offering to lend us the use of the committee room at any and all times when his committee is not actually in session. That is really something to appreciate.

Our own committee room is now in the hands of the architect and contractor and we think in the next 2 weeks we will have our committee room in shape so we can meet there, but it will not be a finished committee room because it is being put together in such a hurry. Nonetheless, it will give us a home and place to meet. I hope we can announce a date for moving to our own quarters in a short time. In the meantime we wish to thank Congressman Teague, chairman of the House Committee on Veterans' Affairs, for lending us this room.

Now before we proceed, I want to say this to the members of the committee: I have just read in the daily press a statement of the Secretary of Defense, Neil McElroy, to the effect that the American stockpile of operationally ready intercontinental ballistic missiles will be within a few of the Russian total by the end of the year.

I want to state that our testimony to date does not support this finding. I want to say further that this committee will welcome the Secretary of Defense at a later date to appear before it, giving the committee the benefit of his knowledge of the development and capabilities of our intercontinental ballistic missiles, at this time and by the end of the year, and also making a comparison of the capabilities of this country with that of Russia.

Mr. Osmers.

Mr. OSMERS. Before we hear the first witness, I would like to make a suggestion, sir. As the testimony has come in from civilian and military branches of the Government, it seems to me that it might be a worthwhile staff task to try to make a chart showing the interrela-

tionship of the military and civilian space agencies of the Government and how they overlap and coordinate. It has been difficult as we hear from the Air Force, and NASA, and so forth, and that is just a suggestion that I make to you, Mr. Chairman.

The CHAIRMAN. You have heard the suggestion; is there any debate or opposition?

If not, Mr. Ducander, will you take that into consideration.

Mr. DUCANDER. Yes, sir.

The CHAIRMAN. Now this morning the first witness is Admiral Hayward, Director of Research and Development, Rear Adm. J. T. Hayward.

Admiral Hayward, we are very happy to have you here before this committee this morning. We are making an intensive study of this situation. We appreciate whatever light you can give us on this matter.

You have a prepared statement there?

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

Mr. MCCORMACK. I would like to say, Mr. Chairman, that Admiral Hayward appeared before the select committee and made a profound and favorable impression upon the members of the select committee and as chairman of the select committee and a member of this committee, I am glad to welcome you back here.

Admiral HAYWARD. I am delighted to be here.

Mr. FULTON. May I join with Mr. McCormack in saying that Admiral Hayward is one of the best witnesses we had and a great supporter of research and development.

The CHAIRMAN. Proceed with safety, you have a lot of supporters on this committee.

STATEMENT OF REAR ADM. JOHN T. HAYWARD, ASSISTANT CHIEF OF NAVAL OPERATIONS, RESEARCH AND DEVELOPMENT, U.S. NAVY

Admiral HAYWARD. They say you should never follow an animal act, but we will do the best we can. I did recognize Mr. Fulton [in reference to a newspaper photograph of Mr. Fulton with a space monkey brought by the Air Force.]

Mr. Chairman, I will discuss briefly the Navy and the space age and will welcome any questions you may have. I will be followed today by Admiral Masterson who will discuss the Navy guided-missile program and by Admiral Raborn who is the head of, and our No. 1 expert on, Polaris. As our final speaker, Captain Wagner will describe a very necessary adjunct to all these programs, the Pacific missile range. I hope that between us we can provide a comprehensive if brief, view of our Navy's endeavors in these fields of modern weapons.

I would keep the classified portion of the briefing until this afternoon if that meets with the approval of the committee. If anything comes up I feel we should discuss in executive session, I will say so.

The CHAIRMAN. Let us proceed in open session as long as we can.

Admiral HAYWARD. Yes, sir.

Now to turn to the subject of space, I will not belabor the reasons of why the Navy is interested in space because the events of the last

16 months have made it quite evident that a nation and the military arms of that nation must choose one of two courses. Either improved accomplishment of their objectives through use of space technology, or alternately, the placid acceptance of being second best and the inescapable road to oblivion that follows.

It is with great pleasure that I see this is called a Science and Astronautics Committee because science goes across the board and does not just apply to space.

The first course, and that only, has been part of Navy thinking since 1942 when the first propositions were made by the Navy for launching of artificial earth satellites. The sequence of events since then is well known: The IGY satellite effort, the unfortunate and unwarranted reaction to Vanguard, and the many recent displays of Soviet and U.S. space capabilities. The results of this first thinking have been grandiose and overwhelming. Although world interest and national thinking have matured somewhat in relation to this new area of man's activity, the United States is still in the throes of adjustment and is still mumbling, "We must get organized." It has not been easy to keep goals clearly defined and objectives firmly in view during this period of frantic activity and changing responsibilities.

Attention has been directed to launching vehicles with an enthusiasm that has almost obscured the reasons for their existence. Pounds-in-orbit has become a fetish that has led to several embarrassments. The only true objective should be the effectiveness of the satellite or experiment, and not the method, the agency, or the number of rocket casings floating in space. We might do well to note that the much maligned, little, experimental Vanguard is the only U.S. object in space that is still faithfully doing the job it was designed for—after almost a year in orbit. It goes around still transmitting on 108 megacycles, still giving us the skin temperature. It has traveled 105 million miles up to the 1st of January. This is equivalent to 438 trips to the moon. It is 12 million miles beyond the sun and it is three trips to Mars, even with the varied distance. This gives rise to the feeling that we must not lose sight of what you are putting in space. It is not pounds in orbit. This example—there are no Russian satellites, no other American satellites that are broadcasting today. This gives rise to one thing and one thing that it is most important for this committee to see and to realize, that it is the development of components that makes it possible for this thing to work.

The component that makes that possible is the solar battery. The solar battery is an effective power source and we thought, of course, that this particular object would only last maybe 200 years. Scientists now feel that it can last 2,000 years; that is the optimistic opinion. How long the solar batteries will withstand the meteorite blows, or if it runs into anything, of course, this would put them out, but it is a serious and sober thing to think because when one thinks of just the vehicle side of it you lose sight of what is in orbit and you all know and are familiar with what the press has said about the Vanguard and the opinion that this program was a failure.

Now this supports the thought that I really want to make clear: The Navy intends to use space to accomplish naval objectives, and, of course, to prevent space from being used to the detriment of those objectives. With the national objectives in mind, we must pursue

those courses of action that contribute directly to the Navy's capabilities. Practically every aspect of space endeavor is related in some manner, but we must temper our participation with the cold facts of feasibility or degree of threat. Right now we are extremely interested in intelligence, navigation, and communication by satellites. The possible contributions of these systems to our Polaris weapon make their vigorous prosecution essential. This does not indicate, however, a lack of interest in ship surveillance, meteorology, and manned space vehicles. Each and every military aspect must be part of our space program.

Because of the tremendous cost involved with space programs and the need to husband our technical knowledge, there must be one national space program. Similarly, there must be one agency to be responsible for the development and execution of that program. Obviously, our national space program must be broad in scope and all encompassing, but at the same time, and this is most important, it should be sufficiently complete to include military programs of the services.

The National Aeronautics and Space Administration is charged with a responsibility to the national program for basic research and civil scientific effort. The majority of these projects, however, are intended to produce scientific knowledge, psychological advantage, or strategic advancements, with all the complex interchange of communications and policy that such systems engender. The services must have a mechanism that insures fulfillment of military needs. Navy operational needs can be summed up by an example such as a fleet commander in the Indian Ocean choosing package No. 3 from the shelf, launching it as a satellite, and recovering his intelligence answer within an hour. That is the tactical concept, and is the Navy's view of an objective goal.

In the newspapers you read a lot about ICBM's and how many missiles the Russians have, but war is complex; it is a spectrum, not just the megawar field. The national strategy has to be one of economic, political, psychological, and military needs in peace as well as war. If you face up to the challenge that we are faced with, you will face it across the whole spectrum not in just anti-ICBM's, or ICBM's, or Fortress America. We are a member of the free alliance and if we go to this concept the free alliance will die. Today this challenge to Western civilization is across the board.

I always like to put my physicist, third-class hat on when I discuss this, it covers the microwar, the miniwar, the mesawar, monowar, and the megawar. We do a disservice to our people to just tell them of the megawar, because you are facing this challenge and we have faced it since I last appeared before the select committee. I do not know if that precise picture was envisioned by Congress in drafting the Space Act of 1958, but I do know that the need for military application of space was well recognized. You may recall that I testified last year as to the need for adequate military representation in the space agency to the extent of proposing a military application division similar to that of the AEC. I cannot accept the concept that a single agency should have exclusive rights to space. The idea of being a user, without enjoying participation, is fallacy. I am also concerned that preoccupation with the peaceful uses of outer space may function to the detriment of military reality. And, gentlemen, after a

year of furious U.S. activity, I sincerely conclude that U.S. supremacy in space science is threatened, not by lack of talent, but by our skill in bureaucracy. I am certain that firm implementation of the intent of the Space Act, and execution of the recommendations made by the Congressional Space Committee, will yield the United States preeminence that we all desire.

Now, I should not leave the impression that all is lost, or that no progress has been made. Advancements have been achieved; the Navy does have active programs for those immediate goals I mentioned, and basic research has not suffered unduly from the battle of the agencies. The same people are still working hard hours to yield each small step forward. That is the secret of the whole problem; long hard work and the freedom to make it pay. This work is being done in many laboratories, by many agencies, and usually in great harmony.

This also goes to the complete spectrum of the challenge. It is hard work we have to tell our people. We are not going to keep our freedom unless we work hard and we have to face the challenge across the board.

Now, I have a short film that will demonstrate the type of work that I am talking about. This is the type of hard work and detailed work that has to go on before you proceed to any definite accomplishment such as the solar batteries in the Vanguard.

Now, I also would like to make the comment you are going to see the first unified monkey in existence. The Air Force introduced him to Congress. The Army rides him in their missile and the Navy trains him. Of course, to successfully place a man in space you are going to have to have continued research in many diverse fields of science. As you will see in this picture, you will see how we train the monkey, and we have been conducting this sort of experiment and research for years before we actually got into Project Mercury, Mr. Chairman. It has lots of application, of course, to the flight of manned vehicles.

We have a centrifuge at Johnsville which is nothing but a large arm that you put a man in and you can subject him to various accelerations. We have put Scott Crossfield in this particular acceleration device and he has actually flown the X–15 600 times. He flies the X–15 within the envelope that is required and his motions are fed back to a computer that tell him exactly and tell the doctors exactly what he has done and what has happened.

I am sorry to say, in the course of the 600 flights he has made in the X–15 to date, approximately 15 percent of them have been failures and would have resulted in crashes. Fortunately, when you crash in this accelerometer, you will see that it does not have disastrous results. But it is the type of hard work in research and development that has to go on in a component field to really be able with any assurance to place a man in space. We have also in this same device used the Dyna Soar principle to see if this was possible for man to accomplish. Of course, at this particular point, Mr. Chairman, it does not look like Ohm's law is going to work. We have not got any juice. It is just such things that make those missiles and space devices fail; it is probable that a 25-cent fuse is gone. Maybe we better turn the lights on while the electricians are working and you can ask me some questions.

I would like to say that the pictures you will see show men subjected to accelerations that no man has ever been subjected to before, up to 31 G and 21 G. You will also see a space suit in here.

[Film begins.]

This is the successful Vanguard launch that is still in orbit. This is a picture of a satellite which is still working. You are going to have to have reliability in space to a much greater degree than you have it on the ground.

This is your friend that you met yesterday and this is the cage that they put him in with his tail wired, of course, and the handle and the light you will see shortly. Incidentally, we found one of these monkeys that liked the shock and he would not do anything. You could just keep on giving it to him and he liked it. This one was not of that nature.

As you can see, he is learning to do his task. We are in the process now of getting ready for the second biomedical experiment. This is a recording of his actions. When you see what we do to the men you will see that we treat the men a lot worse than the monkey. He is anesthetized here and put into his space suit. This is like the plaster that dentists use. We encase him in this. He can move his arm and we then take him for a ride in this machine. He is in his space suit now and all encased and this is an acceleration machine. We did lose one this way that did not survive. He has got his handle there.

This next one will show pictures of the couch, the Mercury couch. We actually put this in the centrifuge and this pilot went to 21 G. One of the things they examine is to see how well it fits. If there is any skin hemorrhaging, the couch does not fit him. This is all done in coordination with NASA and with the Air Force and it is done at Johnsville, Pa. This is the only facility in the United States to do this particular work.

In all of these tests they will give him some function to perform under these particular accelerations. The couch is actually designed by the National Aeronautics and Space Administration. It is one approach to the problem of reducing the accelerations on human beings in flight.

Now when the light comes on he has to press a switch and put the light off. This is the way they measure what he can actually do under these accelerations. His handles are down by his hand. That is a view of the arm of the acceleration machine which will rotate up to the required accelerations.

This boy actually withstood 25 G in a 40-second period that he was accelerated. This gives you the ability, for instance, for a person like Crossfield to actually experience the sensations of a flight—he is going by there in that couch, so you can see he is getting a real rough ride compared to the monkey. Of course they will take him right out and examine him to see his reactions, to see whether he suffered anything and in this particular case he did have some hemorrhages up on his right shoulder where the couch did not fit tightly and, of course, an improvement has been made since these tests on this particular couch to try to increase its usefulness.

Now we found a very peculiar thing. We started off by immersing a man in water and of course there are some people who say that if the Navy is going to space, they have to go in water, but strange as

it seems we have found a man completely immersed in water can stand more acceleration than any other way. So you will see right after this a space suit that weighs a total of 700 pounds and where the subject is immersed completely in water. That is put in the accelerometer and whirled around and he can withstand in this device 30 to 35 G, which incidentally is the same as if you went from zero to 11,000 miles an hour in 30 seconds which is a real good acceleration. When we first did it partially with water up to his shoulders, we found that the acceleration resistance did not go up much at all. We had to completely immerse him in it and he has controls that he has to manipulate under these forces to see whether he could perform his particular job. He did pretty well on his balance test.

This particular force, of course, would have killed any unprotected man. If he had not been in the water, he would have been killed. Now that means that this sort of capsule might very well be used to survive extremely high impact accelerations. Of course it seems awfully strange that a man may enter space immersed in water, yet the increased capability for rapid maneuvers and accelerations may warrant the weight penalty.

We were looking around, of course, like everybody does in the research and development field, to try to find a way in which we could get over some of the fundamental limitations of man. This sort of work, of course, as I say is hard and tedious and it takes time, but it is the only way we are going to make progress, because unless you have components you cannot put a system together. Unfortunately we have had a tendency in the past to try to put a system together without components and then we invent on schedule and then we never keep the schedule, obviously. The tank is being filled up with water at the moment now.

He has special glasses on and, of course, he has his oxygen.

Mr. FULTON. He is a brave man.

Admiral HAYWARD. That is a hard way to make a living. Yes, sir, we have our doctors up there; we have some real brave men.

Mr. FULTON. Does he get extra hazardous pay for that?

Admiral HAYWARD. Yes, sir; he does. I do not know whether he can log that as flight time, however, under the general rules and regulations, but he gets hazardous pay. As you can see, he gets a rougher treatment than the monkey. The thing that amazed me was they gave him this balance test which they give all us aviators and I think he did better than I do without being whirled around at 31 G.

Of course, the Navy has not claimed water rights for space travel either, Mr. Chairman. Now this sort of work has to go on across the board in power sources, guidance, in addition to propulsion. Everybody is worried about propulsion and rightly so because naturally if you do not have the propulsion you cannot get into space but if you just have the propulsion and the rest of it falls by the wayside, you have not done your job either.

Incidentally, these facilities do not come cheaply, as I am sure most of you are aware, but you can see their usefulness in the research and development program. Now, those are all of the controls he had to manipulate under this 31 G and he did very well, actually.

There he is doing his balancing test right after the acceleration with his eyes closed which he does real well, I feel.

(End of film.)

Admiral HAYWARD. Now the reason I showed you that particular film, Mr. Chairman, was the fact that I wanted to emphasize once again the hard work and the detailed work in research and development that has to go on before one says we are really competent and capable to enter this space age to which everybody refers lightly. There is no substitute for hard work and competent people to do it. I will be pleased to answer any questions you may have in regard to the Nation's research program or our space program.

The CHAIRMAN. Admiral, you referred in your statement, on page 3, to reaching over and choosing package 3 from the shelf, launching it as a satellite, and recovering intelligence within an hour.

What do you refer to there as package 3?

Admiral HAYWARD. That is more of a philosophy. I feel very strongly, Mr. Chairman, that the time is going to come when we in the Navy or we in the United States, let us say, have to have the ability to put a small complex satellite into orbit from an airplane. In other words, there is no reason why one cannot. There are no physics laws that prohibit you from taking a solid rocket, flying it at 40,000 feet, and putting it in any orbit that you want, as far as polar or equatorial, and this would give you a tactical application.

For instance, if you just wanted to know one particular frequency spectrum, if you wanted to know one specific thing, let us say you wanted to cover southeast Asia to the north and you wanted some intelligence right then and there. This would give you flexibility in a tactical system. Everybody has referred to space as just a strategic thing. I feel that the ability to launch one of these from aircraft has lots of advantages, as you will see in our Pacific Missile Range where the only real good place in the United States exists to launch polar orbits, and this would give you the ability to launch a small satellite in any orbit you chose.

The CHAIRMAN. Do you have in mind, for instance, if your commander were out in the Indian Ocean and he wanted to know whether there was a mobilization of troops or equipment, he would do it by sending up a satellite?

Admiral HAYWARD. Not necessarily, no, sir. It would be a great tool for tactical intelligence. He might want to know what radar stations were on, he might want to know what communications were on at that particular time.

Now I will go into a bit of this in the classified section. We have a presentation in the classified field of this nature.

The CHAIRMAN. But to demonstrate the practical application; from an airplane, launched from a carrier, you could send up a missile in orbit to obtain very valuable intelligence within the hour for the fleet?

Admiral HAYWARD. That is right.

The CHAIRMAN. That is what you had in mind?

Admiral HAYWARD. That is exactly what I was thinking.

The CHAIRMAN. Now all through the hearing we have been discussing long-range missiles, ICBM's and others.

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. I notice there is no reference to it in your statement. Did you overlook reference to the use of that?

Admiral HAYWARD. No, sir. Of course our ICBM is the Polaris. We are firm believers in mobility. We do not want target U.S.A., we

want to put the target away from the United States, and it is the inevitability of a deterrent that is important.

If you have a system that is invulnerable to surprise attack and effective so it would be possible to be effective even if a man read in the New York Times we were attacked, and still destroy your enemy, this is the thing you are working for. Any system that basically depends on being able to defeat a surprise attack is a weak system, and I say this and repeat it all of the time: Any system completely vulnerable to a surprise attack is a weak one; deterrence should be inevitable. We need flexibility in our deterrent system.

It is what the Russian planner thinks, not what you or I think. If he thinks he is going to be destroyed no matter what he does, he is not going to start it. That is why if we go down this one line of the megawar, if we go down just one part instead of addressing the whole challenge, the whole complex spectrum, we are making a mistake for the United States. We can't afford to do this.

Now, when I did not make any mention of ICBM's, the Polaris to my way of thinking is an ICBM.

The CHAIRMAN. Well, now, what progress are you making which you can speak about in open session—what progress are you making in reference to the Polaris?

Admiral HAYWARD. Excellent progress, Mr. Chairman.

The CHAIRMAN. Is it operational at this time?

Admiral HAYWARD. No, sir; it is not operational at this time.

The CHAIRMAN. How close to operational is it?

Admiral HAYWARD. It will be operational in 1960.

The CHAIRMAN. In 1960?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. It is experimental now?

Admiral HAYWARD. It is in research and development now. We will give the committee in open session a complete rundown on the status of the Polaris program which is our part; this is the first system, Mr. Chairman, that the Navy has had in the deterrent business. This system is primarily a deterrent system. Any deterrent you get from the rest of the Navy, of course, is built in on the other side of the spectrum, and anything you get is a bonus in the general war. You must always remember that the Navy is peculiarly adapted to face the greater part of that challenge across the spectrum of war, from megawar down.

We make no bones, of course, or any hesitations or reservations, that the Strategic Air Command carries the great part of the deterrent force in the megawar part of the spectrum right today, but in that part of it you still have to have flexibility. You cannot just have one system. You cannot be dependent on just one way. Your system has to be inevitable, and it has to have flexibility, and it cannot be built just in fortress U.S.A.

The CHAIRMAN. Well, now who is going to give us that information about the Polaris?

Admiral HAYWARD. Admiral Raborn, who runs this entire program. Admiral Masterson will give you the general missiles, but Admiral Raborn will give you the complete briefing on that in the unclassified form and then we have some classified information on it.

I thought it would be best to have Admiral Masterson on the general situation first rather than the Polaris.

The CHAIRMAN. Mr. McCormack?

Mr. MCCORMACK. No questions.

The CHAIRMAN. Mr. Fulton?

Mr. FULTON. Admiral, we are glad to have you back again. It is always a pleasure to hear somebody who speaks explicitly and in simple English. You come right to the point. Might I refer back to your comment on the fact that the Vanguard will now possibly stay up 2,000 years. That really brings us into the space age with a tremendous start, because if we are looking to see who is ahead in the field of permanency on satellites, it would certainly mean that we with the Vanguard program have been eminently successful.

For example, with 31 million seconds in a year and if the Vanguard stays up 2,000 years, at 5 miles a second, that is 10,000 times 31 million, which is 310 billion miles that the Vanguard will have gone in 2,000 years with one puish, and that is a pretty good success, is it not?

Admiral HAYWARD. Yes, sir, that is the point that I want to make. People are too prone to see what happens on the launching pad and say failure or success.

Mr. FULTON. So really on distance with the Russian satellite now possibly in orbit, although nobody knows, around the sun, as far as distance is concerned we are doing a pretty good job of being ahead of them and being able to instrument it to show that we are right, is that not right?

Admiral HAYWARD. Yes, sir. If they had had our solar cells in theirs, theirs would still be broadcasting, but they do not have them.

Mr. FULTON. That solar battery we estimated would last 150 years. What is your estimate now?

Admiral HAYWARD. It may be more. We do not know. It will depend on how much of the meteorite dust it runs into. We have gotten tremendous value out of the Vanguard and, of course, the second stage of the Vanguard is the same stage that is used in your lunar probes.

Mr. FULTON. So actually then you would say that the Vanguard as a series of tests has been successful on the amount of scientific knowledge that it has relayed to us and the free world as well as the Russians, likewise on the distance because the Russians have not been able to compete on distance.

Admiral HAYWARD. Not that way; no, sir. This is a very stable orbit and we have learned a tremendous amount about the earth. The actual data we have gotten on the earth has been of tremendous scientific value.

Mr. FULTON. Likewise on the instrumentation of the Vanguard we are ahead of the Russians because they do not have the solar battery setup that we have—that is a continuous energy system that needs no repair?

Admiral HAYWARD. That is correct, and of course, as you know, the Vanguard program has been turned over to the National Aeronautics and Space Agency and they are going to continue with the Vanguard program. You know there are 512 separate functions that had to work in the Vanguard system to make it go. On the one that

we had the unfortunate explosion, 511 worked and a microswitch chattered for six-tenths of a microsecond and that was the end of it. That gives you an idea of the complexity of some of these things.

Mr. FULTON. The Army has one more moon shot to go in its program and then there remain two of the payloads that we could use the Thor-Able combination with for a moon shot. The question then comes up as to our programing, whether we should go for deep space probes, possibly Venus or Mars, just for distance, or should we say that strategy comes first in the cislunar area, this is between the moon and ourselves, where it is for our safety and security in the United States to know what it is and be strong. Generally on programing do you lean toward the strategic scientific research in the nearer area or do you think there is more to be gained from deep space probes at this time?

Admiral HAYWARD. Well, of course, I would answer that, Mr. Fulton, at this time, by saying that I have an awful lot of work to do in the state of the art in miniaturization: What will I accomplish with a deep space probe? Is it part of the psychological overall spectrum? If that outweighs other factors, you would go ahead to do it. But when we get to this pounds-in-orbit routine, admittedly, and I do not think anybody in the technical world would dispute it, the Russians have better rocket engines than we have. But has anybody ever looked as to why the Russians have better rocket engines than what we do in the United States. If you go back into Russian history, their Academy of Science, in 40 years—and I attribute a tremendous amount to the U.S.S.R. Academy of Science—they made basic technical decisions a long time ago and they decentralized their research and development. They have state of the art work. In other words, there is one man in Russia who has nothing to do but make the best rocket engines. That is all he does. He has a dual incentive. If he does not do it he gets shot. If he does, he gets lots of money and he is a wheel. But we have gone the other way. Look at the ICBM. The Academy of Science in Russia right after the war decided they were going to go the ballistic missile route. They did not wait for any breakthrough by any Atomic Energy Commission. They did not care whether they had 20 megatons or 20 tons yield. They were going to go the ballistic missile route.

Did they try to make a 5,500-mile system? Oh, no, they said, "We are going to make a ballistic missile that will be better than the V–2." They went to a 700-mile missile, but they went the ballistic missile route. The rocket engine people had the best rocket engine. They had their guidance people. Our approach has been the other way.

You get a big system. We are going to have an ICBM. We rushed around in 1954 after the Killian report, we are going to have an ICBM, we have to have it tomorrow. This is not the way you do things technically, and the state of the art is the thing that you get dividends in, and this is the hardest thing really in this business to ever get anybody to believe. When I go before people I have a glamorous system and it can be put all over the front page. But when I try to get something for a solar battery or try to get something for something else, then I have a real rough time. What the system has done is made congenital liars out of all people like myself to get my money. This is where the Russians in their state of the art development are

ahead of us. They are ahead of us in rocket engines, there is no question about it.

Mr. FULTON. I agree with you thoroughly and yesterday I was trying to build down the ICBM complex, that everything depends on our having an ICBM. Because it is only one of a number of weapons systems and if we put our sole security of the United States on one weapons system and have it outflanked we are done. I agree with you thoroughly.

I am almost finished with this. I will not take too much time. The Navy last year was proceeding with the development of the moon as a ready-made satellite for reflection and reconnaissance purpose. Will you comment shortly, if you can in open session, on the Navy's use of the moon for reconnaissance purposes and electronic processes in taking advantage of the process of ionic emission?

Admiral HAYWARD. I cannot in open session, no.

Mr. FULTON. Have you made progress in that field?

Admiral HAYWARD. "The witness stood mute."

The CHAIRMAN. Let us take that up in executive session.

Admiral HAYWARD. All right, sir.

Mr. FULTON. Do you have any evidence, that has been given to you as the Director of Navy Research and Development as to the Russian progress on ICBM's relative to the U.S. state of the art? If you do, we would like to hear about that.

Admiral HAYWARD. I would rather say that in closed session also.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Admiral Hayward, I am sorry that I could not hear the greater part of your testimony because I had to attend the organizational meeting of another committee, but from what little I heard, I sincerely want to compliment you. You spoke about the U.S.S.R. having an Academy of Science and that has been in existence for about 40 years; is that correct?

Admiral HAYWARD. Yes, it is older than that, actually, but I have traced it for 40 years in its operation.

Mr. ANFUSO. Isn't it a fact that the Rusisans have been fooling around with rockets since 1903 or somewhere thereabouts?

Admiral HAYWARD. Actually they have some very famous firsts in rockets. The rocket staging business was one of the Russian firsts. They have been very well inclined this way. They are good scientists.

Mr. ANFUSO. There is talk that they inherited a great number of scientists from the Germans. That is all very well. But nevertheless they are good scientists by themselves in their own right.

Admiral HAYWARD. Yes, sir.

If you look at the table of elements that you see on all physicists' walls, Mendeleeff, in 1857, was the man who put that together. I don't want to leave the impression all of the Russians are 12 feet tall. They put their pants on just like you and I do, and I think we can beat them.

Mr. ANFUSO. Admiral, I would like to ask you this question. You needn't answer in open session, but I would like to have an answer in closed session.

Assuming that you could look into a crystal ball and saw war with Soviet Russia by 1961 or 1962, and assuming further you were Commander in Chief of all of our Armed Forces, charged with defending

America and the free world, is there any program or programs now in progress or not even commenced that you would want to speed up or have advanced in order to assure victory for ourselves?

Admiral HAYWARD. I will answer that by saying we are at war now.

Mr. ANFUSO. That is the answer I would like to have you make.

Admiral HAYWARD. Only by hard work—we don't get across to our people that it is hard work. We can't get something for nothing. Whenever you look at this, you look and you say the ICBM. You will see a lot of people buy this because then you or I or somebody else won't have to lie in the mud or fight or die. If you are going to keep your freedom, you are going to have to fight and die for it. You are not going to have a simple way to do it, and there is no substitute for hard work. You are at war now, and it is the whole challenge that you have to face, and that challenge, you can look at the gross national product of Russia. It goes up. They produce more for less every year. And this is dangerous. Those curves will cross. If you just read what Khrushchev says and the rest of them, they are going to beat you at your own game. They are going to beat you the other way. They have made no bones about this. They are going to beat you technically. They are going to be better than you are, and we have to face to that.

Mr. ANFUSO. Russia has declared war upon us a long time ago, and I am afraid we have not conveyed that clearly to the American people. Isn't that correct?

Admiral HAYWARD. That is correct.

Mr. ANFUSO. I think we must do everything in our power to get the American people alerted to the point that they must realize that we are in a war, and that they must make sacrifices.

Admiral HAYWARD. That is all.

Mr. ANFUSO. All of us here in the Congress are willing to do the same thing, work day and night to protect this country, because we are at war; isn't that so?

Admiral HAYWARD. That is correct.

Mr. ANFUSO. And we should spare no effort in that respect.

Admiral HAYWARD. We should spare no effort.

Mr. ANFUSO. And we should do that at the expense of not balancing the budget.

Admiral HAYWARD. When you say balance the budget——

Mr. ANFUSO. I don't want to get you into any politics.

Admiral HAYWARD. Well, I will probably get fired anyway.

Mr. ANFUSO. Thank you very much, Admiral.

Mr. MCCORMACK. Will you yield to me?

Mr. ANFUSO. I certainly will.

Mr. MCCORMACK. In other words, to try to bring it to an understandable point, you can't deal with the Soviets on a moral level; is that right?

Admiral HAYWARD. That is correct.

Mr. MCCORMACK. You can't deal with them on the level of idealism; is that correct?

Admiral HAYWARD. That is correct.

Mr. MCCORMACK. The only level on which you can deal with them is the law of self-preservation?

Admiral HAYWARD. That is right.

Mr. MCCORMACK. You can't deny that the law of self-preservation applies to the Soviet Union and her people the same as it does to little Liberia or the people of the United States?

Admiral HAYWARD. That is correct.

Mr. MCCORMACK. Much as we dislike it, we had better be powerful and strong militarily, and that is the main vehicle through which our national objectives in the field of diplomacy are obtained. It is a broad statement. It could be broken down sometimes. But as long as they adhere to world revolution, we have to be constantly on our guard.

Admiral HAYWARD. That is correct, yes.

Mr. MCCORMACK. I didn't ask these question of you for my information. I have said this hundreds of times in and out of Congress, and I will continue to say it. But I was anxious to get your views for the record, because you, like all of us, are concerned not only with today but with these little youngsters walking around the street and wondering what kind of a world they are going to live in, and the answer is that it depends upon the leadership of today.

Admiral HAYWARD. That is correct, sir.

Mr. MCCORMACK. And the soundness of their judgment and their vision and courage to carry their judgment into operation.

Admiral HAYWARD. That is correct.

The CHAIRMAN. Mr. Bass.

Mr. BASS. Admiral, I would like to refer to the last sentence on page 3 of your statement, where you say "After a year of furious U.S. activity, I sincerely conclude that the U.S. supremacy in space science is threatened not by the lack of talent but by our skill in bureaucracy."

Would you mind enlarging on that?

Admiral HAYWARD. I would be delighted, sir.

I am sure when the staff draws you up that diagram, that the chairman asked for, you will see what I mean.

Now, if you go back over my testimony last year, I was with the Manhattan District of Engineers when we went into the atomic energy business. You saw how we went from the military side to the AEC today. Now, the AEC is a very successful agency, and what happened with the space law was that we have a military liaison committee, and one of the strong points of my testimony was that it had to be responsive to the military. But now let's take a look and you will see that you have NASA and ARPA, which is the Advanced Research Projects Agency, and then you have the Director of Research and Engineering in the Department of Defense. Personally—and I am now speaking from my own opinion—I am not speaking for my boss, Admiral Burke, because he would not agree with me. I feel we should have one U.S. space program.

I will give you an analogy. Suppose when the atom bomb was made we had put the AEC over here and said, "Now, look, you go look after the scientific nuclear physics side of it," and we said to the Department of Defense, "Look, boys, you look after the weapons side of it." What do you think would have happened? I do not believe that we would be where we are with the atom today, particularly from the weapons side. I felt—and as I repeat my testimony—really, I don't remember it verbatim—I felt that NASA should have been set

up similarly to the Atomic Energy Commission, with a division of military applications in this agency; that we should have one space program, and when we did this hard work that I am talking about, and we had the components and had a system, they said, "Look, boys, here is what we can do. If you want to make a weapons system out of it, this is the way." When they blow tests out there, they are not weapons, but they have a curve, and they say, "Look, for so many kilograms of this you can get so much bang." This is the way we can package it. When you look at our weapons today, this system has worked. As you will see in our presentation on the Pacific missile range, and the Atlantic missile range—now, the military get into it real well on the operational end of the business. I am convinced that something has to be done along this line in order to streamline and to get the best program for the United States. If you don't do that, how can you distinguish between military and science? It is indistinguishable. You are going to have a continual argument all of the time. Who does what to whom? In the atom business you never had that. You knew who had the responsibility. You knew how it was done. And the military got what we needed.

If you look through the history of your Atomic Energy Commission, you won't see—there is one example which I won't mention in open session, but you won't see where we haven't gotten what we wanted from the Atomic Energy Commisison.

Now, admittedly, the Joint Committee on Atomic Energy has been one of the strongest committees in the Congress. It has monitored the Commission's work, and it has done an outstanding job, and they are a part of our reason for success. I, Admiral Hayward, don't personally feel we can make a successful U.S. space program unless we have responsibility clearly spelled out and completely responsive to our military requirements. That is what I am interested in, not just the Navy or the Army or the Air Force, but the United States. I don't think you are going to get your money's worth.

Mr. ANFUSO. Would you yield to me at that point, sir?

Mr. BASS. Yes.

Mr. ANFUSO. In connection with that answer, I asked this question yesterday, and I would like to get your answer to it.

In connection with those research and development matters in space that represent dual purposes in that there may be developments for peaceful purposes or for military purposes, do you believe these should be financed and managed by NASA or jointly as to financing and management with the Defense Department?

Admiral HAYWARD. I will answer it this way:

I would have no fear of NASA managing that. If we have joint committee in Congress here on science and astronautics, I have a place I can go to, and I have a division of military applications. The military are right there, and it will work. The AEC works. Why won't that work?

Mr. BASS. In other words, Admiral, you feel there are too many different agencies having responsibility in this field and this ought to be centralized, our space program ought to be centralized?

Admiral HAYWARD. Space and aeronautics. You see, the NACA was our central aeronautical agency. There is not an airplane in the world that flies today that hasn't taken advantage of the research

and development work that they have done. The military had no problem with the NACA, and this worked, and was responsive. But as the setup is now, where you say the military is going down one street and the space agency goes another—and I am a great admirer of Mr. Glennan, and I am a great admirer of Roy Johnson, and it doesn't have anything to do with people. This is a government of laws, not people. But if you are going to set up a space agency, it should have been set up as the U.S. space agency, period.

The CHAIRMAN. Will the gentleman yield?

I was on the Armed Services Committee when that was discussed and also when we set up ARPA and, as I recall, there was strenuous opposition to putting all of this scientific effort under ARPA—all of the military scientific effort under ARPA. At that time the departments wanted to participate in the scientific effort.

Is it your idea now, that it would be better to turn the Navy portion over to ARPA and the Air Force portion over to ARPA?

Admiral HAYWARD. No, sir. You must remember, Mr. Chairman, that the research and development work that the services do has great application, not just to space, not just to aeronautics, but it has application to submarine, surface ships, to everything. We do our research and development work, and we have a tremendous job to do. I don't intend that this go to ARPA, and it shouldn't go to ARPA because you have to have the customer relationship; the man who is going to use the weapon has to be able to feed his ideas into it.

I say in the space business now—confining this just to space, not to the normal research and development programs, but the space situation—the reason is that you run into difficulty to try to distinguish between a scientific application and a military application; where you have two people trying to do it, this is difficult.

The CHAIRMAN. Well, I might say to the Admiral I also advanced the thought that we ought to have an atomic energy type of program, put it all together. But that was discarded by men who are experts on the subject, and apparently had given the matter a great deal of thought. They felt there were fundamental differences between the atomic energy and the space program, many of which you couldn't go into in a short period of time. But one thing was that the atomic energy program was set forth in the middle of a war when you could give dictatorial powers to one agency and tell that agency, "Regardless of what you need, take it and do the job." We ran into that problem.

Admiral HAYWARD. Mr. Chairman, the Atomic Energy Commission didn't come into being until January 1, 1947.

The CHAIRMAN. I mean the Manhattan District.

Admiral HAYWARD. Yes; Public Law 585 at that time is really an excellent example. I think you were on the right track at that time, and I think with events in the years to come you will see what I am referring to, Mr. Bass, I am sure.

Mr. BASS. Thank you, Admiral; that is all.

The CHAIRMAN. No further questions?

Mr. BASS. No further questions.

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. Admiral, on page 2 of your statement you stated—

Pounds in orbit have become a fetish that has led to several embarrassments. The only true objective would be the effectiveness of a satellite or an experiment and not the agency or the number of rocket casings loaded into space.

As you pointed out, there has been a great deal said concerning pounds of thrust and our ability to successfully orbit the sun, for example.

Many of us have been led to believe—and I think the public in general—that the No. 1 problem insofar as the so-called race with the Soviets is concerned, is in the rocket engine field.

Now, would you care to elaborate a little bit?

Admiral HAYWARD. As to the pounds in orbit, remember the little business of the Atlas here where somebody came out with a statement: "Well, they have a rocket casing on the payload, when you looked at the payload." But there is no doubt that the rocket business is the key problem to our space program. We don't have reliable rocket engines today. I don't know how reliable the Russians' are, because I don't know how many failures they have had. But reliability—just like when I go out to my jet airplane and I press the button, the turbine turns over, and I don't hesitate to go. I would be very loath to fly on one of our rocket engines today, because this is the No. 1 problem, and that is directly related to pounds in orbit. There is no question about it.

But, unfortunately—we, the United States—have certain launching vehicles now, the Atlas, the Titan, the Jupiter, the Thor, the Polaris, so you are wed to that particular rocket system.

Dr. Glennan has probably told you what the rocket developments are going to be. This is the key problem. I don't say that is isn't. But I want to emphasize just putting mere weight into space doesn't mean too much, because we are, with bated breath, looking for the scientific results from the Russian sputnik. What they really did, they had no hesitation to take our spectograph out of the Vanguard and use it in theirs. So this showed us a weakness. But it is the scientific object of the experiment that has been brushed under the rug.

What are you trying to do? What is the job? But I don't mean in any way to forget about the rocket problem, because you have to have a good rocket engine to do this. There is no question about it.

Mr. ANFUSO. What you are getting at, Admiral, is that we shouldn't just follow, we should have some new projects of our own that we can advance.

Admiral HAYWARD. Yes. You don't want always to react. You want to act. This is important.

Mr. ANFUSO. And you put it better than I.

Mr. MITCHELL. Admiral, something else that is extremely interesting to me, not in this statement, but when you were talking about the Soviet Academy of Science—and I think in response to questions by Mr. Anfuso—you pointed out that they were early leaders in rocket development; that there was no hesitation on their part—as you said, there is one man who has the sole responsibility for developing fine, improved rockets.

I gather by that that you feel that we are emphasizing too much the development of an entire system?

Admiral HAYWARD. That is correct.

Mr. MITCHELL. Rather than the component parts?

Admiral HAYWARD. That is correct.

Mr. MITCHELL. In that connection, let me ask you, Admiral, is there in your R. & D. establishment a component part of a system that you feel should be in the development stage, although it is not related to an entire proposed system?

Admiral HAYWARD. Well, let me tell you what happened when I took this over, over 2 years ago, now.

I immediately saw that we were not emphasizing this side of life. Now, my R. & D. budget is divided into two parts. Part I is the systems. Part II is the basic applied and supporting research, such as components, and that is 60 percent of my total budget, and if they cut me, and in my statement to the Secretary of Defense I said if I had to take a cut in this field, I would go back and just put all of my money in what I call the seed corn, because we have used up a tremendous amount of our basic knowledge. We have to go back to our basic work, and our developments of this nature, which are new, on phenomena, things that we haven't understood, and we can make steps ahead. So we in the Navy—and I have fought real hard to do it—have put our money into this. We have 1,500 contracts, for instance, with nonprofit organizations, universities, things of this sort, in basic research, which is part of the seed corn.

Mr. MITCHELL. Unrelated to any missile system?

Admiral HAYWARD. Unrelated to anything. These are the hardest things to justify. They say what application does it have to the Navy?

Mr. MITCHELL. When you come before the Congress, you don't know what the end result will be.

Admiral HAYWARD. I have no idea what the end result will be.

Mr. MITCHELL. Admiral, is that not one of the major handicaps we are undergoing now, insufficient funds for programs of that type?

Admiral HAYWARD. Yes, sir; it is.

Mr. ANFUSO. Would you yield there again?

Mr. MITCHELL. Yes.

Mr. ANFUSO. Admiral, were you cut in your estimate as to what you needed for your projects?

Admiral HAYWARD. Certainly.

Mr. ANFUSO. How much were you cut?

Admiral HAYWARD. Well, I can give you the rundown on what I asked for and what I finally got, which was roughtly, rather than to go through all of the figures on it, it is roughly what I had last year.

In the basic Navy R. & D. program this year, I have $522 million. I had $521 million or something like that, almost the same, last year.

Mr. ANFUSO. How much did you ask for?

Admiral HAYWARD. To give you a little rundown on this, because I am a program sponsor, and I fight anybody that wants money from some other place, as far as R. & D. is concerned. Originally, in looking on the true requirements, the true requirements that I submitted to my Chief of Naval Operations in the R. & D. program were $770,733,000.

Mr. ANFUSO. You were cut about $270 million, then?

Admiral HAYWARD. That is correct; yes.

Mr. ANFUSO. Now, if you had that $270 million, what would you do?

Admiral HAYWARD. In this part 2 program, for instance, this would make the difference: I would put $150.8 million in that part of the field. Now, the total part of the program—this regular program that I am telling you about is exclusive of the Polaris program, and it is also exclusive of the Pacific missile range, which will be presented to you. They will show you their figures.

Now, of course I realize that I am in competition with everybody else, and this is good. I am only a program sponsor. But I made the same statement that I made to you to the Secretary of Defense, that I do not believe that I have sufficient money to do the research and development work that the Navy needs.

Mr. ANFUSO. The additional money would have helped you to carry on your research in a faster manner, is that correct?

Admiral HAYWARD. That is right, and it would have helped me to cover fields that I am not covering now that I want to cover.

Mr. ANFUSO. Thank you.

Mr. FULTON. Would you yield a minute?

Mr. ANFUSO. Yes, surely.

Mr. FULTON. Actually, NASA can contract for you and help you on doing some of your basic research for the Navy, can it not?

The question is, Would you need separate facilities or can you get this money, which I would favor, and have one of the civilian agencies help you out on the basic science approach?

Admiral HAYWARD. Well, actually, Mr. Fulton, the facilities that NASA has are the three laboratories: Langley, Lewis, and Ames. A lot of ours would be in the basic, the university approach.

Mr. FULTON. So actually yours is not going into facilities but into contracts?

Admiral HAYWARD. And a lot of it would be in-house, to. I have some real fine scientists that work for the Navy, like Dr. MacLean, Dr. Kurie, and people of this kind that have made tremendous contributions. In other words, this money would be in the regular R. & D. program.

I had specific items that I had to discuss with the Secretary when I presented why I needed more money.

Mr. FULTON. But it is specifically in the operations field of R. & D. and not in the facilities field? You don't need additional facilities?

Admiral HAYWARD. No, it is not in the facilities field; no, sir. I have some items I need, but this money is the research and development program for the Navy.

The CHAIRMAN. Now, gentlemen, at this point I want to mention this. It is 20 minutes to 12. I talked to Mr. McCormack before he left, and he said we are going to have difficulty doing much work this afternoon in the committee because there are two bills coming up for vote.

Now, I don't want to cut anybody off, but my thought is this, if it is all right with you: I will ask anybody, from now on, who has any questions, to speak up; we don't want anybody cut off, and then we will try to finish with the admiral and go on through until the first bell.

We are going to have a rollcall rather soon, though. We will go on through to the first bell with the witnesses that we have, and come back during general debate and try to finish the executive session.

Now, we have carried over one witness already, and I would hesitate to carry over too many witnesses. But if we could hear the out-of-town witnesses first, Admiral——

Admiral HAYWARD. Mr. Chairman, we can come any time you want. I have them here. These are people in town, and you can take your time.

The CHAIRMAN. So in the event we don't finish, they will be available later on?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. It might be next week.

Admiral HAYWARD. That is perfectly all right, Mr. Chairman, any time.

Mr. MITCHELL. Mr. Chairman.

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. The first bill coming up is one concerning another committee I am on. I will have to leave. I have one further question.

The CHAIRMAN. They are both important bills, and we will all want to be registered on the votes.

Mr. MITCHELL. I have one further question.

The CHAIRMAN. All right. And give these others a chance to be heard, too.

Mr. MITCHELL. Admiral, the majority leader in the colloquy with you, and which you agreed to, I believe, said the only way we can deal with the Soviet Union is under the law of self-preservation.

I am personally interested in that because I would like to be around for awhile, but I want to ask you in that connection, what do we need in the missile and rocket field besides, as you said, hard work and establishment of a single space program? Would you add to that a need for more money for basic research?

Admiral HAYWARD. Yes, I would.

Mr. MITCHELL. What else, other than those three things that you have very clearly pointed out?

Admiral HAYWARD. From the Navy's point of view, where we have to meet this whole thing, I will tell you what we need, of course, outside of this other:

A missile system that can be used and priced economically enough to make them useful in limited war, and not just all-out war, like surface to surface. This is a technical need.

You say is there anything lacking in my program outside of these two things. I can't say anything at the moment. I couldn't answer.

Mr. MITCHELL. That is all, Mr. Chairman.

The CHAIRMAN. Are there any further questions of this witness?

Mr. WOLF. Mr. Chairman.

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. Admiral, I am Leonard Wolf, of Iowa.

May I say, Admiral, I admire your courage in speaking out on this subject, and I hope you will continue to do so everywhere and every chance that you get. I think it is important.

I also say, as a man who served in the Navy, I love the idea of sending a man to space in a bucket of water. I have some academic ques-

tions, but I will not bore the committee with them. I think I will send them to you.

Admiral HAYWARD. Will you do that?

Mr. WOLF. But I would like to know if you can say in a word how you can overcome this heat factor. Is there a tendency that this man will be boiled alive?

Admiral HAYWARD. We feel we can lick the heat problem. It is still a problem. This is the envelope Crossfield has to worry about. If he is too high, he is too slow. If he is too low, he is too hot. Even with the Vanguard, exposed 2 weeks to direct sunlight, we haven't had this heat problem we were worried about. Out in space your density is greatly down. It is going through the atmosphere that you have the problem.

The CHAIRMAN. Any further questions?

Mr. HALL. I have one.

The CHAIRMAN. Mr. Hall.

Mr. HALL. Admiral, I am David Hall, of North Carolina.

You made the statement as to the unfortunate and unwarranted reaction to Vanguard. Would you expand briefly on that statement?

Admiral HAYWARD. Of course you know, I am sure, I have good friends in the press, but I got really upset when everything was labeled a failure. It is funny. Even today, in the press, it is always news when there is an argument or a difference of opinion, because if you read in the press you will see that Congress "debates" and the Supreme Court "deliberates," but we in the services always "bicker." I hope the press will take that as I meant it. That is the sort of thing, where the thing blows up in all its glory and everything is a failure: "The Vanguard Is a Failure."

Mr. HALL. And yet, the Vanguard is the only one that has been a complete success, so far?

Admiral HAYWARD. You are correct, Mr. Hall.

The CHAIRMAN. Any further questions?

Mr. DADDARIO. Although you say this work is being done by many laboratories, many agencies, and usually in great harmony, taking everything else you have said, both in the printed record here and in your off-the-cuff remarks, Admiral, am I correct in my assumption that you would prefer that you had not these many laboratories, many agencies, but an overall agency and that if we did have that, the job would be better done than it is being done now?

Admiral HAYWARD. No, sir. My real argument, of course—the working people, and I am talking about the working people like those pictures you saw, the Air Force, the Army, the Navy, the scientists, they work in very close harmony. Our only disagreement, as I said in my statement, is this bureaucracy. If you haven't been through this system—I have—in order to get a program, in order to get things through, it takes persistence, and there are many people who can say "No," and only a few people who can say "Yes." That is why.

What I am trying to get across is we want one, a U.S. space program, and this has got to be decided in Washington, really.

Mr. DADDARIO. And you would say that we should have one in the form of the AEC?

Admiral HAYWARD. That was my original testimony.

Mr. DADDARIO. Which was successful in accomplishing a great job that was put before it, and you think that is the kind of formula that would best meet this need?

Admiral HAYWARD. Yes, sir, this was my original testimony.

The CHAIRMAN. Any further questions?

Mr. MILLER. Mr. Chairman.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. Unfortunately, I had to be away earlier this morning, Admiral, but did you touch upon Navy air-to-missiles, Sidewinders, at all?

Admiral HAYWARD. No, sir, we haven't come to the missiles. Admiral Masterson will give you a rundown completely on all of our missiles.

Mr. MILLER. Who developed the Sidewinder?

Admiral HAYWARD. I know the Sidewinder very well. I was the experimental officer. But Dr. MacLean was the man who gets the "kudos" for the Sidewinder, and it was done in spite of the fact that people wanted to kill it. This was a system that was developed in—in 1946 and 1947 we were first looking into infrared at Inyokern, and Dr. MacLean was head of the aircraft fire control section there. He is now technical director, and incidentally, he is the only Government scientist I know of that has received this $25,000 award for scientific accomplishment.

Mr. MILLER. He works for the Government?

Admiral HAYWARD. Yes, sir.

Mr. MILLER. Not for some development company?

Admiral HAYWARD. No, sir, he does not.

Mr. MILLER. As I understand it, this is a Navy baby all of the way through.

Admiral HAYWARD. That is correct.

Mr. MILLER. Conceived and developed in the Navy.

Admiral HAYWARD. That is correct.

Mr. MILLER. It is the only thing that has been tested in war, and it might have had some effect as a deterrent in Quemoy.

Admiral HAYWARD. It was very impressive to the opposition.

Mr. MILLER. I like to say for my colleagues, we hear a lot about the arsenal complex, and whereas I have no objection to great scientific bodies, the development that takes place through a lot of private industry, that the Government pays for—I have been on committees that have investigated that. Don't kid yourself that we don't pay $1.50 for a dollar's worth there. But this was something that was done in this way.

Admiral HAYWARD. Yes, and they wanted to kill this. Its nearest competitor costs $10,000 in production. This costs $2,800.

Mr. MILLER. This cost $2,800. I will say I just came back from the Far East and no matter what the Chinese Communists tell you about why they decided to pull their stakes, it is a fact that six Sidewinders were fired. Three of them happened to be fired in salvo. They got one plane. The others were fired singly, and they each got a plane. So you can, so far, say you got a 100 percent hits out of them, is that right?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. If there are no further questions, we will now hear from Rear Adm. K. S. Masterson, USN., Director, Guided Missiles Division, OP–51.

Admiral Masterson.

Admiral MASTERSON. Mr. Chairman, gentlemen——

The CHAIRMAN. You have a prepared statement, and you may proceed.

STATEMENT OF REAR ADM. K. S. MASTERSON, DIRECTOR, GUIDED MISSILE DIVISION, OFFICE OF THE CHIEF OF NAVAL OPERATIONS

Admiral MASTERSON. I have a prepared statement, and with your indulgence, I will stick by the prepared statement. It may be easier for you to follow it.

The CHAIRMAN. Fine.

Admiral MASTERSON. The Navy guided missile program is based on two fundamental requirements:

1. To provide our air, surface, and submarine striking forces with an attack capability, independent of foreign real estate and changing international politics, employable in the face of strong enemy defenses, and adjustable to the situation that may confront us, whether it be cold, limited or all-out war.

2. To provide a fleet defense capability adequate to support naval operations in the face of strong enemy opposition.

A decade of expenditures and development effort have gone into the creation of the Navy's guided missile potential. That potential is now in hand. Our missiles do not place us in the pushbutton stage of warfare nor do they replace the manned aircraft. Our missiles, per se, represent no capability in themselves, but this capability lies in the operating forces, the ships, submarines and aircraft configured to employ missiles, and in the men trained to use them. It is important to remember that the Navy's mobile forces at sea are relatively invulnerable to the growing Russian ballistic missile force.

In view of the wide publicity which has been accorded certain aspects of the guided missile program during recent years, it is assumed that it is hardly necessary to elaborate upon the various broad categories of missile systems. However, it may not be redundant to mention briefly these categories, of which there are five.

1. Surface-to-air, in which the missiles are launched from land installations or ships against airborne targets.

2. Air-to-air, in which missiles are launched by one aircraft against another, or against a missile.

3. Air-to-surface, in which missiles are launched against targets on the ground or at sea.

4. Surface-to-surface, in which missiles are launched from land or ship against targets on land or at sea.

5. Underwater-to-underwater, missiles launched from submerged submarines against submarines.

Now, I have a slide here today as to the first missile, the Sidewinder. I am not sure the slide will be visible.

The CHAIRMAN. You had underwater-to-underwater in the form of the torpedo?

Admiral MASTERSON. Yes, but these underwater ones are a little different. They go up into the air and then down again. I am not discussing torpedoes here today.

Now, as to the Sidewinder, this missile is guided by an infrared or heat-seeking device. The missile seeks the target by homing on the heat emitted from the aircraft. It is a relatively inexpensive and reliable weapon, measuring 9 feet in length and weighing about 155 pounds. It is about the size of a well-fed man. The Sidewinder is designed for destroying high-performance enemy fighters and bombers from sea level to altitudes over 50,000 feet. The missile, which has very few moving parts, and no more electronic components than an ordinary radio, requires no specialized technical training to handle and assemble it effectively.

The missile is now the primary guided missile weapon used by aircraft squadrons in the 6th Fleet in the Mediterranean and the 7th Fleet in the Western Pacific.

There you have a view of the Sidewinder and the size of a man beside it. It is basically a defensive air-to-air weapon to augment protection of our men and ships at sea from attacks by enemy aircraft. It will also be employed in the air defense of the continental United States by the Navy and the Air Force.

The missile permits defending fighters to knock down the fastest enemy aircraft even when it is miles away.

Now, we have already mentioned that the Sidewinder was developed at NOTS, Inyokern, China Lake. Dr. MacLean is the primary inventor of it. The Philco Corp. and General Electric Corp. are now producing this fine weapon. They are assisted by American Car & Foundry, Eastman Kodak, and Bulova in other phases of the missile system.

The Sidewinder 1–C, an advanced model, is coming along in research and development. It will have improved performance over this one. It is fundamentally the same inexpensive air-to-air missile.

Mr. MCDONOUGH. Is the range classified information?

Admiral MASTERSON. The range is classified, yes, sir.

The CHAIRMAN. Will the Sidewinder be effective against missiles, even slow missiles?

Admiral MASTERSON. If it is emiting a heat source, it will be effective against it. That is, if it is coming through the air fast enough to radiate heat, it will be effective against it.

The CHAIRMAN. Can you use it against a ballistic missile?

Admiral MASTERSON. I am afraid you would have a hard time getting into position to use it against a ballistic missile. You would have to get pretty close.

The CHAIRMAN. You mean to launch it?

Admiral MASTERSON. That is correct.

The CHAIRMAN. It doesn't have the range to launch it early enough to get it into position?

Admiral HAYWARD. Where it could be applicable, Mr. Chairman, would be if you were at sea and a submarine was launching a ballistic missile, coming out of the sea. Yes, you could shoot it, because it has a very powerful heat source, and it would home right on it.

The CHAIRMAN. So you can use it against ballistic missiles?

Admiral HAYWARD. Yes.

Mr. McDonough. Is this a magnetic attraction?

Admiral Masterson. No, sir; it seeks a heat source, infrared. You can hold up a cigarette and this would seek right on it.

The Chairman. Knock the cigarette out of your hand?

Admiral Hayward. It has actually shot down a 5-inch rocket that was shot. It was too expensive to keep shooting drone aircraft down, so they used a 5-inch rocket, and the Sidewinder hit it.

Mr. Fulton. Could I compliment the Navy that we on Foreign Affairs Committee took a look at the Sidewinders and consider they won one of the decisive battles of the world. It will go down in history, some day, where the Formosa Chinese lost only one plane to the Chinese Communist losses of 31 planes. It made the Chinese Communists withdraw to retrain, so it has been the greatest loss of face the Chinese Communists have had to date, that one particular instrument.

Mr. Miller. If the gentleman will permit, I will say not only to retrain but they had to change some of their propaganda, too. They came up with "this wasn't human, unnatural, and should not be used in warfare."

The Chairman. Will you proceed, Admiral, with your statement?

Admiral Masterson. I will show a slide of the Sparrow III. That is the next missile.

That is also an air-to-air missile, developed by the Raytheon Manufacturing Co., of Boston, Mass.

It has replaced its predecessor, Sparrow I in the fleet air defense.

This missile is about 12 feet long, weighs about 350 pounds, and attains a speed of over 1,500 miles per hour seconds after launching.

It is an all-weather missile, which can be fired through clouds or rain, in any kind of weather, from any direction.

Navy fighters can carry two to four of these Sparrow III missiles, and it will be the primary weapon for many present and all future all-weather fighters.

Now, Sparrow III is manufactured by the Raytheon Manufacturing Co., Lowell, Mass. Some of the planes will carry Sparrow III and Sidewinder missiles, but, as you know, a heat-seeking missile like the Sidewinder cannot fire through clouds.

The Chairman. You leave off the range. Did you do that intentionally?

Admiral Masterson. Yes; I will cover that in classified session, if you care to have that later on. These are sizable ranges.

The Chairman. Now, the Eagle is your next one there.

Admiral Masterson. The Eagle is a longer range system that I will cover in classified session, but it will have much longer range than either of these other two missiles.

Now, in the air-to-surface missiles, we have two of them, the Bullpup and the Corvus.

The Bullpup will show here. It is going into service this year. It is a tactical guided missile, designed for use by carrier-based Navy aircraft and shore-based Marine planes. It is for close air support of troops. It is 11 feet long, weighs 540 pounds, and is now in production at the Martin Co. It is a relatively inexpensive, highly accurate, and simple weapon. It too can be maintained on board ship by the normal shipboard personnel, just like all of our missiles. All of

our missiles have to be designed to where shipboard personnel can keep them up, as you know, because we can't take the scientists to sea with us.

It is particularly useful against comparatively small targets like pillboxes, tanks, truck convoys, bridges, anything that you can see from the air you can hit with this missile.

Mr. McDONOUGH. What kind of launching apparatus do you use?

Admiral MASTERSON. It is launched from an airplane, from a regular pylon.

Mr. McDONOUGH. Do you launch them from the ships' decks?

Admiral MASTERSON. No, sir.

Mr. McDONOUGH. How about either of the other two?

Admiral MASTERSON. No, sir; not on either of those yet.

The CHAIRMAN. There is no homing device on this?

Admiral MASTERSON. No; it is launched and controlled from an airplane.

Mr. HALL. That is a solid-propellant missile. Are the others liquid-propellant missiles?

Admiral MASTERSON. Both of them have solid propellant at this time.

Now, the Corvus is an air-to-surface missile for use in penetrating heavily defended areas, and it is also for use against surface ships. It is designed of a size to permit its use on carrier-based aircraft, although it is a fairly large weapon.

The prime contractor for this liquid-fuel rocket is the Temco Aircraft Corp., Dallas, Tex.

The principal subcontractors are Reaction Motors, Inc., Denville, N.J., for the propulsion component; Texas Instrument Co., Dallas, Tex., for the guidance component; and W. L. Maxson Corp., New York, N.Y., for the guidance component.

Mr. FULTON. That is a hypergolic fuel.

Admiral MASTERSON. What is that?

Mr. FULTON. A type of fuel that when you put the two elements together it ignites on its own contact, it is not using air at all.

Admiral MASTERSON. That is right. When they mix they burn.

That is right. In the surface-to-air missiles, we have three. The Terrier is an all-weather surface-to-air missile. Designed to intercept enemy aircraft at longer range and higher altitudes than conventional antiaircraft guns, the 15-foot weapon weighs about 1.5 tons, has a range of about 10 miles, and utilizes a solid-fuel rocket motor. It employs beam-riding guidance. It rides a beam right on out. The missile is suitable for shipboard use or beachhead operations with the Marine Corps.

Shipboard Terriers are selected automatically from the magazine and loaded on the launcher which is then automatically trained, elevated, and fired. The entire operation takes only seconds. Radar then guides Terrier to the target.

The following ships currently in commission have Terrier-missile capability: two guided-missile cruisers, and one guided-missile destroyer. Under the present shipbuilding programs, the following additional ships will have Terrier-missile capability: 2 *Forrestal* class carriers, 3 guided-missile cruisers, 1 nuclear-powered guided-missile cruiser, 19 guided-missile frigates, 1 nuclear-powered guided-missile frigate, and 1 nuclear-powered aircraft carrier.

Terrier is the result of 8 years of research and development by the Applied Physics Laboratory of Johns Hopkins University, Silver Spring, Md., under the direction of the Bureau of Ordnance. This is a contractor-operated scientific organization run on a nonprofit basis by Johns Hopkins.

Now, the production is at the Naval Industrial Reserve Ordnance Plant, Pomona, Calif., by Convair. Other concerns which helped perfect Terrier are the Hicks Corp., Boston, Mass.; Bell Telephone Laboratories, Whippany, N.J.; Vitro Laboratories, Silver Spring, Md.; Reeves Instrument Co., New York, N.Y.; Ford Instrument Co., Long Island City, N.Y.; and the Radio Corp. of America.

Advanced Terrier: The advanced Terrier is intended for the same surface-to-air requirements as noted for Terrier above. However, the advanced Terrier will incorporate improved guidance features and will provide substantial improvements in coverage over the original Terriers. The advanced Terrier will also be made by Convair at the Naval Industrial Reserve Ordnance Plant, Pomona, Calif. It is in production right now and will be going into the fleet shortly.

Mr. FULTON. How many Terriers do you use at once. I was on the cruiser *Boston* and they used two at once to knock a plane down.

Admiral MASTERSON. That is a standard doctrine, to use two to give you close to a hundred percent chance for a kill.

Mr. FULTON. It is actually a twin rocket, two go off, one following the other.

Admiral MASTERSON. That is right.

The CHAIRMAN. What do these cost, Admiral?

Mr. FULTON. $40,000 a piece.

Admiral MASTERSON. The ones on the *Boston* were $40,000 a piece.

The CHAIRMAN. All right.

Admiral MASTERSON. I had command of the *Boston*, sir. Now, the Talos is the next surface-to-air missile. This is a bigger baby than the Terrier. It is now at sea on the *Galveston*. It is a surface-to-air missile powered by ramjet motor. It is launched first with a solid booster, which falls away, and then this ramjet 40,000 horsepower motor takes it on to its target. It weighs about 3,000 pounds, is about 20 feet long, 30 inches in diameter. It can destroy enemy aircraft at extremely high altitudes, and its range is beyond 65 miles. It has a different type of guidance from the Terrier. It has what we call a mechanical brain with input from the ship and the target. When it is within lethal range, a proximity fuze detonates the warhead. It can carry either high explosive or nuclear warheads.

Now, as I say, we have one Talos guided-missile cruiser at sea now, the *Galveston*. We have one nuclear-powered, guided-missile cruiser and five other guided-missile cruisers in the program to carry this weapon.

Bendix Aviation Corp. is the prime contractor for manufacturing this. As I explained earlier, the Applied Physics Laboratory is the main design and development laboratory.

Flight testing is conducted at the White Sands Proving Ground, which is one of the three national ranges. The Tartar is the next of our surface-to-air missiles. That is the baby of the lot. It is virtually the missile part of the Terrier system with some minor changes.

It is an all-weather surface-to-air missile designed especially for use aboard destroyers. It fits in a compact installation that fits in the small spaces associated with destroyers. It has about the same range as the earlier Terrier but not, of course, up to the ranges of the advanced Terrier.

It is a solid propellent missile being built by the Convair Division of General Dynamics Corp. in the same plant with the Terrier missile. It uses about 85 percent common parts with the Terrier.

Under the present shipbuilding program we will have three guided-missile cruisers using Tartar as secondary batteries and 18 guided missile destroyers using Tartar as their primary battery.

The Regulus I is our next missile. It is a surface-to-surface missile. As you see, it looks somewhat like a jet aircraft. This was the first operational attack missile to join the fleet. It resembles a modern swept-wing jet fighter. It is about 30 feet long. Its range is about 500 miles and it travels at high subsonic speeds. It is capable of carrying a nuclear warhead and it is powered by a turbojet engine. It is also guided by an electronic "brain," we call it.

Regulus I launching equipment can be installed in a short time on almost any type ship. Right now we are employing the Regulus I from submarines and from cruisers. We have four submarines now equipped to carry it, with another one coming along. It was developed by Chance Vought Aircraft Co. under a Bureau of Aeronautics contract. Final deliveries of this weapon have been completed. We have a fairly good inventory on hand.

In the underwater-to-underwater missile, the Subroc, we do not have a picture of that. It looks like a torpedo. It is fired out of a conventional torpedo tube. It can be fired underwater or on the surface of the water. It flies up in the air like a ballistic missile and then goes underwater to find a submarine. It is under development at the Naval Ordnance Laboratory at White Oak, Silver Spring, Md.

Goodyear Aircraft Corp. has the commercial contract to work with the Naval Ordnance Laboratory on the development of the missile.

Now we believe the Navy has a well-balanced, well-rounded missile program. It will increase the Navy's striking and staying power in any type of war. We know what objectives and requirements have to be met. The time scale for phasing new weapons into the fleet has not always been broad enough. As you realize, we have to get the ships out there and the planes out there configured for these before we can deploy the missiles, and this goes across the board throughout the Navy—the effort to get missiles in the fleet.

Developing and producing missiles is one thing, and operating them is another. New concepts of tactics, training, logistics, maintenance, and many other factors make the guided missile program a complex one. We believe the Navy can successfully, as we have in the past, continue to coordinate all of these factors directed toward a missilized nuclear-powered Navy of the future. Our efforts are directed to that end.

Now the Polaris missile also is a part of the overall missile program of the Navy. Admiral Raborn is in charge of that entire project and he will cover the Polaris later on. I have left that out of my presentation.

The CHAIRMAN. Thank you very much, Admiral. Now the bell has rung for a quorum. We will adjourn now until 2:30, if that is all right with the Navy, and, of course, if there is a vote immediately at 2:30, the members will return here right after the vote.

Admiral HAYWARD. All right, sir; we will be at your disposal.

The CHAIRMAN. I want to ask all of the newer members of the committee and the Congress to return here. Some of this has been reviewed before, but it is all vital for you people who are new on the committee to be here if you possibly can, as well as the old members. We want the old members, too.

We will adjourn until 2:30.

(Whereupon, at 12:15 p.m., the committee recessed, to reconvene at 2:30 p.m., the same day.)

AFTERNOON SESSION

The committee met at 2:30 p.m., in open session in room 356, Old House Office Building, Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will please come to order.

Now we are in session and of course our attendance is going to be reduced this afternoon, unfortunately, but we have no alternative and, as we proceed, we may be caught with votes later on.

We have a brilliant statement coming up from Admiral Raborn. I wish everybody were here to hear him, but we have a copy of it and I will see that the other members get a copy and will induce those that have not been able to get over here this afternoon to go through it very carefully.

Mr. FULTON. I wish you would have the record show "another brilliant statement."

The CHAIRMAN. Yes, add the word "another."

Admiral HAYWARD. At any time the committee wants to get the full Polaris presentation, and I recommend very strongly that the committee get Admiral Raborn's full presentation at your convenience, I am sure Admiral Raborn would be delighted to give it to you, because I feel they should have it.

The CHAIRMAN. The full presentation, not the presentation this afternoon.

Admiral HAYWARD. No, sir; this is the classified and all of it. I think this committee should listen to the whole thing classified.

Mr. FULTON. Admiral, could I ask you if we could go down to Admiral Raborn's shop and do that, the Navy Building?

Admiral HAYWARD. That is the best place to do it, Mr. Fulton. I think this committee should do it. Other committees of Congress have done it and I feel to really know about it you should do this.

The CHAIRMAN. Well, this is a hard-working committee and we will have to undertake that.

Admiral HAYWARD. Did you want to ask any questions?

The CHAIRMAN. Admiral Masterson was still testifying at the close of this morning's session. There was one thing that I wanted to ask you, Admiral, which was referred to at one point.

I would like to ask you if it was in your statement or in Admiral Hayward's statement? I suppose it was in Admiral Hayward's statement. It was in reference to the threat from Russia regarding the missile program.

Admiral MASTERSON. It might have been on page 1 of my statement:

It is important to remember that the Navy's mobile forces at sea are relatively invulnerable to the growing Russian ballistic missile force.

The CHAIRMAN. Yes. Now that is true, is it; that they are not vulnerable?

Admiral MASTERSON. Let us put it in this way, sir: We have not figured out how to hit a moving target with a ballistic missile yet.

Admiral HAYWARD. The reason for this, Mr. Chairman, is that the basic guidance systems of all the ballistic missiles are using the same fundamental principle known as the Shuler pendulum which has to do with inertial systems. You may have heard it referred to as the 84-minute pendulum. Now a ballistic missile uses this as guidance, which means if a ballistic missile leaves from a point A to hit point B it has to know where it is and where it is going.

Now all of the systems, no matter who comes before the committee—all of the ballistic missile systems, the Atlas, the Titan, and Polaris, the Minuteman, all of them use a guidance system based on the 84-minute pendulum. They are no better than the state of the art as I stated this morning.

So if somebody says their missile will hit somebody in the head at 0.5 nautical mile CEP and the other one will do this, it is generally known in the physical world and in the scientific world that inertial guidance has roughly the same characteristics for accuracy, so the the mobile system at sea is pretty hard to pinpoint from a ballistic missile, even if it moves only 2 miles or 3 miles under this system. Roughly the way a ballistic missile works, and I am sure you have probably heard it, when a ballistic missile leaves the pad and you are going from—let us say we are going from Washington to a target. What it does is this: You have a program in the missile. You have calculated mathematically the trajectory that this missile has to fly to hit that particular point. You compare this program of the missile against where the missile actually is.

As the missile goes up, and it has to pass through a point in space, X, Y, and Z, in time versus velocity to hit that particular point. Now if the missile is off, the programer says "Look, you are to the left, boy, come to the right," and once the cutoff is made at that particular point in space, there is nothing you can do about it, it will go there.

Now this is a fundamental thing that you have to know where "there" is and you have know where you are. And so the mobile base, the submarine, or the ship that is moving does not lend itself at all to this type of guidance system. So this is why from a ballistic missile point of view the Navy at sea is practically invulnerable to it.

The CHAIRMAN. There is not a homing device on the ballistic missile?

Admiral HAYWARD. No. The reason you cannot is the velocity is so great when you are coming back into the atmosphere whether it is an IRBM at 1,500 nautical miles or an ICBM at 5,500 nautical miles, it is the difference between mach 15, 15 times the speed of sound, and mach

25, and you are not about to control anything at this speed in the atmosphere. It burns up. So it is a free-flying object. Now from a technical point of view, I would love to see the day when we could do something about it. It is not here now and will not be for some years, but I wanted to emphasize this point that Admiral Masterson made as to why we felt that the mobile system was hard to hit with a ballistic missile.

Admiral MASTERSON. There is one other point in there, too. Hour to hour and even day by day the enemy does not know exactly where those ships are, so they do not even know what inputs to put into the missile, even if the ship were stationary on the ocean.

Mr. FULTON. Then could we say this: While each of the Atlas, the Titan, the Minuteman, and the Polaris have the same kind of ballistic missile guidance system, nevertheless the Polaris, because of its mobility, has the added advantage that another ballistic cannot hit it because it can move?

Admiral HAYWARD. That is correct.

Mr. FULTON. Where the Atlas, Titan, and Minuteman, once it has been programed in advance and they are tied to their location, are vulnerable to another ballistic missile.

Admiral HAYWARD. That is correct.

Mr. FULTON. So while there is the defect in the Polaris of not being able to hit a movable object, nevertheless the fact that it is on a movable base does make it a preferable weapon; is that right?

Admiral HAYWARD. That is right.

Admiral MASTERSON. That is correct. And there is another factor in there. In any fixed base system you have to either keep increasing the number of bases or the number of missiles as the case may be with time or your effectiveness goes down with time on a fixed base.

Mr. FULTON. And with the Polaris there is no need of invading any territorial waters or any territory of another country whether it is enemy or neutral or an ally of the United States?

Admiral MASTERSON. That is absolutely true, sir. These operate from the high seas.

Mr. FULTON. Could I just finish on one more thing now. On ships where we get these large type missiles that have liquid propellants, it becomes almost impossible because of the danger of handling, they are too hard to handle and stow. Is that not the case?

Admiral HAYWARD. Yes, sir, Mr. Fulton. The Navy, since we have been in the rocket business, we have been solid-propellant people.

Mr. FULTON. That is right.

Admiral HAYWARD. At the close of World War II we were making $100 million a month worth of solid rockets. We believe in the solid rocket. We have always believed in the solid rocket.

People now who come and sell you the solid rocket are buying exactly some of the basic research we did on Polymers Monomers back in 1946 and 1947. The reason we have to do this is we have to live with our missile. We sleep alongside of it. It is aboard ship. You cannot have a liquid fuel. This is where our great difference in environment occurs.

Mr. FULTON. So where there has been testimony yesterday on the possible mobility of the Atlas, Titan, or Minuteman, at sea (there would have to be carriage to get mobility on a ship or on a plane)

you come into the same difficulties—the size, and the handling of the liquid fuel. Even ashore, where we have small countries with old-fashioned roads, it just becomes impossible to handle a missile of that size with that kind of fuel.

So it does become permanently stationed where it is; is that not right?

Admiral MASTERSON. I would say it is an impossible problem unless you leave it in one place, on these big missiles.

Mr. FULTON. I agree. Thank you.

The CHAIRMAN. That is the reason they put them in wells, to make them less vulnerable?

Admiral HAYWARD. That is true, Mr. Chairman. Of course, in looking at the wells, and this is a good approach to it, the one thing that Mr. Fulton didn't cover was the reaction time. You see, when you look at the countdown of some of the large liquid missiles, if your system is based on the surprise motive, as I told you before, it is a weak system, and particularly the reaction time in solids is so much better. Of course, we in the Navy don't say that Polaris is the only thing that the United States should do. What we say is that the other deterrent systems that are proposed and are built should pay the same price of entry that the Polaris system pays, which is that it is relatively invulnerable, it is an effective system, and it is under U.S. control.

Now, we feel that the United States should not go down just one path, and that is why you cannot just go down the SAC path, or just the Atlas or the Titan or the Polaris path. You have to have flexibility in this entire spectrum of the war that faces you. This is what the Polaris gives you, and this is our contribution to the national deterrent.

Mr. FULTON. How many Polaris-type missiles and submarines did you recommend in the budget for the current and coming fiscal year that you did not receive funds for on the budget level?

Admiral HAYWARD. Well, Mr. Fulton, I know I can't take the fifth amendment on this at all. I would rather have Admiral Raborn present the Polaris thing before you ask that question because it would make more sense.

The CHAIRMAN. Well, let's proceed.

Mr. FULTON. How many more do you want? I would like to hear that.

Admiral HAYWARD. Mr. Fulton, to give you the background, the Navy last year went forward from the Secretary of the Navy to the Secretary of Defense for nine submarines and one tender. Actually, we were allowed a total—to begin with, we were allowed only three, and then finally five. Congress gave us the money for the nine submarines, as you probably know, and you probably know the executive branch of the Government said that they weren't going to expend this money.

Now, as you know, there are four very important terms in this town, and in my business you learn them rapidly. One of them is "appropriations," one of them is "obligations," "apportionment," and "expenditures," and in this particular field we didn't get the money, naturally, as the executive department of the Government said they wouldn't expend it. But we haven't gone forward with that program.

Now, if you are referring to the 1960 budget, I would much rather have Admiral Raborn answer that.

The CHAIRMAN. Well, how much money, Admiral, has been withheld from you, from use after we have appropriated it?

Admiral HAYWARD. I can give you that exact figure. I would rather give it to you from the record than from my memory, Mr. Chairman.

The CHAIRMAN. We would like to have it for the record.

Admiral HAYWARD. All right, sir.

(The requested information is as follows:)

DEPARTMENT OF THE NAVY,
OFFICE OF THE SECRETARY,
OFFICE OF LEGISLATIVE LIAISON,
Washington, D.C., February 19, 1959.

Hon. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics, House of Representatives, Washington, D.C.

MY DEAR MR. CHAIRMAN: The following information is provided for the February 4 hearing. Figures are in millions.

(*a*) Fiscal year 1959 submissions for Polaris program:

Shipbuilding and construction, Navy (for 4 Polaris submarines Nos. 1, 2, and 3, and for construction of Nos. 4 and 5)	$252.1
Research and development, Navy	210.8
Procurement of ordnance and ammunition, Navy	253.5
Ships and facilities, Navy	5.2
Servicewide operations, Navy	5.5
Military construction, Navy	52.5
Total	779.6

(*b*) Congressional add-on:

Shipbuilding and construction, Navy (for 4 Polaris submarines (Nos. 6 through 9) and 1 submarine tender conversion	492.6
Research and development, Navy	71.2
Procurement of ordnance and ammunition, Navy	43.7
Servicewide operations, Navy	1.5
Total	609.0
Grand total for Polaris program	1,388.6

(*c*) The entire 609M congressional add-on was initially held in reserve by executive department action. By subsequent action, all funds have been released except 300.3M for Polaris submarines Nos. 7, 8, and 9.

Sincerely yours,

R. L. KIBBE,
Captain, USN, Deputy Chief of Legislative Liaison.

The CHAIRMAN. If you would also give us any statement as to the reason why it was withheld after it was given you.

Admiral HAYWARD. Yes, sir. We can give that for the record. When Admiral Raborn presents it, he will show you exactly the status.

The CHAIRMAN. All right; we will let the admiral proceed.

Admiral HAYWARD. Do you have any further questions for Admiral Masterson at this time?

Mr. FULTON. One more:

On the Regulus, why was that discontinued?

Admiral HAYWARD. The Regulus II, you are talking about, which is the best air-breathing missile in the world.

I was asked this question. It was turned down for money reasons, not technical reasons. This is a good missile, and technically the program is sound, but from the Navy point of view, and my boss, Admiral Burke, is faced with the possibility of having to go to war tomorrow or the next day, and he had a hard decision to make. We had placed our bets on Polaris. We think Polaris is the best weapons system in the country today. We had a hard choice from a budgetary point of view. It was cut out from the budget and not for a technical reason, Mr. Fulton.

Mr. FULTON. When the Regulus requires very little changing over of ships, and the Polaris, of course, has to have an operable Polaris submarine, we will call it, why isn't there a need for the Regulus as an interim missile in the Navy weapons system? Are we leaving a hole in there?

Admiral HAYWARD. I will quote my answer to Mr. McElroy on that, Mr. Fulton.

If the Regulus II is dropped and anything happens to the Polaris, you will have no missile really from a submarine.

Mr. FULTON. That is my point. Where we have one that has been in tests and well along, so that it is really a missile that we could depend on, I have seen the Regulus I shot from the cruiser *Macon*, off Guantanamo Bay last year.

Admiral HAYWARD. I am sure you realize how hard these decisions are.

As a technical person, in my position I don't make them. I sponsor the program, and the people who have the overall responsibility and the authority make those.

However, I have a good saying that I always tell them, which is that the technical answer or the technical policy might not be the best answer, but the man who makes policy should know the best technical answer, and I feel we gave them the best technical answer.

I can't answer for what decision was made after that.

Mr. FULTON. With the chairman's permission, may I read from House Resolution 580 of the House of Representatives? Unanimously, July 1, 1959—it is the jurisdiction of this committee which will be a surprise to some people, and I would like the military especially to know of the jurisdiction of this committee.

> Under rule 11 of the House rules, it is further amended, by inserting after clause 16, the following:
> "17. Committee on Science and Astronautics,"

and under paragraph f of that rule 11, there is this specific provision:

> Outer space, including exploration and control thereof.

That means that the control of outer space and that jurisdiction is under this committee, so that we are interested not only in civilian science but we are interested in helping you people in the armed services in the strategic areas, seeing that we either have the power to control or the power to prevent any other group from having it or any other individual nation to our disadvantage.

You see, so far we have been talking as if this is a civilian committee alone. As a matter of fact, it is much broader when we get to space, because we are interested in how the various services implement their approach to space.

The CHAIRMAN. I would like to say this on behalf of the gentleman, I don't think he ought to limit his statement to space. The jurisdiction of the committee extends, regardless, through all points of science and scientific support, whether it be military or civilian, and likewise in space, whether it be military or civilian.

Admiral HAYWARD. The man who did this, who put science before the head of this committee, was the smartest man for my money, because this covers everything, as the chairman has pointed out. This is the key to it, not only to space, but to an awful lot of the rest of the challenge.

This morning I didn't have an opportunity to tell you part of what science does, and what research does for your country for a reasonable sum of dollars in the cold war.

Now, we have an outfit known as the Naval Research Medical Unit No. 3, in Cairo, Egypt. This particular thing took over a 1,500-bed hospital in 1946. The Navy subsidized it. We support it.

The captain of that unit, Captain Seal, he talks to Mr. Nasser, he talks to the second man in government, he talks to everybody in the Government of Egypt. Even after they threw out the point 4 program, even after they wouldn't talk to the Ambassador or the attachés, my Captain Seal talks to Mr. Nasser and talks to the rest of them.

This particular work we have done in medicine research there, which the Navy has supported in all of the blood parasitic diseases, in all of the tsetse fly and malaria work, we have the best relations there. That costs $265,000 a year. A lot of people want me to stop it. They say, "What is the Navy doing in this business?" This is part of the broad spectrum of science, as the chairman points out.

You must never forget, Mr. Fulton, when you direct yourself to the science part of it, you cover all of it, not just space.

Mr. FULTON. I am accepting your statement, and the chairman's, on science, but I am saying under paragraph (f), where outer space is concerned, we have the jurisdiction, and the duty to explore, to send the new Columbus out under this committee and under policies set by it. Secondly, as if it were Germany in World War II, if we decide the moon is a security annex to the United States of America, this committee runs the people on the moon. That is the difference.

You see, we have the science of getting to the moon and the science generally, as the chairman and you both point out, from the center of the earth through every liquid, on up in the atmosphere. But likewise we have another thing that is very peculiar in this committee, and that is we are to run space, we are to administer it, and there is where we are interested in the armed services in space, as to how you run it, not just how you enter it.

The CHAIRMAN. Let me say this. It is 3 o'clock. We are going to have two votes over there. We want to proceed to hear Admiral Raborn.

Admiral HAYWARD. This is Admiral Raborn, head of our Special Projects, who runs the Polaris program, and I will turn it over to Admiral Raborn.

The CHAIRMAN. Go ahead, Admiral.

STATEMENT OF REAR ADM. W. F. RABORN, DIRECTOR, SPECIAL PROJECTS OFFICE, DEPARTMENT OF THE NAVY

Admiral RABORN. Mr. Chairman, I am delighted to be here to address the distinguished members of this committee.

I have a rather lengthy statement, and if it pleases the chairman, I would like to request that it be inserted in the record, and I would like to brief it down verbally for you, and you can cut me off where you want.

The CHAIRMAN. Just proceed, sir. We are running against time.

Admiral RABORN. Thank you, sir.

I have an unclassified dissertation, and I have a classified briefing which I am prepared to give at your wish.

Briefly, sir, the Navy, capitalizing on the long competence in solid propellants over a period of years, which you have heard a little bit about this afternoon, which gave the world and this country rockets, for full name, was a bold strikeout in the ballistic missile field, in solid-propellant motor developments, while the rest of the national effort was being channeled into the liquid-fuel path.

I am very happy to say that this courage which we showed has paid off and paid off handsomely.

Since the Polaris program was approved in March of 1956, as a formal effort, we have been able to develop large solid-propellant motors of adequate power and adequate stability, and the adequate measures for controlling, something that we did not know how to do, how to control precise termination of thrust and precise control of direction of flight, we have proven this to our great satisfaction, both by static tests and flight tests.

I am happy to say the rest of the weapons system for which I am responsible has kept pace. As you know, my responsibility carries into the building of the submarine. The Chief of the Bureau of Ships has said in his own gracious way he is a subcontractor to me. I have to select and train the crew, and the production facilities as well as the ashore and afloat maintenance facilities. All of this program, because I am a weapons system manager, we have been able to keep in step, one with the other, and I would like to report to this committee that I have had adequate funds for the program which has been approved.

My developmental funds across the board have been ample for the purpose for which we are trying to carry out this project. We are just getting into full-scale flight testing of our missile, itself. We are doing component testing, and the successes which we are having componentwise in these flight tests have been very reassuring to us.

We expect in the very near future to get into flight testing for range, which we haven't yet tried for, and I am confident we will meet the readiness dates for the submarine, which, as you know, Mr. McElroy has said this system will be operational in 1960.

We in the Navy are firmly convinced this weapons system offers a tremendous potential as to the deterrent capabilities of our country, for the reasons you have heard here, the relative invulnerability, chiefly because the launching sites will occupy many thousand cubic miles water, all friendly waters, NATO-controlled, not habitually flown over nor traversed by the surface ships or aircraft of the Soviets.

In addition to this, of course, the shores that are washed by these

waters are not available to the Soviets for shore detection devices, which could conceivably be erected for the detection of surface craft and submarines.

I believe, sir, this just about completes what I can say in an unclassified version.

Mr. ANFUSO. May I ask a question, Mr. Chairman?

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. You said this is rather friendly waters. Does that mean Russian submarines are not in those waters, like the Adriatic and Mediterranean?

Admiral RABORN. No, sir; it does not mean that at all. However, it does mean that the shores that surround those waters are friendly and in effect you do not see the Soviet Navy nor aircraft with any degree of frequency in those waters.

Mr. ANFUSO. Thank you.

Mr. FULTON. And 70 percent of the earth's surface is water, so there is quite a bit of leeway.

Admiral RABORN. Yes, sir.

The CHAIRMAN. Now, the Polaris is operated from a specially constructed craft, isn't it?

Admiral RABORN. Yes, sir.

The CHAIRMAN. That is the Polaris submarine?

Admiral RABORN. Yes.

The CHAIRMAN. What does it cost, that submarine?

Admiral RABORN. Presently they are costed out at a hundred million dollars a copy.

The CHAIRMAN. When it is completed at a cost of a hundred million dollars, how many Polaris missiles can it carry?

Admiral RABORN. The exact number is classified. I can say to you that it is more than 10 and it is a surprisingly large number.

The CHAIRMAN. And that submarine is perfectly mobile, with a full complement of missiles; it can move like any other submarine could anywhere, is that correct?

Admiral RABORN. Yes, sir.

The CHAIRMAN. Now, how far along are we with that program?

Admiral RABORN. We currently have six submarines under construction. The first submarine will be ready for active service in 1960. It is under construction at the Electric Boat Co. at Groton, Conn. It is quite well along.

I have some pictures of it I could show you in a classified briefing.

The CHAIRMAN. How long will it take to complete the program?

Admiral RABORN. This depends entirely on the numbers of submarines that it is finally decided to put into the program, sir. It is a continuing one.

The CHAIRMAN. How many have you announced to date?

Admiral RABORN. Six, sir.

The CHAIRMAN. Then it depends upon the money you get from Congress, I imagine?

Admiral RABORN. Yes, sir, and the force level that is desired.

The CHAIRMAN. Now, the missile is available, though, is it?

Admiral RABORN. The missile is under concurrent development, and it is just entering full-scale flight tests; very beginning.

The CHAIRMAN. Are you satisfied with the characteristics of the missile?

Admiral RABORN. We are quite pleased and satisfied with it.

The CHAIRMAN. What have you announced publicly as to its capabilities?

Admiral RABORN. It has been announced publicly that it falls within the size and range normally allotted to the intermediate range ballistic missiles, the IRBM class, sir. It is a solid propellant.

The CHAIRMAN. So it is an intermediate range missile?

Admiral RABORN. Yes, but married to the nuclear-powered submarine, this makes it equal to or from a standpoint of range, ICBM's or any other target of this kind. You could hit just about any target on the face of the globe.

Mr. ANFUSO. Mr. Chairman.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. This missile will be fired under water, I gather, or it can be fired either way?

Admiral RABORN. Yes.

Mr. ANFUSO. And that is not classified?

Admiral RABORN. You had me squirming for a moment, sir. I don't know.

The CHAIRMAN. It is in one of the statements there, that it can be fired above or below the water.

Mr. FULTON. Well, it has been fired at Canaveral on a pad.

Admiral RABORN. You will forgive me for being cautious. I was just trained this way.

Mr. ANFUSO. Let me ask you another question at the moment.

How about enemy detection? How could the enemy detect such a submarine?

Admiral RABORN. This is a matter we are spending great sums of money and effort on every year, in antisubmarine protection; because these waters and the shores are friendly waters, we think that we greatly compound any enemy detection effort that they may try to expend against this system.

Admiral HAYWARD. I think I better enlarge on that, because we can do this, and we also have the responsibility to protect the United States, and we are faced with a very large problem in this area. This is what worries me personally, that we always look over the North Pole, that the attack is coming over the North Pole. If you look at the map and everything, we have great exposed flanks. The ASW problem in the Navy itself is the No. 1 problem. The Polaris problem is also of No. 1 priority, but we have a tremendous problem facing us in that we cannot go down some of these anti-ICBM streets just coming over the North Pole. You have to look seaward, because if he is only 50 miles off your coast, he can destroy you just as well as if he comes from Russia. So we are faced with this problem, and a great percentage of my effort goes on the other side, which is to oppose the Polaris system in the enemy's hands.

Mr. FULTON. Could I ask one question?

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. It has been reported in the papers generally that the Polaris missile flight from Canaveral recently off a pad was unsuccessful. In congressional hearings I have learned that that flight was successful and was of great value to the Navy as to instrumentation.

Would you comment on that within the limits of secrecy?

Admiral RABORN. I would be pleased to, Mr. Fulton.

At this stage of development, I am sure the committee understands what we are trying to do is component testing. One of the purposes of this flight was to determine if we had fixed the troubles encountered in previous flights. They were fixed. It was also to get smoother burning, to detect if the burning of the propellant that pushes it through the air was smooth and even, the control of it, the separation of the motors at the right time, the ignition of the second stage. This was what we were trying to do in full-scale flight tests, and this was done, and for the purposes of this particular flight I think you have in question, we had about six out of seven of our primary objectives achieved. It was not entirely successful, but then no one in his right mind actually hopes that these early ones would be.

Mr. FULTON. So that actually it corrected six out of the seven deficiencies of the previous flight that were necessary to be corrected, and corrected them satisfactorily; is that correct?

Admiral RABORN. Six out of the seven objectives of the flight, yes. They were not deficiencies. We had only two deficiencies.

Mr. FULTON. And distance was not one of the primary objectives?

Admiral RABORN. It was not an objective at all.

The CHAIRMAN. Mr. Roush.

Mr. ROUSH. Mr. Chairman.

Admiral, this is rather a simple question.

I am bothered by the speed at which things happen. Does the fact that you use a solid propellant make it possible to put a missile in the air more rapidly than if you use a liquid propellant?

Admiral RABORN. From our detailed study on this, yes. You see, we were partners with the Army in the Jupiter program for a period of some 6 to 8 months, and we, of course, delved into this at great length, and I can answer your question very clearly and straightforwardly in the affirmative.

The solid-propellent motor on a missile is a great deal like a cartridge in a gun. If you can aim the gun and pull the trigger, cock it, it will go any time you pull the trigger. It is just that simple.

Mr. ROUSH. Is the propellant stored in the missile?

Admiral RABORN. Yes, it is part and parcel of it. It is like the cartridge in a gun.

Mr. ANFUSO. Mr. Chairman, just one question.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Is it classified information to know the destructive capability of the Polaris as compared to the ICBM?

Admiral RABORN. Yes, sir; it is. The amount of yield in a warhead.

Mr. ANFUSO. Would you let us know that later, please?

Admiral RABORN. I would be pleased to, sir.

Mr. ANFUSO. I have no further questions.

The CHAIRMAN. Any further questions?

Now, what is the pleasure of the committee? Do you think we have enough time to go into executive session now?

All right, let's proceed, then, to go into executive session, and we will proceed as long as we can.

The committee will go into executive session and clear the room.

(Whereupon, at 3:12 p.m., the committee proceeded in executive session.)

EXECUTIVE SESSION

The committee continued in executive session at 3:15 p.m., in room 356, Old House Office Building, the Honorable Overton Brooks (chairman) presiding.

The CHAIRMAN. We have Capt. E. L. Wagner on the agenda. Could we hear him?

Admiral HAYWARD. Mr. Chairman, I would rather you go through and listen to Admiral Raborn because what Captain Wagner is going to cover is the Pacific Missile Range which is a service facility, but it will give you some idea of the magnitude, and why I want to bring it up.

The CHAIRMAN. Well, we will follow your lead on this hearing. Admiral, you just tell us now what you want. Is everybody here cleared for executive session?

Mr. Anfuso?

Mr. ANFUSO. The thought has always occurred to me—maybe it is because of my old experience with OSS—how security minded we Americans are. Now we have these open sessions and we may think that it is all right to let all of this stuff out in open sessions, even though they do become a matter of publication.

Nevertheless, we do let out a lot of information as to our weaknesses which can easily be reported, things that we are not going to do, programs that we are going to abandon, things of that kind, all of which is very useful information.

So I am just laying it out to you, Mr. Chairman, whether or not in the future in all of these hearings, public or private, whether Central Intelligence should not have somebody outside to just take a look at the people who come in at these hearings, public or private.

The CHAIRMAN. I want to say to my friend this: We will discuss that informally, if we may, to see that there are thorough safeguards about everything.

In the meantime we want to finish with the Navy, if we could, this afternoon. I will discuss it with you and with the other members of the committee. We will take the utmost precautions for secrecy.

Mr. MOELLER. Mr. Chairman, may I ask a question, please?

The CHAIRMAN. Yes.

Mr. MOELLER. I wonder also if we should get the impressions of these various branches of the service with respect to this. I gathered yesterday that there was a bit of dissatisfaction that possibly too much information was being circulated. Now maybe it was a false impression that I gathered. I do not know how the people of the naval branch feel about it, but I would think that they are as vitally interested in this as we are and we might attempt to get impressions from them also with respect to our policy on this.

The CHAIRMAN. Do you feel, Admiral, that there has been too much given to the committee?

Admiral HAYWARD. No, sir.

Mr. Chairman, I want to make one point clear. With my past experience with the Atomic Energy Commission I had to have complete confidence in the ability to come before the committee and tell them

the truth and nothing but the truth and what I thought. Now if I did not think it was right for the open session—I am no intelligence expert, I am a physicist—I would tell you this, that I did not think it should be in open session. But I have to be able to come to you in your committee and tell you what I think and what I believe. When I cannot do that, then you are in trouble, just as much as I am.

The CHAIRMAN. Well, I have been on these committees for 22 years taking these military secrets and all and as long as the committee accepts the information given to it, conscientiously and uses it in executive session as it is given to them, there is no trouble at all.

The military is on its own responsibility as to what it releases to the press. We are on our own responsibility that we let nothing get out of these executive sessions that should not be released.

Mr. ANFUSO. For example, Mr. Chairman, we know that Tass and even military attachés have covered our meetings. Now, where in the world can such a comparison be made? I am sure if we went to Russia nothing like that would ever happen.

Admiral HAYWARD. You must remember, Mr. Anfuso, the strength of our country is the strength of the people. We are a republic and if I cannot tell the truth before the people who run this Republic and it cannot get to the people, you cannot run our way of government this way. When I tell you something that you think is real secret, very often I can find it in a physics book, I can find it in encyclopedia. People get carried away with some of these technical things because they really do not know, but when we have something that is closed and should be in executive session, we tell you people everything. I have been in this business a long time, and I have never yet had a committee violate any of our confidences, to my knowledge, for use against the United States.

I think we have to be able to tell you this. A lot of times in open sessions as I said this morning, unless I get the word out to the press and to the people that this is an overall challenge and not just anti-ICBM or pro-ICBM, I am not doing my duty for the United States Government. That is what you people pay me for.

Mr. ANFUSO. That is what I want, Admiral.

Admiral HAYWARD. I know.

Mr. ANFUSO. I have said publicly right along that we ought to let the public know as much information as possible, but my thought was just as a precaution for us, no criticism of you.

The CHAIRMAN. I think the gentleman has well made his point strongly there, and I think we should follow it.

Now, Admiral, if you will, let us proceed with this before they have another bell.

Admiral RABORN. At this time I would like to show you a short progress report which will give the committee the substance of what we have been doing.

Will you please start the movie.

It is a sound movie, sir.

(Film shown.)

The CHAIRMAN. That is very fine. That is the bell over there for a vote on the bill.

Admiral, we can adjourn and finish the Navy hearing next week.

Admiral HAYWARD. Whenever it is convenient to you next week.

The CHAIRMAN. We will ask Mr. Ducander to communicate with you.

If there is no further business, we will adjourn until 10 o'clock tomorrow morning.

(Whereupon, the committee recessed, to reconvene at 10 a.m., Thursday, February 5, 1959.)